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The SES Framework in a Marine Setting: Methodological Lessons*

Abstract:

The paper discusses the application of Elinor Ostrom's Social Ecological Systems (SES) framework, using as example a community organization in Costa Rica, which collectively extracts turtle eggs. The paper does so with the particular aim of examining the coevolving relationship between political science and economics. The SES framework is understood as a useful exploratory tool, which was introduced into a joint research agenda from a political science perspective. The breadth of its approach enables it to capture empirically observable diversity. In this sense it provided a perfect complement to the more partial view that economics brought into the coevolving research process.

1. Introduction

The following paper aims to show, using an empirical example, how an amalgamation of political science and economics, in this case materialized in the Social Ecological System Framework (SES framework) developed by Elinor Ostrom and her colleagues (Ostrom 2007), can enhance our understanding of how people use common pool resources. Elinor and Vincent Ostrom, as well as the Workshop in Political Theory and Policy Analysis have contributed to many fields in the development of political science and economics. In addition to innovative theoretical contributions, for example, in the fields of public choice (Aligica and Boettke 2009), the governance of the commons (Ostrom 1990), institutional theory (Ostrom 2005) and experimental economics (Ostrom et al. 1994), they have made an important contribution to the development of analytical frameworks (Schlager 1999).

We apply the diagnostic approach of the SES framework to a community organization in Costa Rica. For more than 30 years, members of the Association of Integrated Development Ostional (ADIO by its Spanish acronym) have collec-

* First of all I (A. Schlüter) want to thank posthumously Elinor Ostrom. Her thoughts have inspired our work and still do. However, I also personally owe her very much for her constructive criticisms of my papers, as well as her invaluable encouragement and support to myself as a researcher and as a person. She had an amazing personality. Gratitude also goes to the community of Ostional, who allowed us to have such a close look at their way of life, their livelihoods, and their family and community relationships. It goes without saying that we are grateful to the Efd and the ZMT for funding the research.

tively harvested and sold turtle eggs from their beach in Ostional, Costa Rica. These activities are regulated by the Costa Rican government and also involve a variety of conservation duties to be undertaken by the community (Campbell, Haalboom and Trow 2007; Madrigal et al. 2012). Government agencies consider that community use of the resource increases the productivity of the turtles, and this is confirmed by independent scientific research. However, the main purpose of the paper is not to describe this particular case of natural resource management in detail, but rather, at a methodological level, to describe and reflect on how the SES framework can be used, and furthermore, to increase our understanding of human behavior in the use of natural resources. Therefore, this research hopes to contribute to the on-going discussion¹ on the applicability of the recently developed SES framework to different common pool resource systems, such as forestry, irrigation or, as in this case, marine resources (Basurto, Xavier and Ostrom 2009; Fleischman, Boenning, Garcia-Lopez and Mincey 2010; Madrigal, Alpízar and Schlüter 2011; Meinzen-Dick 2007). Focusing on the methodological considerations rather than on the empirical case enables a discussion of the contribution of the SES framework (Ostrom 2007) to the coevolution of political science and economics.

The paper is structured as follows: The next section outlines the usefulness of analytical frameworks and the reasons for their use. Analytical frameworks are, from the perspective of the joint research collaboration between economics and political science, definitely an inherited idea that comes from political science (Edwards and Steins 1998; Schlager 1999). Starting from an epistemological understanding of an economist—the two authors of the present paper are economists—some explanation is required of when and why an analytical framework can be used for the advancement of science. The following section outlines the basic characteristics of the SES framework and its generic structure. The next section introduces the case study and, following a summary description, describes how the SES framework was used as a diagnostic approach for analysis of the community organization in Ostional. The discussion reflects on the advantages and limitations of the SES-framework, and the challenges involved in applying it to this particular case. Reference to Elinor Ostrom's introductory chapter to this special issue is made. Finally, we conclude by summarizing the contribution of the SES framework to the co-evolution of political science and economics.

2. The Intuition of Using a Framework

A framework in general, and in particular the SES-framework, can bridge two important gaps that can exist in research. First, it is able to bridge the gap

¹ The most prominent forum is the SES-Club, a group of scholars, who meet regularly for discussing potential, shortcomings and applicability of the SES-framework.

between different theories and even disciplines. Second, it is able to bridge the gap between a more inductive, empirically driven research approach and a more deductive, theory driven approach.

A framework is nothing more than a broad structuring device for depicting an empirical situation or system. As Ostrom (2005, 28) indicates, “frameworks organize diagnostic and prescriptive inquiry”. A framework identifies the universal blocks that constitute a system, but it does not show how the different building blocks of the system interact, as a model would do. Nor does it explain or try to understand the relationships between the various building blocks, as a theory would do (Ostrom 2005). As different models can fit into a theory, different theories can also fit into a framework. This allows the SES framework to accommodate perspectives from different disciplines and zoom in on particular puzzles or research questions that require different assumptions to be answered. From this perspective, a framework allows for interdisciplinarity between, for example, economics and political sciences.

Understanding a phenomenon, such as, in Ostrom’s case, the governance of common pool resources can adopt either a phenomenon driven (similar to inductive) or a theory driven (similar to deductive) approach. The former starts from an empirical phenomenon and tries to understand it. The latter has a theoretical understanding and investigates whether it matches reality. Both methodological approaches are important for advancing our understanding of the sustainable use of common pool resources (Poteete and Ostrom 2008).

Starting from a study of empirical phenomena obviously invokes a great deal of complexity. If the subject of study is an entire social ecological system, one needs a structuring device, which allows the system to be compartmentalized into its building blocks—the “holons”—which it comprises (Ostrom 2005). Historically, political science has tended to adopt this approach, which starts out by investigating empirical situations, and it has definitely been the approach favored by scholars studying the commons (Agrawal 2001). Having a structured overview of the empirical situation is a necessary condition for being able to develop hypotheses, and later on, theories about what might actually change or drive the development of the system being considered. It is also a necessary component that enables comparative studies of different cases, which is also a condition for theoretical development (Agrawal 2001). To be explicit, a framework such as SES is able to cope with empirically observable complexity.

However, the evidence gathered about cases, with the help of those frameworks, is too complex to be used to test and falsify any theories that might have emerged from observation of an empirical phenomenon. This can only be done with the help of a deductive and theory driven approach, which is more commonly used in economics. Specifically, a theory driven approach allows a compartmentalization of an empirical situation into very small building blocks, so that just one change, which the theory attempts to explain, can be segregated. This approach is particularly suitable for developing a conceptual understanding of a system. It is very reliable for testing theories. However, this understanding might well come at a cost, in terms of rather low external validity, as

empirical examples are characterized by mutual changes and synergies among simultaneously occurring changes (List 2008; Schlüter and Vollan 2011). For this approach, a framework for structuring purposes is not required (see *figure 1*).

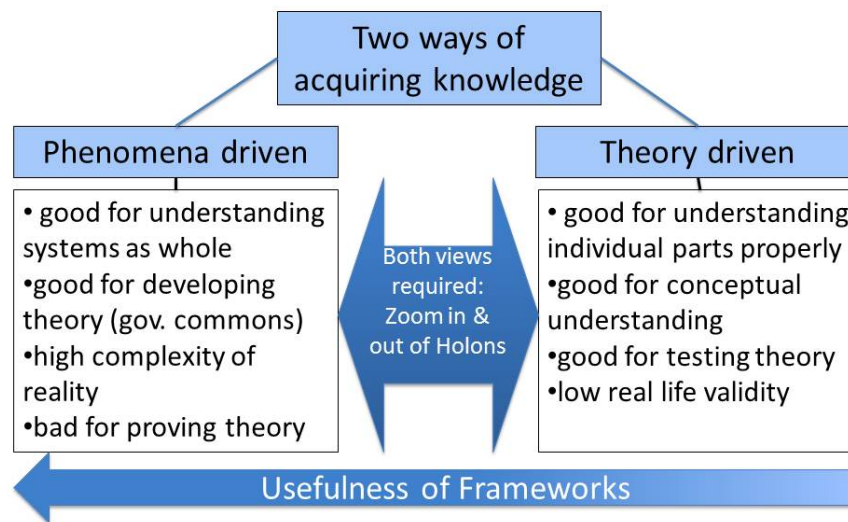


Figure 1: Comparison between two approaches to acquire knowledge

However, the structuring of the empirical situation will allow the empirical situation to be matched with the appropriate theoretical explanation. Both approaches are necessary for improving our understanding. One cannot ask reality-relevant questions without looking at an empirical situation, for example, people who cooperate or do not cooperate. But on the other hand, empirical situations are often so complex that they cannot be understood if they are not anatomized; so that, for example, an individual choice process or a singular issue, such as the role of sanctions, can be analyzed separately. A phenomenon can be understood as a set of interrelated holons and we can look at it at various levels. For a proper understanding, we need to zoom in and zoom out (Ostrom 2005). Depending on the level of diagnosis, a framework for understanding is required to a greater or lesser extent. The more complexity is involved, the more a framework is needed; the more individual processes are separated, the less useful is a framework.

A framework as a structuring device allows us to relate empirical findings to theoretical concepts; in this sense, frameworks have been used to bring more theory into political science.² On the other hand a framework also helps to con-

² In April of 2008 Elinor Ostrom gave a lecture within the Bloomington political science PhD programme—which I (A. Schlüter) attended, where she described impressively the development

nect theoretical approaches, more commonly used in economics, to empirically observable cases. From this perspective the framework plays an important role in bridging the gap between the two disciplines.

It is significant that the main article presenting the SES framework (Ostrom 2007) is called “A diagnostic approach for going beyond panaceas”. Similar to a medical diagnosis (Bromley 2006) and as ‘holistic’ as possible in capturing all important features of a SES, the framework is used to understand a case and where its potential problems might lie. Having diagnosed the particular problems of a particular case, one can use theories—as a specialized doctor can use specialized tools—which represent coagulated knowledge (Hayek) of a discipline. In the SES case, this furthers our understanding, why collective action over a CPR, fails or does not fail (see further below our emphasis on the role of sanctions in the case of Ostional). Obviously, the case can then also be used for a more deductive research approach testing general theories in a particular case.

Elinor Ostrom is one of the most prominent scholars who have used both inductive and deductive approaches for acquiring knowledge explicitly and extensively. “Governing the commons” (Ostrom 1990) was probably the most extensive example of an inductive and empirically driven approach, where a huge number of case studies were coded, enabling the derivation of the design principles for successful management of common pool resources, with the help of a common property regime. Another example of the empirically driven approach is the International Forestry Resources and Institution database, which comprises data from more than 250 different forests around the world, and was constructed in accordance with the Institutional Analysis and Development (IAD) framework (Ostrom and Wertime 2000). On the other hand, we can increase our understanding by starting with rather simple theoretical models and test them in a controlled manner. The experimental economic work of Elinor Ostrom (1994; 2006) is an example of the theory driven approach of knowledge acquisition.

Before presenting the SES framework, we briefly discuss why we have chosen this particular framework. Within economics the use of frameworks is rather uncommon. Frameworks, to be found in economics, are typically derived from (New) Institutional Economics (see, Djankov et al. 2003; Greif 1998 or North et al. 2009), the sub-discipline to which Elinor Ostrom as a political scientist naturally belonged. Reflecting a moment on the question as to why institutions emerge or change, one realizes that a single theory might not be adequate for capturing the different reasons and determinants, and instead a more open framework is required. Comparing other frameworks with the SES framework one realizes that most are following an economic tradition in trying to focus on

of political science during her 50 years lasting academic live. At the beginning of her carrier political science in the US was dominated by purely descriptive efforts. Vincent and Elinor Ostrom (among others) brought more theory to political sciences.

a few dominant and determining factors instead of considering as many as possible factors, like the SES framework does.³

Within political science the use of frameworks is much more common. There is a rich diversity of such frameworks (Schlager 1999; Sabatier 2007). In the case of Ostional it was obvious, though, that we would start our investigation with the help of the SES framework since the research question was clearly about what kind of institutions help to provide successful collective action in the management of common pool resources or more particular in the use of a CPR of an environmental resource.⁴

3. The Framework

The SES-framework is a heuristic for classifying and structuring social-ecological systems. It has been developed on the basis of the IAD framework, which itself had various decades of refinement (Ostrom 2005; Ostrom et al. 1994). An important difference between the IAD and the SES framework is that the latter has been specifically developed for the analysis of social-ecological systems. Therefore, it incorporates tiers, i.e. sets of variables that characterize the ecological dimensions of the system. Ostrom's SES framework attempts to overcome some of the limitations that have been frequently identified in other SES approaches and common-pool resources literature. For example, some scholars argue that the 'resilience community' insufficiently deals with the social aspects of SES (Engle 2011) while others point out that traditional scholarship on common-pool resources has neglected the importance of analyzing the attributes of the resource system (Agrawal 2001).

In accordance with Netting (1981), and possibly as a result of the close collaboration in recent years between Ostrom, her colleagues, and scholars from the Resilience Alliance (Anderies et al. 2004; Berkes et al. 2003), many of whom come from an ecology background, the SES framework assumes that collective action and the management of common pool resources can only be understood if not only the social system, but also the ecological system, are well described and understood. The SES framework is a generic framework, whose first tier

³ North, Wallis and Weingast (2009), for example, focus in their framework about the explanation of the emergence of institutional systems on the role of rents for powerful actors. This results in a reduction of violence and therefore provides a clear benefit to be derived from the emergence of such a system. Djankov et al. (2003), for example, focus with their "Institutional Possibility Frontier" on the continuous, however linear choice between disorder and dictatorship. The SES framework instead builds on a diversity of approaches that tried to understand institutions governing common pool resources. It comprises, for example, more than 30 variables found by Agrawal (2001) in the literature.

⁴ A complementary and somehow competing framework for analysing social ecological systems is provided by the Resilience Alliance (Walter et al. 2002; 2006; Resilience Alliance 2007; 2010). However, its focus is much less on issues of collective action and the role of institutions. This framework is stronger, when it comes to the understanding of the ecosystem and when one is interested particularly in the dynamics of such systems.

comprises 8 different categories (see *figure 2*). A second tier of variables in the framework subdivides these 8 categories into more sub-categories (see *table 1*).

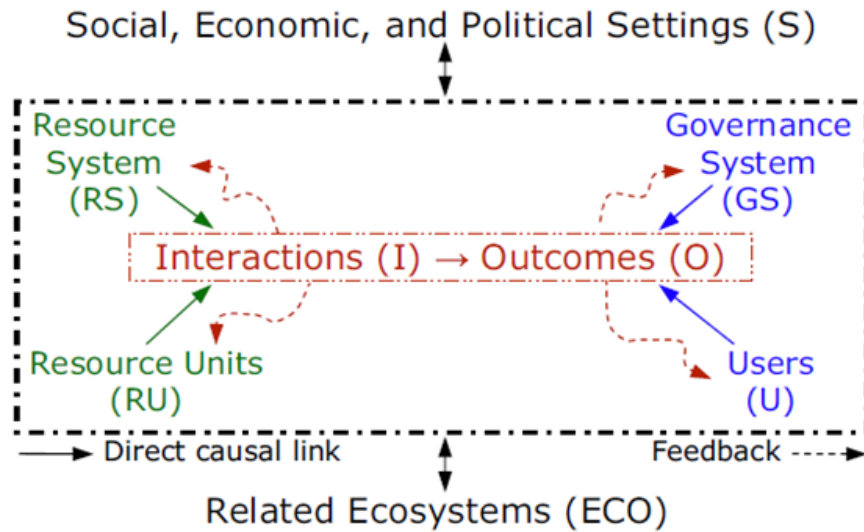


Figure 2: First tier variables of the SES framework (Ostrom 2007)

One of the important motivations for creating the SES framework, was to enable a comparison of the many different case studies that exist and dominate research on common property regimes, not only within one particular type of system (e.g. fishery, irrigation or forestry) but also between the different resource systems (Agrawal 2001; Ostrom 2005; 2007). Accordingly, this generic framework was made to be adaptable to the various ecosystems in which common property regimes exist. Before applying the framework to a new ecosystem, researchers have to consider how it could be adapted in accordance with the characteristics of the ecosystem and the aims of their research. Depending on the goal of the enquiry, certain second tier variables can be additionally subdivided into a third or even a fourth tier (Madrigal et al. 2011). The aim of the framework is not only to be generic in the sense that it can be applied to a variety of ecosystems, but also in relation to the theory required for subsequent explanation. Understanding an SES requires various, sometimes competing theories. The SES framework is ‘open’ to different epistemologies and methodologies. However, looking at a number of second tier variables, one can recognize the theories that have given rise to them. For example, variable GS6 “Collective Choice Rules” relates to Ostrom’s classification (1990), while U7 “Mental Models” might refer to Douglas North (Denzau and North 1994). The SES framework serves as a tool to organize a diagnosis and prescriptive inquiry. It aids in our understanding of configurations of ecosystems and governance systems: “The long term goal for scholars of sustainability science [using the SES

framework] is to recognize which combination of variables tends to lead to relatively sustainable and productive use of particular resource systems.” (Ostrom 2007, 15183)

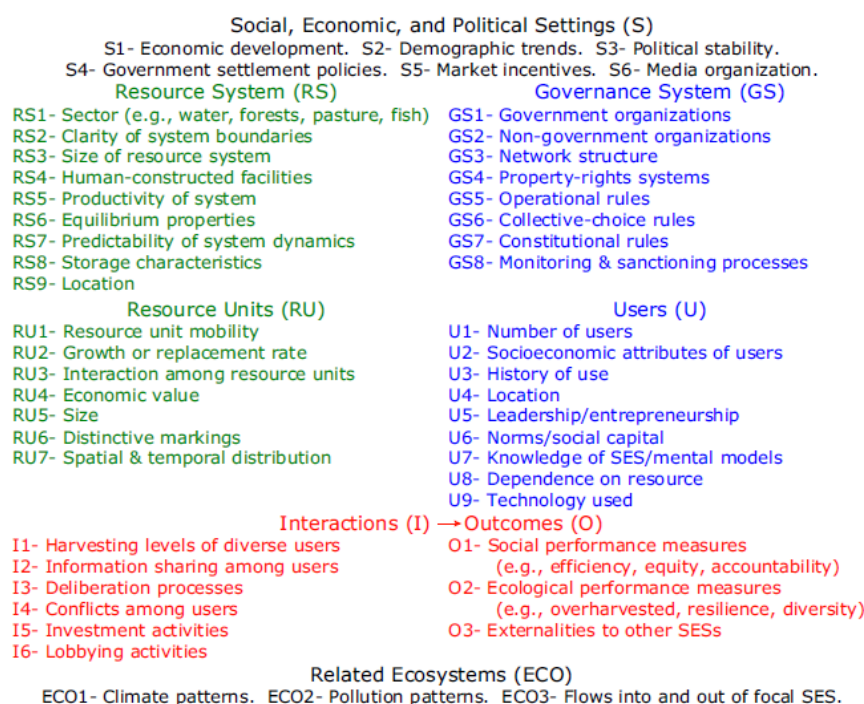


Figure 3: Second tier variables in the SES framework (Ostrom 2007)

4. Site Selection: Ostional

Marine turtles and their eggs represent an important bundle of economic and cultural benefits for different people around the world, in addition to their importance for the health of marine ecosystems and the existence value that the world wide community attaches to them (Troeg and Drews 2004; Campbell 2010). From the institutional perspective, different approaches, ranging from traditional top-down arrangements to community-based alternatives have been employed as strategies to protect and promote their sustainable use. However, some of these alternatives for management are of limited effectiveness, particularly because of difficulties involved in excluding users from marine environments, the limited information available about marine resource dynamics and the inadequate governmental budgets dedicated to the enforcement of regulations (Campbell et al. 2009; Troeg and Drews 2004).

The SES framework was applied to a community organization in Ostional on the Pacific coast of Costa Rica. This community is unique in that it is the only community in the world to have a legal right to extract turtle eggs (see photos below). Ostional is one of the five beaches in Central America where massive landings of olive ridley turtle take place (in certain months up to 100,000 arrive in Ostional within few days).⁵



Figure 4: Members of the community collecting turtle eggs in Ostional, Costa Rica

The community has extracted turtle eggs since its establishment; however this activity became illegal in the 1970s, when the extraction of turtle eggs was prohibited in Costa Rica. After substantial conflicts and campaigning, the local organization succeeded, with the support of biologists of the University of Costa Rica, in getting the right to extract turtle eggs. Extraction by the community association ADIO is approved on condition that a biologist, employed by the association, monitors the sustainability of the harvest, and finally that the state administration approves the biologist's findings. Only eggs laid by the first turtles to arrive on the beach can be extracted, and quotas are determined depending on the number of turtles that land. The collection of eggs in this way leads to increased turtle reproduction, since the first eggs to be laid are usually destroyed by the turtle that arrives next. Removing these eggs prevents this destruction and reduces the risk of bacterial infection. In addition, the community management program also involves beach cleaning activities, which allow turtles to

⁵ For a more detailed description of the case see Campbell et al. 1998; Campbell, Haalboom and Trow 2007; Campbell et al. 2009; Delgadillo 2007; Madrigal et al. 2012.

nest on the entire beach (clearing away sticks and waste increases the nesting space available). There is also a community monitoring program, and members who engage in illegal harvesting are expelled from the organization. Finally, measures are taken to protect hatchlings, so that recently hatched turtles find their way safely to the sea and are not caught by their predators (dogs, birds etc.), while crawling down the beach. The income generated by the organization is roughly US\$ 400,000 per year, of which 70% is divided among its roughly 300 members. For some of the members, the turtle business is their only source of income, but many also obtain incomes from construction, tourism or other business activities. Provided that the state administration approves the management plan submitted by the organization, members are free to create their own rules for organizing this collective action.



Figure 5: Members of the community carrying the eggs from the beach for sale

5. The Use of the Framework

The aim of applying the SES framework was twofold. First, we wanted to see how the generic SES framework could be adapted to the very particular conditions of the marine environment and, even more specifically, the case of turtle egg extraction. This is in line with the aim of improving its usefulness, as well as, widening its applicability to further our understanding of common pool resource use. The second and more immediate objective was to understand the

collective action that takes place in this particular location. The community-led resource management scheme in Ostional is of interest not only in a Costa Rican context, but also for understanding community-led resource management schemes in general.

The first stage of the analysis is a review of literature on Ostional, and on olive ridley turtles and their ecosystem. This allowed us to adapt the SES framework to the particular ecosystem, and to transform the framework into a set of questions, which we could either answer by document analysis or, in most cases, with the help of semi-structured interviews. A team of four—two students of ecology and two economists—spent various weeks in Ostional applying this diagnostic approach. Filling in the SES framework in this way enabled us to identify the key variables for an understanding of the collective action process taking place. We then applied a more theory driven approach to analyzing the variables that the diagnostic had identified as being important in this particular social ecological system.

In the following, we briefly review the different sets of variables within the SES framework in order to demonstrate the usefulness of a broad diagnostic approach. The main objective was to better understand the local collective action being undertaken to use and manage the resource, i.e. the turtles and their eggs. Hence, we highlight the variables that are likely to have a greater effect on the collective action.

The *Resource System* of turtle eggs is particularly complex and still not very well understood (Hamann et al. 2010). This makes collective management rather difficult for a user group. On the one hand, the system boundaries (RS2) seem to be particularly clear in the sense that turtles, like frogs and toads, always return to their place of birth to lay eggs—in our case a beach approximately fourteen kilometers long. On the other hand, olive ridley turtles undertake extensive migrations, reportedly over a range of several thousand kilometers, extending from Peru to the United States. What happens to the turtles over the course of the whole year is entirely outside the influence of the Ostional community. They could, for example, be eaten by people in other communities, or caught accidentally by fishermen; or they could swallow the plastic bags that are lying around on the bottom of the Pacific Ocean. Moreover, from the moment a female turtle is hatched in Ostional, it is between 20 to 25 years before the turtle returns to Ostional to lay eggs, providing feedback to the community that the system is in a sustainable state. The design principles of clear system boundaries and clear association of benefits and costs can never be complied with in the case of turtles, due to the characteristics of their ecosystem and their patterns of reproduction and migration. Hatchling success, rather than population growth, must be taken as an indicator of management success. There are many other uncertainties within the ecosystem (RS7), which make it unpredictable for the users. The phenomenon of massive arrivals first occurred in Ostional in the 1950s; until now no biologist has been able to explain why this started to occur and nobody can predict when it will end. The impacts of climate change are similarly uncertain (Hamann et al. 2010); nevertheless, it is known that the temperature of

the sand determines the gender of the turtle. Therefore, increased temperature associated with climate change has the potential to substantially impact this social ecological system.

In relation to the *resource unit* itself, at least the egg is not mobile (RU1), which makes the management easier, unlike turtles, which are highly mobile.⁶

A particularity of the ecosystem is the massive destruction of turtle eggs (as described above, laid eggs are excavated by newly arrived turtles) that occurs in the absence of human intervention. This allows a proportion of the stock to be harvested without endangering sustainability. The economic value of the eggs (RU4) seems to be in constant decline, and this will probably decrease incentives to overexploit the resource in decades to come. The culture of eating turtle eggs that exists in Central America is apparently being lost in the younger generation.

In relation to the *governance system*, the analysis of the operational, collective choice and constitutional rules (GS5, GS6, GS7) of the social-ecological system was particularly revealing. Over the past thirty years, the rules of these different levels have changed. An evolutionary process has taken place, leading to institutional learning, which has helped adapt the regulatory framework to the changing conditions.⁷

The changes have broadly followed those foreseen in the design principles (Ostrom 1990). For example, clear membership rules have emerged, solving the problem of new entrants, which existed in the past. Monitoring rules have been adapted various times, in accordance with needs and circumstances. The distribution rules have changed, giving free allocation of a quota to old people, without requiring that they contribute to the harvesting effort. The basic principle of income distribution, however, has not changed. That is, every member gets an equal share of income from the sale of turtle eggs. The income provided from the turtle eggs is perceived as a kind of natural 'rent', payable to community members. Obviously, this distribution rule does not give any direct monetary incentive for members to contribute to the collective extraction of the turtle eggs. The community was therefore obliged to introduce severe monetary sanctions for those who did not contribute to the collective good by participating in cleaning the beach, collecting and packing the eggs and hatchling protection. The system of punishment (GS8) has evolved in such a way that non-contribution can in extreme cases lead to a complete loss of benefits from egg extraction or even, as has repeatedly occurred, to expulsion from the organization⁸

According to the literature on collective action, a clear monitoring, sanctioning, and enforcement system is a prerequisite for successful collective action

⁶ In other contexts where people consume the turtles instead of eggs, the resource units are the turtles.

⁷ The development of the formal and informal institutions governing ADIO has been analyzed using the constitution, by-laws and other documents, as well as many interviews.

⁸ Contributions are closely monitored by the group. Deductions from the income are made for any non-contribution (e.g. being five minutes late). If somebody does not contribute to six collective events, the person is expelled from the organization. Sanctions seem to be well enforced. The entire system is described in detail in Madrigal et al. 2012.

(Baland and Platteau 2000; Ostrom 1990). At first glance, such a system seems to have been established in Ostional. Still, the leaders of the association are complaining about decreasing willingness within the community to contribute to the collective good.

This diagnosis led us to investigate this crucial point in more detail, and to consult competing theories in the literature on rule compliance and sanctioning. We added to our diagnostic explorative approach, a more theory-driven and standardized analysis to investigate this particular holon of the social ecological system in more detail. Specifically we examined monitoring and sanctioning practices, as well as the reasons for rule compliance (Madrigal et al. 2012). The results suggest that individual dependence on the income from the sale of eggs, perceptions of rules and their legitimacy, and demographic factors such as age and gender are all important in explaining variations among individual contributions to the collective good.

The analysis of the *users* showed that there is huge heterogeneity in users' dependence (U8) on income from the sale of eggs.⁹

To a large degree, this heterogeneity explains differences among individual contributions to the collective good. Those who are dependent on the resource contribute a lot, while those who are not, contribute much less. However, this economic view explains only part of the behavior. There seem to be clear differences in internalized norms (U6), depending on age and the family ties that individuals have. In general, the older generation, which lived through the battles to get formal property rights to the resource, contribute more than the younger generation, who only understand the conflict through stories told by their parents and grandparents. When collective management of the resource started, norms and informal institutions, supported by delta parameters (intrinsic motivation and social pressure only (Crawford and Ostrom 1995; Schlüter and Theesfeld 2010)), were sufficient to ensure cooperation. However, over time, these institutions have had to be backed up by more formalized sanctions, written into the operational rules. The difference in behavior between generations is also confirmed by analyzing the different mental models of people belonging to the different generations (U3, U7). The stories, the importance accorded to the resource, and the environmental awareness of the old and the young generation are all markedly different.

The analysis of *interactions* between the different actors (I4) is crucial. It is important to understand the information flows, the conflicts that exist and the conflict resolution mechanisms in place to resolve them. Despite the legal acceptance that the community organization of Ostional is allowed to extract turtle eggs, there are substantial conflicts between the local office of the ministry of the environment MINAET and the community organization ADIO. In the first place, there is a huge discrepancy of opinions on who holds or should hold the principal property rights over the turtle resource in Ostional, who has the authority for governance. The government agency sees the resource as a national heritage, in

⁹ The data supporting the claims of this paragraph are provided in Madrigal et al. 2012.

which society at large has a vested interest. Thus, a state agency should regulate the resource. The community organization in Ostional sees the resource as a local heritage, one, that over the last decades, the local community has proven its ability to manage sustainably. As their livelihoods depend on the resource, they have also the right to determine the rules and regulations. In addition to the disagreement about who regulates the resource, there is also competition over the resource itself. The government agency does not want to extract turtle eggs itself; however it is interested in exploring the touristic value of the resource. It is offering a huge volunteer program, which is crucial for income generation of the agency. To a certain extent, the extractive use of the turtles is perceived as being in conflict with the non-consumptive, touristic use. This conflict also extends to the neighboring communities (mainly Nosara), which are dominated by foreign owners, mainly interested in an eco-touristic development of the area.

Related social and ecological systems are also considered to be important, as they provide the community with alternative sources of income, in addition to those derived from turtle egg extraction. However, many of those variables had already been assessed in related sets of (ecological or social system) variables.

The analysis of the *outcomes* relied mainly on secondary data, i.e. the results of analyses by biologists who have studied the case of Ostional (e.g. Chávez et al. 2004). The reason why Ostional was selected as a study site is because of its community-led governance scheme for the extraction of turtle eggs. Furthermore, it has now been running for more than thirty years, and has been judged to be ecologically sustainable since its inception. We also had the opportunity to assess the income generated by the scheme, and the importance this has for its members. However, it proved very difficult to assess this outcome. The sale of eggs still provides a lot of income, and despite its decreasing relative importance in recent years, many members affirm their continued commitment to the association. This could be construed as a positive social outcome. However, while most members would prefer to continue to focus on the core business of egg extraction, some consider that moving into the turtle tourism business would generate greater benefits for the community. This difficult question is currently the subject of intense debate in Ostional. Our preliminary diagnosis following the application of the SES framework was that the community organization in Ostional has a serious problem due to declining commitment to collective action. We therefore suggest that further research should investigate the effects of the institutionalization of sanctions, the changing economic conditions (opportunity costs) affecting the members, and the different mental models and resulting norms of the various groups within the organization.

6. Discussion

What did we learn from applying the SES framework? What were the advantages and disadvantages of using the framework? The SES framework forces

one to produce a holistic picture of a case. It was developed to be applied across a range of different ecological systems. Therefore, in applying it, we felt confident that no aspect, which potentially could have influenced the outcome of collective action in the use of natural resources, could have been omitted. From this perspective, the SES framework might discourage researchers from looking for quick fixes and focusing too quickly on the explanatory variables which they are already familiar with (e.g. market conditions). The framework forces a researcher to look at a very broad range of possible influential variables. This in itself is an important achievement, responding to one of the key lessons identified by the Bloomington school, that there are definitely no blueprints and panaceas for successful collective action (Ostrom 2007). Simply asking such a broad range of questions relating to topics ranging from ecology to various social sciences creates an open mind for the analysis. However, at least in this case, we felt constrained by the limits to possible intrapersonal interdisciplinarity (Schlüter 2010). The ecosystem we observed is complex, and the way in which the economists in charge of the investigation asked questions might have failed to identify key ecological features which determine management success. It is both notable and unsurprising that the results of our diagnosis focus mainly on social and not ecological factors.¹⁰

Collecting data covering all the various variables mentioned in the framework was very time consuming and a lot of this data was not used for further analysis, as during the process it was identified as being irrelevant to the case in question. Accumulating data that are not immediately relevant for the purpose of analysis might not be so problematic, since using the SES framework should ensure that the information is collected in a systematic way and can subsequently be used for larger comparative N studies (Agrawal 2001; Poteete et al. 2010; Poteete and Ostrom 2008). For example, data collected for the IFRI (International Forestry Resources and Institutions) project was used in this way (Agrawal et al. 2008). However, in this case, the initial diagnosis was mainly based on qualitative data (Schlüter 2010), whose use for comparative analysis is particularly difficult and time consuming.

The issues gathered under a particular variable of the SES framework for analysis of turtle egg extraction in Ostional are very case-specific and might only be comparable with other cases about turtle extraction. Comparisons with other resource extraction systems might be problematic. To enable such comparisons would require a much more standardized framework, using a closed interview format to collect information about, for example, group characteristics, similar to data collection by the IFPRI project. Such a standardized investigative procedure would reduce the openness of the framework and would also detract from the intrinsic interest of the researcher, who approaches each case

¹⁰ There is another obvious factor, which will always lead to a focus on social aspects when analyzing collective action by users of environmental resources. While the ecological factors influence the outcomes of collective action, they are normally not action parameter, but have to be taken as given, therefore cannot be used to formulate policy recommendations, which is obviously the ultimate goal of such an analysis.

with a particular research question and interest in mind. During the course of our analysis we quite quickly lost interest in certain variables of the SES framework, as it became obvious that they were of no relevance to the particular case. Third, fourth, and fifth-tier variables were relevant only as subcomponents of a second-tier variable posited to affect interactions and outcomes. This selectivity hinders comparison with other cases, as no information on the variables not considered is available for subsequent comparative analysis.

During the coding process, we realized that it is often ambiguous under which variable particular information should be coded. For example, should information on the income level of the household be coded under U2 "Socioeconomic attributes of users" or should it rather be coded under U8 "Dependence on resource". Another example of ambiguity is between RS5 "Productivity of the system" and RU2, which asks about the growth and replacement rate. If the SES framework is used for a diagnosis of an individual case, it does not matter where and when the information is gathered or stored. However, if the purpose of the exercise is to produce comparable data, then one needs to ensure inter-coder reliability (which could be achieved by means of a code book for the SES framework). Similarly, there are no detailed instructions for the measurement of variables, which would be necessary to achieve the degree of standardization required for comparison of results for the same variable between different social ecological settings.

What can we learn from the application of the SES framework to this case, about the co-evolution of political sciences and economics that Ostrom draws attention to in the introductory paper to this special issue? Public Choice Theory and New Institutional Economics have pointed out that there are governance mechanisms that lie far beyond the market and classical state provisioning, which deserve to be studied and analyzed in depth. Those hybrid forms are heterogeneous and very diverse, and fitted to the particular circumstances. The co- or community management regime in Ostional is such a case worthy of study. The SES framework as an analytical tool is broad enough to capture and to structure such an empirical diversity. Due to its theoretical openness, it allows not only interpretations which consider human beings only as, for example, *Homo economicus*, or slightly more broadly as rational (in the economic sense) individuals. But the framework itself allows for a broader understanding of rationality, and gives a huge role to mental models, norms, intrinsic motivations, and other aspects guiding people's decisions when interacting with a social-ecological system. The structure of the SES framework enables it to relate empirical data to experimental and abstract data from behavioral economics. The concrete empirical example observed in Ostional shows that human beings deviate from standard assumptions of behavior within economics (for example, an increase in sanctions for not cooperating did not lead to increased cooperation, but seem to have crowded out pro-social behavior (Frey and Oberholzer-Gee 1997)). It also shows that the conclusions drawn by Gordon (1954) and Hardin (1968) on the tragedy of the commons were too hasty, and that a more differentiated view is necessary. The SES framework was able to shed light on the subtle

reasons as to why this particular community is not trapped in the tragedy of the commons, without turning a blind eye to the constant potential risk that collective action within a community will fail.

7. Conclusion

The main question raised by Elinor Ostrom in her paper, special issue, is about the mutual fructification of political sciences and economics and vice versa. Referring to Herbert Simon (1999), she uses the picture of gifts brought to a joint potlatch. Her main emphasis is on gifts brought by economists to political scientists (Public Choice Theory, New Institutional Economics). By contrast, this paper reports on a gift, namely, the Social-Ecological Systems framework, which political scientists have brought to economists (the authors of the paper), and which have aided our understanding, the Coaseian question, of why and how people organize economic production and exchange (in this case turtle eggs) beyond the market. It shows how multiple methods and multiple epistemologies are crucial for understanding the use, not only of common pool resources (Poteete, et al. 2010), but also, more broadly, of all economic resources. Economics has made an important contribution to political sciences by emphasizing the need for deductive, theory driven, and quantitative research. The SES framework and its application in Ostional show the extent to which an approach, starting from the opposite vantage point, which tries to do justice to the complexity of real world phenomenon and adopts a less reductionist view, can substantially improve our understanding of economic processes. Such a perspective, which is a heritage of political science, has hardly ever been taken by main stream economists. However, it should be taken and seen as a nice and fruitful gift.

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