Science, Values, and Western Land Governance

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I

Societal governance relies on, minimally, the deliberation of social values, yet governance does not occur in a vacuum and must ultimately appeal to some fact about the world. For example, governance does not consider whether people should breathe pure methane or not because it is a obvious that humans cannot, in fact, breathe pure methane. It does not matter how we know this specific fact, only that our governance institutions often rely on (either implicitly or explicitly) our scientific institutions to supply similar facts with which to make similar value-judgements[1]. These are what I call the traditional roles of science and governance – the former supplies certain facts while the latter deliberates on how society should organize in light of those (and other, non-scientific) facts. In reality this relationship is not so neatly arranged.

This paper weighs in on the role of values in the scientific enterprise from the perspective that values serve to orient science towards certain problems (and, thus, solutions), rendering untenable other conceptions of problems/solutions that may have more purchase in decision-making scenarios, thus complicating the straightforward uptake of science into governance. Using examples from federal land governance in the American West, I aim to show how science – broadly construed – is itself a value-driven enterprise that can serve to complicate land governance without adequate reflection of these values. The paper begins with a brief description of contemporary western land governance in order to contextualize and recognize how science is used and/or engaged with land governance. The following sections discuss the roles of values in science, organized along two dimensions: [1] Values between science and society and [2] Values within science itself. The final section offers strategies for the responsible inclusion of science (and its concomitant values) into western land governance, focusing specifically on the co-development of objectives, methodologies, and collaborative interpretation of results by various stakeholders.

II

Environmental governance in the intermountain region of the American West (hereafter referred to as ‘the west’) is contested and complex, due in no small part to its unique regulatory structures, competing cultural attributions, and high levels of uncertainty regarding issues critical to its communities. The environments of the west are characterized as arid deserts, with elevations ranging from the lowest on the North American continent – Death Valley at 282 feet below sea level – to many of the highest peaks. The arid deserts of the west have evolved highly specialized ecosystems that are specific to the region, developing resilience to the low-precipitation, widely-varying temperatures, and diverse soil types that make concentrated human agri-settlement difficult (Steinberg 2002). The difficulty of human agri-settlement disincentivized euro-colonial settlement in the region, and although the United States

[1] I do not consider an account of what constitutes a ‘fact’ beyond the common usage of the term.

government attempted to motivate settlement through a series of homesteading acts, the current region is predominantly unoccupied. Due to the lack of settlement, the vast lands of the west remain under federal management rather than the private and state management that characterizes much of the country (See Figure 1). Although the region resisted large scale agri-settlement, small settler communities did proliferate around the few industries that could thrive in the arid desert – generally, livestock ranching, sub-surface mining, and timber industries.

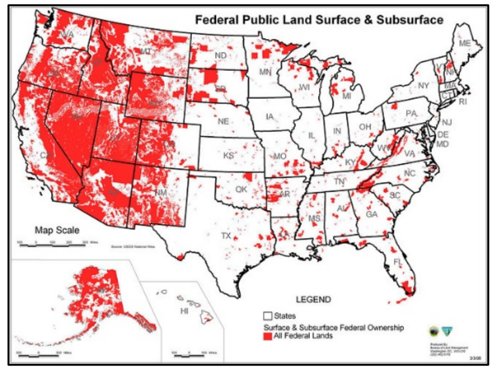

Figure 1 - Federally managed lands of the United States

Amidst environmental degradation from extractive industry and motivated by the proliferation of environmental legislation, the Federal Land Policy and Management Act (FLPMA) was enacted in 1976 providing the framework for western land governance. FLPMA demands that federal lands be managed for *multiple use*, explicitly defined as managing:

> "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; that, where appropriate [management] will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use." (Federal land Policy and Management Act of 1976, 2)

The multiple-use doctrine, as it is often referred, can also be seen as a multiple-value doctrine. Each use in FLPMA is derived from and promotes a host of values that are often conflicting with other uses and it is the job of land managers to balance these. As described above, the management of values is the role of governance whereas the role of science is to provide facts necessary for governance decision-making. With these roles in mind, FLPMA can be seen to demand that governance respond to a multitude of (competing) values while also demanding that science provide facts regarding the multiple-uses of federal lands.

The implied requirement for science to provide facts has been taken up in earnest by the federal agencies responsible for enacting FLPMA (among a host of other legislative concerns). For example, in 2016 the United States Department of Interior's Bureau of Land Management (BLM) – responsible for managing much of the west – issued a proposed management ruling requiring the utilization of "high quality information, including the best available science and geo-spatial data…affirm[ing] the importance of using high quality data as a foundation for BLM planning" (BLM Planning 2.0 Fact Sheet). Although the proposed ruling was rejected in Congress, it is evidence of the commitment that federal agencies have to "best available science". This is further evidenced by the 2016 release of *The Integrated Rangeland Fire Management Strategy Actionable Science Plan* (hereafter referred to as The Fire Plan) as a joint venture of the U.S. Department of the Interior and Department of Agriculture, the two departments responsible for managing the majority of federal lands. This plan details 37 specific research needs ranging from wildland fire and invasive plant species to climate and weather science, demonstrating a commitment to the scientific management of western lands.

Although brief, the previous description highlights three critical characteristics of federal land governance in the west. First, western land policy was initially structured to negotiate competing value-systems which will necessarily beget policy winners and losers. Western lands are governed by federal policy meaning that the entirety of the U.S. populace has legitimate interest in decision-making regarding western lands – the diversity of the U.S. population has and will continue to provide tension and inflate conflicts over competing-values in negotiating land governance. Second, federal land management is invested in the scientific enterprise, at least inasmuch as it provides empirical evidence for governance deliberations. This is further supported by the National Environmental Policy Act (NEPA) requiring government agencies to perform environmental assessments and impact analyses before making decisions using the "best available scientific data" (Kuhn 2016). Third, contemporary federal land management is derived from settler colonial epistemologies and ontologies. Although this point was not explicitly made, the worldviews that support settlement, homesteading, the language of "natural resource management", and deference to western science justifies this claim and, as we will see, lies at the heart of many value conflicts when considering the role of science in governance.

III

Before continuing, it is important to make a distinction. Thus far, I've been referring to "science" and not "scientists". This is intentional, and I do not mean to conflate the two. The institution of science is replete with its own value systems that engage with governance systems in distinct ways. Related to these value considerations, but not necessarily reducible to them, are the value systems of individual scientists. It is prima facie plausible that the values of individual scientists aggregate to inform or construct the values of the institution, and it is plausible that institutional values inform and construct values of the individual scientists. Both the values of the individual and of the institution play roles in the context of this paper and I will use the terms specifically to denote at which level I am evaluating. Further work would do well to explicate this relationship.

The role of values in the scientific enterprise has been explored from many different perspectives. To begin, we may ask whether individual scientists – complete with their subjective biases – are capable of producing objective facts. Presumably, the role of the scientific institution (consisting of individual scientists) as presenting objective facts is critically undermined if it is found that the individual-comprised scientific institution is actually incapable of supplying objectivity.

Many scholars, from a variety of disciplinary perspectives, have argued that science does not supply objectivity, at least not in the sense of strong realism and human-independent referential truth (e.g. Bloor 1991; Chang 2015; Deloria 1997; Ihde 1999; Latour 2005). Outstanding in this literature is Helen Longino's (1990) *Science as Social Knowledge* which argues that the facts of science are socially produced and although individual scientists may bring to bear their own subjective values onto their practice, it is in virtue of the intersubjectivity of the complete scientific institution that renders its products objective. Any scientific knowledge presented to the scientific community at large will, according to Longino, be exposed to critical examination by other scientists and their own diverse subjectivities. This forces potential knowledge to be scrutinized through the lens of varied background assumptions, providing contrasting viewpoints that, upon consensus, result in a high degree of objectivity. It is important to recognize that Longino does not claim that the process of critical reflection renders complete objectivity as "the conditions for objectivity are at best imperfectly realized" (Longino 1990, p. 158). Complete objectivity may never be realized, yet by surrendering potential scientific knowledge to the critical examination of a diverse set of practitioners we can more reliably trust that scientific knowledge is not merely a representation of any individual's subjective – and thus value-laden – desire.

Fundamental to Longino's account of values in science is the interplay between individual scientists. Individual scientists are essential to the enterprise of science as it is the individual that ultimately hypothesizes, develops, measures, and reports scientific findings (among many other activities). Kevin Elliott's (2017) *A Tapestry of Values* provides a detailed and illustrative account of these activities, recognizing that both the individual scientist and the scientific institution make choices in deciding what to study, how to study it, the aims of the research, how to manage uncertainty, and how to report scientific results. Examples of each of these are pervasive: Public and value-informed decisions regarding the distribution of funding will influence which phenomenon are studied (Stephan 2012); Institutionally accepted methodologies will influence how one researches, providing different results to similar questions (Havstad 2015); Calibrating a model with the aim to predict one aspect of a system may misrepresent other aspects of the system (Winther 2015); Moral emergencies and hazards (whether real or imagined) can prompt the reporting of uncertain or underdetermined results (Douglas 2000); and Rhetoric, timing, and audience can impact the uptake of results differentially (Wynne 1989). Elliott et al. provide compelling evidence that values are part and parcel of the scientific institution and to not recognize them is to leave "the scientific enterprise severely weakened and prone to the influences of hidden values" (Elliott 2017, 8). Values in science should not be excised, as Elliott recognizes, but instead reflected on to determine if the socially-objective results of science (in the sense of Longino) are appropriate to public and social values.

The framework that Longino, Elliott, and others provide us is helpful in evaluating the role of value in the sciences that support western land governance. For simplicity, I parse these considerations along two dimensions: [1] Values between science and society and [2] Values within science itself. I take each of these up in turn.

IV

Science and Society

A critical value-conflict in the interaction of science and governance is in the conceptual underpinnings of science itself. What counts as *science* is itself disputed and requires an array of value-judgments – to say that western governance relies on science is to mobilize a value-laden conception of science that itself constrains the possibility of certain (often marginalized) communities to participate in governance. Linda Tuhiwai Smith's (1999) *Decolonizing Methodologies* describes the ways that western scientific institutions developed from Euro-centric thought, rendering inadmissible the knowledges of communities that are derived from different ontologies. Smith argues that the:

> "systems for organizing, classifying and storing new knowledge, and for theorizing the meanings of such discoveries, constituted research [read: western science]…this research

> was undeniably also about power and domination. The instruments of…research were also instruments of knowledge and instruments for legitimating various colonial practices" (63).

Legitimating and privileging western science as critical to environmental governance has already presupposed a commitment to a set of values, namely valuing (presumed) rationality, object/subject dichotomies, reductionism, universality, linear space/time, and value-free methodologies (Smith 1999). In response, authors such as Vine Deloria Jr. (1997), Robin Wall Kimmerer (2013), Niigonwedom James Sinclair (2009), and Kyle Powys Whyte (2018) have challenged these conceptions, citing the ways in which non-western knowledges rely on oral histories, dynamic conceptions of space/time, false subject/object dichotomies, and non-human agency that are not considered as valid presuppositions in western science. Simply, the values that underwrite western science have oriented us to a conception of the world – one that we must govern ourselves within – that marginalizes many communities.

These challenges have been raised elsewhere, such as the concept of post-normal science developed by Funtowicz & Ravetz (1993). Post-normal science is a response to the western scientific institutions derived from the values listed above, demanding that this science "be supplemented by other ways of knowing…need[ing] new methods [and] involving 'extended peer communities'" (Ravetz 1999, 647). In the context of this paper, we can see both the non-western epistemic systems described by Deloria Jr, Kimmerer, and Whyte as well as the post-normal science of Funtowicz and Ravetz as offering competing sets of values for science, requiring scientists to make value judgments at the epistemic and ontological levels, captured in questions such as "what *is* the world" and "how can we *know of* the world".

These are not benign questions when considering western land governance. It is telling that of the 37 science needs detailed in The Fire Plan described above, only one may require methods that diverge from the values of western science. The Invasives Science Need #1 detailed in the plan asks to "Improve understanding of the natural and anthropogenic factors that influence invasive plant species distributions, including invasion *history*, surface disturbance, habitat condition, and fire *history*…" (v, my italics). Given this language, it is possible that resources are directed towards historians or other humanist traditions, yet it is still likely that a proposal to quantify historical trends would be more acceptable given the reliance on western scientific conceptions – replete with their values – in the rest of the document. In many non-western epistemic systems, it is insufficient to understand a problem by constraining the analysis to the non-human world without understanding the historical, cultural, and sociopolitical dimensions of the problem. It is difficult, at best, to analyze these dimensions through reductionist, spatiotemporal linearity, and object/subject dichotomies that western science privileges. Thus, a reliance on western science and its institutional values orients our questions towards only those facets that are considered valid by the institution's own standards. The other dimensions – important by other epistemic system's standards – are underfunded and underrepresented in governance decision-making as evidenced by the The Fire Plan.

Furthermore, the privileging of western scientific values serves to construct and reinforce the role of scientists as experts in modern society. The relationship between "lay citizenry" and experts in society is explored in Frank Fischer's (2000) *Citizens, Experts, and the Environment*. Fischer argues that reliance on experts to deliberate social ills puts governance in a position of "'quasi-gaurdianship' of autonomous experts, no longer accountable to the ordinary public" (7), the "ordinary public" being comprised of many communities that do not share the same values as western science. Experts, in this case, engage in technocratic thought that "is fundamentally founded on an unswerving belief in the power of the rational mind…grounded in principles of positivism…empirical measurement, [and] analytical precision" which "underplays – if not denigrates – everyday moral vocabularies" (16). Fischer argues that the protection of experts from public accountability and their divergence from moral vocabularies – both prompted by the values of western scientific institutions – constructs barriers to citizen participation as the "lay citizenry" come to see experts as "more concerned with their own wealth and status" (3) and not representative of public interests.

Governance relies on western science epistemologies and those scientists who become proficient in them are privileged as experts. These experts enact western science epistemologies, constructing a governance structure that ever-increasingly values western science at the marginalization and cost of non-western epistemologies (Darnell 2008, Tuck & Gaztambide-Fernández 2013). This renders the values of the scientific institution, at large, heavily influential in environmental governance. Communities that value other approaches to knowledge of their environments are discounted, hindering collaborative processes, obstructing access to resources needed to pursue their epistemic aims, and requiring their prerogatives be communicated in the technocratic languages of western science (which, as Fischer recognizes, are often diminished by the reliance on western science), among others. This suggests that the values purported by western science, at large, are critical to examining the role of science in governance. I elaborate on the consequences of this below in the discussion of values in science and their impacts on local communities.

Science and Itself

As shown above, western science presupposes a set of values that may diverge from individual communities, consequently constraining environmental governance to those epistemic foundations that conceptualize the world in a specific way that marginalizes some communities from participation in governance. Turning our attention towards the institution of science itself, we can see how values conflict within science, prompting governance strategies that reflect differential value-sets.

The scientific institution is not – at least empirically – a single unified body of knowledge (Ottinger 2017; Sarewitz 2004; Shrader-Frechette 1995; Takacs & Ruse 2013). Although there are theoretical accounts of scientific unity[2], it is sufficient for these purposes that the scientific institution, as it currently stands, consists of a variety of disciplines that are not themselves unified (Frodeman 2011). John Dupré (1983) offers an account of scientific disunity showing that that the taxonomies relied on by ecology are incommensurable with those relied on by animal physiology or, put differently, "the ideal hare that the physiologist might construct out of ideal cells is just not the same as the ideal hare that is hunted by the ecologist's ideal lynx" (Dupré 1983, p. 335). Dupré is targeting reductionist's accounts of unification, suggesting that with each ascending level of science (e.g. chemistry to biology, biology to psychology, psychology to sociology), the posited entities of study take on different properties in order to provide explanatory power in that discipline.

Divergence happens both inter and intra-disciplinary in a variety of ways, such as methodological choice (e.g. computer modeling versus field studies), ontological entities (e.g.

[2] For example, see Kitcher (1981) *Explanatory Unification*

individuals versus populations), and spatiotemporal scales (e.g. site studies versus landscape studies). These choices are not value-neutral, however. These can be obvious and institutional, such as the ways research funding influence certain methods or research aims. Or they can be deeply entrenched in individual values, such as a researchers ability with computer modeling being influenced by their mathematics capabilities, themselves a product of values for high-paying STEM-related careers or class choices based on affective responses to certain professors, classmates, or programs.

Examples of how the value-choices made within the scientific institution impact western land governance can be seen in two related discussions – the livestock grazing permit renewal process and the scale at which western lands are managed. As mentioned above, livestock ranching is common in the west, but it is managed differently than in other parts of the country. Federal agencies permit livestock ranchers to use federal lands for grazing, whereas the rest of the country grazes on private lands. These permits are subject to federal regulation, including FLPMA regulations and the NEPA processes described above. Thus, grazing permits – and the subsequent impacts of grazing (positive, neutral, or negative) – are an integral consideration in western environmental governance.[3]

Grazing permits were first issued in the mid-20th century at the end of the homesteading era as a way to manage for conflicts arising from usage of the commons by competing ranchers. These permits designate a day of the year when cattle can be "put on" to the range (allowed to graze on federal lands) and a day that they must be "taken off". The number of cattle permitted per grazing allotment was decided by the amount of graze-able feed that the allotment had, itself a product of scientific calculation. At the time, the permits reflected the best available science – replete with their contemporary values. Governance, and the science underwriting it, had decided that the environment was sufficiently stable from growing season to growing season in order to demand specific dates, as well as that the amount of vegetative growth was a sufficient determinant of herd size.

The decades since issuance of these permits have shown that the livestock management they prescribed results in extreme environmental degradation, especially given the relative fragility of arid desert ecosystems. However, the science behind the permits is deemed valid and as such, still permeates research on western lands. For example, the University of Nevada – Reno recently released the 3rd edition of the *Nevada Rangeland Monitoring Handbook* (2018), which serves as a public communication of the current rangeland science. The handbook recognizes that the prescriptions of earlier editions, specifically "weight estimate vegetation inventory [and] forage plant utilization", are "still valid" as indicators of rangeland health (4). These methods are reflective of the methods used to develop the initial permits and are still used heavily in rangeland science in order to provide the "best available science" for new permits and permit renewals. I do not argue that these are *bad* indicators, as such, but the propensity to continue using them as valid data points in rangeland health indication means that the science used in new permits is based on the same value choices of the initial permits further reinforced by the continuation of feed availability being used as a determinant of herd size in governance.

Since the beginning of the permit system, ecology as a field and the sub-field of rangeland science have developed to recognize the rangelands as integrated systems. The handbook referenced above goes on to recognize that "ecological site descriptions were being revised to

[3] Values, of course, are inherent in the decision to allow grazing. I do not discuss this here.

reflect evolving ecological concepts" (4), signaling a shift in the underlying choices to focus specifically on vegetation to include other factors such as riparian assessment, recognizing that although "monitoring…[occurs] at the allotment scale, or smaller", other "strategy[ies] address resource issues and questions at scales larger than the individual allotment. Data collected for one or the other cannot stand alone to answer questions related to the other strategy" (4). This is illustrative: science must choose at which scale to perform an analysis and this choice will relate to different management strategies. In this paper, I do not directly take up how these value choices are made, believing it sufficient to show that the choices impact governance.

The strategies alluded to in the handbook have direct consequences in livestock management and permitting. Site specific analyses are constrained in which ecosystem factors are evaluated as there are a wide range of factors that may or may not be present in specific sites. For example, a site within the riparian zone of a stream versus a site at high elevation will have different biotic communities, soil types, and atmospheric conditions. These site assessments seek to describe appropriate livestock usage rates given site-specific factors, and thus stocking rates vary considerably between sites. Permits developed on site-specific methods require additional labor to collect data and this serves as a critical bureaucratic barrier given the requirements of federal NEPA processes. Furthermore, the additional resources necessary for site-specific monitoring are generally unavailable to the underfunded federal agencies responsible, and so there is a burgeoning movement to allow ranchers to collect data themselves. Although not discussed in detail here, this requires reflection on the moral hazards presented as well as the epistemic trust and validity of citizen collected data – issues that are ethically and socially significant and derive directly from the scientific choice of analyzing at site-specific levels.

In contrast to site-specific analyses, some rangeland ecologists use landscape-level data to develop range assessments. A notable example is Tamzen K. Stringham et al.'s (2016) description of *disturbance response groups* that has received considerable attention in rangeland assessments. Disturbance response groups (DRGs) are landscape categorizations that groups ecosystems into similarly characterized groups based on their response to ecological disturbances including wildland fire, insect herbivory, grazing by domestic livestock and wild horses, off-road vehicle use, and climatic events such as drought. On this view, two specific sites may have drastically different ecosystems yet be classified under the same DRG as they respond similarly to disturbances. DRGs can be developed by aggregating key factors of a landscape, such as precipitation zone, soil type and temperature, moisture regimes, and vegetation dynamics using computer modeling and GIS software. This allows for large-scale classification that is relatively inexpensive compared to the labor requirements of site-specific assessments and, thus, is preferred given the budget constraints and requirements that federal agencies are subject to. This is reflected in the BLM's proposed management ruling described above with the explicitly stated goal of improving "the BLM's ability to address landscape-scale resource issues and use landscape-level management approaches to more efficiently and effectively manage the public lands" (BLM Planning 2.0 Fact Sheet, 1).

In this discussion, I do not mean to suggest that one method is better than the other or should otherwise be desired. However, the choices that rangeland scientists make in understanding western environments do lead to divergent governance decisions that have social and ethical import. The remainder of this essay focuses on the ways in which we can mitigate for unintentional value-laden science decisions in western land governance.

V

How do we mitigate for the role that values play in the science that underwrites western land governance? Before offering a direct answer to this, it is worth exploring a facet of western land governance that is informed by the above discussion, but does not get much consideration. The west consists of small settler-colonial communities that have developed around a few industries, the indigenous peoples whom lived on the lands since time immemorial, and quickly growing urban populations.[4] Of import is the quickly growing urban populations – a 2017 U.S. Census report lists western states holding 7 of the 10 top states in population growth (#1 – Idaho, #2 – Nevada, #3 – Utah, #4 – Washington, #6 – Arizona, #9 – Colorado, #10 – Oregon; U.S. Census Bureau 2017). This growth is fueled, in part, by western lands themselves. According to a 2017 Headwater Economics report, western counties with larger shares of federal lands have higher rates of in-migration and population growth (Rasker 2018). Anecdotally, western governance is increasingly faced with conflicts between outdoor recreationists and rural communities, presumably in some part due to the population increases of western urban centers. As demographics of the west change, so do the sociocultural values that drive environmental governance.

As Smith (1999) argues, the values represented by normal science discussed in the *Science and Society* section above are Eurocentric colonial values at their core. These values underwrite western science as well as western attitudes towards the environment – the same subject/object dichotomies in western science serve to promote wilderness-rhetoric that seeks to remove human use from the environment under the auspices of environmental preservation (Robinson & Tout 2012). Future work would do well to explore the relationships between colonial values, science, and the environment, yet it is not implausible that the same values driving scientific value-decisions also drive personal and social value-decisions regarding environmental governance. The recreational use values of a growing urban population combined with the possibility of inherently colonial values influencing both environmental attitudes and scientific decision-making poses a burgeoning challenge for western land managers to balance local community values – including those rural communities and indigenous communities with different environmental attitudes. If western land governance is left to the socially dominant value-orientations of growing urban centers, it is likely that it will find success and allies in the scientific institution.

Although hypothetical, the previous discussion should motivate robust consideration of marginalized voices in western land governance, whomever and wherever they may be. In order to mitigate for unreflective value-decisions in science as well as to reinforce normative democratic ideals for governance, we must seek the input of a diversity and plurality of values (Agarwal 2009; Douglas 2005; Guston 2014; Lee 1994; Williams & Matheny 1998). We must reflect on these processes through the lenses of power, varying interpretive frameworks and conceptual structures, and other sociocultural differences that may challenge the value decisions of the scientific institution. Simply, and without further argument, this requires that the objectives, methods, interpretations, and reporting out of science be co-developed in processes that engage a diverse public aligning the values of science and scientists with those communities impacted by environmental governance. This is a tall order, and one ill-defended here. I leave it to future work to explore this prescription.

[4] This is an oversimplified division of western demographics. However, it is illustrative for the purposes of this essay.

VI

Western land governance is inherently complicated by its history with colonial settlement, its political and regulatory structures (e.g. FLPMA), and its quickly changing demographics. The role of values, in general, must be clarified given this complexity and strategies to mitigate for value-conflicts developed. The role of science, including its own values, is not neutral towards western land governance. The foundations of science set conditions for governance that may not be shared by local communities. Furthermore, the value-decisions that individual scientists make support divergent governance strategies that have social and ethical consequences. The role of traditional western land governance simultaneously privileges the scientific institution in ways that can run contrary to commitments to epistemic and social diversity. Ultimately, it is through robust collaborative processes that we can begin to mitigate for this.

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