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Editorial: *Governing the Commons* for two decades: a complex story

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1. Introduction

In complex systems, the elements are interrelated in ways that ensure that one element cannot be studied without accounting for the others. We take as a fact that the world over time has become more and more complex. The story of Elinor Ostrom's *Governing the Commons* is among other things a story with a protagonist role for *complexity*. It is also a tale of the emergence and development

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of a complex of diverse but interrelated disciplines, and subsequently, angles, perspectives, methods, themes, insights, and lessons-learned.

In the fall of 2008, it was 40 years since Hardin (1968) created a new research field by expounding his ideas about the commons. At one of our editorial meetings (6–7 November 2008) we realized that in a short while it would be 20 years since Elinor Ostrom (1990) transformed this same research field. We felt it would behoove our journal to take a closer look at what had followed from this publication. As we finalized our list of invitations and a letter explaining our intent, the news broke that Lin had been awarded *The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel* for 2009, sharing it with Oliver E. Williamson. What better reason can we give for what follows? (See also van Laerhoven and Berge 2011).

2. Some background on the study of the commons

Arguably, the commons are best known as that which is being enclosed by capitalist entrepreneurs. For generations, the commons were assumed to be a vanishing species. However, they did not vanish, and after Hardin (1968), the commons were rediscovered in a rather spectacular way. Today, a commons is understood as any natural or manmade resource that is or could be held and used in common. The *International Association for the Study of the Commons* (IASC), for example, "is devoted to bringing together interdisciplinary researchers, practitioners, and policymakers for the purpose of fostering better understandings, improvements, and sustainable solutions for environmental, electronic, and any other type of shared resource that is a commons or a commons-pool resource."[2]

"The commons" is not a precisely defined concept, and maybe less so today than it was when Hardin (1968) popularized the metaphor of the "Tragedy of the Commons." Hardin's (1968) explanation for the need to enclose the commons confounded the *resource* with its *governance regime* (Ciriacy-Wantrup and Bishop 1975). By 1990, the concept of a *common pool resource* (Ostrom and Ostrom 1977) had emerged as a key to understand under what conditions it can be expected that resource governance regimes may result in more sustainable forms of resource use (Ostrom 1990). The core problem of commons regimes is of course related to the governance of individual rational action in a context where outcomes are dependent on the actions of all other resource users. This is in essence "*the*" problem of collective action. It is the core problem for all kinds of government and has been a topic for discussion at least since Hobbes (1651) introduced "Leviathan" as its solution. Today, problems of collective action are discussed as social dilemmas or social traps (See for example Rothstein 2005). They are characterized by the fact that strategies leading to a Nash equilibrium provide considerably less utility for each participant than what would be feasible with a cooperative strategy.

[2] http://www.iasc-commons.org/about/main.

Ostrom understood that real-world commons organizations could be used as a setting for the study of how people overcame the conditions that produced the tragedy. In 1990, her method of choice was a meta-analysis of existing case studies. In fact, case studies were then favoured by most students of the commons (National Research Council 1986; McCay and Acheson 1987). In *Governing the Commons,* Ostrom emphasized agricultural production systems such as irrigation, forestry, fishery, and animal husbandry systems. Based on her analysis, she proposed eight design principles that she associated with sustainable resource governance as measured by survival of the resource system over long time periods (Ostrom 1990). Later research has by and large confirmed the validity of these design principles.

(Ostrom 2005a, 2009b; Cox et al. 2010). The most successful commons organizations tend to[3] operate according to the design principles she identified.

Since 1990, the methodological scope of the study of the commons has broadened (See van Laerhoven and Ostrom 2007). Standard case studies of land held in common based on field observations and archival studies are now complemented by quasi-experimental methods and meta-analysis of core characteristics (Poteete et al. 2010). The essence of the problem of the commons has been taken into laboratories where experiments with students playing commons dilemma games have provided new insights (Ostrom et al. 1994). Later, insights from laboratory studies were taken to field settings where real commoners by and large confirmed the general observations, but also documented larger diversity in responses than found among university students (Henrich et al. 2004; Bouma et al. 2008; Cardenas 2011).

Since 1990, the thematic scope of the study of the commons has broadened, as well. Once the fundamental importance of the distinction between a *common pool resource* and a *public resource* was understood one could take the theory of the commons out of its agricultural production setting. Today, it is for example a core element in the study of complex social-ecological systems (Berkes et al. 2003). Also, the conventional local to regional focus has now opened up to questions of global concern. Can global ecosystems such as the oceans be sustainably governed (Ostrom et al. 1999)? In other contexts, studies of technology-dependent commons emerged. How are the radio spectrum (Henrich-Franke 2011; Wormbs 2011) and the internet (Hess and Ostrom 2003) governed? In what sense is it meaningful to talk of the knowledge commons (Hess and Ostrom 2007)? In the laboratory, the micro-psychological foundations of governance regimes could be studied (Kahneman and Tversky 2000; Gintis et al. 2005). Why do people cooperate better and achieve higher returns when they communicate face-to-face rather than rely on the information provided by the (action) environment (Ostrom et al. 1994)? Or, why does face-to-face communication seems to lead to higher levels

[3] It is worth emphasizing the "tend to" clause. The diversity of commons organizations ensures that few completely conform to all design principles and for every principle one may discuss degrees of conformity.

of trust (and subsequently, a higher likelihood of overcoming social dilemmas) than computer-mediated forms of communication (Kiesler et al. 1984; Bente et al. 2008). Why do centralized, top-down interventions tend to crowd out reciprocity and collective action (Ostrom 2005b)? How does this affect local self-monitoring and rule compliance (Bartley et al. 2008; van Laerhoven 2010)?

Still, 20 years after the publication of Ostrom's *Governing the Commons* probably the most useful generalizations of observations on the commons are the design principles. Modifications and specifications have been proposed. But basically they have held up as scholars have used them to judge the institutions observed in new field studies Ostrom 2005a, 2009b). Why are they so useful? Why are design *principles* better than solid specific *rules*? One of the characteristics of commons that we want to emphasize is their diversity. All surveys of commons research seem to emphasize this characteristic. Efforts at classifying commons into a few neatly defined classes flounder as the group of residuals, the unclassifiable cases, becomes too large. If diversity is taken as a core characteristic, then the importance of *design principles* takes on a new significance. Applying *design principles* to the making of rules for governing commons one can generate rules relevant and useful in a diversity of contexts. It takes us one important step away from the panacea of Hardin and his followers. But it is not sufficient. If we start considering systems that are more complex than the small scale natural resource commons that Ostrom used to synthesize the design principles, we see, as emphasized by Stern (2011), that the principles may need both modification and supplement. The many diverse commons of the world will in certain important governance issues join to become one complex system.

3. It's complicated: Diversity, Complexity, and Chaos

Based on research both before and after *Governing the Commons* it would seem reasonable to conclude that given certain circumstances successful management of a commons is *possible* for a local community if interactions with external agents (i.e. governments, markets) are weak or absent. While weak or absent interactions with external agents may be a stimulating condition, it is by no means sufficient. The characteristics of the resource itself (e.g. response to interventions), the attributes of the community of commoners (e.g. trust levels) and the rules in use (e.g. rules regarding the distribution of costs and benefits) play an important role, as well. As the interactions between the local community and the wider society increase, the requirements for successful commons management change and diversify in response to ecological and cultural contexts, just as the design principles suggest. During the last 40 years, studies of commons have consistently shown an amazing *diversity* of institutions governing commons exploitation and management.

Diversity is not the same as *complexity* and complexity is not the same as *chaos*. Yet, these concepts are linked. Ostrom (2010) in her autobiographical essay "A Long Polycentric Journey" refers to persistent and recurring critiques from

colleagues that her explanations and models introduced too much "complexity". In the studies of local governments that ended up as the theory of polycentric governance she and her colleagues had to battle against the perception that a large number of local government units producing diverse urban services within a region created chaos. It created complexity, not chaos.

In parallel with the development of the studies of commons management, there has developed a science of complexity. Originating in physics and mathematics, its implications for understanding complex non-ergodic[4] development[5] in both social systems and socio-ecological systems were soon understood (Eve et al. 1997; Berkes and Folke 1998; Byrne 1998; Holling 2001; Berkes et al. 2003). In the study of social-ecological systems, the focus was on concepts such as resilience[6] and adaptive management systems.[7] The guiding idea of Ostrom's most recent research is precisely a concern about the governance of complex social-ecological systems (Ostrom 1995, 2009a).

A complex system is different from a complicated one. In a complicated system, there are many and diverse elements that may be isolated and studied without concern for other system components. In a complex system however, the elements are interrelated and one element cannot be studied without accounting for the others. Complexity is seen as lying between order and chaos, but it is not a fixed point. It is observed that over time, living systems tend to become more complex.

The study of the evolution of biospheres has given complexity a place of its own (Kauffman 2000). One suggestion emerging from this particular field is that developments (in material living systems) occur most rapidly on the edge between order and chaos. The idea of a sphere of action between order and chaos as being of interest for evolution emerged in the development of cellular automata and became central in Langton's development of his idea of artificial life (Waldrop 1992; See also Cowan et al. 1994). In this arena, adaptation provides a

[4] We are here using "non-ergodic" in the same meaning as Stuart Kauffman (2000) and Douglass C. North (1999, 2005). One basic consequence is that history does not repeat itself. This does not preclude path dependence. North's concept of path dependence is not far from Stuart Kauffman's (2000) idea of the "adjacently possible."

[5] Kauffman (2000) argues that in the history allowed our universe the second law of thermodynamics may not apply: "… the second law only makes sense for systems and timescales for which the ergodic hypothesis holds. The ergodic hypothesis does not seem to hold for the present universe and its rough timescale, at levels of complexity of molecular species and above." (page 151–152).

[6] In ecology, resilience is the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly.

[7] Adaptive management is based on knowledge and learning. An ecosystem goes through cycles of growth and decay but is also assumed to be non-ergodic in the long run. It will always be able to surprise its users by producing something new. For the management this means that there is no assurance that practices working well last year will work well for the next decade. Management will have to be prepared to adapt. Adaptation can best be prepared by viewing each activity as an experiment and continuously update information about status and development of the ecosystem. For more, see introduction to Berkes et al. (2003).

key mechanism for increasing complexity (Holland 1995). This mechanism also appears to apply to the systems governing commons.

For natural resources, complexity starts with the diversity of the ecosystem that produce the resource, but this complexity is compounded by the complexity of the culture that has developed practices exploiting the resource. Both ecosystems and cultures are complex in a way that makes their trajectories in history strictly non-ergodic. Given this double complexity designing governance regimes to cater for diversity requires at least a double dose of caution.

If we locate complexity – as a concept – on this gradient somewhere between order and chaos, or rather: around this edge of chaos, we may entertain the hypothesis that self-organized adaptive systems probably will evolve most rapidly at the edge of chaos. This raises the question: How can governance systems encourage this kind of creative adaptation of social agents, and how can it limit any destructive aspects of the complexity that is generated? Adaptation must here be seen in the context outlined by Ostrom (2009b, 40): the institutions governing common pool resources must provide "congruence with the local ecology, congruence with the local culture, and congruence between benefits and costs." In a forever changing world that would entail a secure minimum capacity to adapt.

Actors are interdependent and linked to the non-linear dynamics of a commons system. Attempts to better understand how governance systems can take this into account may benefit from opening up to inputs from complex systems theory. We need to recognize that complexity itself will always be there and needs to be included in the theoretical framework we use to study commons. To varying extents – some more detailed and explicitly than others – the contributors to this special feature have taken up the challenge to give complexity a place in their argument.

4. The contributions to this special feature

4.1. New metaphors?

Commons scholars are painfully aware of the persistence of metaphors. When on day one of class we ask our students if they know what a *commons* is, probably few hands will go up. When subsequently we ask them if they have ever heard of the *tragedy of the commons* it is very likely that most if not all students will respond affirmatively. In his contribution to our special feature, Young (2011) proposes two new metaphors to counter the bias that Hardin introduced to the debate about the governance of resources. Rather than just one tragedy, he recognizes at least three tragedies, much like McCay and Jentoft (1998).

The tragedy of the commons is a no-brainer, really. It has been intuitively understood by all users of natural resources for centuries. Since Gordon (1954), Scott (1955), and Hardin (1968) have reflected on the concept in writing, it has been on the agenda of academics and practitioners, as well. "In its simplest terms, the tragedy occurs because rational users thinking in individualistic terms

lack incentives to contribute to the common good and, as a consequence, act in ways that lead to the depletion of fish stocks, the degradation of grazing lands, the destruction of forests, the onset of climate change, and so forth, leaving all members of the user group with outcomes that are inferior to what they could have obtained by acting in a cooperative manner" (Young 2011, 69).

According to Young, the commonly proposed solutions to the tragedy of the commons – i.e. converting a commons into either a private or a public good – correspond with equally tragic scenarios. He coins them the *tragedy of private property*, and *the tragedy of the public domain*, respectively. Young's idea of a *tragedy of private property* is inspired by a rich and longstanding literature on market failure (e.g. Wolf 1988; Buchanan and Musgrave 1999; Stone 2002). In the realm of human-environment relations, three types of market failure stand out, according to Young. First, under a private property regime, it may be completely rational for the owner to use up the resource completely and then to invest the proceeds in some other goods or services. Second, private property arrangements may provide owners of a resource with incentives to favour some uses (e.g. in the case of forests, the production of timber or pulp) at the expense of others (e.g. ecosystem services). Thirdly, commodification of resource and (certain) resource units may lead to negative externalities, e.g. related to land degradation, species extinction and climate change.

Putting the commons under public rule may lead to a *tragedy of the public domain.* Also in his attempt to draw this particular metaphor, Young can lean on an established literature on government failure (e.g. Mitchell and Simmons 1994; Winston 2006). He highlights three particular elements from this literature that are relevant for the commons debate. First, due to a general inability to create winning coalitions, decision- and policy-making processes in political arenas – especially those characterized by a system of checks and balances – are notoriously vulnerable to gridlocks, resulting in a strong tendency to favour status quos.[8] As 'adaptive' is the middle name of complex systems, a gridlocked status quo can be disastrous for the survival of natural resources. Second, decision- and policy-making in political arenas is especially susceptible to claims and demands of well-organized or particularly powerful interests. "Corruption in the form of the activities of special interests, iron triangles, and lobbyists leading to subsidies, tax breaks, and a host of other outcomes favouring the interest of certain user groups" will undermine good governance of resources placed in the public domain (Young 2011, 74). Third, the public domain suffers from institutional arthritis, resulting from "the entrenchment of defenders of the status quo in legal settings, and the ossification of bureaucracies responsible for the implementation of policies" (Young 2011, 75).

Eloquent and subtle, Young introduces us to the fact that one simple metaphor doesn't suffice for the study of the commons. By combining existing and long-

[8] Compare also how North (1990) uses this mechanism to explain path dependence of economies.

recognized insights regarding market and government failures into two alternative, simple and convincing metaphors, he effectively neutralizes the power of the *tragedy of the commons*. In his essay, Young also shares his thoughts on ways to solve the three tragedies, either through regulatory, top-down interventions, or via normative, bottom-up solutions.

4.2. Global commons

Two of our contributions reflect on the consequences of the difference between the local to regional commons analyzed in *Governing the Commons*, and the more complex, regional to global commons that are at the centre of many sustainability debates, today. Henry and Dietz's contribution (2011) deals with the complexity of 'trust' in the specific context of commons governance. Trust has always been a central variable in the study of ways to avoid the tragedy of the commons. In early contributions such as Gambetta (1988) the problem is usually depicted in the form of the prisoner's dilemma game. Ostrom (1998) made trust a central variable for the theory of the commons. Trust is generally thought to support cooperative behaviour (i.e. *trust in action*) and social learning (i.e. sending and receiving *information*). However, the development of analytical concepts and the empirical setting in which trust has been studied so far have not fully kept pace with the growing complexity of many commons governance issues. Henry and Dietz propose an avenue out of the impasse by adding *complexity* to the general discussion on trust. They do so by relying to an important extent on the work of Sabatier and Jenkins-Smiths (e.g. 1999) on advocacy coalition frameworks.

So far, scholarship has focused more on '*trust in action'*, whereas many sustainability issues – also those concerning commons governance – involve important '*trust in information*' issues. Henry and Dietz argue that for analytical purposes, '*trust in information*' should be decoupled from '*trust in action*'. Overcoming collective action dilemmas indeed requires '*trust in action*' (e.g. can you trust the other actors in the arena not to free ride on your efforts? Can you trust them to act according to what was agreed upon?). However, many sustainability issues involve conflict over *information* about the definition, causes, and/or severity of a problem, and the adequate solutions. Appropriate action hinges on the trustworthiness of *information* regarding actor behaviour in a *social system* [e.g. can you trust the information provided by monitoring mechanisms – i.e. do you trust that (known or anonymous) defectors will be caught and stopped? Can you trust the information regarding the lessons-learned during previous efforts to act collectively?]. It is also dependent on the trustworthiness of information regarding the *resource system* that the commoners use [e.g. can you trust information regarding the status of the resource (i.e. problem framing)? Can you trust information about what causes the resource to be in that particular condition (i.e. causal mechanisms)? Can you trust information about the likely effect of alternative solutions or interventions?]. The information that users of the commons need to rely on, oftentimes is not acquired from primary sources,

but from other members in the action arena. Actors have to assess how much to trust each source. How do they do that? Henry and Dietz provide a number of propositions with regard to this question:

1. Trust in information is proportional to trust in the actions of the information provider;
2. Trust in information is proportional to the degree in which information is congruent with prior beliefs of the receiver of that information;
3. Trust in information is proportional to congruence between the belief system of the provider and the belief system of the receiver of that information.

Also, the literature has emphasized situations that are institutionally simple and where trust can be built based on personal relations or behaviours that are directly observed. For many commons today, trust is generated and maintained outside of repeated, direct interactions that characterize the local commons described in *Governing the Commons*. Hence, Henry and Dietz propose to consider trust from a network perspective. The network literature offers a number of useful concepts for the study of the emergence and development of trust in complex settings. In complex networks, rather than relying on observations in dyadic, interpersonal relations, individuals use heuristics to assess trustworthiness of others. These shortcuts are based on network positions and shared attributes and driven by *homophily* ('birds of a feather flock together') and *transitivity* ('a friend of my friend is my friend'). To continue the previous list, the propositions developed by the authors regarding the emergence and development of trust in complex networks, are the following.

4. Ego's trust in Alter is proportional to the similarity between Ego and Alter;
5. Due to reputation effects, Ego is more likely to trust Alter if that decision creates a cycle in a trust network;
6. The probability of Ego trusting Alter due to reputation effects is inversely proportional to the length of the cycle within the trust network that would be created by that decision;
7. Due to transitivity effects, Ego is more likely to trust Alter, if at least one other actor also trusts Alter;
8. The probability that Ego will trust Alter due to transitivity effects is proportional to the number of actors that trust Alter and are trusted by Ego.

In conclusion, Henry and Dietz state that their thoughts on the importance of information and the existence of complex networks, is particularly relevant for the kind of polycentric governance systems that Ostrom writes about. They suggest investigating further the ways in which network structures can influence the evolution of trust.

Like Henry and Dietz, Stern's contribution (2011) departs from the notion that there is a growing gap between what is available and what is required for the study of increasingly complex commons. He particularly analyzes the extents to which local and regional commons (watersheds, forests, etc.) differ from global commons (climate systems, the ozone layer, oceans that acidify, biodiversity, etc.). The notable difference that he accentuates has significant consequences for the required content of the analytical toolkit of students of the commons.

In his overview, Stern compares different types of commons, based on geographic scale, the number of resource users, salience, the distribution of interests and power, the level of cultural and institutional homogeneity, and the feasibility of 'learning' as a management strategy. From this overview it becomes obvious that local and regional commons on the one hand, and global commons on the other, are to an important extent, different things. Subsequently, a very pertinent question is raised: If both types of commons differ so much, what is the value of the 'lessons-learned' by students of local and regional commons for the solving of puzzles related to the governance of global commons? As these lessons-learned can be argued to boil down to Ostrom's design principles, it only makes sense to start answering this question, here. Stern assesses all eight design principles in terms of their respective applicability to efforts to understand the governance of the global commons. He goes on to list the particular challenges in applying the principles in a global context. For example, the principle to allow most users to participate in the development of rules may indeed apply to a global commons but is challenged by the size of the appropriating group (which could be the entire human population!), the disconnect between winners and losers from resource use, and the fact that meaningful participation becomes difficult when the system is so complex as to challenge the understanding of even the most expert scientists.

After assessing if and to what extent the original design principles are useful for the study of global commons and analyzing how they can be reinterpreted in order to become more useful, Stern continues to develop a set of additional principles. Leaning on among others Dietz et al. (2003), Stern arrives at the following preliminary list of design principles for global commons:

1. Invest in science to understand the resource and its interactions with users and those affected by its use;
2. Establish independent monitoring of the resource and its use that is accountable to the range of interested and affected parties;
3. Ensure meaningful participation of the parties in framing questions for analysis, defining the import of scientific results, and developing rules;
4. Integrate scientific analysis with broadly based deliberation;
5. Higher-level actors should facilitate participation of lower-level actors;
6. Engage and connect a variety of institutional forms from local to global in developing rules, monitoring, and sanctioning; and,
7. Plan for institutional adaptation and change.

Stern illustrates the use of these design principles for global commons by applying them to the governance of emerging technologies. New and emerging technologies often present commons problems, many of them global, when their implementation creates externalities in the form of risks of harm to parties beyond the set of users: common-pool hazards.[9]

4.3. Property rights

Three essays in this special feature explore the specific meaning of *Governing the Commons* for our thinking about and understanding of *property rights*. Rose (2011) discusses how *Governing the Commons* has been received by legal scholars and the impact the book has had on their particular field of study. The book's message of a place for communities and community resource management somewhere in between private property and state regulation, proved appealing to many in this field. Legal scholars, particularly those working on environmental and resource management and intellectual property, have used this message for developing new ideas and novel ways of looking at property rights. Among the first to apply the ideas underlying *Governing the Commons* to the study of law were Rose herself and Robert Ellickson (1991). Their previous work had prepared them for it (Rose 1985, 1986; Ellickson 1986, 1987). In the wake of *Governing the Commons*, two conceptual developments are noteworthy: one is Heller's development of the idea of an *anti-commons* (Heller 1998). An anti-commons arises when the number of stakeholders with ability to exclude each other creates insurmountable transaction costs for anyone wanting to change the pattern of resource use (Buchanan and Yoon 2000). The idea proved productive, for example in the study of intellectual property rights (Heller and Eisenberg 1998; Murray and Stern 2007). The other idea that developed was that of *semi-commons*. In a semi-commons, resources are partly individually owned and partly held in common in ways that make them interdependent like for example the open field agriculture of medieval England (Smith 2000).

But legal scholars were also presenting critical comments on *Governing the Commons*. Many were skeptical to the emphasis on informal law and pointed to unattractive characteristics of many communities governed by customary law such as sexism. It was argued that the commons governance depicted was fundamentally illiberal in the sense of preventing exit. Dagan and Heller (2001) try to chart a way between the cooperative use requirement and the liberal commitment to allow exit. Rose notes that this concern with exit in the form of alienability of assets is also prominent in the seminal work of Merrill and Smith (2000) on the optimal standardization of property rights. She also notes that judging from references there is no impact from *Governing the Commons* on this work.

[9] Stern subtly points to the fact that the risk governance literature is not very familiar with the Ostrom tradition: a recent extensive work on Risk Governance (Renn 2008) includes no reference to Ostrom's work in a 60-page reference list.

In environmental law, *Governing the Commons* and its design principles got immediate attention in discussions of community forestry and ecosystem and watershed management. Problems appeared when the scale of the system became too large (e.g. greenhouse gas emissions) or the group benefitting from some common resource was different from the one bearing the costs of maintaining it (e.g. tourists benefitting from wildlife while local farmers bear the costs). The problem of scale is familiar. To what degree will the design principles proposed by *Governing the Commons* apply to governance problems at global scales? As noted above this topic is also a concern for Stern (2011) and Henry and Dietz (2011).

Also the studies of intellectual property rights found inspiration in *Governing the Commons*. The observations of collective rights for example in patent pools, performance rights associations, and the 1930s Fashion Guild, got new significance when studied in the light of the book's design principles. Studies of scientific knowledge followed. In this, legal scholars were joined by Lessig (2001) and others. The problems discussed range from congestion on the internet by way of copyright to computer software to open access to the knowledge commons. It is noted that much of the discussion takes the rights of the creator of an artistic or intellectual work for granted. One of the outgrowths of this, the Creative Commons license for granting access to intellectual works,[10] is constructed on the basis of ordinary copyrights. However, the application of insights from *Governing the Commons* and the understanding of differences between various types of public and private goods were remiss. Hess and Ostrom (2007) try to clarify concepts. One of the many interesting observations that Rose presents is Robert Merger's view that individual rights are intimately interlinked with commons management regimes. Only by having individual rights can commoners bargain for changes in the management of a commons. This can be seen as a key to encourage foresight and adaptive behaviour of a commons organization.

Fennell (2011) also reflects on the impact of *Governing the Commons* on legal scholarship in particular. In her essay she emphasizes the role that Ostrom has played in thinking about *property rights*. While in legal circles, Commons' (1893) idea of a 'bundle' of property rights is upheld still by some (e.g. Stone 2009), it seems to be increasingly challenged by those who wish to turn the conceptual focus of the property rights debate towards *boundaries* and *exclusion* (e.g. Merrill 1998; Smith 2004). Ostrom's treatment of property rights has enriched this debate between legal realists on the one hand, and those challenging the 'bundle' metaphor, on the other. Property theorists opposing the 'bundle' metaphor critique the concept because they feel that its implicit message of infinitely decomposable property devaluates property to nothing more than a list of use rights. Ostrom, especially in her work with Schlager (Schlager and

[10] The present journal subscribes to these ideas.

Ostrom 1992), dodges this critique by identifying five resource control rights – access, withdrawal, management, exclusion, and alienation – that are cumulative in nature. To hold some of these rights implies the possession of others. E.g. the exercise of withdrawal rights is not meaningful without the right of access. The 'bundle' proposed by Schlager and Ostrom *cannot* be thrown together or pulled apart in just any odd way. However, this notion doesn't put Ostrom automatically in the legal realists' camp. In a sense, Ostrom's treatment of property can be squared quite well with the growing tendency to equate property with boundaries and exclusion. After all, exclusion can help transform what would otherwise be an open-access regime into a manageable commons. Fennell points to some of the limitations related with the application of the exclusion paradigm to a commons context. While exclusion helps commoners fencing off intrusions from 'the outside', much of the relevant action with regard to commons-use takes place 'on the inside'. Blunt exclusion boundary-based rights would be nonsensical within such a shared resources setting. Fennell concludes this part of her analysis by observing that "property theorists have much to learn from the complex ways in which resource users in practice slice and dice entitlements into special-purpose tenure niches"(Fennell 2011, 15). Complexity in practice must be given a place in property theory.

After reviewing the property and property rights debate from an Ostromian perspective, Fennell continues to draw upon *Governing the Commons* in order to illustrate how property is never wholly individual nor wholly held in common, but instead always represents a mix of ownership types. E.g. a neighbourhood consists of individually owned houses but also of 'ambience' and amenities, goods that arguably are held in common by the entire neighbourhood. Furthermore, individual houses in these neighbourhoods consist of living rooms and kitchens that all family members may use in common but also of private bedrooms reserved for certain occupants, only. A similar rationale can be applied to corporations. With specific regard to the commons, Fennell argues that the prototypical tragedy of the commons is produced not by common ownership alone, but rather by the interface between a communally owned element (the pasture – i.e. the resource system, or 'stock') and individually owned elements (cows, the grass they ingest – i.e. the resource units, or 'flow'). For Fennell then, property theory must zoom in on the interface between individual and collective entitlements. How can the two intelligently confront one another? When and how should this interface be adjusted in order to avoid a tragedy of the commons? The challenge of property theory in a world of mixed ownership systems is to find ways to meaningfully study the potential of property systems to dynamically adapt to changing circumstances. Also here, Fennell touches upon the general need to give complexity a prominent role in our efforts to build (property) theory.

Eggertsson's contribution (2011) focuses on the impact of *Governing the Commons* on thinking about property rights, as well. However, he does so from an institutional economics perspective. His essay concerns an investigation of the process of establishing property rights to a new resource: the health records of

the Icelandic people. At the outset, these records can be described as a club good, available to the "insiders" of various clubs, i.e. doctors and scientists, primarily those who collected the data. This good was generally considered to have no monetary value. However, in the mid 1990s, biomedical researchers had come to believe that by combining health records with genealogical and genetic data, one might be able to develop new drugs. All of a sudden, health records appeared to become commercially valuable to these biomedical researchers. Consequently, a newly established research company sought access to Iceland's health records, and the genetic and genealogical data on the population.

Standard theory of institutional evolution suggests that clearer definitions of property rights will emerge as competition for access to a new resource increases. Referring to Riker and Sened (1991) who work on the assumptions that (1) agents maximize their utility, and (2) governments have a monopoly on the use of coercive force, Eggertsson claims that there are four necessary conditions for the emergence of agent-specific property rights in a society: (1) The content of the right is valuable, (2) right-holders desire to possess the right, (3) rule makers desire to enforce the right, and, (4) some duty-bearers respect the right.

Making rules and enforcing them implies transaction costs. With complete information, the transaction costs of creating and enforcing new property rights would be incurred only if the value of the resource provided more benefits than costs for the rule makers. One problem implied by the conditions formulated by Riker and Sened (1991) and discussed by Sened (1997) relates to incomplete or erroneous mental models of both individual and state actors. If the models in use lead to outcomes at variance with expected benefits, one would expect either changes in the rules or the abandonment of their enforcement. Competition between mental models is one of the features that Eggertsson's case illuminates. While the model that persuaded the biomedical researchers to believe that there was profit to be made from the health records was probably wrong, the Icelandic government's reluctance to incur any enforcement costs for granting them exclusive rights may be seen as grounded in a more realistic picture of the world.

Sened (1997) also emphasizes the importance of the game of politics: the struggle over distributional issues connected to the newly discovered resource. Eggertsson's case illuminates how this can play out. The de facto rights that each insider group holds over their sub-section of the health records provided them with sufficient leverage to block the enforcement of the rights that the government awarded to the research company and enabled them to contract with the company to get access to part of the perceived value. However, the importance of de facto rights in a decentralized system is not fully recognized by Sened. In this respect, Eggertsson is closer to Ostrom in his essay. The heterogeneity of actors in the game of politics, each one acting strategically based on incomplete models and insufficient if not erroneous data, creates a complex system where adaptive behaviour becomes a critical factor in understanding the historical trajectory of the system.

4.4. Governance

Burns and Stöhr (2011) choose to reflect on the impact of *Governing the Commons*, on ideas about governance in particular. They propose to expand the range of the tools available for comparing governance systems. Their point of departure is that "governance arrangements exhibit great variability, in particular in their specific relation(s) to the objects of regulation." They contribute to the ongoing development of a full-fledged institutional approach with the potential to address all levels of governance, including multi-level, complex governance systems. They develop their approach to the architecture and functioning of governance systems through two foci: the social-organizational and the cognitive-normative configuration.

Within the analytical system they propose, Burns and Stöhr discuss the particular role of power, knowledge and conflict. Power comprises much more than only the ability to command and control in hierarchical relations. It also includes more horizontally organized varieties, such as committees or networks, and "market-like" or "democratic-like" forms of decision-making. Governance systems comprised of multiple regulatory mechanisms require multiple bodies of knowledge. The authors observe that "one of the challenges in contemporary governance design is to effectivize legitimate procedures incorporating the increasing diversity of expertise." One result of the increasing diversity of expertise consists of increasingly complex governance arrangements creating non-linear dynamics within the system that leads to unforeseen developments and outcomes. The complexity of the system also provides context for contestation and conflict. Diversity of the cognitive-normative backgrounds of agents leads to struggles over the governance system itself as well as over goals and values at the meta-level.

Above we reviewed Henry and Dietz's discussion of trust in information and the role of networks in forming trust. The obvious further step is to link this to the concept of epistemic community (Haas 1990, 1992; Adler and Haas 1992). The diversity of expertise discussed by Burns and Stöhr would profit from the same conceptual link. The role of epistemic communities in governance processes seems to become more important as the world becomes more complex (Chilvers 2008; Stephens et al. 2011).[11] Maybe the various groups professing specialized knowledge in the framework proposed by Burns and Stöhr can be generalized to a number of epistemic communities?

Burns and Stöhr apply their framework to the Baltic fisheries.[12] Its governance system is the EU's Common Fisheries Policy (CFP) currently comprising some 2000 rules. The most important decision made by the EU commission regards

[11] We are of course also aware that the students of commons may be partitioned into various epistemic communities (Goldman 1997). Based on our values and policies of this journal this is seen as a good thing. From the arguments here we begin to see why.

[12] They also briefly consider the governance of chemicals and gender issues.

the annual Total Allowable Catches (TACs). This decision is informed by several expert groups: Two scientific groups, one group comprised of industry representatives, and one group consisting of so-called regional advisory councils. The diversity of interests and knowledge gains importance due to the poor ability to predict future fish stocks. The incomplete scientific understanding of the dynamics of fish communities leads to an increased demand for the inclusion of fishers' knowledge and a higher degree of self-governance by the fish industry. However, environmental NGOs see the system of determining catch quotas as too accommodating to the fishing industry. The current system has not been able to achieve compliance from the fishers and the whole governance system may be vulnerable as the various interest groups try to achieve a change in the system.

Arguably, the main causes of difficulties for the governance system relate to 1) the complexity of the social-ecological system of fishing which leads to divergent interpretations of both the status and future development of fish stocks, and 2) a deep mutual mistrust between fishers and fish scientists which makes mutually agreed upon compromises nearly impossible. These problems are probably compounded by the legislative and bureaucratic process determining the regulations the fishing industry is supposed to follow. The level of compliance is dangerously low. The proposals for reform of EU's Common Fisheries Policy in 2012 indicates a move towards more participation of a more divers set of interest groups, perhaps moving towards some kind of polycentric governance system.

Pálsson and Prainsack (2011) in their contribution discuss the extension of Ostrom's work to the governing of human genes and genomes. In considering an answer to their question "Do we need specific governance regimes for genomics and, if so, what could they look like?" we should keep in mind Eggertsson's observations on the conditions that make "stuff" (health records for example) valuable enough to bother with creating and running a governance regime. Creating regimes is costly, and so is running them. The first step Pálsson and Prainsack engage in is to investigate what kind of good this "genomic stuff" is[13]: is it a chemical substance or is it digital information? It is, of course, both. The context decides. For the most part, use of the stuff does not subtract from the value of the resource for the next user. Often, it will add new information to the stock of knowledge. Exceptions relate to for example the destruction of DNA-samples during certain kinds of tests, and the patenting of genetic information. This renders things more complicated. Studies of epigenetics show that the meaning of the information contained in DNA sequencing is context-dependent, thus emphasizing the importance of the personal data that go along with the chemical DNA information. This has governance implications, given the emphasis on the guarding of personal identities when storing stuff in genomic data banks.

While genomic stuff for the most part does not conform to the definition of a common pool resource, Pálsson and Prainsack argue that "stewardship and self-

[13] In Pálsson and Prainsack "genomic stuff" comprises genomic material, data, and information.

governance are typically also the most effective and efficient ways of governing genomics." They review five cases that span a wide variety of exploitation of genomic stuff. In the HapMap project the data generated goes into the public domain. The problem of "property rights" relates to the question of who is represented by the data: the individuals providing the samples or the communities that these persons come from. The benefits of bio-medical research seldom go back directly to the persons or groups providing samples and data. Patents granted (something like 20% of the human genome is currently identified in at least one granted patent claim) will sometimes combine into a serious obstacle for further developments (the tragedy of anti-commons, see Rose's contribution), but will for the most part be disregarded in actual research. It seems that the only value that can justify the study and use of genomic stuff are community benefits such as in public health measures: "genes are something that humans have in common, something that makes us human and grants us equal rights." This notion too, has implications for governance.

Investigating the degree of conformance between Ostrom's design principles and the world of genomic stuff leads to the conclusion that for most of the design principles the degree of conformance can be judged only on a case-by-case basis. In practice, the field of genomics comprises many communities that so far have been able to create their own informal and sometimes also formal rules for maintaining and exploiting the resource. Within the context of the modern rule-of-law state the niche for genomic stuff has been able to govern itself somewhat reminiscent of the traditional self-governed commons.

Pálsson and Prainsack's study of the governance of genomes illustrates how the diversity of cultural meanings of "genomic stuff" and the realities of the biological world with its atomic structures and complex relations combine in complex patterns necessitating recognition of a diversity of commons organizations for a complex world. Neither can we fail to take note of the possibility of seeing this world built around genomic stuff as a kind of complex adaptive system comprising both the genomic and environmental aspects creating the epigenetic observations. The observed variety of governance of genomic stuff seems to be generated by this system complexity. Complexity here can be understood as a strong argument in favour of self-governance, but self-governance within the limits set by the rule-of-law and driven by more general questions regarding distributive issues, rights to meaningful participation, social justice, and intergenerational fairness.

4.5. Social capital and collective action

The main goal of Anthony and Campbell (2011) is to discuss and expand on our understanding of the role of the state and social capital in the institutional conditions shaping people's propensity to set aside short-term personal interests to cooperate for a common long-term benefit. Their point of departure is *Governing the Commons*, recognizing that Ostrom's later work has done much to expand our understanding of the importance of social capital, in particular. They note that while

empirical descriptions of cases in *Governing the Commons* contain observations on the role of the state, the theoretical discussions do not say much about its role. The same can be said about social capital. They remain in the theoretical shadows. One reason for this is the basic idea that the state is a predatory organization only interested in cooperative behaviour in so far it can increase their revenue. But states can also be benevolent and supportive and try to facilitate cooperative behaviour more generally. Cooperative behaviour often requires resources. The state will sometimes provide such resources. It may also provide legitimacy to a cooperative association for example by exempting it from rules against limiting competition. The state may also in various ways affect the perception of costs and benefits of cooperation as well as ways of achieving it. One of their examples, the West German co-determination legislation for work, shows that it did not only improve cooperative behaviour but firms became more adaptable and better able to exploit new opportunities in the market. So, a benevolent state may enhance cooperative behaviour to the long-term benefit for all.

However, it does not invariably do so as the studies of the Newfoundland cod fisheries show. Here the state can be said to have actively – if unwittingly – worked towards the resource destruction (Hannesson 1996). More generally, it is often seen that in the world of resource management "the success in managing a target resource (food, fibre) for sustained production has led to an ultimate pathology of more brittle and vulnerable ecosystems, more rigid and unresponsive management agencies, and more dependent societies" (Folke et al. 2007, 9).

Anthony and Campbell provide a short survey of the role of social capital in furthering cooperative behaviour, discussing the conditions for compliance with cooperative agreements including uncertainty about motives and future commitments, levels of trust, costliness of relevant information, importance of reputations and competences, and the role of repeated encounters and reciprocity. They also take note of the "weakness of strong ties" and the ways in which social capital diminishes rather than facilitates cooperative behaviour when, for example, high levels of trust make monitoring and sanctioning an offensive activity leading to lower levels of compliance. At the end, they discuss the governance of the internet noting in particular how the state created policy of Net Neutrality shapes current governance arrangements and facilitates the development of self-governing commons like Wikipedia and Linux.

Governing the Commons in essence studies the emergence, evaluation and performance of common property institutions. The case material used in the book, and certainly in studies that appeared after its publication, are frequently located in so-called developing countries. In his contribution, Rudel (2011) tries to spell out how macro-sociological trends associated with political and economic development would affect the incidence of such common property institutions in societies. Social capital plays an important role in Rudel's essay, as well. Rudel leans on Woolcock (1998) when discussing social capital in its occurrence at the community level. In a developing society, at the local level social capital – i.e. the accumulation of information, trust, and obligations of people who comprise social

networks – requires both 'bonding' (i.e. cohesion and trust among themselves), and 'bridging' (i.e. links to centres of power and wealth outside of the community). For his discussion of social capital in the larger societal arena, Rudel leans on Evans (1995) who speaks of 'embedded autonomy' referring to state officials' relations with individuals and enterprises. Social capital has an impact on organizational density, which in turn increases the likelihood of common property institutions emerging.

After outlining in broad strokes how political and economic development, social capital, and incidence of common property institutions are related, Rudel continues to discuss more specifically the ways in which development advances or retards the fortunes of common property institutions (and its users). He does so by deriving from Ostrom's work a number of key variables that relate to the attributes of the people who create the institutions (i.e. salience, common understanding of the resource, discount rates, the distribution of interests, trust, autonomy, and prior organizational experience), and the list of design principles. He then continues to derive from development sociology literature a number of core concepts associated with economic and political development (i.e. social capital, state-strength, affluence, globalization, migration, and duration of settlement). In order to analyze if and to what extent development affects the likelihood that common property institutions will occur, the variables from both literatures are cross-tabbed. Rudel concludes that the theoretical connection that he started to draw between the commons, common property institutions, and development "might at best be construed as a heuristic, an analytical point of departure and a spur to further research." Modest as that may be, the heuristic offers a splendid opportunity to continue thinking about complex issues, such as the relation between economic, political and institutional development.

Acheson was an early and significant contributor to the body of literature currently identified as the theory of the commons. His studies of the lobster fisheries of Main have become standard references (Acheson 1975, 1988; McCay and Acheson 1987). In his contribution to our special feature on *Governing the Commons* he sets out to survey the work of Ostrom emphasizing those themes that he sees as having most interest for anthropologists in particular (Acheson 2011). The themes he singles out are the problems of collective action, the analysis and classification of rules, and how the nature of the good affects its management as a commons. The problem of collective action is perhaps *the* central theme of Ostrom's work. Although it is a theme for all social sciences, Acheson notes that few anthropologists have devoted time and effort to this field after a number of seminal contributions during the 60s and 70s (e.g. Barth 1959; Bailey 1969; Heath 1976; Kapferer 1976; Netting 1976). His survey of this core area highlights eloquently the main themes of social traps, the design of institutions to avoid such traps, and the importance for the sustainability of the resource of the fit between the rules and the ecosystem on the one hand, and the rules and the community, on the other. It can be recommended as a short introduction for more people than students of anthropology alone.

Acheson notes at several points that Ostrom does not shy away from complex problems and that she meets them with complex theoretical schemes, such as in the classification system for rules based on a syntax Ostrom developed in collaboration with Sue Crawford (Crawford and Ostrom 1995). The ADICO syntax (see Acheson's essay, for explanation) as the classification scheme is called, also proves useful for the clarification of the meaning of the concepts of rules, norms and shared strategies. Acheson acknowledges the need for thinking in new ways about the complex ecosystems that humans try to manage for the common good such as the fisheries (Wilson et al. 1994; Acheson and Wilson 1996). Since 1994 he and James Wilson have advocated a new approach for fisheries management based on theories of chaos and complexity (see also Waldrop 1992).

5. Conclusion: it's complex ...

Above, we emphasized that complex systems are different from complicated ones. In complex systems the elements are interrelated in ways ensuring that one element cannot be studied without accounting for the others. Most articles we have surveyed use "complex" or "complexity" in its dictionary definition of something that is "made up of multiple parts; intricate or detailed." Interestingly enough Rudel's only use of this word is in the phrase "organizational complex of societies undergoing political and economic development." This would allude to another common meaning of complex: "A collection of buildings with a common purpose." This is so despite the very broad (and important) topic he discusses: the relation between processes of political and economic development and the creation of common property institutions. One may speculate that in sociology "complexity" is so much taken for granted that it is hardly recognized.

One article may be on the verge of doing more than recognizing the various types of complexities involved. Burns and Stöhr are more self-consciously grappling with complexity as something more than our limited understanding of the intricate working of the world. They provide a definition: "*By complexity we understand that the governance system is characterized by a high number of actors, relations and dependencies between them, regulatory processes, forms of knowledge and interests that are difficult to understand and coordinate, create non-linear dynamics and may therefore lead to unforeseen developments and outcomes of the governance system as such.* The observations they are discussing are the "Case of EU Baltic Fisheries." It would seem that various fisheries provide us with the most persistent reminder of the fact of unavoidable complexity in actor-nature and actor-actor relations. Acheson in earlier works as well as Wilson (2002) are grappling with the persistence of complexity and how to devise governance systems taking this into account. Both Acheson and Wilson's case material is the collapse of the cod fisheries of New England.

One could also apply Ostrom's Law: A resource arrangement that works in practice can work in theory, to the phenomenon of complexity. As long as we see that communities sometimes are successful in designing sustainable systems

governing complex resources in a complex setting we should accept that there must be a theory that can explain how it is done. And it is not done only in small-scale communities and for resources where market forces do not reach. Many of the developed economies in Western Europe do have management systems that work – after a fashion. Some may, however, be on the verge of failing, or maybe they already have failed. At the EU level it seems fair to say that for example the fisheries of the North Sea or Baltic Sea are on the verge of failing or may already have failed. Some traditional agricultural commons may have lost their ability to adapt and are now in the process of disappearing. But many are also able to sustain a reproducing ecosystem at the same time as they contribute valuable parts of the livelihoods of local communities (See e.g. Rodgers et al. 2011). So we can say with confidence that we do have commons governance systems in complex societies that work in practice. But since we do not know much about how they work we cannot give any credible advice on reform proposals if improvements in adaptability and resource management are needed.

One difficulty in developing a theoretical understanding of the role of complexity in governance of common pool resources is the fact that the dynamics of complex resource systems is unpredictable in ways that make central or state management difficult if not impossible with ordinary bureaucratic technology. The link between the empirical diversity, the sustainability of the resources, the design principles, and their bureaucratic environment is poorly understood. In some broad circumstances[14] traditional commons organization may be better than individual ownership in overcoming the inherent uncertainty of the resource dynamics, and transforming experiences into practical management decisions. But we are not allowed to assume that this is so in all cases and in all places.

At the end of this investigation we do not want to conclude on anything in the way of how to handle complexity or what it means. But we do want to state that research needs to look at complexity in new ways. Complexity is not a nuisance we rather would be without. It is not something we can do away with or that will wither away as history progresses. It is a core driver for change in both ecosystems and social systems.

Recognizing the pervasive presence of social dilemmas in the governance of common pool resources, the challenge for students of the commons concerned with the relations between the self-organized aspect of the commons and the public regulation of it, is to find ways of channeling the self-organized adaptive dynamic around, beside, or above the various paths leading into dilemmas and traps waiting to capture and destroy unaware communities.

One may ponder how contract law and surrounding regulations have harnessed the forces of the market to stay within a common morality in broad terms. As we did for capitalism we need to develop ways of managing complexity, to harness

[14] The circumstance might be described on the one hand by the discount rate and degree of other regarding preferences among agents, and on the other hand by the scale and resilience of the ecosystem that needs management.

its potential good effects, and to avoid the many unwanted paths into the future that also may follow from local adaptations within complex social-ecological systems.

Taking complexity as a constant and for many reasons also wanted feature of the social-ecological systems we want to govern, some assumptions about what governance systems look like may have to change. For example:

- A complex system is assumed to consist of systems nested within systems at multiple scales above and below.
- The governance system for a complex system needs ability to adapt to new features emerging. This means that the system – as a system – needs to be able to learn.
- Learning within a complex system involves localized observations and interpretations. This means that local stakeholders of various types need to be involved in the governance system.
- Local observations need to be integrated into the local practice and advanced towards more central agents for inclusion in larger scale considerations.
- The problem of coordination and the collective concerns with common values and goals do not disappear. Common and global concerns need to find ways of being integrated with the local interpretations and solutions.

It is known to work in practice in some cases. It can work in theory!

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