Institutions and Environmental Change:
The Scientific Legacy of a Decade of IDGEC Research

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1. Introduction

How does our current thinking about the institutional dimensions of environmental change differ from the way we thought about this subject a decade ago (Young et al. 1999b)? Can we make scientifically valid claims about conditions that determine the success of environmental and resource regimes? What insights can we derive from this effort that will prove helpful to policymakers responsible for creating such arrangements dealing with the most pressing environmental problems of our times (e.g. the impacts of climate change, the accelerating loss of biological diversity, the depletion of marine living resources)? Can we offer practical advice to those responsible for administering environmental governance systems once they are put in place? Has recent research in this field helped us to formulate new cutting-edge questions?

This volume addresses these questions through an assessment of the scientific contributions of the long-term, international research project on the Institutional Dimensions of Global Environmental Change (IDGEC). In the process, it seeks to distill and to assess critically the project's legacy in a manner accessible to a variety of audiences. Individual chapters evaluate the contributions of the project both to generic issues relating to governance systems and to issues that are more specific to environmental governance. Separate chapters explore the policy relevance of research carried out under the auspices of the project and consider cutting-edge questions that will be of interest to researchers working in this field in the coming years. Uncertainty remains a prominent feature of our knowledge regarding the institutional dimensions of largescale environmental change; there is no shortage of priority topics for future research in this field. But we will endeavor to demonstrate in this volume that the work of members of the IDGEC community together with that of many others engaged in related research is advancing our knowledge regarding the institutional dimensions of environmental change substantially.

IDGEC is one of the original core projects of the International Human Dimensions Programme on Global Environmental Change (IHDP); the project's history is more or less coterminous with that of IHDP itself. The Scientific Committee (SC) of the then Human Dimensions Programme (HDP) authorized a feasibility study for a potential project on institutional issues at its final meeting in September 1995. The process of developing what became the IDGEC Science Plan featured a number of phases including a rigorous review process mandated by IHDP, which replaced the HDP in 1996. The Scientific Committee of IHDP formally approved the Science Plan in November 1998, and the project hit the ground running with the appointment of a Scientific Steering Committee (SSC), the inaugural meeting of this committee, and the establishment of an International Project Office all taking place during the first half of 1999.

Like other global change research projects, IDGEC has passed through a well-defined lifecycle lasting approximately 10 years. Now we are engaged in a synthesis process designed to capture the

scientific legacy of the project, to explore the policy relevance of IDGEC science, and to evaluate future directions in research on the institutional dimensions of largescale environmental changes. Apart from the project on Land-Use and Land-Cover Change (LUCC), which was already underway when IHDP came into existence and which was sponsored from the outset jointly with the International Geosphere-Biosphere Programme (IGBP), IDGEC is the first IHDP core project to pass through a focused and comprehensive synthesis process. The results will therefore be of interest to all members of the IHDP community and to members of the broader global change research community as well as those whose primary interests concern the institutional dimensions of environmental changes.

IDGEC operates within the milieu of the "new institutionalism" in the social sciences, treating institutions as set of rights, rules, and decisionmaking procedures that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of these roles (North 1990; Young 1999b). Looked at in this way, institutions are not only important in efforts to solve problems; they also can play a role in the onset and impact of environmental problems. The "tragedy of the commons," for instance, is basically a story about missing or inappropriate rights and rules governing the actions of users of renewable but depletable resources (G. Hardin 1968). Most proposals for avoiding or overcoming this problem focus on introducing changes in prevailing rights and rules, whether they prescribe a transition to private property, a shift to public property, or the development of some form of restricted common property (Baden and Noonan 1998; Ostrom et al. 2002). These are precisely the sorts of issues that lie at the heart of the project's research agenda. When and how do prevailing institutional arrangements influence the incentives of subjects in such a way as to give them reasons to behave in a manner that is unsustainable, whether this takes the form of depleting renewable resources (e.g. stocks of fish or mammals) or emitting pollutants (e.g. sulfur dioxide or greenhouse gases) into the Earth's atmosphere. Under what circumstances can institutional reform solve or alleviate these problems – or even prevent them from occurring in the first place – and what are the prospects for initiating such reforms and implementing them successfully (Young 1999b)?

The goal of this chapter is to introduce readers to the world of IDGEC science and to set the stage for the substantive chapters to come by introducing the overall character of the project and touching lightly on some of its major findings. The first section, entitled *Starting Points*, situates the work of the project within the new institutionalism, identifies overarching issues regarding the roles that institutions play, and relates the project's scientific agenda to the concerns of the wider global change research community. The next section, called *Institutional Discourses,* focuses on contributions that take the form of innovative ways to organize our thinking about governance and to frame more specific questions of interest to scientists and, in many cases, to members of the policy community as well. The following section turns to the project's *Research Foci*. The emphasis here is on issues of interest to all students of

institutions – the questions of causality, performance, and design – as they arise in the particular setting of environmental change. A section on the project's *Analytic Themes* – the problems of fit, interplay, and scale – follows. Unlike the research foci, which are generic concerns within the new institutionalism, this section deals with a set of issues that are more specific to the global environmental change agenda. The next section addresses *Methodological Matters* as they arise in the study of environmental institutions. All research on social institutions must confront serious methodological challenges owing to the fact that institutions are socially constructed. IDGEC is no exception to this proposition. The penultimate substantive section turns to matters of *Policy Relevance*; it addresses the results of IDGEC science from the vantage point of a broad perspective on the two-way interactions between science and policy with particular reference to environmental change. The final substantive section identifies *Cutting-edge Themes and Topics* brought into focus by the work carried out under the auspices of the project and offers some suggestions about the next phase of research on institutional issues relating to global change. A brief section on the *Plan of the Book* brings the chapter to a close. All the substantive topics introduced in this chapter are examined in greater depth in the chapters that follow.

2. Starting Points

We have sought from the outset to set our work on the institutional dimensions of environmental change into a broader research program of interest to social scientists. This effort has led to conceptual, methodological, and substantive choices that define the overarching character of this research program.

2.1 The New Institutionalism. Although IDGEC deals with the roles that institutions play regarding *environmental change,* the project has sought from the outset to ground its work in the broader stream of analysis known as the *new institutionalism* in the social sciences, to take advantage of this movement's intellectual capital in formulating its research agenda, and to bring its findings to the attention of those who are interested in institutional issues more generally. To take a single prominent example, the project shares with the new institutionalism a strong interest in what are known as collective-action problems or situations in which seemingly rational choices on the part of individual members of a group lead to societal results that are undesirable from the perspective of all the members of the group (Schelling 1978; R. Hardin 1982). We have known for some time, for instance, that the tragedy of the commons exhibits the defining features of what is known to those who analyze collective-action problems as the prisoner's dilemma (Ostrom 1990). It is apparent as well that efforts to address many environmental problems involve the supply of collective goods and, as a result, often give rise to what is known as the free-rider problem (Olson 1965). Under the circumstances, it makes sense to think about the

creation of institutional arrangements designed to solve or alleviate environmental problems as exercises in overcoming collective-action problems.

The new institutionalism has become influential throughout the social sciences and in law. An interest in institutions treated as clusters of rights, rules, and decisionmaking procedures constitutes the glue that holds those who work in this realm together and gives this movement a distinctive personality that is well-known not only to practitioners of the new institutionalism but also to the movement's critics. As one would expect from such a wide-ranging movement, however, the new institutionalism encompasses a number of analytic strands that are quite distinct (Rutherford 1994; Scott 1995). Research on environmental institutions has taken a particular interest in two of these strands which we call the *collective-action perspective* and the *social-practices perspective* on the nature and role of institutions (Young 2002a).

It will come as no surprise that the collective-action perspective is the better known of the two. This perspective assumes that individuals have preferences that pre-date and are exogenous to their membership in groups, that they act on the basis of utilitarian calculations, and that they endeavor to maximize payoffs to themselves as individuals. Institutions form through a process – explicit or implicit – of developing social contracts. The prisoner's dilemma, the free-rider problem, and, more generally, problems of burden sharing and compliance loom as critical concerns among those who think in this way (Barrett 2002). The social-practices perspective, by contrast, assumes that the identities of individuals are shaped in part by group membership, that actors are influenced by what is known as the logic of appropriateness in contrast to the logic of consequences, and that compliance with institutional rights and rules often becomes a matter of second nature or habit (March and Olsen 1998; Hart 1962). Not surprisingly, economists and many political scientists are attracted to the collective-action perspective, whereas sociologists and many anthropologists find the social-practice perspective more appealing.

The collective-action and social-practices perspectives existed prior to the initiation of our research. During the course of our work, a third perspective on the links between institutions and environmental change has emerged. Less crisply articulated than the preexisting perspectives, this way of thinking, which we would characterize as the *knowledge-action perspective*, stresses agency, leadership, and the role of governance systems in shaping how we think about environmental problems (Breitmeier, Young, and Zürn 2006). Knowledge brokers play particularly prominent roles in this perspective (Litfin 1994). So do power brokers or those who have the ability to move issues to the top of the policy agenda and to make sure that they do not get relegated to the backwater of the policy process. We expect future research in this realm will make a concerted effort to enhance our understanding of this perspective.

A hallmark of our research program is an effort to marry – or at least to deploy in tandem – the three perspectives to analyze the roles that institutions play both in causing and in addressing

environmental problems. Difficulties in (re)forming institutions, for instance, can be attributed both to the transaction costs associated with institutional bargaining and to the stickiness of institutions once they are firmly entrenched and embedded in the thought processes or standard operating procedures of actors as a matter of second nature. Compliance with sets of rights and rules can be explained both in terms of calculations regarding the costs of non-compliance and in terms of the influence of socialization or the habit of obedience. Sluggishness in responding to major environmental problems may reflect either opposition on the part of influential interest groups or the absence of clear characterizations of the problems and the champions needed to make sure they are not ignored. We are not in a position at this point to merge the three perspectives fully to create a single, overarching theory of environmental institutions. But researchers studying these institutions regularly make use of all three perspectives, often in efforts to explain the success or failure of specific institutional arrangements (e.g. the successful ozone regime as articulated in the Vienna Convention of 1985 and the Montreal Protocol of 1987 as amended in contrast to the limp climate regime embedded in the 1992 UN Framework Convention on Climate Change [UNFCCC] and the Kyoto Protocol of 1997 as operationalized in the subsequent Marrakech Accords).

2.2 Complex causality. A second and clearly related concern has to do with the roles that institutions play as determinants of societal outcomes. Mirroring broader perspectives in the social sciences, many observers approach this issue in terms of the idea of causal chains and draw a distinction between what are typically called underlying factors and proximate factors or intervening variables. From this perspective, the underlying forces in human affairs are factors like population growth, increases in affluence and shifts in consumption patterns associated with affluence, and the emergence of new technologies. Those who think in these terms typically treat institutions as intervening variables in the sense that they influence the impact of underlying forces but are not such forces themselves (Krasner 1983). Thus, institutions may play some role in channeling or guiding demographic forces or patterns of consumption and therefore steering interactions among the members of societies. But they do not account for the nature and causal impact of the underlying forces.

From a methodological point of view, this perspective actually makes life easier for students of institutions. As researchers have discovered time and again, the most recent links in causal chains are easier to identify and analyze rigorously than links located farther back in these chains. Clues regarding causal connections grow cold quickly as we move backward from one link in the causal chain to another. By contrast, it is often comparatively easy to identify the links in such chains located closest to outcomes of interest to the analyst. To take a single example, it is easy to see the causal connection between the 1987 Montreal Protocol and the title of the US Clean Air Act Amendments (CAAA) of 1990 dealing with

the implementation of the Montreal Protocol. It is far more challenging to probe the economic and political sources leading to adoption of the Clean Air Act Amendments themselves (Bryner 1995).

At the same time, research on environmental institutions has raised profound questions about the usefulness of the simple view of causal chains outlined in the preceding paragraphs (Young 2002b; Lambin and Geist 2006; Young, Lambin et al. 2006). Systems of rights and rules (e.g. arrangements regarding taxes and subsidies) can and often do serve to guide the choices individual subjects make regarding consumption. The operation of rules dealing with patents and copyrights can influence substantially the incentives of those endeavoring to develop new technologies. Even demographic trends are influenced by prevailing rights and rules. Compare China with its one child per family rule, for instance, with India that has no such rule in place at this time. Restrictive rules regarding family size not only affect overall trends in population – India will soon surpass China as the world's most populous country – they also affect things like the sex ratio of children added to the population.

What can we conclude from these observations? Institutions certainly can operate as proximate forces. Arguably, this is an appropriate way to think about the arrangements set up to curb emissions of greenhouse gases or to preserve stocks of fish that move in and out of the jurisdictions of a number of coastal states. But institutions can also operate as underlying forces. One important inference to be drawn from this account is that it often makes better sense to think in terms of causal clusters than in terms of causal chains. Systems of land tenure, for instance, interact both with patterns of social stratification and with biophysical forces like patterns of rainfall and soil types to produce changes in land use and land cover over time (Lambin and Geist 2006). Emissions trading schemes interact with broader investment opportunities, tax policies, and technological advances to determine the results of efforts to use incentive mechanisms to curb greenhouse gas emissions.

Causal clusters made up of a number of interacting variables are difficult to analyze, a point to which we will return later. Yet the shift from causal chains to causal clusters has major implications for how we think about the roles that institutions play in steering societies toward desirable outcomes and away from harmful outcomes. A focus on causal chains leading from deep structure to intervening variables and on to outcomes is perfectly appropriate in some settings. But in analyzing the institutional dimensions of environmental change, we will regularly find ourselves seeking to sort out the various elements of causal clusters and, more often than not, analyzing the impacts of these clusters as composite drivers rather than engaging in frustrating attempts to assign weights to individual elements in these clusters as determinants of collective outcomes. One important consequence is that it is often helpful to employ the idea of complex systems to the study of institutions and to approach outcomes in terms of the concept of emergent properties.

2.3 Crosscutting applications. A third starting point centers on the observation that social institutions constitute a crosscutting theme in research on various forms of environmental change. Most projects launched under the auspices of the global environmental change research programs – the World Climate Research Programme (WCRP) and Diversitas as well as IGBP and IHDP – focus on more or less bounded issues. These include matters like industrial transformation, urbanization, coastal zone processes, the carbon cycle, and food systems. They strive to bring an extensive collection of tools to bear in efforts to enhance our understanding of matters like transitions from industrial to postindustrial societies, the extraordinary growth of cities during the 20th century, or changes in the concentration of greenhouse gases in the Earth's atmosphere. By contrast, researchers analyzing institutions seek to understand the roles that institutions play in all these realms. How do rules affecting the use of the atmosphere as a repository for wastes or residuals resulting from the burning of fossil fuels affect rates of emissions of greenhouse gases? How do systems of taxes and subsidies influence decisions about investments that have consequences for the introduction of new technologies or the development of new products involved in the transition from industrial to postindustrial society? Can the creation of quasi-markets help to control greenhouse gas emissions and avoid severe depletions of living marine resources? In each of these cases, will the results be favorable from the perspective of various conceptions of fairness or equity?

The crosscutting nature of the role of institutions is both an opportunity and a potential pitfall for analysts interested in environmental institutions. It has produced no end of requests for collaboration with those associated with other projects, whether they involve issues relating to the allocation of carbon allowances, the development of entry barriers designed to conserve fish stocks, the protection of coastal wetlands and mangrove forests, or the degradation of dryland ecosystems. At the same time, researchers studying environmental institutions are acutely aware that the pursuit of many issues of interest to other global change projects could easily become a diversion with regard to research on environmental institutions per se. The need to establish priorities does not preclude mutually beneficial collaboration between those focusing on institutions and those concerned with climate change, the loss of biological diversity, the allocation of freshwater to different uses, and so forth. But it does set up a tension within the global change research community that is worth considering carefully and reflecting on regularly.

In the case of IDGEC, a decision made at the first meeting of the project's Scientific Steering Committee in 1999 has had long-term consequences regarding collaboration with other projects. To provide empirical grounding for studies of a wide range of institutional issues, the SSC created three flagship activities known respectively as the Political Economy of Forests (PEF) (Contreras, Lebel, and Pasong 2001), the Performance of Exclusive Economic Zones (PEEZ) (Hoel 2000), and the Carbon Management Research Activity (CMRA) (Sewell et al. 2000). These activities have turned out to be useful, especially in efforts to address questions of causality, performance, and design, and we will have

more to say about them in a later section of this chapter (Young 2003b). Still, it is only fair to observe that the existence of the flagship activities has constrained interactions with other global environmental change research projects. Built-in sources of rich empirical materials dealing with terrestrial, marine, and atmospheric systems have weakened incentives to go further afield in search of interesting applications than would have been the case in the absence of the flagship activities.

3. Institutional Discourses

One of the most far-reaching and powerful contributions a body of scientific work can make arises from it role in structuring our mental maps and framing the questions we ask in contrast to providing answers to individual questions (Kuhn 1962). The rise of the Keynesian approach to fiscal policy growing out of the experiences of the Great Depression and its subsequent displacement by an approach placing greater emphasis on monetary policy is a well-known case in point. With respect to the environment, both the rise of interest in incentive systems in contrast to command-and-control regulations as a means of channeling behavior and the shift from a focus on deriving sustainable yields from discrete populations or stocks of living resources to the idea of ecosystem-based management have changed our ways of thinking about human-environment interactions profoundly.

The emergence of a stream of research rooted in the new institutionalism and centered on the idea of environmental governance constitutes another major shift in discourse among those working on human-environment relations. The rise of a new discourse is a complex process involving both perceptions and judgments regarding probable payoffs. Assessments of the roles that specific actors play in this process are notoriously subjective. Nonetheless, paradigmatic change is an important part of the legacy of recent work on the institutional dimensions of environmental change. As a result, it is worth describing this development in some detail and paying careful attention to the conceptual building blocks that serve to fix IDGEC's place in the resultant discourse regarding governance.

3.1 Institutions vs. organization. To start with, IDGEC follows the new institutionalism in drawing a clear distinction between *institutions* treated as clusters of rights, rules, and decisionmaking procedures that give rise to social practices and *organizations* construed as material entities that have personnel, offices, equipment, financial resources, and (often) legal personality (Young 1989; North 1990; Young 1994). The political system set up under the terms of the American constitution with its emphasis on federalism together with checks and balances is an institution; the US Congress is a large and highly complex organization whose purpose is to select policies through a legislative process spelled out in the constitution and to ensure that these policies are properly implemented. The world market for oil is an institution; British Petroleum, Royal Dutch Shell, and ExxonMobil are all organizations formed to take

advantage of opportunities for producing, refining, and marketing petroleum products through the operation of this market. For shorthand purposes, we often say that institutions are the rules of the game and that organizations are the players in these institutions.

The introduction of a distinction between institutions and organizations is not meant to downgrade the importance of understanding organizations. Not only are organizations the key players in many institutions. But also, as the example of the US Government in the preceding paragraph suggests, organizations can and often do become important as bodies responsible for administering the rights, rules, and decisionmaking procedures that constitute the defining features of institutions. In this light, the new institutionalism highlights the relationships between institutions and organizations as a prominent topic for research. Studies of smallscale, traditional societies have made it clear that the establishment of organizations is not a necessary condition for the creation and operation of effective institutions. Many smallscale societies, for instance, have developed sophisticated arrangements governing the appropriation of living resources and competing uses of land without creating a government in the conventional sense to administer these arrangements (Ellickson 1991; Ostrom et al. 2002). Nor is the creation of organizations sufficient to ensure that institutions will be implemented efficiently and fairly in more complex social settings. The world is full of failed states along with organizations that greedy leaders have established and operated largely as vehicles for acquiring power and wealth for themselves. Nonetheless, the link between institutions and organizations is an important one.

3.2 Governance vs. government. Institutions arise in many settings and play a wide variety of roles. When institutions emerge in response to a demand for steering mechanisms to guide societies toward outcomes that are collectively beneficial and away from outcomes that are harmful they become elements of *governance systems*.[2] IDGEC belongs to a broad stream of research concerned with conditions that determine the success or failure of governance systems in a variety of settings and with the unintended consequences or social costs of arrangements designed to solve specific problems. The development of thinking about governance – in contrast to government – has become a growth industry among those interested in a wide range of issue areas. Several of those who crafted the IDGEC Science Plan were influenced by the emerging discourse on governance before assuming their roles in the project (Young 1994); many scholars having no affiliation with the project have played influential roles in the development of the discourse on governance (Rosenau and Czempiel 1992; Kooiman 2003) in recent years. Yet it is helpful to place the work of the project in an intellectual setting featuring the emergence of new thinking about governance treated as a social function. Environmental issues have triggered some of

[2] . This does not mean that governance systems are always successful. Both success and failure are common in this realm, and systems that become corrupt or generate severe social costs are common.

the most innovative experiments with new forms of governance over several decades (von Moltke 1997; Young 1997). The project has enjoyed the good fortune, under the circumstances, of operating within a vibrant intellectual setting.

A recent development, stimulated in part by work carried out under the auspices of IDGEC, seeks to clarify the relationship between institutions and governance. Institutions play critical roles in meeting the demand for governance treated as a social function, but they are not the only factors that contribute to the supply of governance in most settings. Thus, belief systems, norms, culture, and a sense of community typically operate alongside institutions as mechanisms guiding the behavior of actors toward collectively desirable outcomes and away from social traps. This is not to downplay the roles that institutions play; they are necessary to the supply of governance. Yet the performance of institutions is conditioned by the character of the socio-cultural environment in which they operate. To take a single example, the presence of a broader culture of compliance can alleviate or even eliminate the need to build elaborate compliance mechanisms into institutions created to address specific problems. It follows that efforts to design effective governance systems must pay attention to the fit between institutional arrangements and the principal features of the relevant socio-cultural setting.

3.3 Resource and environmental regimes. Although governance systems come in many forms, researchers working in this field have found it useful to draw a distinction between broad, overarching arrangements designed to address a wide range of substantive issues and issue-specific arrangements focusing on a particular issue area and often created to address a particular problem. The US constitution, the UN Charter, and the Law of the Sea Convention are all examples of broad constitutive arrangements; they provide mechanisms for arriving at collective choices about all sorts of issues. The international arrangement created to protect stratospheric ozone, the procedures established under the terms of the US Fishery Conservation and Management Act (FCMA) as amended, and informal practices that arise to handle disputes between neighboring landowners, by contrast, are all specific governance systems (Ellickson 1991; Parson 2003; Young 1982). IDGEC has adopted the usage of those who employ the term *regime* to refer to the large universe of these issue-specific arrangements as they arise and operate at levels of social organization ranging from the local to the global. This has produced a strong interest in interactions – both horizontal and vertical - between and among regimes dealing with specific issue areas (e.g. the interaction between the international trade regime and the regimes embedded in multilateral environmental agreements or MEAs [Chambers, Kim, and Young forthcoming]). There are obvious links as well between broad constitutive arrangements and issue-specific regimes. Regional fisheries regimes, for instance, operate within the overarching framework of the law of the sea (Ebbin et al. 2005); the US

regime created to curtail emissions of sulfur dioxide operates within the broader framework of the American political system (Tietenberg 2002).

Given IDGEC's Focus on environmental concerns like global warming and the loss of biological diversity, researchers associated with the project have taken a strong interest in the creation and performance of issue-specific regimes. This strategic choice has played a role in bounding the scope of our efforts, producing a body of research that casts an intense light on issues like the formation and effectiveness of regimes created to address specific problems, while directing less attention to issues like the links between issue-specific regimes and overarching governance systems. In our view, this choice has proven fruitful. We will endeavor to justify this judgment both in later sections of this chapter and in the substantive chapters to follow.

When regimes are created to address issues relating to natural resources and the environment, we generally call them *resource and environmental regimes* (Young 1982). It is common to speak of resource regimes managing human uses of renewable and nonrenewable resources (e.g. fish, hydrocarbons) and environmental regimes managing anthropogenic pollutants and the disposal of wastes or residuals (e.g. air pollution, greenhouse gases). Our working hypothesis is that the two categories are sufficiently similar to justify treating them as a single universe of cases. Taken together, such regimes are common across the spectrum from local arrangements to global arrangements, and they deal with a wide range of substantive issues. The potential universe of cases is large, though we are confronted immediately by questions relating to generalizability both across levels of social organization and across issue areas (Young 2005a). The project joins others who ask whether it is possible to scale up/down conclusions across levels of social organization or to transfer conclusions derived from the study of regimes operating in one issue area to understand what is happening in other issue areas. We will return to the problem of scale in a later section of this chapter.

Our project shares the tendency of much regime analysis to look first at arrangements that are governmental or intergovernmental in nature (Haas, Keohane, and Levy 1993; Miles, Underdal et al. 2002; Young 2005b; Breitmeier, Young, and Zürn 2006). Yet we now know that such arrangements are special cases of a broader category of environmental regimes that include private governance systems (e.g. the Chicago Climate Exchange), systems in which actors located in civil society play prominent roles, and hybrid arrangements in which several distinct types of actors emerge as prominent players (e.g. the Forest Stewardship Council and the Marine Stewardship Council). This is good news not only in the sense that it expands the scope of efforts to address problems of environmental governance in today's world but also in the sense that it increases the size of the universe of cases available to researchers seeking to answer fundamental questions about the formation and effectiveness of environmental governance systems. Work on systems featuring important roles for customs, markets, and various types

of networks is now going on in many quarters. IDGEC researchers have joined others in pursuing this line of thinking.

4. Research Foci: Causality, Performance, and Design

From the outset, one of the project's goals has been to address a set of generic questions of interest to all those who analyze institutions in order both to take advantage of the broader stream of thinking about institutions and to elicit attention on the part of scholars conducting research on institutions who have no special interest in resource and environmental regimes. This goal is reflected most clearly in the Science Plan's emphasis on research foci and, more specifically, on the questions of causality, performance, and design. The question of causality is a matter of the extent to which institutions influence the course of human affairs in a variety of social settings. The question of performance examines that subset of institutions that do make a difference; it seeks to evaluate institutional consequences in terms of well-defined criteria of evaluation, including efficiency, equity, and sustainable development. When institutions do play a role of some importance in solving problems, questions of design also arise. Can we hope to (re)form regimes in ways that will enhance the prospects for achieving collective outcomes that are socially desirable or avoiding outcomes that are harmful? All those who think about institutions and especially governance systems are concerned with these questions in one form or another. Part II of this volume includes separate chapters devoted to each of these research foci. Here, we aim only to introduce the issues at stake and to capture the flavor of the contributions of IDGEC science to our understanding of these matters.

4.1 The Question of Causality. Despite the rise of the new institutionalism as a powerful force throughout the social sciences, there are lingering doubts regarding the roles that institutions play in influencing the course of human affairs. Partly, this is a result of criticisms launched by those who argue that other drivers account for most of the variance in collective or societal outcomes. Analysts who emphasize the central role of power, for instance, regularly assert that institutions are epiphenomena reflecting political bargains underlying them and changing or adapting readily when the distribution of power in society shifts (Strange 1983: Mearsheimer 1994/1995). In part, it is a reflection of methodological problems confronting those who seek to develop and test propositions regarding the roles institutions play (Underdal and Young 2004). Like ecosystems, governance systems have fuzzy boundaries, a fact that can make it hard to separate individual regimes cleanly and that can lead to disagreements about what to include in our universe of cases. And because opportunities to engage in natural experiments – much less controlled experiments – are limited in research on social institutions, testing hypotheses about the formation and effectiveness of regimes requires a lot of ingenuity.

Two distinct messages regarding causality are worthy of note in this overview chapter. The first centers on the distinction among outputs, outcomes, and impacts that many analysts working in this field have adopted (Underdal and Young 2004).[3] It is a relatively easy task to demonstrate causality at the level of outputs or immediate products (e.g. treaties, statutes, regulations) of the political process. No one doubts the persuasiveness of counterfactuals that take the following form. The US Government would not have adopted implementing legislation in the form of a major title of the Clean Air Act Amendments (CAAA) of 1990 if there had been no 1987 Montreal Protocol. The Environmental Protection Agency would not have promulgated regulations covering phase-outs of certain CFCs and related ozone-depleting substances in the absence of the CAAA. And efforts to apply them to specific cases would not have occurred in the absence of these regulations appearing in the Code of Federal Regulations (CFR). In this sense, it is a fairly simple matter to demonstrate the occurrence of some cause-and-effect relationships regarding environmental institutions.

This is not a trivial matter; it would be a mistake to dismiss the significance of such relationships out of hand. Still, it is obvious that focusing only on outputs in examining the causal significance of institutions will not do. We want to know something about outcomes or the effects of institutions on the behavior of key actors in the relevant systems. Even more to the point, we would like information about impacts or the extent to which resource and environmental regimes play influential roles in solving or at least alleviating the problems that lead to their creation (Miles, Underdal et al. 2002; Breitmeier, Young, and Zürn 2006). This is where the problems begin to mount. There is, in short, a direct relationship between the importance of the issue and the methodological challenges involved in addressing it. The causal role of institutions in producing outputs is easy to demonstrate, but outputs are relatively unimportant as measures of the significance of institutions. Demonstrating the influence of institutions in terms of impacts, by contrast, is hard. Yet this is precisely what we want to illuminate in thinking about the roles that institutions play in causing and addressing environmental problems.

An understandable, though less than fully satisfactory, response to this tension is to focus attention on the effects of institutions on the behavior of key actors (Young and Levy 1999; Young 1999b). Guiding the behavior of human actors is essential to the success of any effort to solve environmental problems. Increasingly, we have come to realize that human actions are critical drivers in the onset of these problems. Human behavior is easier to analyze rigorously than the impacts of institutions measured in terms of problem solving. We can examine large universes of cases to develop propositions about human behavior; there is even considerable scope for the conduct of controlled experiments dealing with such matters as the prevalence of behavior conforming to the logic of

[3] . Alternative but roughly equivalent terminology differentiates among policy, behavioral, and environmental consequences.

appropriateness in contrast to the logic of consequences (March and Olsen 1998). It is well worth noting, for instance, that individuals do not always choose the defect option in situations exhibiting the structure of the prisoner's dilemma, that cooperation increases when subjects are allowed to communicate even in the absence of enforcement mechanisms, and that many subjects are risk averse in the sense that they will choose the certainty of a fixed payoff over a probabilistic payoff yielding a higher expected return (Kahneman 2003).

Still, this does not allay our concerns regarding the causal significance of resource and environmental regimes. This is where the second message relating to causality comes into focus. As we indicated in the previous section, complex causality is the norm rather than the exception in this realm. What this means is that institutions typically form elements of interactive clusters of driving forces that determine collective outcomes in social settings (Young 2002b; Lambin and Geist 2006). For the most part, these clusters include biophysical forces (e.g. changes in the length of the growing season, the extent of seasonal sea ice, the temperature of ocean water) as well socioeconomic forces (e.g. the emergence of new harvesting technologies, shifts in human consumption patterns, changes in dominant political coalitions, movements of human populations). The fact that these forces interact – movements of human populations may follow environmental changes and affect political coalitions, new technologies may play a role in altering consumption patterns – means that it is always hard and sometimes impossible to separate out the signals of individual elements in causal clusters and assign specific weights to them in terms of explaining or predicting the character of collective outcomes.

This observation is sobering. It complicates – though it does not preclude – the use of many familiar statistical procedures in evaluating the causal significance of institutions (Young, Lambin et al. 2006). It also explains why institutional arrangements that yield satisfactory results in some settings (e.g. systems of land tenure based on private ownership) may work poorly or even fail completely in other settings (Komesar 2001; Cole 2002; Rejesh and Lebel 2006). It is a simple exercise to compile a long list of instances in which recommendations regarding institutional arrangements that worked well elsewhere have failed or, in some cases, even generated negative results for those who have adopted them. This has profound consequences for the question of design to be addressed later in this section. But for now, we simply want to emphasize that the question of causality with regard to the effects of resource and environmental regimes is one that often calls for a high order of sophistication in the analysis of causal clusters rather than the application of reductionist procedures designed to tease out the significance of individual factors through the application of methods that hold other factors constant.

4.2 The Question of Performance. As the preceding account suggests, there is a clear link between causality and performance. It is pointless to worry about the performance of a resource or environmental

regime, unless there are good reasons to believe the arrangement makes a difference in causal terms. But the analysis of performance differs fundamentally from the study of causality. An institution that alters a problem without solving it or that engenders new problems as side effects of efforts to address a preexisting problem makes a difference in causal terms. The question of performance comes into focus, by contrast, when we ask not only whether a regime makes a difference but also whether it produces results that meet the requirements of criteria of evaluation involving standards like efficiency, equity, sustainable development, robustness, or any other standard deemed appropriate (Young 1982). There is, therefore, an essential normative component to the question of performance that is not present in the question of causality.

Some researchers in this field – especially those concerned with the performance of international environmental regimes – have sought to address this question in one bold stroke (Helm and Sprinz 1999; Sprinz and Helm 2000; Young 2001; Hovi, Sprinz, and Underdal 2003; Young 2003a; Bernauer forthcoming). They propose a scale ranging from the outcome that would have occurred in the absence of a regime (i.e. the no-regime the counterfactual) to some outcome that is deemed to be the social optimum. Performance, on this account, is a measure of the location of the actual outcome on the continuum from the counterfactual to the optimum. This procedure has the virtue of creating a scale ranging from 0 at the no-regime counterfactual to 1 at the social optimum and providing a way – at least analytically – of measuring the actual performance of a regime against a well-defined yardstick. A particularly attractive feature of this approach is that it offers a means of comparing and contrasting the performance of different regimes with one another. A regime that scores .7 on this 0-1 scale, for example, is turning in a better performance than another that scores only .4.

The appeal of this way of thinking – sometimes described as the Oslo-Potsdam Solution - is obvious. Yet there are also grounds for questioning the usefulness of this appealing stream of analysis. It is hard to deal with the counterfactual embedded in most efforts to predict what would have happened in the absence of a regime. Observers can and often do differ in their conception of the social optimum, and the idea is difficult to operationalize, even for those who agree on the optimum in conceptual terms. Judging the state of affairs at any given time with regard to its location on this scale is by no means straightforward. Further work on the development of the Oslo-Potsdam Solution and other approaches to the evaluation of performance constitutes a high priority for those interested in the institutional dimensions of environmental change.

What other approaches are available for evaluating the performance of regimes (Mitchell 2004; Zürn and Joerges 2005; Zaelke et al. 2006)? One alternative is to apply familiar concepts of efficiency, equity, and even sustainability to the consequences of specific regimes. It is hard to judge the efficiency of regimes, except in terms of very weak standards like Pareto optimality. This is largely a consequence

of problems in calculating the benefits associated with steering clear of harmful outcomes or increasing the probability that desirable outcomes will occur over long time periods. As a result, it is easier to think in terms of cost effectiveness in this endeavor. Could a concrete goal or objective, such as curbing intentional oil pollution at sea, have been met through the use of some means other than the equipment standards that constitute core elements of the regime established under the terms of the International Convention for the Prevention of Pollution from Ships (MARPOL) 1973-78 (Mitchell 1994)? Are the claims regarding cost effectiveness of those who favor cap-and-trade approaches to curbing emissions of airborne pollutants persuasive?

Beyond these issues of efficiency, we have come to believe that many studies of resource and environmental regimes have not placed enough emphasis on evaluating their consequences in terms of standards of fairness (Hoel and Kvalvik 2006). The fact that this criterion encompasses a range of issues framed as matters of equity and justice complicates this endeavor. But there is a need to devote more systematic consideration to the roles that regimes play in determining who gets what and the extent to which subjects regard regimes as fair or just in procedural terms, regardless of the identity of winners and losers. One way to put this point is to say that there is a compelling case for paying more attention to the politics of the (re)formation and operation of regimes in future research in this field. Such an emphasis would naturally lead to more sustained research relating to a range of topics including leadership, coalition formation, and rent-seeking behavior.

A cruder but in some respects more tractable approach to evaluating the performance of resource and environmental regimes is to address the issue in terms of the idea of problem solving (Miles, Underdal et al. 2002; Breitmeier, Young, and Zürn 2006). We may be able to arrive at relatively clearcut conclusions regarding problem solving and the roles that regimes play in solving problems, even when there is no consensus regarding specific criteria such as efficiency, cost effectiveness, fairness, justice, and so forth. Thus, it is relatively easy to gain consensus around the propositions that the Antarctic regime has worked well in alleviating jurisdictional conflicts; the ozone regime has played a significant role in reducing the production and consumption of ozone-depleting substances, and the cap-and-trade system established under the CAAA of 1990 has been successful in cutting emissions of sulfur dioxide regarded as a precursor to acid rain. Nor would anyone disagree with the judgment that the regime articulated in the UNFCCC and the Kyoto Protocol has failed so far to mitigate the problem of climate change. These are crude judgments; they tell us little about whether some alternative approach might have produced equally good results at a lower cost or generated an outcome that would seem preferable in terms of some conception of fairness or justice. Still it would be a mistake to underrate the significance of this mode of thinking about performance. Even a 4 or 5 point nominal scale ranging from no effect on the problem to decisive resolution can provide the basis for exploring and even "testing" a range of hypotheses regarding

factors identified in theoretical work as significant determinants of success or failure in efforts to address environmental problems.

Using the International Regimes Database (IRD), participants in the project have taken some initial steps in this direction (Breitmeier, Young, and Zürn 2006). It turns out, for example, that consensus decisionmaking does not always give rise to the law of the least ambitious program (Hovi and Sprinz 2006). A number of regimes that rely on consensus (e.g. the regime for stratospheric ozone) have performed well in terms of the criterion of problem solving; even the use of a unanimity rule (e.g. the Antarctic Treaty System) turns out to be compatible with problem solving under some conditions. Although enforcement is clearly important in efforts to maximize compliance, such utilitarian mechanisms cannot account for all the variance in compliance. Our studies point to factors like juridification and legitimacy as important determinants of compliance (Zürn and Joerges 2005). What is more, regimes often achieve results in terms of problem solving by shaping and refining actors' understanding of the problem rather than by the establishment and implementation of conventional regulatory arrangements (Young 1999a). And these findings are merely illustrative of a wide range of relationships that come into focus and can be investigated empirically in the context of this problem-solving approach to performance.

4.3 The Question of Design. One reason why policymakers and scientists alike exhibit an intense interest in institutions arises from the presumption that these determinants of the course of human-environment relations are more malleable than other determinants (e.g. population, consumption patterns), so that we can hope to exercise some control over our destiny by crafting the provisions of resource and environmental regimes and adjusting key provisions of these regimes in order to improve their performance in the light of experience (Young 2002a). For many analysts, this is the fundamental justification for devoting time, energy, and resources to the study of institutional arrangements. We seek to take charge of our own destinies by crafting governance systems that guide behavior in such a way as to generate socially desirable outcomes and learning from experiences in this realm how to promote the public interest or the common good. Ideally, this should lead over time to the development and refinement of a set of tools for designing governance systems applicable to a wide range of specific cases.

Research on environmental and resource regimes makes it clear that success in crafting the provisions of these arrangements is easer said than done. Some cases appear to exemplify what Hayek and others have called spontaneous or self-generating regimes (Hayek 1973). What this means is that institutions often take the form of emergent properties of complex interactions among a number of self-interested actors. On this account, actors are not able to design resource and environmental regimes in order to solve specific problems (e.g. climate change, the loss of biological diversity); shifts in the

character of these arrangements are largely byproducts of the efforts of numerous actors to pursue their own interests. The views of neo-realists who regard institutions as surface manifestations of underlying power relations and shifts in institutional arrangements as reflections of deeper changes in power relations constitute one line of thinking of this type. But there are other, more benign views that also belong to the Hayekian perspective on institutions and institutional change (Fiori 2006). One example is the idea of the environmental Kuznets curve, with its emphasis on the proposition that rights and rules shift to favor environmental protection as a society passes through the process of industrialization on its way to modernization (Deacon and Norman 2004).

Still, research on issues of environmental governance indicates that this is by no means the whole story (Dietz et al. 2003). Actors from the public sector, the private sector, and civil society all devote large amounts of time and resources to negotiations that give rise to specific regimes, and they pay a great deal of attention to the processes through which these constitutive agreements are implemented on the part of individual subjects (Chayes and Chayes 1995). The resultant institutional bargaining has been a topic of great interest to members of the research community. Unlike ordinary legislative bargaining which exhibits a tendency to revolve around efforts to forge minimum winning coalitions (Riker 1962), institutional bargaining often aims for the creation of larger coalitions and, in many cases, something approaching the coalition of the whole (Young 1994). The reason for this is simple. The success of regimes requires behavioral change (though not necessarily compliance in the normal sense) on the part of subjects; change of this sort is easier to obtain from subjects who have participated in the process of regime formation and believe that the key provisions of a regime are fair or at least legitimate. But this feature of regime (re)formation can and often does lead to the crafting of important provisions that are opaque and difficult to interpret; it also accounts for the fact that many constitutive agreements include distinct sections that appear to be at odds with one another (e.g. fisheries regimes that promote the conservation of stocks and subsidize fishers to increase their fishing power at the same time) (Young 1982). Such results are hard to square with the idea of institutional design.

Even so, it is understandable that interest in institutional design remains high and that policymakers and researchers alike expend a lot of effort on issues of (re)design. A significant contribution emerging from the resultant dialogue centers of the idea of a diagnostic approach to design (Young 2002a). This approach grows out of the central role of complex causality as discussed in a previous subsection. Institutions are only one of a number of driving forces that interact with one another to determine the outcomes of human-environment relations. This means that we are unlikely to be able to develop design principles in the sense of propositions that identify necessary or sufficient conditions for success in the creation and operation of regimes that are effective and durable (Ostrom 1990). A factor that is important in one setting may be of marginal significance or even irrelevant in others. What we can

hope to do is to identify and evaluate the key characteristics of individual situations and craft specific constitutive agreements to fit the circumstances at hand. To take a couple of simple but illustrative examples: there is no need to worry about compliance when dealing with coordination problems in contrast to collaboration problems (Stein 1982); the problem of burden sharing to pay for the production of collective goods is much less severe in privileged groups than in groups that lack a dominant member (Olson 1965). Chapter Four explores the diagnostic approach in depth. Here, we want only to set this idea in perspective. There are good reasons to believe that we can shape the terms of regimes to enhance their fit with individual situations; this is one reason why those negotiating the terms of individual statutes or treaties expend so much time and energy crafting the content of these agreements. But there are many traps in this realm awaiting the unwary and especially those who tend to reason by analogy, borrowing provisions from previous efforts to form regimes and applying them to new cases without careful scrutiny.

5. Analytic Themes: Fit, Interplay, and Scale

In addition to its research foci addressing issues of general interest to students of institutions regardless of form or substantive issue areas, the IDGEC Science Plan highlights a set of analytic themes or issues that are more specific to resource and environmental regimes and that the drafters of the plan judged to be cutting-edge concerns during the late 1990s. The problem of fit is a matter of the match or congruence between biophysical systems and governance systems. Here we ask what are the determinants of fit, and can we improve fit as part of the process of regime building and adaptation? The problem of interplay grows out of a perception that discrete regimes can interact with one another and that such interactions will become both more common and more significant as the density of governance systems increases in any given social setting. For its part, the problem of scale concerns the extent to which institutional arrangements are similar and exhibit comparable processes across levels of social organization ranging from the local to the global. As a global change project, IDGEC has had a particular interest in governance systems operating at a large scale (e.g. the arrangements established under the terms of multilateral environmental agreements or MEAs). Still, it is apparent that there is a need to consider arrangements operating at other levels as well, both because of the importance of what we call vertical interplay and because of the prospects for gaining important insights by comparing and contrasting governance systems across levels of social organization.

We make no clam that these three analytic themes encompass all the important questions ripe for consideration in a project dealing with resource and environmental regimes. Other questions relating to matters concerning the growth of knowledge, the role of leadership, and the nature of institutional change, for instance, have surfaced in work carried out under the auspices of IDGEC and deserve more

concentrated attention (Walsh 2004; Ebbin 2004). Even so, the analytic themes embedded in the problems of fit, interplay, and scale have proven fruitful and given rise to significant insights.

5.1 The Problem of Fit. Creators and operators of resource and environmental regimes have struggled for a long time to create governance systems that are well-matched to relevant biophysical systems. But it is worth noting here that the importance of fit has increased along with the role of anthropogenic forces in biophysical systems. When human actions play no more than a minor role in the dynamics of biophysical systems, institutional arrangements are more relevant to the achievement of efficiency and equity than to the pursuit of sustainability. As anthropogenic forces rise and begin to take center stage, however, the problem of fit comes into focus. We know now that human actions have had far-reaching consequences for biophysical systems for hundreds - perhaps thousands - of years (Turner et al. 1990). Even so, there is no escaping the conclusion that human drivers and with them the importance of fit have come into focus as central concerns in recent times. As some observers have put it, we are now in a no-analogue situation with regard to human-environment interactions (Steffen et al. 2004), a fact that has led prominent scientists in many quarters to argue that the Earth has moved from the era known as the Holocene to a new era best described as the Anthropocene (Crutzen and Stoermer 2000).

Misfits or mismatches between biophysical systems and institutional arrangements are common; they are often hard to eliminate or alleviate even when their existence and negative consequences are widely known within the relevant community. Mismatches may be either spatial or temporal in character. The boundaries of legal and political jurisdictions often bear no relationship to the areal domains of ecosystems, and jurisdictional boundaries are usually hard to change. The rhythms of decisionmaking procedures frequently differ from the cycles of biophysical systems. A particularly important problem arises in cases where normally stable biophysical systems are affected by rapid change events that produce non-linear changes known as state changes or system flips (Gunderson and Holling 2002). It is difficult for governance systems to match a pattern of this sort, operating in one mode most of the time but being able to switch quickly into a distinct crisis mode when the need arises. This is why governance systems often seem to be caught unprepared by the occurrence of largescale and rapid biophysical changes and to experience great difficulty in reacting in a timely manner when such non-linear changes occur. IDGEC research has identified other types of misfits as well. An important case involves the connectivity or level of interdependence of biophysical systems and institutional arrangements. When internal links within a biophysical system tighten but the relevant governance system is highly decentralized or even fragmented, for example, efforts to deal with spreading or even cascading biophysical changes are apt to be tardy and uncoordinated (Crowder et al. 2006; Worm et al. 2006; Young et al. 2006).

Why are mismatches between biophysical systems and governance systems so hard to avoid in the first place, to recognize, and especialy to eliminate even after their existence is widely recognized? A number of factors that typically operate together account for this phenomenon. Sometimes, limited knowledge makes it hard to construct regimes that match biophysical systems. It is difficult to forecast the occurrence of non-linear changes in complex systems, even when the basic character of the systems is well understood (Ebbin 2004). A particularly serious obstacle arises from the rapid growth of anthropogenic drivers in large socio-ecological systems and the need to understand the dynamics of coupled systems. Not only do we lack experience in connecting the component parts of coupled systems; it is also hard to garner support for studies of coupled systems and to assemble teams of scientists willing to devote time and energy to the analysis of these systems. Natural scientists have little experience with efforts to endogenize the human dimensions of these systems in their models. Much the same is true in reverse regarding the research of social scientists. As the experiences of the Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment (MEA) make clear, we have a long way to go in building the scientific capacity, resources, and commitment needed to understand complex systems like the carbon-climate-human system or the global food system well enough to improve the fit between biophysical systems and governance arrangements with regard to most largescale environmental problems.

Yet this is only part of the explanation for the stickiness of misfits between biophysical systems and governance systems. Political factors also play an important role in this realm. Some actors or interest groups may well benefit, at least in the short run, from maintaining or even nurturing the growth of misfits. The infamous assertion that “rain follows the plow” is easy to understand once we recognize the desire of politicians to gain admission to the union for arid western states, so that they could occupy positions as senators, representatives, and governors in these newly established members of the United States (Stegner 1954). Nor is there any cause for surprise in the observation that those who play central roles in individual MEAs (e.g. the climate regime, the biodiversity regime) generally resist efforts to integrate their activities into larger clusters and ultimately to create a World Environment Organization (WEO), despite the evidence that such a move would enhance the effectiveness of environmental governance systems (Biermann and Bauer 2005). This is a familiar problem of protecting turf and blunting pressures for change that arises in all governance systems and that is just as pervasive in regimes designed to handle human-environment interactions as it is in other realms.

To add another complication, efforts to eliminate or alleviate mismatches normally require acts of institutional reform aimed at altering the features of resource and environmental regimes that give rise to these problems. This brings us back to the issue of institutional bargaining. There are good reasons to make the requirements for changing constitutions or constitutive arrangements relatively stringent.

Creating institutions that are too flexible or easy to change is to increase the likelihood that the resultant governance systems will turn out to be epiphenomena. Yet making the requirements for reform too stringent is to ensure that mismatches will be difficult or impossible to eliminate. It is easy to propose a general strategy of striking a balance between the marginal costs of misfits and the marginal costs of excessive flexibility. But it is hard to operationalize an abstract principle of this sort for use in real-world settings. The best we can do is to make a conscious effort to steer a middle course between these threats to the performance of specific regimes. In the meantime, it is clear that the complexities of institutional bargaining can and often will thwart well-intentioned efforts to come to terms with mismatches between regimes and the relevant biophysical systems (Young 1994), even when there is no secret about the existence of the mismatches and key players have been struggling to address them for long periods of time.

IDGEC's flagship activity on the Performance of Exclusive Economic Zones (PEEZ) has provided a particularly rich laboratory in which to study the question of fit (Ebbin, Hoel, and Sydnes 2005). The creation of EEZs - formalized in the 1982 UN Convention on the Law of the Sea (UNCLOS) - was one of the most dramatic and far-reaching institutional changes of the 20th century. A critical argument emphasized by those in favor of this dramatic extension of coastal state authlority focused on the need to manage marine resources – especially harvestable fish populations – sustainably and the inadequacy of preexisting arrangements to address this problem. The addition of the 1995 Straddling Stocks Agreement has helped to alleviate some problems (e.g. jurisdictional boundaries that ignore the behavior of fish populations) arising from the creation of EEZs. Still, the state of many of the world's fisheries has continued to deteriorate (Worm et al. 2006). The shift from maximum sustained yield (MSY) management practices to ecosystem-based management (EBM) has proven difficult, despite widespread agreement among scientists and even many policymakers concerning the need for such a transition. All the factors identified in the preceding paragraphs are at work here. High levels of uncertainty plague efforts to understand the dynamics of marine systems. Entrenched interest groups are fearful of harm to their interests likely to flow from a transition from MSY to EBM. Although progress is occurring in some areas, we are far from agreement concerning how to structure management systems to achieve EBM, even in cases where the need for a major change is acknowledged. As a result, mismatches prevail, and the crisis in ocean governance continues to deepen (Crowder et al. 2006). Still, the work of PEEZ indicates that this situation is far from hopeless. The secret of success appears to lie in coordinating distinct regimes at the local, state, regional, and global levels to produce positive or even synergistic effects rather than conflicts (Ebbin 2005; Henriksen, Honneland, and Sydnes 2006) rather than attempting to create one overarching arrangement dealing with marine resources.

5.2 The Problem of Interplay. Studies of institutional interplay or, as some prefer to say, interactions between or among distinct governance systems have developed into a cottage industry during the lifetime of our project. The explanation for this development is straightforward. We can expect interplay to increase - often at an exponential rate - as the density of discrete institutional arrangements increases in a social setting. This has obviously occurred in recent times at the international level. MEAs, for instance, now number in the hundreds. But similar developments occur regularly at lower levels of social organization as well. As new activities come on stream and the interdependencies between new and preexisting activities increase, the demand for governance grows. As a result, research on institutional interplay certainly would have been on the rise even in the absence of IDGEC. Still, the project has played a pivotal role in shaping the development of this area of research. Many of those who study interplay are active members of our community, and much of the resulting literature engages – sometimes critically – with the approach to interplay set forth in the project's Science Plan (Stokke 2001a; Stokke 2001b; Oberthür and Gehring 2006; Cash et al. 2006; Young 2006; Chambers, Kim, and Young forthcoming),

The Science Plan differentiates between vertical and horizontal interplay or, in other words, interactions across or within levels of social organization, and between functional and political interplay or, in other words, de facto and intentional interplay. The vertical/horizontal distinction is now widely accepted among those analyzing institutional interplay. Interactions between environmental regimes and the trade regime at the international level and interactions between rules relating to clean air or water and rules governing taxation at the domestic level are obviously important (von Moltke 1997). But so are interactions between national and even international governance systems and (often traditional) arrangements operating at the local level (Berkes 2002; Young 2002c). An important finding in this regard is that smallscale systems based on traditional practices that work perfectly well on their own often fail when they are impacted heavily by the operation of largescale resource and environmental regimes. So is the fact that trade regimes tend to affect ecosystems more through their general success in stimulating the expansion of trade than through clashes involving specific provisions of environmental regimes dealing with matters like ozone depletion, trade in hazardous wastes, or climate change.

The distinction between functional and political interplay, on the other hand, has come in for cogent criticism (Stokke 2001b; Oberthür and Gehring 2006). As the preceding paragraph suggests, it is certainly true that functional or unintentional interactions are important. But those working in this field have pointed to other factors, such as the behavioral mechanisms that give rise to interplay or the substantive features of the issue areas within which interplay occurs, as key distinctions needed to explain or predict the occurrence and consequences of institutional interplay. This is clearly a healthy dialogue (Chambers, Kim, and Young forthcoming). We are at a relatively early stage in our efforts to understand

the sources, consequences, and dynamics of interplay in a variety of settings. The project has figured prominently in the growth of interest in this area of analysis; moving beyond the crude, preliminary roadmap for the study of interplay articulated in the planning process almost a decade ago is a sign of intellectual vigor.

Another point worthy of consideration concerns the sign – positive or negative – of institutional interplay. It is probably safe to say that a good deal of the early interest in this phenomenon arose from a concern about negative effects and specifically about the prospect that regimes dealing with matters like international trade and finance would interfere with efforts to deal with problems like climate change and the loss of biological diversity through the creation of MEAs. But research in this area has raised searching questions about the prevalence of this perceived problem. Using a relatively large set of cases pertaining to the European Union as well as to international society, Oberthür and Gehring have concluded that positive - or even synergistic - interactions are at least as common as cases of interference (Oberthür and Gehring 2006). There is much more to be done to flesh out our understanding of these matters. But it is clear that research on questions of institutional interplay will continue to flourish during the near future.

IDGEC's flagship activity on the Political Economy of Forests (PEF), focused primarily on developments in Southeast Asia, has provided a helpful vehicle for thinking about interplay (Lebel 2005; Rajesh and Lebel 2006; Garden et al. 2006). The most significant finding here relates to the effects of the devolution of authority from central governments to regional or even local governments that has been occurring in many countries in recent years (Pasong and Lebel 2000; Contreras 2003). The case for devolution is based on the logic of subsidiarity and the expectation that regional or local authorities not only understand the dynamics of specific ecosystems and the needs of their constituents better but also are less susceptible to corruption than those located in national capitals. For the most part, these expectations or hopes have not fared well, at least in the forests of Southeast Asia. PEF's explanation for these disappointing results focuses on complex causality and especially on matters of interplay between local activities and the overarching processes of globalization. The growth of regional and increasingly global markets has shifted power to actors (e.g. multinational corporations in Japan) that have little knowledge of or interest in the fate of local communities in places like Indonesia, Malaysia, and the Philippines that are heavily dependent on renewable forest products (Dauvergne 1997). And pressures on central governments desperate to increase exports to service national debts or to encourage export-led growth have reinforced the influence of the multinational corporations in this realm rather than providing a counterweight for those seeking to stem the tide of globalization at the regional and local levels.

5.3 The Problem of Scale. As formulated in IDGEC's Science Plan, the problem of scale is a matter of the transferability of knowledge regarding governance systems from one level of social organization to another. If we know something about the determinants of effectiveness in resource and environmental regimes operating at the local or micro-level, can we scale up these findings and apply them to the national and even the global levels? Conversely, if we arrive at conclusions about the relative significance of various compliance mechanisms at the global or macro-scale, can we scale down these findings to shed light on sources of the effectiveness of institutions operating at the national and even the local levels? The question of scale in this sense has long been a focus of attention in most of the natural sciences. But it is a comparatively unfamiliar topic for research among social scientists (Gibson, Ostrom, and Ahn 2000). In highlighting this question, the project has made a deliberate effort to alter this situation and to give more play to research on matters of scale among those interested in the institutional dimensions of environmental change.

A notable finding in this connection is that there are substantial similarities between resource and environmental regimes operating in smallscale, traditional societies and in international society (Ostrom et al. 1999; Young 2002a; Young 2005a). Both settings lack states in the conventional sense of the term. The evolution of governance systems on the basis of practice in contrast to a reliance on formal, constitutive agreements is important in both settings. Regimes in both domains are likely to depend heavily on stakeholder involvement and on the power of legitimacy in contrast to enforcement as a source of compliance. Needless to say, it is important not to ignore critical differences between these settings. Often, smallscale systems can rely on a relatively high level of cultural homogeneity, so that the phenomenon of community can play a significant role in the success of issue-specific regimes. In international society, by contrast, the role of community seems less significant. Although some analysts do think in terms of community at this level (Bozeman 1960; Claude 1988), arguments regarding the effects of community in the sense of a group of actors who share beliefs, attitudes, norms, and a sense of social solidarity in this setting seem thin. Similarly, the implementation of rights, rules, and decisionmaking procedures is far less complex in smallscale systems than in international society. As a number of analysts have pointed out, many resource users in smallscale settings can represent themselves in key decisionmaking processes, and the users themselves often play key roles in monitoring compliance with the provisions of regimes on the part of their peers (Ostrom 1990). Contrast this with international society in which implementation is at least a two-step process requiring efforts to incorporate the provisions of international agreements into domestic practices, and the monitoring of compliance is apt to be carried out by specialized public agencies that have little or no connection with those who users of living resources, nonrenewable resources, or ecosystem services. In terms of the terminology introduced

in the discussion of regime consequences, outputs (e.g. the passage of implementing legislation) do not necessarily generate outcomes (e.g. behavioral change) in this realm.

A different – more political - perspetive on scale has arisen in recent research carried out by a group of European and Asian researchers (Lebel 2004; Lebel et al. 2005; Gupta and Huitema forthcoming). In essence, the idea here is that problems are socially constructed, that they can be framed in such a way as to make them suitable for consideration at different levels of social organization, and that it often makes a difference in terms of the interests of key actors whether they are addressed at one level or another. Those concerned with the rights of indigenous peoples, for instance, are likely to prefer to address problems at a local scale, whereas those acting on behalf of multinational corporations will often have a preference for global arrangements that produce systems of rights, rules, and decisionmaking procedures that are uniform across the globe. Under these circumstances, we should expect actors to think of scale in political terms, engaging in scale shopping along with the more familiar activities known as forum shopping. This research is still at an early stage. So far, it has proceeded inductively and identified long lists of reasons why individual actors may want to engage in scaling up or scaling down in addressing problems arising in human-environment relations (Gupta and Huitema forthcoming). But this is a promising initiative; further research in this realm seems likely to prove fruitful in adding to our knowledge of environmental governance.

IDGEC's Carbon Management Research Activity (CMRA), which directs attention to the design of the global climate regime both under the terms of the Kyoto Protocol and beyond Kyoto, has taken a particularly strong interest in the problem of scale. As we endeavor to establish cap-and-trade arrangements as mechanisms for reducing greenhouse gas emissions, what lessons can we draw from experience with such arrangements at different levels of social organization? Is the generally positive experience in the United States with the creation and operation of markets in allowances for sulfur and nitrogen emissions under the provisions of the CAAA of 1990 transferable to the level of the European Union and even the global level (Tietenberg 2002)? Can we draw inferences from the operation of the EU Emissions Trading Scheme (EU-ETS) that may prove helpful in the operation of a global regime and in redesigning the climate regime for implementation beyond the end of the first commitment period in 2012 (Capoor and Ambrosi 2006)? Are we likely to be better off with a small number of linked regional arrangements than with a single, global market for emissions allowances? It is already clear that key issues in this realm will involve matters like procedures governing the initial allocation of allowances, compliance and enforcement mechanisms, the volatility of the resultant markets, and the ability of these arrangements to learn through a process of adaptive management without losing their impact on behavior (Sugiyama 2005). These are classic concerns that center on issues of scale. It may be some time before we

are in a position to provide confident answers to questions of this sort. But the importance of tackling them now with regard to concrete issues like climate change is apparent.

6. Methodological Matters

We have commented on a number of methodological matters in passing in the preceding sections of this chapter. But it will be helpful at this point to back up a step, to address methodology in a more synoptic fashion, and to discuss the project's contributions to dealing with methodological chalenges that arise in studies of social institutions. In doing so, we aim to describe the nature and the magnitude of the challenges clearly as well as to comment on strategies and tactics to address them. The result is a cautionary tale but not one that should give rise to pessimism on the part of analysts seeking to answer questions about the (re)formation and effectiveness of institutions and especially those that govern human-environment interactions.

Resource and environmental regimes, like all social institutions, are socially constructed (Onuf 1989; Wendt 1999). This means that they have no existence outside the behavior of human actors – individually and collectively – and that they are subject to change as a consequence of human actions. Institutions differ from biophysical phenomena like the Earth's climate system or the ocean conveyor belt in these terms. Some analysts and especially those who describe themselves as constructivists claim that this makes it difficult or even impossible to engage in normal scientific research dealing with the (re)formation and effectiveness of institutions (Kratochwil and Ruggie 1986). But this claim is surely exaggerated. Few would deny the feasibility of conducting empirical research on markets, which are institutions themselves, and more specifically on the occurrence of market failures and the consequences for the operation of markets of variations in rules relating to contracts, liability, property, taxation, and so forth. Similar observations are in order regarding research on the effects of laws. There is an extensive body of research, for instance, on matters like the economic consequences of alternative zoning systems and alternative interpretations of the commerce clause and the provision dealing with "takings" in the US Constitution.

Still, institutions do have characteristics generating methodological pitfalls that can easily trap the unwary. What we have called complex causality makes it hard to separate out the signal of institutions from the noise of a variety of other driving forces. In cases where it seems important to focus on the impacts of interacting clusters of drivers, it may even be undesirable to attempt to pull apart the individual factors included in these clusters for separate treatment. The fact that universes of cases are often (though not always) small in studies of institutions adds to the resultant difficulties. It means, for instance, that there may be little scope for subdividing the universe of cases in order to control for factors other than institutions themselves. To take a single example, if we were to hypothesize that democratic countries are

more likely to comply with the requirements of environmental regimes than countries whose political systems are non-democratic, it would be helpful to subdivide the overall universe of cases to test the validity of this hypothesis. But under the best of circumstances, the number of cases in each of the categories would be small.[4]

There are also problems with specifying and analyzing the dependent variable in efforts to evaluate the effectiveness or the success of resource and environment regimes. Unlike familiar concerns relating to trends in voter turnout or the frequency of wars, for instance, the idea of effectiveness has a causal judgment embedded in it (Levy, Young, and Zürn 1995). So long as we treat effectiveness per se as our dependent variable, therefore, we must find a way to address this issue of causality. One way around this problem is to replace effectiveness with some other dependent variable for purposes of analysis. We can treat some measure of problem solving, for instance, as the dependent variable and seek to assess the roles of regimes in accounting for success in these terms. The Oslo-Potsdam Solution, discussed earlier, provides a particularly elegant example of this strategy. Of course, this approach runs the risk of ending up with spurious correlations. If a problem goes away following the creation of a regime, can we safely assume that the regime has played a significant role in bringing about this result? This is exactly the sort of problem that statistical procedures, like various forms of regression, are designed to illuminate (Young, Lambin et al. 2006). Although the nature of these procedures is such that they cannot produce clearcut results regarding mattes of causality, they can and often do help us to identify and understand what is going on in complex systems. But here, too, there are significant limitations when it comes to the analysis of governance systems. The small size of universes of cases and difficulties in finding a common measure of the dependent variable stand out in this connection.

As the preceding paragraph suggests, measurement problems relating to the dependent variable are a constant concern in the analysis of resource and environmental regimes. The beauty of the Oslo-Potsdam Solution in this regard is that is offers an approach to measurement that can be applied to all regimes and that yields a normalized – and therefore comparable - score for each regime on a scale ranging from 0 to 1. This procedure or some similar approach to measuring the success of regimes may well figure prominently in future research on environmental and resource regimes. For the moment, however, the practice of approaching effectiveness in terms of problem solving and measuring it on a nominal scale containing 4-5 discrete points seems likely to attract considerable interest among those desiring to assess the consequences of environmental governance systems (Miles, Underdal et al. 2002; Breitmeier, Young, and Zürn 2006). Yet this methodological concern is fundamental; researchers should

[4] . One strategy for increasing the universe of cases is to treat actions (e.g. compliance) by country per year as separate observations (Mitchell 2004).

and will devote sustained attention to the issue as we move forward in the analysis of institutional effectiveness.

How should we respond to these challenges in the near future? Recent work on regime consequences (Underdal and Young 2004) as well as collaboration with our sister project on Land-Use and Land-Cover Change (Young, Lambin et al. 2006) has highlighted the value of what we call a *portfolio approach* to the analysis of systems that exhibit complex causality. The resultant toolkit contains a range of methods including enhanced statistical procedures, comparative and meta-analyses, narratives and case studies, systems analysis, and simulations. We believe that it is desirable to make use of a number of these individual tools in studies of particular institutions or categories of institutions such as environmental and resource regimes. When the results converge, we are entitled to have added confidence in the robustness of our findings. Divergence can be useful, too, in identifying important areas where more research is needed.

This approach to the methodological challenges arising in the study of governance systems does not offer neat solutions to our problems. Still, we are no worse off than analysts concerned with other complex systems, like the Earth's climate system. Climate researchers must resort to a range of methodological procedures including the extensive use of proxies for key variables, natural experiments, and largescale simulations (Linden 2006). Those working in this field have not been able to answer all our questions about climate change. But they have produced a stream of sophisticated insights that are improving our understanding of the Earth's climate system at a rapid pace. There is no reason to conclude that the challenges facing those studying resource and environmental regimes are any more daunting.

7. Policy Relevance

Researchers engaged in studies of global environmental change are hearing more and more requests to tease out and highlight the policy implications of their findings. Nowhere is the value of such an effort more apparent than in studies of the institutional dimensions of environmental change. Policymakers and administrators allocate large amounts of time to (re)forming and administering resource and environmental regimes. Any knowledge that can help them to design better regimes in the first place and to implement the resultant institutional arrangements more successfully will have obvious policy relevance. Moreover, a sizable proportion of those engaged in research on environmental regimes have personal experience in the policy world or have observed policy processes closely enough to have a good grasp of the world of applications.

All this bodes well for efforts to highlight the policy relevance of studies of environmental and resource regimes. Yet the application of findings about the role of institutions to issues currently on the policy agenda is anything but straightforward. As both this chapter and the substantive chapters that

follow make clear, we are not likely to be able to develop simple and powerful prescriptive generalizations about institutions that provide surefire recipes for solving the problems of those responsible for creating and managing regimes addressing specific problems. It is apparent that one size does not fit all in this realm and that we must cultivate skill in crafting specific regimes in such a way that they are well-matched to the major features of the relevant problems (Cole 2002; Komesar 2001). What is more, scientists working on institutional issues cannot expect to be close enough to the ups and downs of specific negotiating processes in either legislative or treaty-making settings to be able to jump in on the spur of the moment to suggest explicit provisions for incorporation into the text of statutes or treaties. As a result, the occurrence of a gap between the expectations of members of the policy community and the realities of what members of the research community can deliver is common.

Does this suggest pessimistic conclusions about the policy relevance of our research? Work carried out under the auspices of IDGEC does not license this conclusion. The important thing, in our judgment, is to distinguish among different phases or stages of the policy process and to identify those phases in which contributions from the research community are most likely to prove effective. Research on environmental and resource regimes is likely to prove useful, in our judgment, in those phases featuring (i) the initial framing of problems and the identification of solution concepts for consideration in the policy process, (ii) the provision of input into the day-to-day activities of those charged with administering specific regimes, and (iii) evaluations of the performance of regimes and, in the process, the creation of a basis for adaptive management. Each of these types of contribution deserves a few clarifying observations.

As many observers have noted, framing issues for consideration in policy processes and identifying options for policymakers to consider can have far-reaching consequences for efforts to solve problems not only with regard to environmental matters but also with regard to the demand for governance more generally (Kingdon 1995; Stone 2002). In this connection, scientific research has already had a profound influence on policy processes relating to the institutional dimensions of environmental change by clarifying the distinction between governance and government and, as a result, directing attention to ways to supply governance without government (Rosenau and Czempiel 1992) as well as to the roles of non-state actors – including corporations and groups operating in civil society – in meeting the demand for governance in a variety of settings. Less prominent but still important is the role of scientific research in expanding the range of policy instruments available for treating environmental problems. The Carbon Management Research Activity, for instance, has participated actively in assessments of the relative merits of “targets and timetables” in contrast to “policies and measures” under the terms of the UNFCCC and the Kyoto Protocol and, in the process, in efforts to evaluate the

transferability of insights about cap-and-trade arrangements derived from studies of domestic systems to the operation of governance systems at the international level (Sugiyama 2005).

When it comes to inputs into the day-to-day activities of those responsible for operating regimes, the contributions of the research community take a different form. Here, studies of the sources of compliance and, more generally, the roots of the behavior of the subjects of regimes come into focus as key concerns (Breitmeier, Young, and Zürn 2006). Statutes, treaties, and especially informal agreements typically provide administrators with considerable discretion when it comes to moving systems of rights, rules, and decisionmaking procedures from paper to practice (Mitchell 1994; Underdal and Hanf 2000). Sometimes this is a reflection of the fact that policymakers cannot agree on such matters in the course of institutional bargaining. But even when this is not the case, there is little point in tying the hands of administrators who must cope with the complexities of real-world situations too tightly. It follows that those who engage in systematic research on matters like burden-sharing arrangements, compliance mechanisms, systems of implementation review, and so forth are often in a position to advise managers about matters of administration that can make a difference in determining the success of regimes created to address specific problems and about implementation strategies that can produce the desired results while limiting the costs to society of solving specific problems.

Processes of evaluation and adaptive management offer another attractive point of intervention for bringing research on environmental governance systems to bear in the policy process. Complex and dynamic systems require constant assessment to keep management systems in tune with changing circumstances. But policymakers and administrators seldom have the leisure to step back from day-to-day responsibilities to gain perspective on the performance of institutional arrangements and to adopt a synoptic view in assessing what works or does not work in efforts to solve or alleviate specific problems. But this sort of analysis is the stock-and-trade of the research community (Underdal and Young 2004). Policymakers periodically embrace innovations (e.g. cap-and-trade systems for managing emissions of pollutants). But neither they nor the agency personnel charged with implementing such arrangements are likely to have the time or the peace of mind needed to assess the results systematically, much less to compare and contrast the results arising in specific cases with those arising in other issue areas, in other countries, or even at other levels of social organization. Given an attitude of mutual respect and trust, there is much the scientific community can do along these lines to strengthen efforts to engage in a step-by-step process designed to improve the fit between governance systems and environmental problems. In the process, researchers will benefit as well from enhanced opportunities to test theoretical ideas against evidence derived from real-world experience.

The opportunities for initiating mutually beneficial interactions between policymakers and administrators and members of the scientific community are substantial with regard to the creation and

operation of resource and environmental regimes. Yet we have often failed to take advantage of these opportunities. Our experience points to two factors that are critical to success in fostering a productive dialogue between policy and science. Feelings of mutual respect can make a big difference in this realm. We have found repeatedly that once individuals on both sides of this relationship get to know each other as real people and to develop a sense of mutual trust, communication improves dramatically. Once the ice is broken, in other words, members of the two communities find that they share many interests and have a lot to say to one another that is thought provoking for all concerned. The second factor concerns the role of individuals we call "knowledge brokers," who are seldom researchers themselves but who have the capacity to understand complex scientific arguments and to communicate them in an accessible manner to policymakers and to members of the attentive public (Litfin 1994). The demand for knowledge brokers interested in the human dimensions of environmental change is rising rapidly as we move deeper into an era of human-dominated ecosystems (Vitousek et al. 1997; Steffen et al. 2004) and as the science of coupled socio-ecological systems becomes more complex. We have taken some steps already to meet this demand. But there is a great deal of room for improvement in this realm in the future.

8. Future Directions: An Integrative Approach to Governance

IDGEC has completed its lifecycle, a development that raises questions about future directions in research on the institutional dimensions of global environmental change. Efforts to address this topic as part of the synthesis process have produced substantial results. As described in some detail in Chapter 9, there is clear consensus not only within IHDP but also throughout the Earth System Science Partnership (ESSP) that IDGEC's research agenda is important and research on these institutional issues must be carried forward in some appropriate manner. To be more specific, this consensus suggests that we should frame future work in this field in terms of the overarching idea of governance and ask about interactions between institutions and a variety of other factors that play a role in the supply of governance to address specific problems. Already, some hints of interesting research questions regarding these links are emerging. The role of knowledge systems and more specifically discourses in shaping institutions and the reciprocal influence of institutions in shaping the content of discourses, for instance, has emerged as a rich domain for systematic analysis (Ebbin 2004; Agrawal 2005).

Of course, the Research Foci pointing to the generic issues of causality, performance, and design will remain central concerns in any scenario for the future. But the IDGEC team working on future directions has identified a number of more focused analytic themes that can serve to guide the ongoing efforts of the research community in much the same way that the themes of fit, interplay, and scale directed attention during the last decade. Among those that have evoked particular interest in the global

change research community are matters of architecture, agency, allocation, and adaptation (Biermann forthcoming).

Architecture has to do with complex linkages among institutions or, more broadly, the elements that make up complex governance systems. Arising in part from what IDGEC calls the problem of interplay, the emerging interest in institutional architecture points to a broader set of developments. Individual regimes dealing with related issues are evolving into what some investigators have called institutional complexes (Raustiala and Victor 2004). Linkages across levels of social organization that have significant implications for efforts to address environmental issues have given rise to a growing interest in what analysts have begun to call multi-level governance (Karlsson 2000; Gupta and Huitema forthcoming). More generally, many have observed that individual environmental and resource regimes are embedded in broader or more general governance systems, whether these are states at the national level or the web of laws, norms, and practices operating at the international level. Although there is much to be learned from additional research on individual regimes, therefore, there is an evident need to build out to encompass a range of issues associated with the theme of architecture.

The theme of agency directs attention to the constraints arising from IDGEC's focus on (inter)governmental institutions and calls for increased attention to what many have identified as agency beyond the state. Partly, this is a matter of directing attention to the growing roles that a variety of nonstate actors are now playing in the creation and operation of environmental and resource regimes (Betsill and Corell forthcoming). But the theme of agency raises issues of a more fundamental nature. Increasingly, we are witnessing efforts to bypass the state and, in the process, to develop a variety of new forms of governance ranging from wholly private governance systems to a wide variety of hybrid arrangements. Beyond this, those who speak of agency beyond the state have noted the importance of leadership on the part of individuals both in the creation of issue-specific regimes and in moving the resultant arrangements from paper to practice under real-world conditions. Although this type of leadership is hard to analyze systematically, the evidence that individuals can and often do make a difference in these settings is compelling.

The theme of allocation picks up on an observation made in an earlier section that IDGEC has directed attention for the most part to the roles that institutions play in causing and addressing environmental problems in contrast to their influence in determining who gets what in relevant issue areas. But it is not necessary to ignore or even to downplay the importance of institutions in problem solving in order to consider the allocative or distributive consequences of institutional arrangements. Sometimes this influence is quite specific as in provisions governing the initial allocation of individual transferable quotas (ITQs) in various fisheries or the initial allocation of emissions allowances under the terms of emissions trading systems like the cap-and-trade arrangement set up under the terms of the EU's

Emissions Trading Scheme (Raymond 2003). In other cases, distributive effects are implicit or more diffuse, but no less important for that. Systems that embrace the establishment of private property rights in contrast to various forms of public property or common property, for instance, invariably affect the interests of various players in the system differentially, whatever the pros and cons of arguments about their effectiveness in solving specific problems arising in human-environment relations.

Finally, there is the set of issues often addressed under the rubric of adaptation. This theme, too, has several components that are worth differentiating. Institutional adaptation comes into focus whenever the relevant problems are dynamic. Our growing awareness of the non-linear character of many environmental problems and the resultant prospect of abrupt changes has led to a recognition of the importance of creating institutional arrangements that are able to monitor biophysical systems closely, provide early warning of the onset of dramatic changes, and respond to these changes in a timely and effective manner. Beyond this, we have come to realize that environmental and resource regimes – like the biophysical systems they address – are dynamic and subject to many forms of change. Putting these observations together poses a particularly difficult challenge. We need to learn how to manage non-linear systems through the development and operations of governance systems that are themselves subject to changes that we do not understand well and that may have far-reaching consequences for their capacity to solve – or least manage – the problems they are created to address.

9. Plan of the Book

In closing, we offer a few remarks intended to set the substantive chapters to come in perspective. The body of the book is divided into an introduction, a conclusion, and three substantive sections: one on Research Foci, one on Analytic Themes, and one on Policy Relevance and Future Directions.

The sections on Research Foci and Analytic Themes cover the core of the IDGEC research agenda as laid out in the project's Science Plan. Chapters in these sections identify and evaluate in depth the contributions of the project to the generic questions of causality, performance, and design and to the specific problems of fit, interplay, and scale. In each case, we start from the most fundamental question articulated in the Science Plan: what do we know now that we did not know at the time the project was launched in the 1990s? To this core question, we have added during the synthesis process related questions concerning the policy relevance of research findings and future directions for research during the next phase of work in this field. There is no simple way to quantify or determine the exact role the project has played in stimulating the emergence of insights relating to the Research Foci and the Analytic Themes. We have tried to exercise caution in evaluating the project's role in stimulating specific advances in knowledge relating to institutions. In the nature of things, contributions dealing with the Research Foci are particularly difficult to attribute, since these findings are relevant to understanding institutions in

generic terms and belong to a much broader stream of research encompassing the work of those representing a variety of disciplines and issue areas. Because the project has been a leader in prioritizing the Analytic Themes of fit, interplay, and scale, contributions in this realm are somewhat easier to attribute. Where the project has become a forceful champion of the importance of a particular theme; there is reason to believe that it has made a difference in the growth of research on that theme.

The third substantive section of the book contains chapters on the policy relevance of the project's findings and future directions for research in this field. In our judgment, the policy relevance of this work has grown over time, although this is an area where it is particularly hard to sort out the contributions of specific projects or research groups. The issue of future directions is a vital one. There is widespread agreement that a continued emphasis on issues of governance is essential for research on the human dimensions of environmental change. Exactly what form the next phase of research should take is a topic for lively discussion. But there can be no doubt that this debate can and will be informed by the IDGEC's track record.

The book concludes with a chapter that ties up loose ends, comments on some topics not addressed or passed over lightly in the substantive chapters of the book, and reflects on the conduct of "big" (i.e. large scale, long-term) science regarding the human dimensions of global change. Long familiar in the natural sciences, this mode of operation is relatively new to the social sciences. It is clear that operating in such a mode has both strengths and weaknesses when it comes to research on subjects like the institutional dimensions of environmental change. The chapter explores ways to take advantage of the strengths of this form of research, while minimizing the problems arising from the weaknesses.

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