The Tragedy of the Diffusion of the Commons Metaphor:
Bringing the Environment Back in to Environmental Studies

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DRAFT as of April 16, 2018 11:25 am CT time. Please do not cite without permission.
Prepared for delivery to the Ostrom Workshop at Indiana University, April 23rd, Bloomington, Indiana[2]

"*Policies based on metaphors can be harmful*," Elinor Ostrom (1990: 6)

"The issue in this case - and many others - is how best to limit the use of natural resources so as to ensure their *long-term* ***economic*** *viability*" (Ostrom 1990: 1) [italics and bold added].

I. Introduction

Schools of Environment and Resources in general, and graduate professional environmental programs in particular, since the 1980s have been profoundly shaped by Elinor Ostrom's path breaking work on understanding and overcoming local, and globally relevant, resource depletion challenges. Highlighted by *Governing the Commons: The Evolution of Institutions for Collective Action* (1990), Ostrom's work was innovative for two reasons. First, in contrast to much extant institutional scholarship, she treated the emergence, design, and implementation of institutional development *inductively* by working backwards from a particular type of resource problem commonly known as the 'tragedy of the commons' (Hardin 1968).[3] Now familiar to generations of students, practitioners and scholars, the tragedy refers to the phenomenon in which perfectly rational, utility maximizing individuals, will, in the absence of 'collectively optimal' institutions that constrain behavior, overuse a resource at levels higher than the sustainable yield rate, resulting in complete loss of the (economic) resource in question – such as fish, timber or grasslands.

Second, and as a result, careful conceptual unpacking of the nature of (economic) resource depletion tragedies led Ostrom to discover, and highlight, that in addition to the 'subtractibility' feature of these problems (the act of using it reduces the ability of others to use

it), they are also largely 'non-excludable': at least some, if not all, beneficiaries of the resource cannot be excluded from using it. Prior to Ostrom, it was often assumed in institutional analysis that excludability was always possible.

Focusing on a class of local resource depletion tragedies in which excludability was physically impossible, highlighted by fisheries upon which communities depended on the resource for their livelihoods, Ostrom (1990: 22) identified a third potential institutional form for overcoming commons tragedies: locally-based "self-organized and self-governing" institutional regimes, developed by participants themselves to address locally relevant features, that fit neither the private or public (top-down regulatory agency) model as potential solutions.

She argued that local institutional approaches might be a better 'means-oriented' approach for this class of resource problem than public property or private property solutions that dominated much of the literature before her. She subsequently devoted significant attention to these approaches in her 'Institutional Analysis and Development' (IAD) framework (Ostrom 2007, 1999). Hence, Ostrom inductively built her models from empirical research on how a wide range of communities at different scales managed common pool resources (CPR). This strategy enabled her to identify innovative means to address specific and very clear 'ends,' i.e., "governing and managing diverse CPRs for which at least some potential beneficiaries cannot be excluded" (Ostrom 1990: 22). It also distinguished her work from institutionalist theorists at the time, many of whom were criticized for, pathologically (Shapiro and Green 2007, Shapiro 2007, 1994), emphasizing rational choice as a universalistic, ahistorical approach to explain and address *any class* of problems.

The purpose of this article is to develop two distinct, but related arguments, about the direct and subtle effects, positive and negative, Ostrom's approach has had in shaping the way in which institutionally relevant environmental governance and policy research is conducted, and the way in which professional environmental managers are trained.

First, her careful attention to the *problems at hand* – which requires conversations with knowledge and data generated by natural, biological and physical scientists who generally sit outside of political science, policy and governance communities – is now recognized as critically important for resource and environmental problem focused scholarship. That contribution extended to political science and international relations and resulted in calls for much greater attention to *unpacking the type of problem* in question when developing, designing and applying, institutional approaches.[4] Although this lesson is somewhat lost in contemporary scholarship and training for reasons we discuss below, the relevance of requiring that 'means-based' approaches be justified based on the 'ends' (i.e., the resource or environmental issue) in question, remain as

critically important today for problem-oriented policy scientists, economists, and political and other social scientists as it was in 1990.

Second, and in contrast, a countervailing dynamic has worked to the detriment of the problem focused research approach Ostrom nurtured: her means-oriented approach to overcome Nash equilibrium tragedies have been cast adrift from the problem features themselves, such that they are now used to justify, and anchor, all types of problem boats. Specifically, scholarly research and practitioner training over the last 20 years have extended Ostrom's utility-oriented, Nash-equilibrium/sub-optimal common pool resource (CPR) tragedies to universalizing metaphors such as 'collective action dilemmas.' They now form the underlying justification for research programs and training on almost every type of resource and environmental problem **whether or not they share the features that Ostrom had identified**.[5] Ironically, Ostrom herself worried about the power of metaphors to limit policy options for the CPR problems on which she did focus.[6] She saw the tendency of existing analysis to gravitate towards centralization or privatization as oversimplifying metaphors that lead to "idealized" institutional solutions to managing CPRs when actual effective institutional arrangements in particular situations contained complicated mixes as well as alternative arrangements that didn't fit either metaphor very well (Ostrom 1990: 21-23). Yet, she didn't anticipate the limiting power of the metaphor of the problem definition itself. Instead, she opened herself up to overextension by suggesting that common pool resources describe a much wider range of problems that it only loosely – and sometimes very poorly – fits (Ostrom 1998).

In other words, application of the commons metaphor, which focused clearly on commons tragedies as *economic* problems, is now included to address *environmental* problems.[7] This had the effect of conflating actual environmental problems, such as species extinctions and ecological effects associated with catastrophic climate change, with social welfare or Pareto optimal economic problems. While there are good philosophical and practical reasons to examine environmental, social and economic aspects of many problems, the reduction of all problems to pareto optimality is a highly problematic aspect for Ostrom's entire analysis as applied to the environment. In the very first paragraph in Governing the Commons, Ostrom could not be more clear that she was not discussing environmental challenges: "The issue in this case – and many others- is how best to limit the use of natural resources so as to ensure **their long-term economic viability**" (Ostrom 1990: 1). Such an orientation not only reduces environmental issues to economics frameworks, it also made it **impossible to address the environmental issue in question, since utility enhancing behavior was frequently the cause of the environmental problems in the first place.** Efforts by Ostrom and others to overcome these challenges focused

on the impossible task, as we detail below, of drawing on Ostrom's original ontological assumptions to address global environmental problems through the concept of 'polycentric' governance (Ostrom 2010) Jordan et al. forthcoming) and/or socio-economic systems (Brondizio, Ostrom, and Young 2009) that tend to underplay exogenous shocks such as norm changes, or unpredictable 'critical junctures' that seem key for addressing what we identify below as Type 4 solutions.

The effects of this shift permeate political science research on international environmental governance, comparative politics, local resource management. For example, it has led to a leading school of environmental effectiveness (Hovi, Sprinz, and Underdal 2003), with clear prescriptions for moving forward, that are often disconnected from the nature of the problem at hand (Kutting 2000b, Young 2003). It also affects teaching and training on the part of leading environmental schools whose effects on the practice of thousands of environmental professionals is hard to overstate. The result, including choices of faculty hires, centers, and fundraising, is a tragedy in education because research and training on climate change and species extinctions challenges are now subjugated to analysis as a particular class of economic problems that fit poorly both the nature of the problesm and the kinds of institutional responses needed to address them.

In sum, the shift is significant: the theoretical attention, research methods, and data collection preferences that Ostrom developed inductively from a particular class of problems is now diffusing and entrenching, without any reference to a problem-oriented rationale, as the dominant way to research, teach, and train professionals how to manage every class of environmental problem.

To overcome the tragedy of the diffusion of the commons metaphor, we argue that the same approach Ostrom took to unpacking CPR problems and institutional responses must be applied to different types of environmental challenges. This approach has led us to identify not one, but four conceptions of resource and environmental problems. Type 1 ('win/win') and Type 4 ('win/lose priority) both lead to the identification and development of institutional responses inductively. Type 2 ('win/lose' optimization) and Type 3 ('win/lose' compromise), lead to deducing "universal institutional panaceas" of the type Ostrom criticized, regardless of the nature of the problem in question. We argue that the type 4 conception (win/lose prioritization) is the most appropriate metaphor for a range of environmental problems especially those that risk irreversibility, such as species extinctions and climate change – a problem that Levin, Cashore, Bernstein and Auld have labelled "Super Wicked". (It is also the most appropriate for social problems that are fundamental not subject to compromise, such efforts to address modern day

slavery). Type 4, like Ostrom's Type 1, but unlike Type 2 and 3, requires working backwards from a targeted problem. Type 4 'working backwards' was actually prevalent during the 1970s, where scholars and practitioners assumed that the most effective way to ameliorate Type 4 species extinctions was to develop binding hard law, such as the US Endangered Species Act. Also working inductively from a subclass of Type 4 problems, Levin, Cashore, Bernstein and Auld (Cashore et al. 2016, Levin et al. 2012, Levin et al. 2009, Levin et al. 2007) introduced Type 4 challenges that they label "super wicked": time is running out, those seeking to solve the problem are also causing it, no central authority exists, and policies are discounting environmental futures irrationally: i.e. they are not being developed in ways consistent with the climate science. Since Levin, Cashore, Bernstein and Auld introduced "super wicked" as a term, scholars (Lazarus 2009), practitioners and the media,[8] are paying greater attention to super wicked problems. However, environmental institutional scholars are giving them significantly less attention than, ironically, economic commons challenges. Meanwhile, US-based professional environmental managements programs essentially ignore them altogether, a trend reinforced as they hire an increasing number of neo-classical and behavioral economists while downplaying the political science, sociology, history and ecological economics training necessary for ameliorating this class of problems.

We argue that failure to explicitly identify these distinctions, and to develop research and training 'backwards' from the conception of the type of challenge in question, has resulted in the subtle ways Type 1 methods and approaches diffuse into global environmental politics and professional training. Consequently, they influence the methods to analyze, and the deliberative approach to address, Type 2 and 3 problems. More insidiously, they fail to provide research space for, or marginalize, efforts to conceptualize, research, or train practitioners to address Type 4 environmental problems known as 'super wicked' tragedies. This diffusion helps explain, for example, widespread paradoxical accounts by institutional scholars that the Paris Agreement is at once 'transformative' alongside acknowledgments that it is highly unlikely to meet its problem-focused emissions reduction targets or sufficiently catalyze decarbonization to prevent dangerous climate change.

We proceed in the following steps. First, we elaborate the four conceptualizations of environment and resource problems identified above. Second, we show that type 4 conceptualizations used to dominate understandings of environmental problems in the United States in the 1970s, thus challenging those that argue that, for feasibility reasons, Americans would never support such an orientation. Third, we review the key dynamics among the four Types to illustrate the importance of making explicit the implications of the largely uncontested

prioritizations of Type 1, 2 and 3 orientations to the expense of Type 4. Fourth we show how institutional scholarship on environmental effectiveness and the Paris Agreement reveal biases towards means-oriented solutions Ostrom offered for Type 1 problems and the universalistic approaches offered through Type 2 and 3, with almost no attention to Type 4 Super wicked features. Fifth, we apply the framework to review pedagogical and outreach approaches within Yale University's school of Forestry & Environmental Studies to illustrate the hegemonic and pervasive infusion of these trends in professional environmental schools, to the point where almost all teaching fails to conceive of type 4 problems or develop research and training to address them. We conclude by suggesting ways in which problem focused institutional theorists, and professional environmental management schools, might work to overcome these challenges.

II. Four Types of Resource and Environmental Problem Conceptions

Following a similar research strategy to Ostrom (1990), this section identifies four ways to conceive of resource and environmental problems, outlined in Table 1.

Table 1: Four Resource and Environmental Problem Conceptions			
		Institutional Project	
		Generalizable (Rational/utility)	**Historically contingent** (path dependency/critical juncture, change in normative obligations)
Inductively derived from targeted problem? (i.e., is the ***rationale*** for the means-oriented approach based on ameliorating a targeted problem?)	**Yes** (Ends determines the means)	**Type 1: 'win/win'** • **Commons tragedies** • Utility maximization identifies the problem • Subclass includes Common Pool Resources • Ontology: Rational Choice Institutionalism • Dominant method: quantitative • Anthropogenic	**Type 4: 'win/lose', priority** • *Environmental norms/ethics identify the problem* • **Environmental irreversible tragedies** • ***Social norms such as anti-slavery*** • ***Subclass includes* "Super wicked" problems** • Ontology: Historical Institutionalism, historical sociology • Dominant method: path dependency, qualitative process tracing, forward reasoning • Environmental norms dominate, anthropogenic factors treated as causes
	No (Means determines the ends)	**Type 2: 'win/lose' optimization** • **Social Welfare** • **Pareto Optimal, *some win/no one loses*** • Ontology: Cost-benefit analysis • Dominant method: quantitative predictions • Anthropogenic	**Type 3: 'win/lose' compromise** • ***'win/lose' compromise*** • Ontology: **Pluralism; Sustainable Development Sustainability Science**; • Dominant method: mixed quant and qualitative, multi-goal policy analysis • Mix of anthropogenic and environmental norms

Type 1: Commons Tragedies (Win/Win)

The first type of conceptualization directs attention to specific problems where failures to address them make everyone worse off in the long run. Following Ostrom,[9] the most common example is resource depletion "tragedy of the commons" [10] in general, and her specific subset of CPR problems as described in the introduction in particular. Hence, Type 1 problems derive their conception from the nature of the problem itself: without collectively optimal institutions (means)

a type of "Nash equilibrium"[11] exists that will lead, through rational behavior, to the depletion of the economic resource in question. Largely inspired by rational choice and ahistorical ontologies, scholars such as Ostrom focused on designing the 'right' types of internal rules and procedures for developing collectively optimal solutions for ending such tragedies, including fisheries loss, deforestation, and overgrazing. In these cases natural science evidence is important for providing information about species loss that has economic value, such as Canadian scientists warning policy makers that the cod fishery was being overharvested (Chase 2003, McKenna 1992); while social science is important for devising rules capable of avoiding the loss. (In the case of Newfoundland the lack of meaningful institutional rules – arguably caused by applying Type 3 conceptions - contributed to the collapse – the result of which benefited, in the long run, almost no one (Ommer 2002).)

Ostrom's and her students' work in fisheries and forestry has been significant in this regard. They have worked to both develop theory about, and research empirical evidence on, what appear to be the most effective design principles for promoting management of CPR resources through her rational choice, ahistorical "IAD" framework (Ostrom 2007, 1999). For Ostrom and her followers, the trick was to find the right types of interventions or institutional designs capable of eliminating this resource depletion tragedy. In this case then, a relatively important but narrow problem was established (tragedy of resource depletion), and institutional design principles were prescribed with very clearly elucidated "causal logics." Hence in Type 1 efforts, means-oriented solutions are adjudicated on their ability to causally address a specified (usually economic) problem to the betterment of an entire community or society (Andersson 2004).

However, identifying resource depletion tragedies as the focus, which sit within a broader web of ecosystems that cannot be reduced to Nash-equilibrium utility enhancing tragedies, means that the CPR conception also generated some negative consequences. For example, it has arguably resulted in policies that address complex forest governance challenges reinforcing neo-liberal problem orientations in which sustainability is reduced to "timber" rather more complex ecosystems (Wright 1995) (Cashore, Vertinsky, and Raizada 2001). In fact, Ostrom (1990) herself recognized that her approach addressed only a narrow class of resource challenges and provided a focus largely on economic incentives (Bartley, Andersson, and Jagger 2008). She specifically limited the scope of her 1990 study to small scale, renewable resource problems and excluded situations of asymmetries of power of individuals or groups to cause harm to other participants (Ostrom 1990: 26).

Yet, there and in other writings she also suggests that the findings about self-organization at small scales might provide general insights into collective action: "All efforts to organize collective action. whether by an external ruler, an entrepreneur. or a set of principals who wish to gain collective benefits, must address a common set of problems. These have to do with coping with free-riding, solving commitment problems, arranging for the supply of new institutions, and monitoring individual compliance with sets of rules" (Ostrom 1990: 27). In her presidential address to the American Political Science Association, she goes a step further, arguing that: " … the theory of collective action is *the* central subject of political science" (Ostrom 1998: 1) Others argue that CPR is the most appropriate way to characterize international environmental conflict generally (Barkin and Shambaugh 1999, Dietz, Ostrom, and Stern 2003). No wonder others see CPR problems everywhere in environmental studies and political science.[12] What is important about Type 1 solutions is that whereas the scholarly work in this vein focused on a diverse set of examples and approaches, it is united in a search for a 'generalizable' theoretical framework to inform institutional design and policy interventions at multiple scales.

Hence, Type 1 conceptualizations, especially the application of means-end reasoning, is now being applied far beyond the specific set of problems Ostrom originally envisioned, including to non-depletion environmental challenges such as climate change. Its dominance in policy and political sciences of the environment may explain, for example, why Sabatier (1999) included Ostrom's IAD framework (Ostrom 1999) in his edited collection, Theories of the Policy Process, but excluded historical institutionalists, such as Hall (1993) or Skocpol (Skocpol 1995).. Sabatier limited his book to those bodies of scholarship on the policy process that emphasized developing generalizable theories and frameworks which, by definition, would not include identifying causal mechanisms with which to explore and understand a range of historically contingent factors. These approaches, while highly useful for addressing Type 4 problems as we discuss below, were deemed by Sabatier, as less "rigorous" than efforts to develop universally applicable hypotheses. While generalizability might be a virtue for Type 1 challenges, we argue that Type 4 problems require attention to methods and approaches offered by historical institutionalists. Hence, in the name "rigor" and misguided to a Popperian view of social science, the academy has become disconnected from the types of approaches and methods needed to address some of the most important and pressing challenges facing our planet (Kutting 2000a).

This shift from a focus on inductively designed institutions to deductively applied prescriptions is also evident in some of the work of Ostrom's students. For example, Prakash, who has made a major contribution to conceiving of voluntary standards as "club goods" (excludable, non-rivalrous), has inverted Ostrom's approach by making such goods both an

independent variable and a prescribed institutional solution (Prakash and Potoski 2007, Prakash and Potoski 2006, Kolln and Prakash 2002). Whereas Ostrom intended this category to be about an actual 'on the ground' resource (and the 'dependent variable'), that like a 'common pool resources' problem would require some institutional arrangement to maintain, Prakash treats them as the institutional arrangement (i.e., the independent variable or prescription itself). This inversion has, arguably, the effect of studying club goods to address a great many problems outside of her conceptualization of club goods, including ecosystem protection, sustainable yields, and broader sustainable forest management. It also had the effect of reinforcing a social science, data-driven orientation to assessing support for these 'club goods' that gave much less attention to understanding how a particular environmental problem might be addressed by such an approach.[13] Indeed, this led to a labeling of some "brown" type club goods (i.e. developed by industry to limit both government regulation and higher standard certification systems) as "green" (Prakash and Potoski 2007, Prakash and Potoski 2006, Kolln and Prakash 2002), leading to conclusions about environmental governance that did not flow from the analysis itself. Hence, the precedent for the anchorless metaphor approach that shows up so clearly in Type 2 and 3 problem conceptions, seems to have originated, in part, in Ostrom's own lab.

This is just one example of how Ostrom's means-oriented framework has also influenced, and reinforced, means-oriented Type 2 and 3 universalist conceptions which are applied to all types of resource and environmental challenges, regardless of their features. This shift from inductively derived institutional designs to deductively derived prescriptions typical of Type 2 and 3 problem conceptions represent, as we discuss below, their own type of tragedy.

Type 2: 'win/lose' optimization

Type 2 problems are consistent with Ostrom's utility enhancing rationale but are developed deductively as universalist approaches for helping society deliberate on how to address trade-offs between different problems. The challenge to be addressed is social welfare or Pareto optimality inspired by neo-classical economics and cost-benefit analysis (Adler and Posner 2009), in which economic values are assigned to different outcomes, and, following modelling and the application of discount rates, analysis identifies the most efficient and effective trade-offs for enhancing welfare. Hence, this problem conception accepts that there will be winners and losers (or, in the Pareto optimal scenario winners and no losers) but based on a transparent model in which social welfare is advanced. These approaches underpin the core approach of many agriculture, resource, and forestry schools, including Yale Forestry School, founded by Gifford

Pinchot to advance forestry for "the greatest number for the greatest good in the long run". Entirely utilitarian in nature (Sinden, Kysar, and Driesen 2009, Kelman 1981), Type 2 is universalistic in the sense of seeking generalizable institutional models that respond optimally to the problem structure, and requires training in large-N statistical techniques, modelling, and other type of data analysis such as "willingness to pay" (Turner et al. 2003, Ozanne and Vlosky 1997).

The challenges with the means-oriented nature of Type 2 approaches is that, as we discuss below, utility maximizing frameworks are set up to provide the **'**rigorous' 'data driven' scientific *answer* (Carpenter et al. 2009) about *whether*, rather than *how*, society is able to address environmental problems. For example Type 2 approaches seems to explain the emergence of '*ecosystem services*' (Sell et al. 2007) approaches even when doing so is *inconsistent with basic scientific research* and *evidence* (Turner et al. 2003) about a particular environmental challenge (Kosoy and Corbera 2010) (Cashore 2018). In addition, as the focus on optimality usually involves some type of discount rate application, Type 2 conceptions, when applied through a neo-classical lens, not only undermine environmental problems by treating them as economic, they also, by definition, value the future less through the concept of a "discount" rate (Winkler 2006, Yang 2003), serving to implicitly undermine institutional analysis for long-term problem solving (Sprinz 2009). Somewhat ironically, debates about where to set the discount rate (Hepburn and Stern 2008), have reinforced the legitimacy of Type 2 solutions, which has served to undermine, however well intended, long-term environmental problems solving (Barkin 2006).

Type 3: 'win/lose compromise'

Type 3 conceptions, like type 2, are derived top down or deductively, rather than inductively, on the belief that 'balance' and 'compromise' can be guided by science and rationality. Inspired by the discourse of sustainable development popularized by the Brundtland Report (WCED 1987), this conceptualization suggests hard trade-offs between environmental, economic and social values can be avoided if science can develop integrative solutions (Saez and Requena 2007). Type 3 problem conceptualization certainly fits a 'distributional' orientation to politics (Aklin and Mildenberger 2017) that has long been the focus of political science (Lowi 1964), and which may help focus efforts on understanding domestic political struggles that are key to address climate change. However, the danger of staying within a Type 3 paradigm is that researchers often undertake their questions in ways that are disconnected from the problem at hand. In other words, most political studies say very little about whether distributional politics that favour a green agenda will have any chance of achieving a 2 degrees future. In addition, the

compromise approach inherent in these efforts seems reinforced by sustainability science and norms associated with sustainable development that have ascended again in the international community, most notably with the adoption of the 2015 Sustainable Development Goals (United Nations 2015; Kanie and Biermann 2017).

Arguably Type 3 conceptions apply to a great number of resource challenges. Type 3 conceptions occur when stakeholders decide that winning and losing should be shared among different interests. The classic example in environment and resource studies are those governing "land use" in which the landscape is divided up according to different functions, from biodiversity to forestry management to mining to community forestry to agriculture. In fact, Type 3 land use processes were often advanced by forest industry and logger interests (Kelly and Alper 1995, Coglianese 1996, Beyers 2001, Brach et al. 2002) (Halbert and Lee 1990) following the effects of Type 4 endangered species laws in the United States especially in the Pacific Northwest (Yaffee 1994).

During processes that deliberate on how to accomplish these multiple goals, each interest explains why they feel they should have so much land designated as such, and, in the end, some type of government body or agency makes a policy decision (usually a state/province or national government). In practice, these processes are often incremental in nature and the institutional arrangements that result can reflect dominant discourses and institutional path dependencies that favour some interests and values over others (Bernstein and Ven 2017) However, research on land use planning in British Columbia, Canada, Ontario, and New Zealand has found that proactive efforts that integrate key stakeholders, especially marginalized indigenous peoples, industrial interests and environmental groups, in ways that a range of stakeholders support, can yield surprisingly durable and legitimate policy decisions (Cashore et al. 2001). In these cases, policy learning is successful when it marries a focus on substance with knowledge on policy instruments and legitimatization processes (discussed below).

As Cashore (2018) argues, the challenge for Type 3 for problem solving, given it derives from mean rather than ends, is that it often occurs alongside increasing "engagement with powerful 'stakeholders' – often with those whose businesses practices caused the environmental degradation in question –and whose motivations for engaging, and providing resources for teaching, internship opportunities, and training, is to promote compromise that undermines" Type 4 environmental priorities (Cashore 2018). The result can be a subtle but powerful shift away from the championing of 'science'[14] as a source of knowledge for understanding and addressing Type 4 environmental tragedies, typical of dominant approaches in the 1970s. Instead, a Type 3 conceptualization can be a powerful ideational tool in which a **subjective belief system** that

promotes, as scientifically objective, the balancing of environmental, social and economic goals, reinforced by the twin concepts of 'sustainable development' and 'sustainability science' (Glaser and Bates 2011). As Kates (2011) notes, the ***Proceedings of the National Academy of Sciences***, "defines 'sustainability science' as "...an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: **meeting the needs of present and future generations** while substantially **reducing poverty and conserving the planet's life support systems**."

The treatment by the National Academy of Sciences as needing to balance among these three goals as "scientific" has led to an ironic situation in which professional environment programs now treat 'conflict resolution' 'neutrality' and 'balance' as scientifically objective for addressing a host of societal, economic and environmental challenges consistent with Type 3 approaches which, by design, propose a mode for adjudicating balance among problems, regardless of a specific problems targeted features.

Type 4: 'Win/lose, Prioritization'

Type 4 problems, adjudication of which will result from societal and stakeholders learning processes – either formal or informal – are conceptualized as "win/lose" but in which there is a clear prioritization of the problem in question. In these cases, society or learning processes finds that some problems simply should not be contrasted, or traded off, with others. Laurence Tribe made this observation back in 1972 when he argued that since species extinction was final, it made little intuitive logic to 'rationally' permit the loss of species because it led to higher social welfare. They simply were not contrastable. This type of conceptualization clearly informed the 1973 US Endangered Species Act, which formally prohibits economic cost-benefit analysis when adjudicating whether to save a species.

Arguably most relevant for this analysis is the case of global climate change, where, owing to learning about the nature of the problem, there is a general consensus among most social and natural scientists that failure to address climate change and to reduce emissions below two degrees Celsius will lead to catastrophic environmental, economic, and social impacts. Drawing inductively from the nature of the problem, Levin et al. identify a particular kind of Type 4 problem akin to Ostrom's CPR delineations known as " super wicked" problems that contain four key features: time is running out, no central authority, those seeking to address the problem are also causing it, and the future is discounted irrationally (i.e., short term economic priorities trump long term environmental concerns, even when collective interests desire long-term problem

solving). In these cases, multi-stakeholder learning processes are important to assess, and understand, strategies for addressing the problem at hand, but are not useful if they end of shifting conceptions to Type 3 compromise away from the targeted problem in question. In other words, well intended dialogues cannot "compromise away" the two degrees finding – deciding instead that a compromise approach that respected different interests means that say, "six degrees" was more reasonable. In these cases, policy learning would render transparent this decision, and the implications for current and future generations. However, the failure to engage in such an explicit distinction among problems has led, we argue, to Type 1, 2 and 3 solutions being applied to Type 4 problems. The result is that innovations that might exist for addressing Type 4 solutions are not being given sufficient attention or resources – reinforcing the tragedy of "super wicked problems" (Levin et al. 2012).

To nurture the necessary multi-stakeholder policy learning consistent with a Type 4 conceptualization, Cashore et al. (2016, 2015) argue that policy learning protocols can be designed to assist those seeking to co-generate collective strategic insights for ameliorating specified problems (Humphreys et al. 2017). As we discuss further below, this literature tells us that without a clear problem oriented learning protocol, simply "throwing" multi-stakeholder dialogues at the issue of the day will either be doomed to fail and/or narrow problems to those powerful interests prefer, serving to reinforce traditional power dynamics under the pretense of problem solving. An effective learning protocol, and more generally an approach to addressing Type 4 problems, requires attention to historical institutionalist approaches, process tracing methods, and deep reflections on the nature of power, structure, and the interactions of state and society (Kutting 2000c).

III. The Analytical Framework: How Types 1, 2 and 3 undermine Type 4

These distinctions provide an analytical framework for assessing the diffusion of Type 1, and to a lesser degree Types 2 and 3, thinking into political science, international relations, and environmental scholarship; US and global policies; and, curiously, dramatic shifts in the composition, and training of US environmental management professionals. First, Type 1 is 'long-term' oriented in the sense that its purpose is to overcome a Nash equilibrium tragedy, which can be achieved by developing design principles that would, as long as maintained, end this tragedy. In other words, the goal is to develop a generalizable theory and design principles with which to adjudicate locally relevant ways to build institutions capable of overcoming depletion tragedies. However, the challenge is that the orientation risks being applied to other problems such as ecosystems, such that scholars either fail to see the Type 4 challenges (such as endangered

species), or they work hard to fit the species (or other environmental challenge) into Type 1 conceptions by converting them to economic, utility enhancing objects. This orientation almost always leads to 'sub-optimal' results for irreversible environmental tragedies (Tribe 1972, Kysar 2010, Ackerman and Heinzerling 2004). Hence, Type 1 orientations are decidedly not future oriented for a whole host of issues that reflect broader normative concerns about the environment than cannot be reduced to our own anthropogenic utility, or even biophilic (Kellert and Farnham 2001) needs for that matter. A classic example, when making this point, is that society now accepts that slavery is not appropriate and must be avoided regardless of depletion tragedies (Type 1), social welfare optimization (Type 2), or be the subject of 'compromise' since it would be abhorrent to 'balanced' it against other interests (Type 3).

These distinctions also lead us to reflect on the role of Ostrom's Type 1 emphasis on 'feasible best' solutions and 'better than otherwise would have been' definitions of effectiveness that permeate scholarly and practitioner assumptions about what is possible or useful. Type 1's emphasis on utility, has diffused to Type 2 directly, and Type 3 indirectly, such that students are being trained to believe that the only possible answers, for feasibility reasons, can emerge from Type 1, 2 or 3 methods. The result is that Ostrom's metaphor has locked future-oriented policy analysis into present day feasibility calculations: arguably the most insidious kind of short term focused policy analysis envisioned as it is being taught to us under Orwellian notions of 'avoiding short term tragedies" (Type 1) and Brundtlandesque sustainable development "that meets the needs of current generations without compromising the needs of future generations to meet their needs" (Type 2), both of which are shackled by short term oriented methods and conceptions through a range of overt, covert (Bachrach and Baratz 1962), and latent (Lukes 1974) power dynamics that, even when revealed, most ignore, let alone attempt to overcome. The result is an implicit type of Faustian bargain in which 'future generations' rhetoric is being used to justify conception types that cannot, in the name of feasible best (Kutting) and norms about the moral superiority of being 'pragmatic', address the most insidious and important questions of our times (Bernstein and Hoffmann 2018).

IV. Application: US and global environmental politics[15]

During the 1970s Type 1 conceptions of environmental problems, especially regarding species loss, had reached mainstream status in the United States and globally. In particular, the Endangered Species Act required not only listing of threatened and endangered species, but for federal agencies to develop management plans on public lands designed to ensure species

viability. Similar themes emerged during the 1972 Stockholm conference, which coincided with the creation of domestic environment agencies to act as an alternative, and often counter, voice to economic and extractive agencies at the highest levels of policy making.

However, the priority of economic goals, and subjugation of environmental and social concerns to those consistent with economic development associated with Type 1, 2 and, to a lesser degree 3, conceptions occurred alongside a shift in the 1990s from 'environmental management' among US resource agencies in general, and the US forest service in particular to today's 'ecosystem services' metaphor that dominates the teaching in most environment schools. This shift is telling, and consistent with broader global trends towards what Bernstein (2001) has called the compromise of liberal environmentalism. Ecosystem management emerged in the 1990s following Type 4 court mandated rulings that forest dependent endangered species – in particular the Northern Spotted Owl – required for their survival massive biodiversity conservation. In direct contrast, industry and community interests, reinforced by professional forest scientist communities, responded in several ways to champion Type 1, 2 and 3 conceptions under the rubric of 'Sustainable Development' (Type 3), sustained yields (Type 1) and ecosystem services (Type 2). The purpose was to downgrade the prioritization of ecological concerns to those largely consistent with utilitarian social welfare maximizing benefits.[16]

This shift was accomplished on a number of fronts. First came the reaction of the US forest products industry, whose image was tarnished by successful protests in the 1980s by social and environmental groups in the US Pacific Northwest to preserve old growth forests (Yaffee 1994). Frustrated by their limited influence and poor public image triggered by the protests, they drew on Brundtland Type 3 norms to offer their "Sustainable Forestry Initiative" (SFI) and the 'sustainable forest management' (SFM) concept as an alternative to Type 4 ecosystem management which prioritized environmental science. The AF&PA's SFI approach promoted Type 3 compromise and balance among economic, social and environmental goals rather than prioritizing environmental crises such as species extinctions that explained old growth forest preservation policies in the early1990s.

The creation of the SFI helped the US forest products industry 'fend off' US EPA efforts to increase environmental regulations on Type 1 oriented private forests (Northwest Management 2001, National Woodland Owners Association 2000), and to offer a 'business friendly' alternative to the environmental social movement initiated Forest Stewardship Council (FSC). Many US company officials reasoned that their own institutions were a way to avoid what they perceived at the time to be burdensome standards (Cashore, Auld, and Newsom 2004) inconsistent with their preference for Type 3 balanced approaches.

Likewise, government granting agencies that fund faculty research appeared, in some cases at least, to shift their attention to market mechanisms and sustainability that prioritized human development over the environment, and voluntary standards over mandatory regulations. During this time, even the EPA shifted towards Type 2 voluntary and market mechanism. For example, it promoted consumer oriented eco-labeling program to identify energy use of electrical products, rather than regulating mandatory energy efficiency for appliances. This was in contrast to other institutional models that had some success under a Type 4 conceptualization, such as Canada-US regulatory agreements to combat acid rain that had affected the great lakes region.

International

At the global level, and in contrast to the regulatory approach offered at the 1972 Stockholm conference, these shifts had taken hold by the 1992 Rio-Earth Summit. Whereas the agreements reached there ostensibly drew on Brundtland's 'three legged stool' (World Commission on Environment and Development 1987) that promoted a balance among environmental, social and economic goals, in practice the agreements incorporated a normative framework that prioritizes markets and economic goals over social and environmental ones (Bernstein 2001).

The jury is still out on whether the SDGs offer a corrective or simply reinforce these understandings while fitting squarely within the Type 3 framing. The preamble to the SDGs claims to both "integrate" and "balance" economic, social and environmental purposes, which raises questions about whether a coherent agenda will result or how sustainability science – which has emphasized integrative ideas such as the "nexus" approach (e.g., water, food, energy) – will fare in practice in providing "solutions" when incoherence remains in the political framing. Similarly, the SDGs call for both "sustained" and "sustainable" economic growth and employment in goal 8, but avoid any mention of planetary boundaries, despite attempts to include the concept in negotiations over the "growth" goal (ENB 2014)(Bernstein 2017).

The Paris Agreement

The prevalence of Type 1, 2, and 3 conceptions helps explain the emergence of, and support and criticism, of the Paris Climate Agreement. For instance, those who support the Paris Agreement tend to approach climate change as a Type 2 problem and have market liberal and institutionalist worldviews (the categorization of worldviews is from Clapp and Dauvergne 2005). For example, Victor (2016) argues that Paris "worked" "when almost everything before it failed" owing to Paris' nonbinding "pledge-and-review system" that "transformed climate diplomacy

from past gridlock by creating flexibility". Meanwhile, and for the same reasons, Type 4 focused bio-environmentalist and climate scientist Hansen (2016) calls the talks a "…a fraud really, a fake… It's just worthless words." What is important is that both agree Paris will not be able to achieve its science-based target of 1.5 degrees (aspirational in the agreement) nor even agreed target of 2 degrees. As Victor acknowledges, "…the *world has dithered for too long* [on climate] and must now brace for the consequences...[A] realistic crash program to cut emissions will blow through 2 degrees; *1.5 degrees is ridiculous. New goals are needed.*" Whereas Hansen, the bio-environmentalist, whose concern is with climate change itself, evaluates the call for new goals that are *inconsistent with the climate science* as a failure. Victor, the market liberal institutionalist, evaluates the same agreement as *successful*.

To be sure Paris is more complicated than its articulated targets and could yield potentially successful efforts to address Type 4 super wicked problems (Cashore et al. 2016). Our point is that those trained in a social welfare utility model are more likely to see Paris as transformative even if they also view the problem for which it was created as being insufficiently addressed because they are primarily motivated by a means-oriented type 3 problem conceptions rather than ends-oriented Type 4 problem conception.

V. Application: Professional Environmental Schools

These dynamics, in turn appear to have, strongly influence professional environmental management and studies programs, implicitly and explicitly as businesses, non-state actors, and governments made a range of decisions about how to engage, and influence, higher learning.[17] Note: for purposes of this draft we are referring to anecdotal examples from Yale University's School of Forestry & Environmental Studies. We will extend out this analysis more systematically to Duke's Nicholas School, Michigan, and the Bren School of the Environment**.**

Faculty composition

While more research would need to be undertaken, anecdotal evidence is consistent with the proposition that ***faculty hires*** – at least in the social sciences and humanities – correlate with an emphasis of those championing Type 1, 2 and 3 conceptions. For example, in the mid-2000s the retiring of a senior environmental focused faculty, who might have been open to viewing problems as Type 4 and who could be characterized as a problem focused socioiologist, was replaced by two environmental economists. They arguably are best classified as championing, and teaching, Type 1 and 2 conceptions. In contrast, Yale F&ES does not employ any tenure

track or tenured faculty in the fields that are more likely to produce Type 4 orientations including ecological economics, history, philosophy, or discourse theory (although it has an excellent group of non-ladder faculty in these areas). To be sure, F&ES does employ a tenure track sociologist and social green anthropologists, at both the senior and non-tenure track levels. And F&ES also employs two senior political scientists, including an author of this paper. However, until recently most of his research and teaching reinforced Type 3 conceptions (notably, the original job posting for Cashore's position identified a forest policy specialist working on Type 2 and 3 market mechanisms and eco-labeling).

Centers

Likewise, other policy relevant centers at F&ES seem to prioritize Type 2 and 3 perspectives including Cashore's Governance, Environment and Markets (GEM) Initiative. It was initiated as a way to bring different disciplines and methods, as well as practitioners and scholars, to think about complex historical pathways through which problems might be addressed. While there might have been some hints of Type 4 behind its creation, standing back, many of the questions GEM asks, and the topics of consideration, give priority to Type 3 compromise solutions. Not only is 'markets' in the name, but the research and practice efforts have emphasized prioritizing market mechanisms, financing incentives, and global trade that promotes the balancing of environmental objectives with development interests and economic priorities. Although the focus may stem in part from individual faculty interests in the role of market mechanisms in addressing public policy questions, organizations that interact with it may have also reinforced these priorities. Future scholarship might examine whether a range of environmental groups, development agencies, business associations and even government agencies are also inadvertently reinforcing Type 1, 2 and 3 conceptions over Type 4 owing to prevailing discourse and norms that prioritize market friendly solutions. These norms could also help explain why so much of the work on the plight of local peoples and biodiversity conservations champions a largely rationalist, Type 1 and 2 Ostrom inspired utility maximizing rationale for fostering 'rights to resources.'

This orientation has also, it seems, fostered research aimed at identifying a positive correlation between biodiversity conservation and local resource use. These assumptions stand in contrast to the large-scale Type 4 biodiversity conservation efforts promoted in the 1970s and 1980s in the heyday of bioenvironmentalist world views (Clapp and Dauvergne). Even GEM's efforts with the International Union of Forest Research Organizations has, at times, adopted, a UN approach to "major working groups" that fosters Type 3 compromise among various resource

users, and that seeks to champion forest management within the context of the sustainable development goals, rather than prioritizing biodiversity conservation over other values. We are not arguing that these approaches aren't useful, but these norms may help explain the shift in orientation and problem definition away from Type 4.

Such reflections could also be applied to other Centers and Programs, which could pave the way for conducting systematic research on these questions. For example, it also seems that one of F&ES flagship centers that has accomplished a great deal of important integration of scholarship to practice, the Yale Center for Environmental Law and Policy (YCELP), is also part of these trends. In the last 20 years, it has shifted its own emphasis that included Type 4 public regulation and large-scale conservation towards business friendly Type 2 and 3 technical solutions that champions 'business and the environment.' Likewise, the path breaking Type 4 problem oriented Center for Biodiversity Conservation – which like YCELP has undertaken critically important work linking science to practice – does seem to have, arguably for instrumentalist reasons, increasingly engaged in Type 3 and 2 conceptions. The 1980s Type 4 approaches that involved drawing 'lines on a map'[18] (protected areas approaches to biodiversity conservation) has now expanded to include a Type 2 'ecosystem services' discourse and Type 3 tradeoffs between conservation and development. Whatever the merits of these approaches, their effect is to de-prioritizing Type 4 problems in subtle ways that may both limit and expand the range of options that are deemed appropriate. In contrast, Yale F&ES does not currently have a counterpart "Center for the Study of Environmental Social Movements" that, arguably, might champion research on Type 4 problems.

External engagement[19]

The shift away from Type 4 conceptions seem to have concrete implications for the way in which F&ES engages external interests. For example, in the early 2000s the World Business Council on Sustainable Development engaged F&ES through type 3 consensus oriented "The Forest Dialogue", which it housed, to champion and promote as legitimate and acceptable an industry and land owner initiated 'business friendly' certification programs that emerged to compete with the approach offered by the Forest Stewardship Council (FSC). To be sure, these dialogues fostered Type 3 greater understanding among stakeholders and working to foster 'learning' across disparate organizations aimed at developing a common purpose.

Taking the above story to the present, it seems reasonable, if not awkward, to reflect on what type of problem conception the WBCSD is bringing to its current engagement on climate matters with Yale University's Center **for** Business and the Environment. It connects the School of Forestry &Environmental Studies with Yale's School of Management. Whereas scholars championing Type 4 orientations might have preferred a "Center for the Study of Business and the Environment", CBEY's emphasis appears to reinforce a Type 1, 2 and 3 market liberal, institutionalist conceptions. In this regard a key emphasis over the last seven years has been to train students with sophisticated method for measuring environmental and carbon emissions, and for finding business friendly Type 2 and 3 solutions for reducing climate impacts. It also funds a host of research assessing business and market friendly solutions and is active at placing students in exciting careers promoting business sustainability. To be sure, CBEY also has a grand contest every year that has led to a number of wide ranging research projects that foster innovation around technological reductions, but it seems clear that the success of these efforts will determine whether the climate crisis will be addressed, potentially undermining more purposeful Type 4 solutions that would not leave ambiguous solutions. At the same time, it is interesting that there is no similar granting agency, such as a Center for Environmental Social Movements, that might offer Type 4 research and training that would include attention to the history of environmental social movements, class conflict, and other types of non-business transformative change.

These patterns might help understand some of the controversies behind the speech, and student led protests, of a former Shell oil executive at F&ES in the fall of 2016. The speaker – a highly knowledgeable expert who discussed the importance of technology in helping limit global warming to 2 degrees Celsius, alongside the goal of energy security in developing countries, was invited with the best of intentions: to get diverse voices to F&ES that might help us think more carefully about how to manage climate change – arguably the most important environmental problem facing the planet. However a number of students viewed the speaker as symbolic representative of the very companies who had been responsible for climate emissions – similar to smoking companies causing cancer (Yona 2017). Their visible protests focused discussions over appropriate forms civil disobedience[20], including ad hominem discussions about personal ethics and judgements. Somewhat lost in these conversations and discussions was the potential broader role of world views behind Type 1, 2, 3 and 4 conceptions that all of us have and that tend to reinforce, rather than carefully question whether our world views inadvertently reduce, rather than address, Type 4 problem solving. Could it not be that this awkward interaction was in fact best seen as a clash of different problem conceptions? If Type 1, 2 and 3 perceptions dominated dominate F&ES administrative, policy and programing decisions, how do we think about, and

generate research and teaching on Type 4? Just being aware of these differences, and turning attention away from frustrations with individuals, might be helpful for fostering community cohesion and forward-looking strategies. What does seem reasonable to hypothesize is that the discussions about the appropriateness of the (understandably uncomfortable for many) student led protests might have been different, if the student actions had been seen as part of a longer set of civil disobedience practices by the likes of Gandhi, Martin Luther King Jr and even, more recently, former Dean Gus Speth (Collett et al. 2017). This thinking might, in turn, lead to the invitation of organizations that might be more likely to champion Type 4 conceptions, such as Greenpeace or an Indigenous community.

VI. Conclusion: Towards a Type 4 Future

Drawing on Cashore (2018) we *argue graduate professional environmental management programs ought to reinstate Type 4 conceptions – since it is the only one that focuses solely on the environment as their 'raison d'etre'*. Just as public health continues to be the focus of professional public health programs; forestry practices the focus of professional forestry programs, mining the focus of professional mining programs, crop management the focus of agricultural programs, sick and injured people the focus of medicine and nursing programs; people in need of help are the focus of social work programs; business organizations the focus of business programs; and government the focus of schools of public administration and public policy; environment ought to be the focus of environment schools.[21] How might we maintain the innovation that comes from fertilization across different disciplines, but avoid "tail wagging the dog" means oriented approaches? Some ideas are discussed below.

a) Engage Historical Institutionalism

Ensure that there are a 'critical mass' of faculty that focus on historical processes through which norms and critical junctures shape, and are shaped by, institutional arenas. More particular, Levin et al. (2012) argue that path dependency analysis, research and training, are fundamental for addressing Type 4 Super Wicked problems (Ostrom 1995).

b) Create departments/units

Ironically, an effort to build interdisciplinary collaborations by having all faculty being housed in the same structure has led instead, to hegemonic debates that reinforce Type 1, 2 and 3

conceptions at the expense of Type 4. This is not owing to some Machiavellian plot, but because faculty and scholars belonging to each world view have a tendency to favour hiring and promoting people who "look like them." This means that seemingly small changes that might, say, see a sociologist replaced by a neo-classical economist, leads to a tipping point effect that, over time, results in decisions that reinforce one world view over another. The only way out of this situation is to create an institutional framework in which disciplinary approaches and world views are institutionalized rather than debated. Current efforts to address this in the absence of an institutionalized approach such as Yale F&ES' recent "environmental humanities" initiative is laudable. At the same time, I suggest that these efforts must be careful to be designed in a way that doesn't simply work to reinforce one worldviews over another but develops the strength to engage them over environmental problem solving.

*c) **Deliberations for Stakeholder Engagement***

One creative idea is to foster reflections on the important stakeholder deliberations many of us undertake. Rather than being a defensive document, perhaps these could focus creative, analytical and deliberative thinking about how external engagement was shaped by, or reinforced, different worldviews and stakeholders, and their role in promoting, and addressing, Type 4 environmental conceptions

The School of Forestry & Environmental Studies new proposed "Center for Dialogue" is intriguing in this regard. Currently it seems fashioned to fit Type 3 conception with the benefit, and/or danger, that it will work to reinforce compromise and 'conflict resolution' over type 4 environmental problem solving. Put in a more targeted way, key questions for future design of the center will be whether it reinforces the Type 3 'balance' approach of the examples noted above in a way that provides an opening for actors who prioritize economic values or balance ahead of environmental ones. Alternatively, the dialogue could champion Type 4 problem concpetions if it emphasizes problem focused learning dialogues, rather than interest-oriented compromises.

*d) **Create a Center for Environmental Social Movements***

Such a center could act to target faculty and student interest in the very disciplines that carefully unpack social structure, class and power in which we are all embedded. Such a center might even generate new sources of funding from concerned philanthropists that could help, simultaneously, address the diversity challenges everyone at F&ES seek to address.

e) ***Foster integration***

Drawing on Clapp and Dauvergne (Clapp and Dauvergne 2005), we note that some of the greatest innovations in conducting problem focused research, teaching and outreach, lie in the integration of insights from different world views. However, this can only happen if implicit and explicit hegemonic battles are avoided, and instead, the integration 'anchor' is the specific set of problems in question which can, and must, include efforts around Type 4 problems. Such efforts must avoid subtle ways in which research steps reinforce compromise and consensus biases over scientific queries and knowledge generation. The action for sophisticated approaches for ameliorating problems lies in the integration of prescriptions, while acting in ways consistent with the core knowledge of the environmental problems in question. (For example, neo-classical economics played a great role in reducing the costs of Type 4 regulation in the acid rain issue in the Great Lakes in the 1980s).

This is also important because, as a range of scholars and practitioners are finding, their does indeed appear to be great promise in integrating technical knowledge around climate emission reductions with broader social science scholarship on class, inequality and economic globalization (Auld et al. 2010, Cashore, Howlett, and Sewerin 2016). This outreach focused research is showing great promise. However, continuing along this path requires moving beyond the comfort of our own particular world views, to rolling up our sleeves, and to targeting the critical problems facing our planet. Similarly, we could nurture protocols (Cashore and Lupberger 2016) for integration might be one way to avoid world view capture, while fostering creative innovation.

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Endnotes

[1] We thank for comments on a previous version of this paper Jeremy Moon, Jette Knudsen, Karen Seto, Detlef Sprinz, Cristina Y. A. Inoue, Dimitris Stevis, Michael Albert, Clayton Dasilva, Yelda Erçandırlı, Sina Leipold and Ken Gillingham. For comments on a related paper (Cashore 2018) we thank, Jennifer Clapp, Peter Dauvergne, Josh Galperin, Oran Young, Michael Maniates, Tom Princen, Paul Steinberg, Erika Weinthal, Paul Wapner, Joanna Dafoe, Susan Clark, Cristina Balboa, Os Schmitz, Mark Bradford, Hahrie Han, Karen Seto, Kim Smith, Kelly Levin, Alisa Zomer, Kate O'Neill, Laura Bozzi, Karen Hebert, Stefan Renckens, Gus Speth, Amity Doolittle, Mary Evelyn Tucker, John Grimm, Justin Farrell, Steven Bernstein, Doug Kysar, Michael Dove, Paul Sabin, Kalyanakrishnan Sivaramakrishnan, Paul Anastas, Anthony Leiserowitz, Kenneth Gillingham, Emma Shortis, Michael Stone, Constance McDermott, Gordon Geballe, Tim Brown, Marc Saner, Theresa Cashore, Janina Grabs, Katie McConnell, Anthea Roberts, Tim Bartley, Indy Burke, Jane Lister, Caroline Compton, Emma Shortis, Jette Steen Knudsen, Jeremy Moon, and Hamish Van Der Ven.

[2]An earlier version of this paper was presented to the International Studies Association Annual Meeting, April 3-7th, 2018.

[3] As Araral (2014: 12) notes, "One of Ostrom's main contributions in the literature is to bring these disparate case studies together, carefully select them to test her hypotheses about the evolution of institutions for collective action overtime, point to the similarities of the institutional dilemmas plaguing the commons, *extrapolate the design principles of long lived commons* and show why Hardin's conclusion is flawed."

[4] Note, this argument applies to the impacts of her earlier work. We discuss below, how her later work attempted to grapple with these very issues.

[5]Ostrom strongly argued against this potential trend: "It is my responsibility as a scientist to ascertain what problems individuals are trying to solve and what factors help or hinder them in these efforts. When the problems that I observe

involve lack of predictability, information, and trust, as well as high levels of complexity and transactional difficulties, then my efforts to explain must take these problems overtly into account rather than assuming them away. In developing an explanation for observed behavior, I draw on a rich literature written by other scholars interested in institutions and their effects on individual incentives and behaviors in field settings."

Ostrom made it very clear that her approach was only meant for human focused resource depletion CPR problems in two ways. First, she made the point that other scientists will focus on other problems and also 'work backwards' form a specific focus to identify solutions: "Biologists also face the problem of studying complex processes that are poorly understood. Their scientific strategy frequently has involved identifying form empirical observation the simplest possible organism in which process occurs in a clarified, or even exaggerated, form. The organism is not chosen because it is representative of all organisms. Rather, the organism is chosen because particular processes can be studied more effectively using this organism than using another." Second, and as a result, she made it clear that "My 'organism' is a type of human situation. I call this situation a CPR situation and define exactly what I mean by this and other key terms in Chapter 2." (Ostrom 1990: 25-26).

[6] She also says: "What makes these models so interesting and so powerful is that they capture important aspects of many different problems that occur in diverse settings in all parts of the world. What makes the models so dangerous – when they are used metaphorically as the foundation for policy – is that the constraints that are assumed to be fixed for the purpose of analysis are taken on faith as being fixed in empirical settings" Elinor Ostrom (1990: 22)

[7] This shift is reinforced, and diffused, through the work of her students, such as Aseem Prakash (Potoski and Prakash 2009, Prakash and Potoski 2007, Potoski and Prakash 2005), Krister Andersson, and Arun Agrawal, (Agrawal and Ostrom 2001) all of whom refer to themselves as environmental governance scholars. This shift is illustrated in Araral (2014: 12) who highlights three of "Ostrom's legacies to **environmental governance**" as a "critique of Hardin", "establishing an international research agenda to identify the determinants of collective action in the commons" and "establishing the Bloomington School of institutional analysis otherwise known as the Ostrom Workshop." However, **none of these are actually about environmental problems**, but rather fit squarely within human focused utility maximization challenges that, as Ostrom was clear, fit squarely within the rubric of **economic problems**, and to which so many economists and rational choice oriented political scientists, have devoted so much attention. Indeed, Ostrom's contribution for bringing economic challenges to political science was what marked so much of her impact, and it is why she earned the Nobel Prize in economics.

[8] For two latest examples see Andrew C. Revkin, December 12, 2015, "The Climate Path Ahead" http://www.nytimes.com/2015/12/13/opinion/sunday/the-climate-path-ahead.html; and Andrew C. Revkin, November 30th, 2015, "In Paris, Managing Humanity's Relationship with Earth's Climate Becomes Normal" http://dotearth.blogs.nytimes.com/2015/11/30/in-paris-managing-humanitys-relationship-with-earths-climate-becomes-normal/?partner=rss&emc=rss (We were also cited by Revkin in separate posts in 2012, 2013 and 2014). See also http://www.bbc.com/news/science-environment-33782943 and http://www.theguardian.com/environment/2015/nov/14/un-climate-change-summit-paris-planet-future-balance-science http://www.theguardian.com/news/2015/nov/22/for-the-record

[9] To be sure, Ostrom's approach was consistent with, and reinforced broader Olsonian collective action metaphors of human behavior (Olson 1965) in which individuals, unless in small organizations, will not always act to develop collective responses, even if there are clear and rationale benefits for individuals in the organization to do so (Ostrom: 6).

[10] The designation of a problem as a "tragedy of the commons" can also bring covert and latent power into play by limiting how the problem is conceived. For example, what appear to be "commons problems" actually are more complex – with those who can "move on" or live off accumulated gains having much to lose if the problem is addressed? This illustrates our point below that "Type 1" problems are quite rare, and potentially over diagnosed by those who are lured by the elegance of the tragedy of the commons metaphor.

[11] I refer to the Nash equilibrium since this is the metaphorical starting point for utility-oriented Hardin, Ostrom, and international environmental effectiveness scholars when describing a resource problem that is not subject to any rules or institutions, all of whom draw on the 'prisoner's dilemma' to anchor their analysis. And this, of course, is a decidedly anthropocentric problem.

[12] Many of Ostrom's students and followers argue that Ostrom's IAD framework as helpful for addressing biodiversity loss and other environmental problems (Andersson and Ostrom 2008, Andersson, Evans, and Richards 2009).

[13] In general, scholars have given much less attention to studying the substantive regulatory content of these systems, arguably because it is so difficult and challenging to do so – owing to constantly changing, and wide ranging, standards. While the paucity of research on these questions is someone understandable, failure to undertake this type of analysis means that it is almost impossible to 'process trace' support by firms to 'on the ground problems' if it isn't clear just what the firm is supposed to be doing, and what that 'supposed to' requirement might meant for environmental problem solving. The poor proxy, has been to undertake rather static correlational analysis, and/or applying "better than otherwise would have been" approaches in which the 'collective optimum', rather than the environmental problem, is treated as the actual goal.

[14]Another potentially important avenue of inquiry to explore comes from a point Marc Saner made to me on October 17, 2017: that industrial processes, such as aquaculture, need to incorporate science not only to make them operate more efficiently, but also in ways that minimize their negative impacts on existing natural ecosystems. This is because industrial systems are introduced into natural ecosystems, the latter of which, although highly complex, do not need to be understood by humans to make them function. It may therefore follow that the pursuit of science itself implicitly prioritizes industrial activities over ecosystem protection – a point that is slightly different from, though consistent with, James Scott's point below about the way in which the German school of forestry drew on science as a rationale for justifying converting old growth forests to second growth forests in order to enhance development and human utility.

[15] Please note that this empirical review has been applied by Cashore (2018) using Clapp and Dauvergne's Four World Views framework. This paper reviews the same data, but applying the four problem Types instead. We are reflecting on which framework seems most useful for unpacking these empirical trends.

[16] These values are voiced in Pinchot's classic book on US forest management that emphasized the 'greatest good' for the greatest number (Brown and Harris 1991, Miller 1992).

[17] These trends may also help account for the apparent prioritization of private governance and 'business and the environment' emphasis within professional environmental management programs coinciding with less attention, relative to historical efforts, in training students for careers in public administration/government agencies such as the EPA.

[18] Schmitz argues in his book, The New Ecology, that lines on a map are too blunt, and don't take into account the need to manage extractive practices.

[19] We reinforce that this section is drawn from Cashore (2018). We are deliberating whether to move this review to this paper, or keep it in the former.

[20] Interestingly, there seems to be a similar trend in US culture generally, including peaceful protests led by Kaepernick focusing on oppression of 'black people and people of color' in the United States have ended up in a debate about the the appropriatenesss of the method, and, arguably as a result, less on the substance behind the protest.

[21] From Cashore (2018) "I certainly recognize that many professional environmental management programs were first initiated in what were originally forestry or agriculture programs, departments, schools and faculties. These historical legacies may help explain some of the challenges I am highlighting, but my point is that professional environmental management programs were created, just as environmental agencies were created offer a different problem orientation than traditional resource and forestry agencies, to provide a different problem orientation than traditional resource and forestry programs and schools were addressing: i.e. to create a program in which science about ecosystems and pollution could be understood, and drawn upon to ameliorate. This is quite different from traditional professional forestry programs which were created to champion 'forest science' that explicity biased attention on promoting the forest sector in general, including sustained yield logging, as a way to meet societal needs for development and growth. These schools openly embraced, a Pinchoesque 'utilitarian' 'greatest good for the greatest number' approach, and have, arguably, served well this purpose. And they have certainly adapted to incorporate and 'balance' other values and perspectives, while maintaining their core historical missions. Recognition of this is why I focus on professional environmental management programs, rather than the broader schools in which they are situated, which often house very different programs within them."

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