Science, Practice and Place

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Bridging the Science-Practice Gap

The organizing theme of this book is to better connect place concepts and studies to wildland management practice. In my role as a research social scientist employed by a public land management agency I regularly participate in agency meetings intended to narrow the seemingly unbridgeable science-practice gap. Typical sessions have dealt with a range of practice domains from managing endangered fisheries, to constructing future scenarios for fire and fuels management, to designing regional approaches to managing Colorado's high elevation wilderness trails. Substantive foci aside, these efforts appear to have common institutional underpinnings when viewed from a social science perspective. In this chapter I will argue the gap persists and even widens over time, not out of some lack of commitment or failure to communicate on the part of scientists and practitioners. Instead the problem reflects fundamental differences between the nature of science, which seeks to transcend place, and the nature of practice, which is by necessity place-based. In other words, it is impossible to close the gap between science and practice because the former seeks context (place) independent principles whereas the latter requires context dependent synthesis.

Contrary to popular models of science, which build on the assumption of an ability to achieve a "gods-eye" (objective) grasp of the world, every scientist occupies a somewhat unique (subjective) position within the world by virtue of culture, history, training, and personal experience that limits and conditions that scientist's knowledge of it. Likewise in the real world of action where citizens and practitioners are embedded, knowledge is always partial and incomplete and likely over time to grow more fragmented than integrated. Put another way:

> [Even] after the best of scientific studies a judgment must be made about the relevance of a piece of scientific research to a manager's … practical question at hand. In this judgment science is not at all helpful … [H]ow to integrate the kind of knowledge that science can give with the practical judgment about what the [managerial] situation requires [remains one of the] great unresolved questions (Hummel, 1994, p. 314).

To address this "great unresolved question" requires an exploration of the realm of practice. My intention here is to begin such an exploration by examining how place concepts illuminate the challenges we face in trying to bridge the gap between science and practice. This paper will argue that place-oriented inquiry and practice are the keys to overcoming the ever present if not ever expanding science-practice gap. I hope to show that place can better frame the problem and help managers and scientists appreciate the inevitably plural and partial (incomplete and uncertain) character of all knowledge. In addition, I will suggest what I hope are more productive ways forward that not only embrace this pluralism and partiality but find greater efficacy and advantage in the fact that all practitioners are differently positioned to perceive and act on the world (i.e., context dependency). Thus, rather than trying to inform all problems with an

integrated top-down view of knowledge, informed action can be conceived as guided by the collective wisdom of networked actors and institutions governing complex systems, each informing one another in a collaborative form of rationality that operates both horizontally (place to place) and vertically (upwards and downwards in scale).

Why Science Fails to Simply Practice

The idea that science can perfect environmental decision making is still largely taken for granted in the professional cultures and institutions of environmental management. Among social scientists, however, it has received considerable scrutiny (Flyvbjerg, 2001; Pilkey & Pilkey-Jarvis, 2007; Sarewitz, 2004; Allen et al., 2001). In their book *Useless Arithmetic*, for example, Pilkey and Pilkey-Jarvis (2007, p. 32) challenge the basic efficacy of quantitative models of natural processes. Drawing from anthropology and ecology, Tainter and colleagues (Allen et al., 2001; Tainter 1999) similarly point to social/institutional limits on managing complex systems by examining how complexity has contributed to the collapse of civilizations in the past. In particular, Tainter (1999; 1988) details the history of collapse to develop the argument that the evolution of complex social-ecological systems (i.e., a given society and its resource base) tend over time to outstrip that society's own institutional capacity to manage such systems. As a society grows and matures the cost-to-benefit ratio of problem solving escalates because the solutions to new and emerging problems always come at a higher cost or require proportionally more inputs than the problems already solved. Because human societies tend to apply the easiest (cheapest) solutions first, over time problem solving becomes progressively more costly (that is we experience a diminishing return on problem solving – sometimes to the point of collapse or a deliberate adoption of simplification). Sometimes societies delay collapse by subsidizing complexity (what Tainter describes as complexification) through developing new resources (historically through territorial/spatial expansion) and more recently through fossil fuels. But even if we can subsidize complexity to some degree with energy or technology, the situation still leaves the practitioner with the cognitive challenge of complexity (e.g., the need to synthesize and integrate the exponential growth of knowledge at multiple scales).

Taking a sociologic approach Scott (1998) similarly documents the failure of state inspired schemes to improve social conditions. He notes that major sources of failure are states' tendencies to promulgate a hegemonic planning mentality that excludes the necessary role of local knowledge from consideration. He attributes this to an adoption of what he calls "high modernist" ideology promoting unrealistic confidence in scientific and technical progress and the design of a social order commensurate with natural science. From planning theory, Fisher (2000) attributes failure to the "overapplication of scientific rationality to public policy making" (p. x).

Drawing from contemporary political science, Sarewitz (2004) argues that science makes environmental controversies worse for three reasons. First, science supplies contesting parties with their own bodies of relevant and legitimate facts (a problem only compounded by the universal access to information and data via the internet). Second, the necessity of looking at nature through a variety of disciplinary lenses also brings with it a variety of normative-ethical lenses. Third, scientific uncertainty persists and grows, not for a lack of increasing scientific understanding, but for a lack of coherence among competing scientific understandings – amplified by the various political, cultural, and institutional contexts within which the science is

carried out. In another example, van Wyk, et al. (2008) highlight the persistence of a contextual/cultural gap between information providers and information users as reasons that scientific information fails to be incorporated into decision making. In sum, social analysis of the science-mangers nexus suggests that knowledge complexity decreases institutional efficiency, increases scientific uncertainty, and amplifies policy conflict.

Place and Pluralism

The persistent if not widening gap between science and practice cannot be solved by calls for more science, better science, or more focused science. Nor can it be solved by simply finding more effective ways to communicate and deliver new science to practice. More fundamentally, continuing to address the gap from an exclusively context independent, top-down, unidirectional, f*rom*-science-*to*-practice mindset exacerbates the problem. In this hierarchically dominated model, knowledge will always expand much faster than our individual and collective capacities to absorb, process, and apply it to particular situations and circumstances. But what if we conceived of knowledge as not simply a collection of ideas, facts and values waiting to be integrated into some grand unifying model (algorithm) that any manager could easily and effectively apply? What might we gain by conceiving the structure of knowledge not in disciplinary terms but in spatial-ecological terms, as embedded in and distributed across places and the people who occupy and interact with those places? Would it be possible to approach knowledge as distributed throughout a social-ideological space, organized not so much by discipline or algorithms but by relational geography? What leverage on this problem might be gained by viewing knowledge as something produced and articulated in a multi-scaled, relational geographic field of embedded, partially informed practitioners organized within both vertical and horizontal planes of relationships?

Two key features of a spatial/relational view of knowledge are (1) the irreducible *pluralism* of knowledge (contra fundamental knowledge unity) and (2) the subjective *positionality* (contra "gods-eye" objectivism) of observer-actors embedded in both vertical and horizontal relations to the world. While these ideas challenge the naturalistic (positivist) assumptions in common in ecological science – the assumption of a single fixed or absolute system of reality in which all life-forms are subject to the same underlying processes (e.g., Lowe, et al. 2009) – in favor of a "constrained" constructionist epistemology (see Hayles, 1995), they also regard knowledge as ecologically relational (situational and relative) to where one is positioned within a social-ecological field. Accordingly, all observers or actors have only a partial (incomplete) understanding owing to their ultimately unique positioning within spatial-temporal reality. But this need not be viewed as a weakness: encountering and considering the knowledge of others who occupy different positions within the world (or the flux as Hayles prefers to call it) strengthens our collective understanding. Grasping the flux from multiple vantage points enriches each perspective and reveals assumptions that may have otherwise remained hidden especially to those who occupy the dominant roles (p. 58-59). Below I want to elaborate on these two features of place and suggest an alternative framing for understanding the science-practice relationship.

Geography and spatial studies highlight three sources of pluralism. The more typical way in which pluralism is recognized and studied is within an *ontological* approach to place (Patterson

& Williams, 2005). In most discussions, place is typically conceived as a location or container of material and ideational relationships to the world, that is, a socially constructed site that organizes and constitutes human material and social relationships and meaning. Ontological pluralism is strongly associated with cultural differences and competing systems of meaning across groups of stakeholders and domains of expertise. It represents the pluralism in the nature of what exists; that is, the contents of reality and, per place, where those contests are located. We often experience it as the different meanings, uses, and values people hold for a place and it is often discussed in terms of competing "senses of a place" held by various groups of stakeholders (Williams, 2008).

Whereas social science of place is typically occupied with *ontological* descriptions, some philosophers and geographers have drawn on place and spatiality to advance an *epistemic* perspective on knowledge – place as a *way* of seeing and thinking about the world (Nagel, 1986; Entrikin, 1991; Sack, 1992; 1997). Place facilitates multiple perspectives or ways of knowing highlighting multiple, differently disciplined context independent (objective, scientific) and context dependent (subjective, local) lenses or positions through which knowledge may be generated. Such epistemological perspectives are proposed to help transcend what geographers regard as a deep and long-running tension within Western intellectual traditions between universalist (context independent) and particularist (context dependent) views of knowledge (See also Fischer, 2000; Flyvbjerg, 2001; Williams, 2002a). As Sack (1992, p. 1) has argued, place is more than mere setting or container of reality. It is integral to how human beings experience and organize their world, a "fundamental means through which we make sense of the world and through which we act." Individual awareness and knowledge of the world is fundamentally a spatial awareness, informed by the particular cultural, experiential, temporal and spatial positions that we happen to occupy. Likewise for Hayles (1995) our positioned, embodied, human-situated interaction with the world conditions how we can understand of the world.

This universalist-particularist tension for organizing knowledge has been particularly salient in geography (Entrikin, 1991), with important though less recognized parallels in natural resource management. Progressive/scientific management of nature historically was been built on the universalist impulse of science and knowledge whereas land/nature management practice operates, by definition, in the arena of the particular. The geographic discourse on place and spatiality highlight this tension and provide some insights into how to profit from it. Specifically, place helps to address the growing disciplinary fragmentation of knowledge, connect empirical and normative lenses, bridge the epistemological divide between local/contextual knowledge and global/generalizable knowledge and organize and validate knowledge originating in a bottom up synthesis of networks of actors. The knowledge and wisdom required to manage complex social-ecological systems is not likely to emerge out of top-down expert driven knowledge systems (which become too unwieldy and expensive) but through the combined and less formally coordinated efforts of more embedded practitioners (managers) learning though their own local efforts. In other words the future of practice and problems solving is more likely to be organized and directed from what Entrikin (1991) refers to as the epistemological position of *betweenness* – informed by top-down scientific discourse but also invigorated through bottom-up engagement in which practitioners play a more prominent role in the production and validation of knowledge.

The third source is *axiological* pluralism. Axiological pluralism focuses on various normative lenses or prescriptive statements and valuations about place. It seeks to recognize the diverse social processes for prescribing particular valuations, preferences, and choices. These may range from the technical lenses of economics and decision science, to legal-political systems and institutions, to moral-ethical systems embedded in culture, religion, and moral philosophy. Axiological pluralism contrasts particularly with monistic theories of value (See Norton, 1996), such as economics and rational choice theories in political science in which all goods are assumed to be commensurable on a single value dimension such as utility. In contrast various pluralist theories of value have been proposed (Anderson, 1993; Norton & Toman, 1997; Price, 2004) to highlight the incommensurability of values. Reconciling the divergent meanings and constructions of places is not just about which meanings and values are at stake, it also involves a plurality of social processes and institutional arrangements by which society orders, evaluates, and decides about their relative production, maintenance, and distribution. From a progressive, Enlightenment inspired perspective, the most appropriate method for ordering or allocating goods was the market, an institution with rational procedures for making valuations (and in the absence of markets for certain goods artificial, surrogate markets were promoted). Within natural resource management this approach reached its zenith with operations research thinking in which experts would identify the "outcomes" of plan alternatives, economists would measure their values, and analysts would calculate the best, most efficient alternative. Accordingly, values did not pertain to places or other holistic spatial entities, but to their useful and exchangeable (fungible) properties.

The interaction of the three (ontological, the epistemological, and the axiological) contribute to pluralism with each dimension. For example, the Enlightenment-inspired pursuit of universal, context independent knowledge has constrained the ontological meanings and values of nature to the tangible utilitarian realm and epistemologically narrowed what counts as legitimate means to knowledge and marginalized the context dependent knowledge of place an the particular (Entrikin, 1991). This same impulse for context independent knowledge has also constrained the methods for adjudicating among competing values and preferences in natural resource policy and management (Williams, 2002a; 2002b). For practice the core challenge to recognize the diverse ways in which a community or society orders or chooses among alternative courses of action learn how to negotiate within and across these different kinds of pluralism. In other words, practice requires social institutions that can recognize and negotiate among pluralistic conceptions of the good and the political and pragmatic task of adjudicating among competing representations of a place produced as a result of ontological and epistemological pluralism.

Place is important for understanding the persistence of the science-practice gap and the irreconcilable ubiquity of knowledge pluralism. When dealing with complex social-ecological systems all attempts to close the gap and overcome plurality and uncertainty ultimately rely on being able to attain a universal, context independent, gods-eye view of reality. Alternatively, adopting a spatial or place-based perspective helps to recognize that all knowledge -- even exalted scientific knowledge -- is to a significant degree *local* or context dependent because all observers and actors – by virtue of their biography and geography – occupy a particular, delimited position from which to observe the world. Still, our diverse pluralistic culture must somehow manage to co-exits in shared spaces despite our unrelenting differences. Pluralism operates in the realm of practice by recognizing and profiting from different kinds of knowledge

and skills. Natural resource practice requires the cultivation of the capacity, habit, or knack for collective sense-making that moves beyond the mere application of science and technical know-how. In other words, it is through real world practice, embedded in actual places that knowledge pluralism and value differences are transcended.

The point is not to argue against investing in science, only that it is unreasonable to expect those investments alone to deliver efficient and effective solutions to complex problems. At the very least we need to recognize that those who are engaged in practice cannot be expected to absorb all the latest science that might apply to their practice. Rather what is being argued here is that we need to develop strategies for using and accessing the accumulated wisdom of the practitioners themselves as they go about their work. Addressing the science-practice gap requires a rethinking of how practical knowledge is produced and applied. This rethinking needs to take place on two levels. At one level we need to address how individual practitioners learn and interact. Another level involves a shift in how we conceive the tasks of management and governance writ large.

Place and Practice

Given chronic system complexity and ambiguity and limited institutional and cognitive capacities to process ever grander, yet unalterably thin models of reality, one level for addressing the science-practice gap is to elevate practice as a form of knowledge production and management. Place and spatiality facilitate such an elevation by highlighting different ways of knowing and acting that emphasizing "knowledge nested in a context of time and local circumstance" (Fisher, 2000, p. 69). A number of social scientists have focused on a kind of epistemic pluralism that can be found in the Aristotelian intellectual virtues of *epiteme* (abstract scientific knowledge)*, techne* (the kind of technical knowledge found in a craft)*,* and (depending on the author) *phronesis* (Fisher, 2000; Flyvbjerg, 2001) or mētis (Scott, 1998). These authors make the case that we could do more to integrate and profit from the practical and informal knowledge that exists among both citizens of places and emplaced professional practitioners.

Scott (1998) characterizes local, practical knowledge as the lost art of *mētis* – local, experiential knowledge that resists simplification into deductive principles which can be readily transferred through book learning – which has been systematically replaced by state-inspired projects of rational management. Scott documents numerous examples of "natural and social failures of thin, formulaic simplifications" imposed on society through the agency of state power (in fact his first case example deals with the failures of utilitarian logic used to impose mono-cropped, even-aged forestry in early modern Europe). He notes that large scale processes and events are inevitably far more complex than any models we can devise to map them. What these schemes "ignore – and often suppress – are precisely the practical skills that underwrite any complex activity … variously called know-how … common sense, experience, a knack or *mētis*" (p. 311). Rather than a dialogue existing between practical knowledge and formal scientific knowledge, he argues that the state has sought hegemony over the former.

A good example of this distinction has to do with the application of fire science. One of the most exalted topics in fire science is fire behavior modeling, which is intended to help fire fighters anticipate how a wildfire will spread. But as one highly experienced fire manager once explained

he would never rely on such models, which he saw as over-simplified and exceedingly poor at factoring in local topography and meteorology. He would much rather rely on his years of experience fighting wildfires in his district as well as the experience he brought from many years on the fire line in different settings.

A line of reasoning similar to Scott is offered by Flyvbjerg (2006; 2001). But whereas Scott examines "how certain [state inspired] schemes to improve the human condition have failed" Flybjerg directs his gaze more generally at "why social inquiry fails" and "how it can succeed again". With a strong echo of Scott, Flybjerg (2001) builds his argument by comparing Aristotle's term *phronesis* (practical wisdom) to *episteme* and *techne*. Whereas *episteme* refers to knowledge that is abstract and universal and *techne* describes the know-how associated with practicing a craft, Flyvbjerg seeks to elevate a version of *phronesis* as the domain of the social sciences in sharp contrast to the natural science model rooted in *episteme* and *techne*. Flyvbjerg employs Aristotle's *phronesis* to highlight the comparative advantages of practical wisdom that comes from "an intimate familiarity with the contingences and uncertainties of various forms of social practice embedded in complex social settings" (Caterino & Schram, 2006, p. 9). According to Flyvbjerg (2006, p. 68) *phronesis* concerns the kinds of value judgments and decisions that are "so commonly involved in political and administrative practices that any attempts to reduce them [to *episteme* or *techne*] or comprehend them in those terms are misguided." *Phronesis* was deemed most important to Aristotle because (as Flybjerg argues) "it is that activity by which instrumental rationality is balanced by value-rationality" a balance crucial to the sustained happiness of citizens in any society. Yet it is that very balance that has been displaced by instrumental rationalities of *episteme* and *techne* as evidenced in part by the fact that modern languages no longer have a word containing a variant of *phronesis*.

In comparing Scott's use of *mētis* to Flyvbjerg's *phronesis*, *mētis* appears closer to the idea of *local* knowledge or wisdom. It is not as refined and systematized as *techne* (which by Scott's reckoning is more universal, organized, and ultimately expressible in the form of rules, principles and propositions), but rooted in a history of local problem solving. For Flyvbjerg, *phronesis* is tied more closely to political/administrative skills such as reasoning about values, the good life, and the exercise of power. Both emphasize *emplaced* knowledge and stand in contrast to the view from nowhere or what Scott calls "thin simplifications" that "can never generate a functioning community, city or economy" (p 310). Both kinds of knowledge are exist among practitioners and can be cultivated within organizations and institutions.

A key argument of Flyvbjerg is that social science (and I would include practice) should not try to emulate natural science by trying to build predictive models, but instead focus on case study knowledge, which typically reveals a kind of practical wisdom emphasizing value rationality and power rather than the maximization of specific outcomes or objectives (typically prescribed from above). More socially and ecological integrated knowledge will not result from social science increasingly emulating the natural science's quantitative and mechanistic "gods-eye" view from nowhere, but by natural science adopting a concept of nature that emulates the social realm as active, creative, and agentive (closer to somewhere). This kind of practical wisdom need not be managed from above, but is augmented, refined and validated by systems of networked learners. In other words, practical wisdom is shaped, evaluated, and refined by the practitioners themselves rather than produced and transmitted via expert systems (though experts can certainly

help in this effort). Finally, such a distributed, bottom up system of knowledge creation helps to counter the otherwise diminishing returns and escalating costs of traditional hierarchically directed information systems.

Flyvbjerg makes a number of recommendations for how to practice social science that matters, which, at their core, involve doing context dependent case study research. Aristotelian *phronesis* involves deep knowledge of circumstances, concrete examples, and case exemplars. Flyvbjerg (2001) cites Richard Rorty (who invokes John Dewey) in this regard: "the way to re-enchant the world … is to stick to the concrete" (p. 136). This doesn't necessarily exclude generalization, but such generalizations are more often built from the examination of many particular cases. Examples of fields we might emulate are business and law, where practical knowledge is developed around learning cases and developing the judgment or wisdom for how to creatively apply cases to the situation at hand.

The second recommendation is to balance instrumental/technical rationality with what Flyvbjerg calls value rationality. The goal is to increase the capacity of individuals, organizations, and society to think and act in value rational terms. This forces researchers to face the contextual nature of problems instead of assuming some universal foundation on the one hand or indulging in paralyzing relativism on the other. He argues that the socially and historically conditioned context of a research problem constitutes the only foundation we have and is best defense against relativism and nihilism. Validity comes from testing assumptions through the comparison of contexts (e.g., different positionality) where interpretations are built on validity claims that can be examined and deliberated.

His third recommendation is to make power a core part of analyses. Who gains and who loses? What kinds of power relations are involved? Are there possibilities to change these power relations and would it be desirable to do so? What kinds of power relations apply to those asking the questions? In other words, who governs and what governmental rationalities are at work? Such a focus is in stark contrast to our utilitarian history in natural resource management which has avoided power questions in the vain hope that technical rationality would render them irrelevant.

Fourth, in addition to asking the usual why questions, we should ask how questions that reveal narrative: how did this situation come to be? The key idea here is that history and narrative are fundamental to social science. Historical narrative helps us anticipate situations before we encounter them. It is also important in distinguishing a place-based approach from a resource orientation. Places have histories, both natural and social, whereas resources focus on utility in the present and future. The very idea of resource is to decontextualize what is there, to strip the landscape of history, and eliminate past or pre-existing meaning as a constraint on its use. In building narrative one must acknowledge the past in consideration of the future.

Finally, social science should be directed at building dialogue with diverse stakeholders. The aim of social science, according to Flyvbjerg is to provide input into the ongoing social dialogue and praxis in a society, rather than producing generalized, unequivocally verified knowledge. Social science knowledge should not be privileged – it must enter into the dialogue, not take it over.

Flyvbjerg's recommendations, though intended more for individual social science researchers, could also be applied to the training and preparation of practitioners. Many professional fields from business to law, medicine, and planning employ and teach case-based knowledge. For example, describing someone as a *clinician* is often meant to distinguish a professional who is primarily devoted to practice from one primarily devoted to research. Clinical knowledge in a profession such as medicine is nurtured through the accumulation of experience from the careful analysis and treatment of many actual cases. Over time the practitioner is expected to learn how to diagnose and treat conditions by drawing on case-based experience. Likewise a good bit of the learning and practice of law involves the careful application of case law to new situations. In important ways, what distinguishes the professions from the academic disciplines is their relatively greater emphasis on learning from real-world practice. Professional knowledge builds much more on inductive, situational, bottom-up learning than top-down, deductive extension of theory to practice.

Part of the challenge of such a bottom up knowledge system involves the structuring the interactions among practitioners. Professionals of one sort or another spend a great deal of time sharing their case knowledge. But applying this to complex social ecological systems suggests another aspect of case-based knowledge. In such contexts the health of the overall system depends on the combined actions of many practitioners each responsible for various jurisdictions whether divided by geography (e.g., a wilderness) or by resource and/or function (e.g., wildlife, or wildfire). The overall performance of a system at any scale depends on the collective actions or lack of actions by managers distributed across space, scales, and resource functions.

As one case example I recall participating in meeting to discuss how to bridge the science-practice gap concerning fire effects on endangered fisheries. The meeting brought together scientists from several federal agencies to respond to managers needs for better information to help them make decisions about the managing the use and suppression of wildfire in riparian areas, especially when such fires threaten endangered fish species. Much was made of dynamic landscape processes and identifying criteria for defining a resilient landscape. The research ecologists pointed out ever greater complexity of the phenomenon (patchy, multi-scaled, dynamic landscapes) in which the right prescription for any one stream network was elusive if not indeterminate. According to these ecologists no singular riparian condition could be described as necessarily better or healthier than another because the viability of endangered fish populations actually hinges on a dynamic spatial variety in which some patches (streams) are in the process of becoming better habitat for a given species and some worse habitat. Adding to the complexity and uncertainty for management prescriptions, one could arrive at very contradictory recommendations depending on one's disciplinary focus. For example, because stream culverts are impediments to the adaptive dynamics sought by systems ecologists (culverts being iconic stand-ins for everything that disrupts the movement of fish populations through a system of branching streams), removing them would increase the connectivity of streams (ostensibly a good thing for the survival of threatened and endangered species). But if a manager happens to be more worried about the spread of invasive aquatic species removing culverts also makes it easier for such species to spread (ostensibly a bad thing). Instead of clarifying best management practices, additional science often leaves managers more confused about best practice. Best practice in any given situation is contingent on conditions and actions in adjacent landscapes as well as interactions at both high and lower scales of decision making. The real challenge for

managing such a system is figuring out how each manager, acting on his or her particular jurisdiction is most able to take into account the knowledge and past and present actions of other mangers who themselves take similar partially informed actions.

The solution to this dilemma is not likely to be found by traditional transfer of knowledge from expert to practice, but by learning to take into account the actions and individual partial understandings of diverse practitioners distributed cross resource specialties, landscapes, and scales. By thinking about practice as *emplaced knowing* we can begin to reconceptualize the practitioner as part of a network of practitioners and rethink knowledge/learning as a "distributed" product/process of learning or practice communities. As understood in the field of knowledge management, this can be equated to a community of practice (Wenger, 1998). Practice communities constitute groups of people who share a concern or interest in some domain of activity and learn how to do it better as they interact regularly. According to Wenger, three characteristics are crucial to distinguishing a community of practice from other kinds of communities. First, they have an identity defined by a shared *domain* of interest such that shared competence distinguishes members from other people. Members value their collective competence and learn from each other, even if few people outside the community value or even recognize their expertise. Second, they act as a *community* with respect to their domain. Members engage in joint activities and discussions, help each other, and share information. They build relationships that enable them to learn from each other. Third, members of a community of practice develop a shared *practice* in something. They develop a shared repertoire of resources, experiences, stories, tools, and ways of addressing recurring problems. This takes time and sustained interaction.

To return to the fire and fish example, it is at least as important to help practitioners better organize themselves as communities of practice as it is to produce the next scientific synthesis of knowledge, which by necessity will emphasize context independent knowledge. Practice communities draw from each other to advance situation specific problem solving. They might do this by requesting information from community members, seeking out people with specific experiences suited to a particular problem at hand, making site visits, documenting cases and solutions, and mapping knowledge and gaps in knowledge.

Place and Governance

Thus far I have described the science-practice gap as a knowledge problem without much regard to the institutional or governing structures within which practice is ultimately carried out. While a pluralist conception of knowledge gives greater recognition to the wisdom and experience of embedded practitioners (and citizens), learning and operating in real places and developing context dependent knowledge also needs to be addressed at an institutional or governance level. An expanded conception of practice that nevertheless remains embedded primarily within the existing institutional structures of hierarchical governance will do little to escape the vice of complexity and uncertainty. Perhaps recognizing this, Scott (1998) concludes his work by making a case for developing *mētis*-friendly institutional structures that emphasize plurality and diversity. He notes that in natural systems, diversity is "demonstrably more stable, more self-sufficient and less vulnerable" (p. 353). As with complex natural systems, *mētis*-friendly institutions benefit from diversity, redundancy, and decentralization.

Within natural resource management many have turned to various forms of adaptive management (Stankey et al., 2005) or adaptive governance (Scholz & Stiftel, 2005) as a place-based strategy for addressing the chronic insufficiency of knowledge in the face of complexity, uncertainty, and change of the sort faced by natural resource managers. Tognetti (1999), in particular, describes adaptive management as a way to address the challenge of epistemic pluralism in natural resource management:

> At one end, the more deterministic approaches are associated with the characteristics of Newtonian science, the Darwinian theory of evolution, neoclassical economics and methods such as cost-benefit analysis that provide utilitarian justifications for decision-making and technical solutions within the existing paradigm of status quo, and which have dominated policy dialogues. At the other end, adaptive approaches are more associated with institutional, political economy, social learning and conflict resolution frames of reference that challenge existing institutional structures and that have raised fundamental questions regarding scientific practice in relation to high stakes and fundamentally political decisions, which are not new but which have had a marginal presence in policy discourse. (p. 690).

In theory adaptive management involves multi-scalar, place-sensitive policy experimentation (and by implication more case/context sensitive knowledge). As often practiced, however, adaptive management tends to privilege formal scientific knowledge (*episteme*) over other forms of knowledge held by practitioners and citizens and is insufficiently adaptive in its conceptions of value (Norton, 1999). As a pragmatic approach to adjudicating among the plurality of competing management prescriptions for a place or landscape, it "pays little attention to the question of what types of institutional structures and processes are required for the approach to work on a large scale basis" (McCain & Lee, 1996, p. 446). It also tends to be costly and time consuming, making it less attractive as a way to improve the benefit/cost ratio of problem solving. Recognizing that effective institutions for adaptive management defy all attempts at standardization (Stankey et al., 2005, p. 51-52), the concept of adaptive governance is being put forward to emphasize the importance of context and the value of institutional diversity in sustaining complex social-ecological systems (Folke et al., 2005).

The emerging discourse on adaptive governance coming out of ecological systems theory conveys strongly prescriptive ideals in citing such positive virtues of institutional diversity, wider public participation, and social capacity and flexibility to respond to unplanned change. A separate but less normatively disposed discourse examining how governance practices have evolved in response to global scale social complexity has also emerged in sociology (Ilcan & Phillips, 2008; Urry, 2003) and public administration (Goldsmith & Eggers, 2004; Pierre, 2000; Pierre & Peters, 2005; 2000; Rhodes, 1997). First and foremost, governance is distinguished from government. In the more traditional notion of government is "state-centric" examining how government institutions "steer" society and the economy. The latter tends to be associated with a "society-centric" examination of the co-ordination and self-governance through networks and partnerships. What were previously as the indisputable role of government are increasingly seen as the province of various societal institutions (Pierre, 2000). Accordingly, much of contemporary governance takes place outside formal government institutions and bureaucracies and involves increasingly complex linkages and collaborations among multiple public and

private organizations (see also Flint this volume). The governance of complex systems increasingly emphasizes the need to reconcile traditional top-down hierarchical public administration built on vertical lines of authority with emerging complex, social networks of actors, stakeholders, and governmental and non-governmental organizations interconnected by horizontal lines of interaction. These perspectives contrast with Progressive Era institutions of governance that are not as well suited to the administration of modern social-ecological systems marked by dynamic, multi-scaled complexity.

This has posed something of a theoretical dilemma for sociology, which has long vested the nation-state as the primary unit for social regulation. In *Global Complexity* Urry (2003) makes the case that as the world has become more globally interconnected, nation states appear to play a lesser role in creating social order. If, as complexity theory suggests, executive control in a state-centric, top-down approach to governance cannot keep pace with the complexities of the social and ecological systems being managed, the question becomes how is it that global social systems manage to create any social order at all? Reviewing the various arguments about globalization, Urry (2003) concludes the world is neither self-organizing, anarchically disordered, nor the intentional outcome of some global conspiracy. Rather global complexity is "partially organized" by social networks which exhibit pockets of autopoeitic ordering. The key to modern global scale social order, he argues, is the global expansion of communication. Modern communications enable co-ordered knowledge structure to emerge on their own. In other words, organized global complexity is made more likely though enhanced communication at ever larger scales. Larger scale coordination emerges through larger scale networks of communication and action.

A similar conclusion has emerged in theories of governance. Traditional models of governance (public administration) start with the organization as the basic building block in a system in which top officials direct management practice to accomplish program goals. This literature describes the ways in which government has increasingly come to rely on partnerships and networks to accomplish its program, at least in part, driven by increasingly complex global scale social interactions. The growth of governance by complex networks of governmental and non-governmental actors and institutions has been propelled by as sense that government has become "'overloaded,' that is, unable to resolve all the tasks and demands placed upon it by society" (Pierre, 2000, p. 4). Some have gone so far as to suggest idea that government has largely been replaced by "self-organizing" markets and networks of organizations and actors (Rhodes, 1997).

Such a view of governance comports well with the view of complex adaptive systems, in which pluralism and uncertainty dominate and institutional capacities struggle to keep pace with complexity. The challenge of governing in the face of excessive complexity and uncertainty can be addressed, particularly at a local scale, when self-organizing networks of practitioners, institutions, organizations, NGOs, and various kinds of expertise and citizen interests coordinating come together and begin to govern the system. Flint (this volume) provides a good illustration of emergent governance regimes in her examination of mountain pine beetle problem in north central Colorado. She notes that in the context of such large scale disturbance new governance relationships are being forged rather quickly with both large scale regulatory institutions at the state and federal level and local residents, interest groups, government agencies

and organizations drawing on existing and emerging networks to address place-specific issues in response to the regional beetle outbreak.

Williams and Metheny (1994) describe the importance of interactions across scale in the regulation of environmental problems suggesting that different models of democracy should play different roles depending on scale. At larger scales traditional interest group politics provides a way to settle on the basic rules to guide more local decision making. At the local scale, context specific dialogic processes dominate, in part because decision begin to matter to local constituencies in ways that at a larger scale were obscure and remote except to the most committed interest groups. This is essentially an explanation for the NIMBY (not in my backyard) response to many environmental policies. It is only when decision making takes on specific, local consequences that most are likely to become see as stake. At this level place becomes the basis for forming a polity (e.g., Kemmis, 1990) as people find "themselves in geographic proximity and economic interdependence such that the activities and pursuits of some affect the ability of others to conduct their own activities" (Young, 1996, p. 126). I would argue, with participants potentially motivated based on both their membership in a space of dependence and/or a space of engagement (see Flint, this volume). Despite diverse and plural interests, place forges a minimal commonality among participant/stakeholders to make possible and motivate political action as people find "themselves in geographic proximity and economic interdependence such that the activities and pursuits of some affect the ability of others to conduct their own activities" (Young, 1996, p. 126). In other words, unity within the polity results from people having to co-exist in a shared space even if they don't share much else. Healey (1997) characterizes such collaboration as "making sense together while living differently."

Whatever social differences exist regarding the valued uses and meanings for a place, there is often a shared concern for particular places. The basic task of any area planning process is to negotiate a shared, pragmatic sense of place (make sense together) as a beginning to the process of developing management objectives for that place. In this model public involvement is vigorously engaged throughout the process, from landscape assessment (mutual, shared learning about the landscape) to the identification of plan alternatives and their objectives. One could conceive landscape assessment as a process of collecting local knowledge and context for characterizing the meaning and value of particular natural landscapes. At the same time, while expert/agency input and collaboration also compete with public or citizen knowledge and values pertaining to places, agencies also bring to bear larger scale external considerations on desired landscape conditions and management objectives, particularly in the form of laws and regulations that frame natural resource management and articulate the national interest in these lands. Recognizing that places are the products of continuous social construction, these senses of place are contested throughout the planning process as well as in feedback on planned and unplanned social action, which re-creates the landscape and leads to a future round of negotiation.

Conclusion

Faced with irreducible pluralism in the knowledge and meanings of places, irreconcilable diversity in the practice and products of science, and incommensurable differences in valuation

what practitioner wouldn't wish for some all-powerful analytic tool to close the gap between knowledge and practice? But framing the science-practice gap as one of access to and consolidation of knowledge in a top down conception of expertise is a major source of the problem. Again following Tainter's (1999; 1988) assessment, society simply can't afford to invest in the ever increasing cost of knowledge so conceived and generated. Clearly, investing in science and the expansion of knowledge will always be important, but it is unreasonable to expect those investments alone to yield increasing efficiencies in solving complex problems. Certainly those engaged in practice cannot be expected to absorb or master all the latest science that might apply to their practice. Place helps us rethink the science-knowledge-practice nexus by putting more emphasis on the capacity of embedded knowing and experienced agents to act and learn in a networked system in which horizontal linkages are given greater emphasis. In a model of hierarchical governance, practice entails the execution of direction from above. In the networked, partnered, deliberative model, knowledge is emergent from a network of actors, each actor with some partial context dependent knowledge (rich in particulars of the situation) but relatively less cognizant of both horizontally adjacent understandings and understandings that operate at different scales.

A focus on specific places helps to ameliorate the disciplinary fragmentation of knowledge. First, it confronts the subjective positioning of scientific observers reminding us of the inherent selectivity of that all representations of the world. Second, by helping to organize and validate knowledge originating in a bottom up synthesis of networked it reduces the epistemic tension between local/context dependent and global/generalizable knowledge. Finally, a place perspective can help to address the "capacity" limits of top-down, expert driven knowledge systems by recognizing and capitalizing accumulated wisdom of emplaced practitioners acquiring and sharing case specific knowledge.

Literature Cited

Allen, T. F. H., Tainter, J. A., Pires, C., and Hoekstra, T. W. (2001). Dragnet ecology – "just the facts ma'am": The privilege of science in a postmodern world. *BioScience, 51,* 475-485.

Anderson, E. (1993). *Values in ethics and economics.* Cambridge, MA: Harvard University Press.

Caterino, B., & Schram S. F. (2006). Introduction: Reframing the debate. In Schram S. F., & Caterino, B. (eds.), *Making political science matter: Debating knowledge, research and method* (pp. 1-13). New York: New York University Press.

Fisher, F. (2000). *Citizens, experts and the environment: The politics of local knowledge*. Durham, NC: Duke University Press.

Flyvbjerg, B. (2006). A perestroikan straw man answers back: David Laitin and phronetic political science. In Schram S. F., & Caterino, B. (eds.), *Making political science matter: Debating knowledge, research and method* (pp. 56-85). New York: New York University Press.

Flyvbjerg, B. (2001). *Making social science matter: Why social inquiry fails and how it can succeed again*. New York: Cambridge University Press.

Entrikin, J. N. (1991). *The betweenness of place: Towards a geography of modernity*. Baltimore, MD: John Hopkins University Press.

Folke, C., Han, T, Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environmental Resources, 30,* 441-73.

Goldsmith, S. & Eggers, W. D. (2004). *Governing by network: The new shape of the public sector*. Washington, DC: Brookings Institution Press.

Hayles, N. K. (1995). Searching for common ground. In Soule, M. E., & Lease, G. (eds.), *Reinventing nature? Response to postmodern deconstruction* (pp. 47-63). Washington, DC: Island Press.

Healey, P. (1997). Collaborative *planning: Shaping places in fragmented societies*. Vancouver, BC: University of British Columbia Press.

Hummel (1994). Commentary. *Public Administration Review, 54,* 314.

Ilcan, S. and Phillips, L. (2008). Governing through global networks: Knowledge mobilities and participatory development. *Current Sociology*, 56, 711-734.

Kemmis, D. (1990). *Community and the politics of place*.

Lowe, P. Whitman, G., & Phillipson, J. (2009). Ecology and the social sciences. *Journal of Applied Ecology, 46*, 297-305.

McLain, R. J., & Lee, R. G. (1996). Adaptive management: Promises and pitfalls. *Environmental Management, 20,* 437-488.

Nagel, T. (1986). *The view from nowhere*. New York: Oxford University Press.

Norton, B. G. (1996). Integration or reduction: Tow approaches to environmental values. In Light, A., & Katz, E. (eds.), *Environmental pragmatism* (pp. 105-138). London: Routledge.

Norton, B. G. (1999). Pragmatism, adaptive management, and sustainability. *Environmental Values, 8,* 451-466.

Norton, B., G., & Steinemann, A. C. (2001). Environmental values and adaptive management. *Environmental Values, 10,* 473-506.

Norton, B. G., & Toman, M. (1997). Sustainability: Ecological and economic perspectives. *Land Economics, 73,* 553-568.

Patterson, M. E., & Williams, D. R. (2005). Maintaining research traditions on *place*: On the value of history and diversity of thought. *Journal of Environmental Psychology, 25,* 361-380.

Pilkey, O. H., & Pilkey-Jarvis, L. (2007). *Useless arithmetic: Why environmental scientists can't predict the future*. New York: Columbia University Press.

Pierre, J. (Ed). (2000). *Debating governance: Authority, steering and democracy*. New York: Oxford University Press.

Pierre, J. & Peters, B. G. (2000). *Governance, politics and the state.* New York: St. Martins Press.

Pierre, J. & Peters, B. G. (2005). *Governing complex societies*. New York: Palgrave Macmillan.

Price, M. (2004). Ecology, economics, and the value of nature. In Daston, L., & Vidal, F. (eds.), *The moral authority of nature* (pp. 182-204). Chicago: Chicago University Press.

Rhodes, R. A. W. (1997). *Understanding governance*. Philadelphia: Open University Press.

Sack, R. D. (1992). *Place, modernity and the consumer's world*. Baltimore, MD: Johns Hopkins University Press.

Sack, R. D. (1997). *Homo geographicus*. Baltimore, MD: Johns Hopkins University Press.

Sarewitz, D. (2004). How science makes environmental controversies worse. *Environmental Science and Policy, 7,* 385-403.

Scholz, J. T., & Steiftel, B. (eds.) (2005). Adaptive governance and water conflict. Washington, DC: RFF Press.

Scott, J. C. (1998). *Seeing like a state: How certain schemes to improve the human condition have failed*. New Haven, CT: Yale University Press.

Stankey, G. H., Clark, R. N., & Bormann, B. T. (2005). *Adaptive management of natural resources: Theory, concepts and management institutions* (General Technical Report PNW-GTR-654). Portland, OR: USDA Forest Service, Pacific Northwestern Research Station. 73p.

Tainter, J. A. (1999). Post-collapse societies. In Baker, G. (ed.). *Companion Encyclopedia of Archaeology* (pp. 988-1039). London: Routledge.

Tainter, J. A. (1988). *Collapse of complex societies*. Cambridge, UK: Cambridge University Press.

Tognetti, S. S. (1999). Science in a double-bind: Gregory Bateson and the origins of post-normal science. *Futures, 31,* 689-703.

Urry, J. (2003). *Global complexity*. Cambridge, UK: Polity Press.

Van Wyk, E., Ronx, D. J., Drackner, M., & McCool, S. F. (2008). The impact of scientific information on ecosystem management: Making sense of the contextual gap between information providers and decision makers. *Environmental Management, 41,* 779-791.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, UK: Cambridge University Press.

Williams, B. A., & Metheny, A. R (1995). *Democracy, dialogue, and environmental disputes: The contested languages of social regulation*. New Haven, CT: Yale University Press.

Williams, D. R. (2002a). Post-utilitarian forestry: What's place got to do with it? In *Proceedings of the Human Dimensions of Natural Resources in the West Conference* (Alta, WY, October 18-21, pp. 114-123). Fort Collins, CO: Colorado State University, College of Natural Resources.

Williams, D. R. (2002b). The social construction of Arctic wilderness: Place meanings, value pluralism, and globalization. In A. Watson, L. Alessa, & J. Sproull (compilers), *Wilderness in the circumpolar north: Searching for compatibility in traditional, ecotourism and ecological values* (Anchorage, AK, May 15-16, 2001*,* USDA, Forest Service, Proc. RMRS-P-26, pp. 120-132). Ogden, UT: Rocky Mountain Research Station.

Williams, D. R. (2008). Pluralities of place: A user's guide to place concepts, theories, and philosophies in natural resource management. In L. Kruger, T. Hall, &, M. Stiefel (tech. eds.), *Understanding concepts of Place in Recreation Research and Management* (PNW-GTR-744, pp. 7-30). Portland, OR: USDA Forest Service, Pacific Northwest Research Station.

Young, I. M. (1996). Communication and the other: Beyond deliberative democracy. In Benhabib, S. (ed.) *Democracy and difference: Contesting the boundaries of the political* (121-135). Princeton, NJ: Princeton University Press**.**