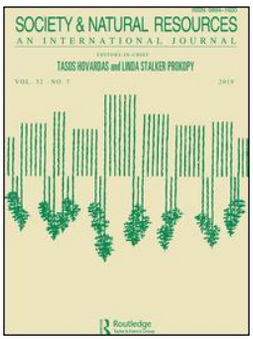

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Science, Data, and the Struggle for Standing in Environmental Governance

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ABSTRACT

Here, we explore how people entangled in natural resource conflicts employ and discuss data. We draw on ethnographic research with two cases of conflict: salmon fisheries in Alaska, USA, and agricultural water management in Saskatchewan, Canada. Both cases illustrate how data, through the scientization of environmental governance, can become a means of empowerment and disempowerment: empowering those with access and influence over data and disempowering those without such access. In both locales, people find it necessary to perform their expertise, justify the veracity of their data, and discount the data held by others if they wish to achieve or maintain standing. We call this "datamentality" and draw lessons from these cases for how we can structure environmental governance such that it benefits from robust data and science while meeting the needs of individuals, avoiding or managing power struggles, and protecting the rights of all involved.

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Introduction

In 2012, New York Times columnist Steve Lohr welcomed his readers into the "age of big data" (Lohr 2012). The dawn of this age was indicated, in Lohr's assessment, by the proliferation and ubiquity of data-driven decision making across all aspects of society and scientific inquiry. No doubt, many aspects of our lives are rapidly becoming "scientized," meaning that they increasingly value and rely on scientific authority for decisionmaking (Kinchy 2010; Cordner 2015). As a result, data are becoming increasingly central to a diversity of human pursuits, from art to agriculture, healthcare to environmental analysis and management (Raghupathi and Raghupathi 2014; Weersink et al. 2018). In the realm of environmental management, which we focus on here, data as "evidence" are now widely considered to be a gold standard for achieving effective conservation and sustainable resource use (Sutherland et al. 2004). Indeed, the entire process of environmental management has been reimagined around narratives of

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evidence (Sutherland et al. 2004), big data (Hampton et al. 2013), and the best available science (Lowell and Kelly 2016).

As people continue transforming their lives and the lives of others with increasingly large datasets and sophisticated analytical approaches, it is essential that we do not overlook the possible societal implications of reliance on data when making decisions that affect people's lives. Data are powerful, socially constructed windows on the world. As such, when you engage with data, you are also engaging with the contours of the political and ontological systems within which those data were created (Goldman, Turner, and Daly 2018). Likewise, there can be social, political, and technological barriers that limit some people's ability to access, interpret, or contribute to the creation of data (Nguyen et al. 2019). Data are also not value-neutral; how data are gathered, selected, and used or interpreted is structured by societal mores and priorities (Latour and Woolgar 1986). What we choose to monitor or study reflects assumptions and decisions that we make about what features or aspects of the world are relevant or important, and which are not (Bourdieu 1991). Similarly, the levels of uncertainty and disagreement that people are willing to tolerate in data are often unstated, poorly deliberated, and embroiled in power and politics (Cordner 2015).

As such, it stands to reason that the scientization of society can turn data into a means of empowerment or disempowerment (Nader 1996; Nadasdy 1999): empowering those with access to data and to how it is being defined and generated, and disempowering those without such access, including those whose data has been generated through alternative, and perhaps less recognized, systems of knowing (e.g., local and Indigenous knowledge). Persistent critiques of bringing local and Indigenous expertise into environmental decision making provides a case-in-point , in that data produced by positivist, western-science frameworks still carry far more weight than local expertise and practice (Hall, Dei, and Rosenberg 2000). Accordingly, there is an increasing attention in sustainability and conservation sciences to knowledge co-production, the aim of which is to enable stake- and rights holders to participate in the creation of knowledge to be used in policy and practice (e.g., Ban et al. 2018).

In this paper, we explore how people entangled in conflicts over natural resources employ and appeal to data when making their respective arguments about the conflict's key challenges and their preferred solutions. Conflict over natural resources is often an indicator of a failure of governing institutions to protect people's rights (Harrison and Loring 2020). As such, conflicts can offer an ideal opportunity to explore whether there is evidence that data, as an increasingly prevalent technology of environmental governance, contribute to power differentials and lead people to comport themselves in specific ways in order to receive full support or equitable treatment from the state. Importantly, we use the term "data" here in the broadest way, to refer both to specific datasets as well as to the many models and concepts produced by science that managers and others use to interpret and make decisions based on those datasets. We opt for this broad, praxis-oriented definition of data because models and heuristics are necessary for putting data into practice and are no less socially-constructed or contested than the data that they are used to interpret (e.g., Larkin 1977).

We base this analysis on previously completed ethnographic research with two cases of natural conflict in North America: conflict over salmon fisheries in Alaska, USA

(Harrison and Loring 2014), and conflict over agricultural water management in Saskatchewan, Canada (Minnes et al. 2020). Both are cases where conflict is escalating among the various sectors involved to the point where they have been described as wicked problems (DeFries and Nagendra 2017). Both cases also involve statutory mandates for science-based decision-making and data are frequently at the center of these disputes. Below, we start with a short overview of how science and data in society have been contested. We then present our reanalysis of ethnographic data gathered from our research in the two locales and offer a discussion of how data in each locales has become a basis by which stake- and rights-holders must defend and advance their own ethical and moral position and standing. We conclude with a discussion of how we might anticipate and counteract the potential power and perils of science and data in environmental governance.

Science, Data, and Governance

Many aspects of contemporary society are in the process of swiftly becoming scientized: remade through a new attention to data and science-based frameworks as the principal basis for planning and decision making (Cordner 2015; Kinchy 2010). While the impetus behind this transformation—improving lives and governance based on a purportedly value-neutral and objective basis—is appreciable, in practice, this invigorated emphasis on empiricism has not proved to be as politically equalizing as many might expect. Access to, and transparency of, the scientific process does not always succeed in making science apolitical (Neville and Weinthal 2016). The notions of objective science and raw data have both proved to be a myth (Latour and Woolgar 1986; Gitelman 2013), especially in contested settings (Cordner 2015). As Cordner (2015) explains,

> Because stakeholders deploy imbalanced resources when they participate in contested environmental fields, their actions in those fields and the resulting policy outcomes often reduce not to the settling of scientific truths but to power differentials (p. 915).

What counts as science, and as such what does *not* count as science, is an inherently political, and hence historical, process (Gieryn 1983; Nader 1996). For a variety of professional and academic purposes, scientists and science advocates regularly seek to proctor the boundaries among science and pseudoscience, with the goal of establishing a sacrosanct form of informational or academic authority (Gieryn 1983). No doubt, politically-motivated efforts to discredit and sow denialism around such issues as climate change are problematic for society and necessitate careful attention to the veracity of scientific claims (Dunlap and McCright 2011). However, western science, whether in the ideal sense or its necessarily socially-constructed form of practice, is not the only system knowledge capable of generating veracious, empirically-grounded information (Johnson et al. 2016).

Scholars have likewise explored the variety of ways that data, and the institutions of western science's primary emphasis on quantitative data, can both reveal and obscure social problems. Merry (2009, 2016), for example, shows how the construction of indicators to measure complex features of society can have the appearance of certainty and objectivity, but can also shift the emphasis within governance and decision making from values and principles to purportedly more rational decisions based on statistics or

other quantitative data. These data, explains Merry, can be used to reveal inequity and injustice, but at the same time, they can be used to establish norms or legitimize categories that marginalize diversity and alterity. Star and Bowker (2007) also explore how systems of scientific classification, which often rest on the collection and categorization of data, can marginalize and obscure people's complex identities and lived experiences. These observations are similar to Scott's (1998) discussion of how governments make societies governable by imposing systems of legibility (e.g., systems for weights, measures, and zoning) on otherwise messy human affairs.

In this paper, we contribute to this emerging area of research with a focus on the uses and societal implications of data in natural resource governance and conflict. Generally, we know that the structure of governance can influence the experience of being a citizen or subject of a society (Agrawal 2005). This is in part because the tools and concepts that governments create for governing often create power imbalances that people need to learn to accommodate or resist. Policies for natural resource harvests, for example, can render some practices more familiar, and thus, more legitimate in the eyes of the state than others' (Loring 2017; Wilson 2019). Systems of natural resource governance also can change the very language and concepts with which people relate to nature and engage with environmental problems (Brosius 1999). Foucault called this "governmentality," arguing that a government's "technologies of power" encourage people to define and comport themselves in particular ways if they wish to receive full support and protections. He and scholars since have explored how governmentality affects not just the process of governing across a variety of policy domains, but also the actions and the mentality that the governed develop in response (Rose 1999; Agrawal 2005). For example, Agrawal (2005) proposed a variant of governmentality called "environmentality" to capture how environmental governance can transform not only the relationship between governments and their subjects but also subjecthood itself, producing what he calls "environmental subjects." Likewise, Wilson (2019) shows how First Nations in Yukon Territories, Canada, have had to conform to western norms and expectations for the proper organization of environmental governance as a prerequisite for pursuing self-governance of their water resources.

Here, we build on these collective bodies of work to show how, through the scientization of environmental governance, data are emerging as a distinctly unique technology of power, one that forces people to change how they assert their values, needs, and rights in order to realize their full standing as citizens.

Methods

This paper draws from data collected by the authors during two ethnographic research projects, both of which explore the experiences and values of different groups caught up in conflicts over natural resources. Ethnographic research is particularly suited to exploring issues of power and disempowerment, in part because research participants can feel empowered by their inclusion in the research (i.e., they feel that that they are being listened to), and also because a driving ethical mandate for ethnographic research is to empower marginalized voices. Also, there is a performative aspect of ethnographic engagement that is particularly helpful for learning about people's pressing fears,

concerns, and insecurities (Denzin 2001). That is, activities such as interviews and site tours create a low-risk setting in which research participants are able to surface the various feelings, issues, and concerns that they have regarding the conflict at hand (Porter 2000).

All ethnographic research is intersubjective (Agar 2013), meaning that the practice and resulting data are highly contextualized by the specifics of engagement among multiple subjects—in this case, between the fishers or farmers or scientists embroiled in conflicts and our team of researchers. Accordingly, we interpret the data we gathered in both projects as not indicative of "normal" or "business as usual," but necessarily oriented to the conflicts in each region.

Case Studies

We draw from two conflicts from different parts of the world where we have previously completed ethnographic research and observed shared patterns of concerns and behaviors regarding data and governance. We treat these as both representative and revelatory cases (Yin 2009)—the former meaning that they reflect common features of natural resource conflict, and the latter meaning that their details help shed light on how parties to natural resource conflict discuss and otherwise engage with data and science. As such, the goal is to infer broader significance from the similarities and shared patterns observed in what are otherwise quite different social and ecological settings.

The first case study explored involves conflict over salmon in the Upper Cook Inlet (UCI) area of Southcentral Alaska, USA. Multiple user groups fish for salmon in the UCI, including commercial fishers, sport anglers (both locals and tourists working with charters), state residents fishing for food (known in Alaska as personal use fisheries) and Indigenous subsistence fishers. For decades, the allocation and management of salmon among these various groups has been the center of contentious and adversarial conflict, principally between advocacy groups representing the commercial and sport sectors (Harrison and Loring 2014). At the center of the conflict are king salmon (*Oncorhynchus tshawytscha*), and how they are allocated among the various fishing groups. King salmon are considered a highly desired "trophy fish" among tourist anglers who travel from around the world to fish in the area's rivers. Advocates of these sport fisheries argue that commercial fishers — who have access to king salmon in the inlet and, hence, before they reach anglers — should not be allowed to catch king salmon. However, commercial fishers, by state law, have equal right to catch the fish; whether this ought to remain the case has been an ongoing dispute in state politics, driving local unrest and even motivating litigation to The Alaska Supreme Court (Loring 2017). These fishing sectors have managed to coexist despite rancorous conflict, but the debate continues over which sectors, if any, ought to have priority and why.

Specific management features of Alaska's salmon fisheries are particularly important to the present discussion. Alaska's constitution mandates management of natural resources under state jurisdiction based on the "sustained yield principle," i.e., maximum sustainable yield (MSY). In practice, this necessitates the use of historical data along with test fisheries and fish counters, models, and run size estimates built primarily around the concept of minimum sustainable escapement (MSE): the fewest salmon that must

reach spawning grounds in order to maintain a sustainable fishery. Generally, managers at the Alaska Department of Fish and Game (ADFG) use historical data to identify a target range for how many salmon should reach spawning grounds, with the low end being the minimum necessary for a healthy population and the high end being a point before which too many fish reach the spawning grounds, a phenomenon known as over-escapement. Over-escapement is problematic from a management perspective because if too many fish reach spawning grounds, they can can degrade those grounds and reduce fish numbers in future years.

Based on the data-driven recommendations of ADF&G, the state's Board of Fisheries (BoF) then establishes a management plan that determines when and where different fishing sectors will be allowed to fish in order to keep total escapement within the desired range. During the season, managers are required to keep close tally on fish counts, and adjustments are then made to the prescribed opening schedule through emergency openings and closures to keep total escapement past all fishing sectors within the desired range. It is important to clarify here that there is a clear delineation in this system of governance between matters considered to be science-based (e.g., how much to fish) and political matters (e.g., how to allocate catches among sectors). The former is an internal matter handled by the ADFG, while public participation is generally limited to the latter, via testimony and written proposals to the BoF.

The second case study involves agricultural water management in Saskatchewan, Canada. Conflict here is focused principally on a practice known as drainage: where farmers move surface water, generally with ditching, to make seasonally wet or inundated land available for cropping (Minnes et al. 2020; Baulch et al. In Press). With tightening profit margins and rising agriculture production costs, increasing land productivity is important not only for farmer livelihood but for the economic development of rural Saskatchewan (Cortus et al. 2011). As with the management of fisheries, drainage has complex social and ecological consequences and tradeoffs, which make it difficult to govern effectively (Breen, Loring, and Baulch 2018). While farmers use drainage to mitigate their own flooding issues and make their land easier to crop, the actions they take can worsen downstream flood risk, decrease water quality, elevate nutrient export, and increase biodiversity loss at the regional level through declines in habitat (Pattison-Williams et al. 2018).

Starting in 2015, Saskatchewan reworked its policy regarding agricultural drainage, eventually passing new legislation a year later that require all existing and new drainage infrastructure be permitted through the province's Water Security Agency (WSA). Two key aspects of this policy are important to the current discussion. First, the WSA mandates that farmers work together in networks to develop drainage plans and that they must work with a Qualified Person (QP), i.e., an engineer, agricultural scientist, or other appropriately qualified and accredited technologist. Second, the drainage plans must identify an Adequate Outlet (AO)—a point down-stream of all the drainage works that can accommodate the increase in water flow without fundamentally affecting downstream hydrology. Identification of the AO relies generally on existing geospatial data and hydrological modeling for the landscape in question, as well as data for flood frequency and severity and new physical observations of the contributing area and existing channels and their conditions made by the QP. To date, only a small number of these

drainage networks have been permitted. Some drainage networks in process are coping with conflict among landowners and other stakeholders, such as conservation organizations focused on the protection of wetlands and waterfowl habitat, albeit with various degrees of success.

Governance in both these case studies have specific requirements regarding the use of data, which we define in this paper as a nexus of information and the models, frameworks, and heuristics that are required for putting that information into practice. In Alaska, this entails data regarding the strength of salmon returns from year to year used to create seasonal forecasts as well as contested understandings of the relative impacts of different kinds of fishing gear. Likewise, MSE, over-escapement, and the constitutional mandate to manage for sustained yield collectively comprise the science-based framework with which these data are interpreted. Similarly, in Saskatchewan, drainage permitting is based on the AO framework as well as a framework for wetland definition and classification based in part on a localized classification systems and in part on a national wetland classification system (National Wetlands Working Group 1997). As we discuss below, both frameworks are points of contention in how the different parties involved experience and respond to their respective conflict.

From 2010 to 2013[1], Authors 1 and 2 performed ethnographic research with fishers from four salmon fishing sectors in South Central Alaska. These include: the sport fishery, the personal use (food) fishery, and two distinct small-scale commercial fisheries (a "set-net" fishery that uses gill nets set to fixed anchors close to shore, and a second "drift" fishery that uses gill nets out in open water). The two authors performed semi-structured interviews and life history interviews, along with participant observation working as deck hands on commercial vessels and direct observation with sport fishers and at public events such as rallies and protests. From 2017 to 2019, authors 1, 3, and 4 performed ethnographic research with farmers, conservationists, policy makers, and other actors involved in conflict over agricultural water management in Saskatchewan. Specific methods included semi-structured interviews, direct observation of stakeholders at workshops, as well as site tours of farms, drainage projects, and flooded areas.

In both cases, we adopted a team ethnography approach, where a pair of researchers led most interviews together as a means of calibrating observations. We held debriefs immediately after interviews to discuss our observations and explore any differences in our experiences. We then coded interview transcripts for themes in qualitative analysis software (Atlas.ti for Alaska, NVivo for Saskatchewan) using an inductive thematic approach (Braun and Clarke 2006). We also relied in both cases on our field notes and post-interview discussions of direct observations of participant behavior, emphasis, and emotion, not easily captured by recordings or transcripts.

For our analysis, we held multiple synthesis discussions among the two research teams. Importantly, Author 1 was a principal researcher in both studies, and led these synthesis discussions. We did not reanalyze transcripts, but instead relied on our existing analyses for examples of how people spoke about or otherwise engaged with data or science. We knew *a priori* that data and science are present as themes in both cases and were adequately captured by our existing coding structure (Table 1), so the research question was not whether data were discussed, but how.

Table 1. Example codes related to science and data from the initial qualitative analysis of both cases.

Case study	Example codes	Notes
Alaska	MSY, escapement, overescapement	Science frameworks, possibly contested
	Bycatch impacts, fish abundance, population health, change over time	Local knowledge of fish run status
	Test fishery, fish counts	Monitoring and perceptions of data quality
Saskatchewan	QP, wetland definition, wetland class	Science frameworks, possibly contested
	Drainage impacts	Contested ecosystem dynamics
	Experience, local conditions, change over time	Local knowledge of hydrology and agricultural impacts
Both	Reports, studies, records	Sources of data, validity of data
	Organization	The role of associations / user-groups in establishing the validity of data

Results and Discussion

In Alaska, we completed interviews with 33 fishers (10 set-net fishers, 13 drift fishers, 10 sport fishers) as well as 4 representatives of natural resource management agencies. In Saskatchewan, we completed 32 interviews with 36 informants, focusing on three different watersheds in Southern Saskatchewan with ongoing drainage projects: Dry Lake, Black Bird Creek, and Atwater-Kaposvar watersheds. Informants included 15 farmers; 4 QPs; 6 provincial government staff; 2 First Nations community representatives; 1 agricultural industry representative; 3 environmental stewardship group representatives; 1 rural municipality representative; 1 provincial legislator; 4 technical professionals (one participant represented more than one category). Additional information on both cases is available in the resulting publications (Harrison and Loring 2014; Loring, Harrison, and Gerlach 2014; Minnes et al. 2020).

Across these two cases, we observed multiple examples of people interacting with and contesting data as what Rose (1999) calls a "technology of the self." Rose (1999) discusses how, when faced with the technologies of power that governments create (e.g., natural resource management regimes), people will create technologies of the self as a way to represent and advance their own ethical and moral position and standing. Rose contends that expertise is one of the most central of these technologies, that expertise can "mobilise and be mobilised within political arguments in distinctive ways, producing a new relationship between knowledge and government" (p. 156). Below, we discuss three ways that people in both cases engaged with data as a technology of the self, through performance of data, by contesting the legitimacy of others' data, and by contesting or allying themselves with central science-based frameworks or concepts for interpreting and acting on data.

The Performance of Data

The first pattern of behavior observed in both settings (and which, incidentally, inspired this comparative study) was having participants present to us their own sources of data as a way to establish their expertise and value as a participant. Fishers and farmers alike would regularly show us their logbooks, historical photos, fishing reports, and other such records. In Saskatchewan, examples included photos of land inundation from year to year and readouts from GPS enabled farm equipment to show land changes in

productivity over time. In Alaska, this data often took the form of catch records kept by hand in spiral-bound notebooks and heavily marked-up nautical charts. Participants regularly contextualized these sources of data by referring to the depth of their ecological expertise (i.e., how many years they have been fishing or farming, patterns they have observed over the years). Reports prepared by government agencies, or in some cases by independent researchers and consulting firms, were also common sources of data that participants presented during interviews and site visits.

Participants signaled to us several purposes for this performance of expertise. First, they shared data in this way to ground and validate their perspectives on the issues at hand as being neutral and fact-based. In Alaska, for example, commercial fishers were concerned about "ballot box biology," where public opinion and political capital influences whose data the BoF recognizes as most valid and important. As such, when working with researchers, fishers from both sport and commercial sectors found it essential to ground their own perspectives on management challenges with evidence and stories of their long histories of experience in the fishery. The same was true for many farmers in Saskatchewan; one farmer explained,

> Very carefully I said [to the scientists], "I don't know how you can model that. If you take, in 2010, of rain, 33 inches here," I said, "In 2016 it rained 27 inches," obviously less, but I said, "2010 was a catastrophe. 2016 wasn't that bad." I said, "What it is, John, it's not necessarily the amount of rain, it's when it falls." It didn't start raining heavy until the middle of June, crop used it. 2015 was a little drier, there was storage in the soil. You can't model all that.

Thus, it was not only textual digital sources that people offered, but also stories rich with details about dates and other environmental data, whether rainfall or fisheries returns.

Next, respondents used the performance of expertise as a way to position themselves with respect to their ostensible adversaries. For example, one Alaska commercial fisher explained,

> I don't like the way our fishery is being managed … We're the stewards of the resource, I feel like it would be unfair to say that commercial fishermen are responsible enough that they created good fish runs, but proper management has helped with fish runs, and we've been an active part of that for a very long time. If I'm not mistaken, we have the longest history of sustainable yield from this resource of any user group, and we have a lot more accurate management data than any other user group. I feel like the other user groups that are better into it have no limits, have no background from which to pull their data to defend the fact that their user group is sustainable.

While it is common for people to share data and stories with researchers, the context of the interviews, combined with the urgency and manner in which participants in both case studies shared these materials, made it clear that the performance was at least partially rooted in the experience of not being heard. Author 1's field notes, for example, record a farmer saying, "Be careful with that folder. No-one will listen to me without it."

The above quotes are also examples of how respondents offered their data and records, alongside their vested interests in the outcomes of management, to justify an outcome that meets their needs and values. In Saskatchewan, one farmer repeatedly referred to an analysis created by a "well-respected agronomist around here" that

proposes a strategy for keeping wetlands over a particular size threshold but draining any smaller features as a way to reduce over application of fertilizer. We witnessed farmers presenting copies of the same analysis to scientists and WSA officials at a variety of scientific meetings and workshops, not just for circulation, but also as a tool justifying their very presence at the event.

We also witnessed farmers and fishers present their expertise in an ironic or sarcastic way by performing ignorance. Phrases along the lines of, "well you tell me, you're the college professor," and, "but what do I know" were spoken frequently, in a friendly but intentional way during our interactions with participants on site tours and during participant observation. The intended meaning was always clear—to point out that in the realm of environmental governance, and even society in general, their knowledge, and hence ability to contribute information of relevance to decision making, is often given limited credence.

Whose Data?

These performances of expertise, and at times of ignorance, touch on a common perception that we encountered among fishers and famers: that natural resource managers, and to some extent the general public, have discriminatory perspectives on what constitutes data and whose data are valid. In UCI, fishers of all gear types expressed frustration with how mangers making decisions did not incorporate their own observations of fish abundance and harvest effort and success. As one sport fisher described,

> The whole sustainability [issue], they want to put their best scientists on it. Nobody wants to listen to the people that are on the river every day. Back on the last seven, eight years, Fish and Game had regular counts. This many kings came in, this many kings came in. Every day they gave us a number. And we would be on the river fishing, we would say, "No possible way that that many kings come in because we would have been catching some." 2500 kings came in - no way. A thousand kings came in - nope. But they wouldn't listen to us. So, here we are now for the last seven, eight years, them looking at a sonar that was malfunctioning, and the number was going up. So, they were getting a bad reading. They wouldn't listen to us, our words of warning, our words of caution. So, they just kept the fishery going, kept it open. We were saying, "We don't have that many fish, we don't have that many fish," but because I guess we don't have a degree, they didn't listen.

In both case studies, we likewise encountered disagreement between people from conflicting sectors about the legitimacy of different groups' data. For example, many fishers noted that when interacting with the ADFG, they needed to focus on very specific information—numbers of escaped salmon—for their concerns to be heard. One participant explained, "When the department determines this stuff [openings] they don't go by poundage [of salmon caught]. They go by numbers [of escaped salmon]." The implication in this quote is that other data, by comparison (such as catch data or local knowledge) carry less weight. One set-netter, also speaking to this point, described taking his young daughter to see the managing biologist during a fishery closure. In the manager's office, the fisher emotionally gestured to his young child and lamented to the biologist about how the closure was depriving her of a future in the fishery. While recounting this story, the set-netter admitted that, though it was emotionally gratifying to make his

point this way, he did not expect his effort to influence the manager toward re-opening the fishery.

It is important to reiterate that the only sanctioned venue for providing input in the Alaska case is testimony to the BoF. There is no formal venue for contributing or collaborating with the state on data, and as such, people are turning to their advocacy organizations to elevate the legitimacy of their data. In UCI, each fishing sector has its own advocacy organization—the three most active at the time of data collection were the United Cook Inlet Drift Fisheries Association (UCIDA), Kenai River Sport Fishing Association (KRSA), and the Kenai Peninsula Fisheries Association (KPFA, representing set-net fishers). Many participants described their advocacy groups as the only way to get managers to consider their collectively held knowledge. When asked why he made annual financial contributions to UCIDA, one drift fisherman described: "Because there's power in numbers. And in this business, you have to have a voice. An individual voice gets lost".

Another fisher expressed similar sentiments by drawing a link between available funding to generate data for fisheries managers to consider and the opportunity to insert the funder's biases into the dataset. They explain,

> Okay, so us as a small organization, I can tell you right now that [advocacy group for different gear type] has been gathering data, has the money, has the resources to gather data, to try to shut us down. And the problem is that as with anything, it's going to be skewed in their favor, it's going to be biased.

In Saskatchewan, similar advocacy organizations have formed around agricultural water management. One group, the Saskatchewan Farm Stewardship Association, was founded in 2011, according to some participants to deal specifically with this issue. We speculate this is due in part to the common feeling of disenfranchisement expressed by farmers—that their knowledge of their lands and expertise about the environmental and social issues surrounding how they manage water carry little weight in how decisions are made unless those knowledges are endorsed by recognized bodies. Explained one interviewee,

> It doesn't matter how much [data] we have about how much good farmland is under water or how much better things would work if we could just build the right control structures. We've got reports by scientists, but we need a bigger voice before anyone will look at them. But one photo of a flooded cottage gets in the paper. Heck we're lucky if we get asked to participate at all.

Embedded in the various quotes above, we argue, are multiple contestations about what are (and should be) counted as data. In practice, practitioners in both Alaska and Saskatchewan expressed that data held at the individual or collective level (i.e., local knowledge) is regarded as less valuable and legitimate than data generated, held, and managed in a way that is more legible to the norms of dominant science institutions (e.g., created through state-based science and stored in textual or digital databases).

Contesting or Appealing to Science

In addition to concerns about what ought to qualify as data, we also encountered people actively contesting the credibility of the science-based concepts used by other parties to

the conflict. In both cases, science-based concepts for interpreting data are among the most hotly contested features of the conflict. In Alaska, we saw many signs at a local protest that read, "Manage to MSY" or, "Manage Biologically, not Politically." Similarly, many farmers in Saskatchewan expressed concerns about the validity of certain scientific approaches to studying drainage, and a concern with a lack of inclusion of their own local knowledge. One farmer explained,

> There's been a lot of studies done ... Ducks Unlimited has done a lot, Global Institute for Water Security as well. With Ducks Unlimited, anyways, they are all about ducks so they want more potholes in the general landscape. They're results of their studies are, well, they probably have a predetermined conclusion. Slanted is maybe another word.

This concern is especially evident in how farmers talk about the ostensibly science-based concept of the Adequate Outlet (AO). As specified by the WSA, the AO is,

> The location where no further land control is required to address neighbor to neighbor flooding impacts. The intent is that … the additional water from drainage works will not create flooding impacts on lands outside of the Crown-owned bed and shore (Water Security Agency, n.d., p. 147).

In our research, few people could provide or point to a consistent definition for the AO beyond this general one, though every drainage plan, to receive a permit, must identify an AO. As such, the AO was described by some participants as being, in practice at least, more of a political tool than a scientific benchmark—a location in the watershed where there will be the least amount of resistance from landowners. Multiple participants explained their belief that when the WSA sets the boundaries around a geographic area to delineate where a drainage network must be permitted, it is done to intentionally to mitigate conflict. Other farmers, however, argued that the AO concept, if properly implemented with the best available science about regional hydrology, could have helped to solve some of the more tense conflicts that have been experienced over drainage,

> They couldn't explain why it had to be there, it had to be here to involve one more landowner and logistically the more landowners you have the more chance for conflict. It's just true. If that landowner would be directly impacted, that's different, but if it's just saying, "Well, I pick this spot," and can't justify why it couldn't be a clear path to your adequate outlet.

Both case studies included disputation of scientific concepts and classifications, such as how the province of Saskatchewan is defining wetlands. Whereas the province and conservation organizations rely heavily on this system, many farmers find it to be arbitrary and politically motivated. One QP explained that some farmers believe wetland classifications are a tool used to delay the permitting process,

> Focus on water management, get that done today and don't hold up the process because you think that that particular place is a wetland that needs to be preserved so we're going to block this. If they don't fast track it, if they don't get off the environmental perfection mindset, it's going to be basically centuries, not years. And so, a lot of the farmers are feeling that, maybe there's some people in WSA that really don't want this [drainage] done at all.

Another farmer offered, "To me "wetlands" is a swear word, I don't use it very often. That's my nature, because [the word] didn't exist until Ducks Unlimited came along."[2]

Adding to the confusion, some participants argue that wetland mitigation requirements are inconsistent across the province. One municipal government worker explained,

> Stakeholders in the group are concerned that the goalpost kept moving, some of the policies kept changing, or getting [added] to, or moved along the way, or some of the measurements or metrics were changing as they went through the process. We would talk about mitigation strategy, we would talk about class one to five, classifications of wetlands and how those are being interpreted and utilized there.

Similarly, another provincial worker argued that an even more rigorous approach to data was necessary in the application regarding the specific information about wetland types. They explained, "…we need more detailed information on wetland types and relative percentage or impacts of drainage". Evident here, arguably, is a case where stakeholders are contesting the framework for data, but within governance, the response to that contestation has been to exert further control over the data defining wetlands.

In Alaska, we experienced similar debates over the impacts of a specific kind of fishing gear and the veracity of the concept of overescapement. The first point of contestation relates to the stationary nets used by set-net commercial fishers in the region and their relative selectivity for different salmon species. Sport fishing and tourism organizations who have continuously lobbied to close the set-net fishery point to catch data that shows these nets are effective at catching king salmon, which is valuable as a trophy fish for the sport/tourism sector. They combine this with their own economic data that suggests their sector would better capitalize on the same fish, and therefore ought to have more right to it. To counter these claims, set-net fishers not only have had to point out that their commercial fishing permits afford them the right to catch king salmon, but must also appeal to alternative economic data to assert the benefits of their fishery to the region (Knapp 2012).

A second contested issue in the Alaska case study is the concept of overescapement, informing the evaluation of salmon counts, as being either good or bad. The ADFG operates with the assumption that if too many salmon can escape to the spawning grounds, the spawning fish will exceed the grounds' carrying capacity and collapse the run. As such, the management regime considers the commercial fleet essential to the maintenance of the fishery. Not surprisingly, perhaps, some participants in the sport angling sector argued frequently that the entire notion of overescapement is a myth, suggesting it is biologically impossible to hurt future returns by allowing too many fish to enter the spawning grounds. Sport anglers appeal to their own interpretations of historical catch and escapement numbers to make this argument, some point specifically to the return data from 1999, the year that many fisheries in the UCI closed outright because of the Exxon Valdez oil spill. That the limited fishing that year did not result in major declines in years later, they argued, was proof that the concept was at best overexaggerated, and at worst a fabrication. Incidentally, however, there was commercial fishing in the UCI. With a closed drift fleet, many set-net fishers were not, and they logged their highest recorded catches that year. Debates over the veracity of the concept aside, given that the existing management regime uses commercial fishing openings as

the principle tool for avoiding overescapement, arguing against the concept indirectly argues against the legitimacy of the commercial fishery.

Data as Standing

The examples above illustrate the nuances of how access to and interpretation of data can influence how people experience and engage with existing policies and regimes of governance. We see fishers and farmers responding to the use of data in their respective systems with frustration, irony and self-deprecation, or eager and aggressive endorsement. Many fishers and farmers appear to find it necessary to justify their needs and values with data, and in some cases, they must rely only on specific sanctioned types of data over which they have little control. When a fisher was showing us their logbooks, for example, it was not to marshal or mobilize that data/expertise in service of some collaborative process. Rather, it was an attempt to justify their standing as a citizen with legitimate needs and values and concerns, a need pointing toward a problematic failure of existing systems of stakeholder input. This pattern echoes the observations of Wilson (2019) noted above, where First Nations in Yukon Territories were forced to comport their self-governance in ways that are legible to the federal government. This is evident also in cases where people appeal to or contest the conceptual aspects of data that constitute each system of environmental governance's "best available science": the concepts, rather than the societal needs and outcomes of the stake- and rights-holders involved, appear to have become the goals to pursue.

Collectively, these uses of data as a technology of the self are ways for a stakeholder to assert their own standing from a perspective of social justice, as people do not (and should not) derive their rights or standing within environmental governance from data or their access to it. Rather, they derive their rights from their status as citizens and as human beings (United Nations 1948). To put it another way, subjects of environmental governance are not merely stakeholders but also often rights holders. As such, an environmental governance process must proactively reflect and protect their rights, including rights to cultural autonomy and other social securities.

It is worrisome that some participants find it necessary de-legitimize the science, and hence standing, of others in community, to ensure their own standing. One's rights and standing are neither competitive nor subtractive, but in the example of the Alaskan case study, critiques of the validity of overescapement as a meaningful scientific concept have become a proxy by which sport fishers seek to undermine the right of commercial fishers to fish. While there is nothing inherently wrong with contesting science, the apparent links in these cases between *whose* science is deemed legitimate and whose needs are met raise ethical questions about whether these environmental management regimes are fulfilling their obligations regarding human rights and public trust doctrine.

Returning to Rose's premise, power and expertise are mobilized, redefined, and contested, in both case studies. Data, as a transformative new development in environmental governance, has become the centerpiece of this process. Mirroring Agrawal (2005)'s notion of environmentality, this turn to relying on data as a basis for standing has created what one might call "datamentality". The question that remains is whether this datamentality, as a feature of the widespread scientization of environmental governance,

is helping or hurting societal outcomes like equity and social justice. In both Alaska and Saskatchewan, though to differing degrees, there is a sense among some participants that they are being marginalized or excluded. When people performed their data and expertise, for example, it was often moving, visibly and emotionally evident to us that this was a plea to be listened to, a plea borne from having not been listened to, despite the stakes to their livelihoods being high.

Conclusion

Governments are increasingly turning to science and data to improve environmental governance—but data, as a technology of governance, is also remaking these systems of governance and possibly creating new lines along which power and disempowerment can emerge. The question of interest here is whether this process is remaking what it means to be citizen in those systems. In these cases, the subjects of these governance regimes are not simply experiencing this process of scientization in a passive way but are actively negotiating and contesting it. As such, we can see scientization as not simply a top-down or linear process of adopting new and "better" approaches, but instead as a process that is more emergent and involves interactions and contestations of what constitutes better or fuller knowledge, and how and by whom it ought to be produced.

It is important to not lose sight of the environmental stakes in these issues. Both cases involve rapid environmental change, multiple uncertainties, and real potential for irreversible environmental impacts (e.g., Harrison 2021; Baulch et al. In Press). Conflict and lack of trust can undermine effective management and stewardship and exacerbate the "wicked" nature of environmental problems, no matter how high quality the available data are from a descriptive or predictive sense. To that end, there is a presently a push in the world of environment and sustainability research to more fully partner with communities in the co-creation of knowledge. While not evident in the cases reviewed above, such paradigms as post-normal research, de-colonized research, and citizen science are but a few of the emerging opportunities to reimagine not just how data on the environment are collected but who is involved and how those data are contextualized and validated.

These emerging approaches surely have promise for addressing some of the concerns and conflicts explored in this paper. However, data creation is only one part of the issue, how governance engages with people to navigate the social and political dimensions of data is another. There is no doubt that when collaboration brings together people with different knowledge systems and worldviews, there will be conflicts over data. Rather than addressing this as a problem to be resolved, with some data being deemed "correct" and other being "incorrect," the alternative is to create the space for difference to coexist (Stevenson 2006; Nicolescu 2008), and foster the relationships necessary to move forward with that difference intact. Even with this, it is also essential that the quest for science-based decision making, no matter how collaborative, does not unintentionally eclipse or distract from the fundamental mandates of environmental governance: to steward the environment for the public trust while protecting and enforcing the rights and needs of its citizens.

Notes

1. Despite completing this work a decade ago, we continue to do research on related topics in the region and are aware of no developments that would influence the data or interpretations offered here. In part, this is because the experiences related to us in the research are meaningful and important regardless of when they occurred in the past.
2. Note that here, we understand this respondent to be referring to whether the term was commonly applied in local policy and discourse, not that the word itself was recently coined, given that the word has been used in North American policy since at least the 1950s and its etymology traces back even further (Cowardin 1978).

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