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1 Introduction

The oceans are heavily overfished. There is some argument among scientists, observers, and stakeholders over the degree of overfishing, but all agree that current practices are unsustainable (Ludwig, Hilborn, and Waters 1993). Some barriers to sustainability are technical. Marine ecosystems are complex and changes in fish population dynamics are hard to predict, so it is difficult to know exactly how management measures will affect fish stocks. However, the greatest challenges in fisheries governance are economic and political (Barkin and DeSombre 2013).

This book describes how the political economy of fisheries evolved from early times to today and then highlights key patterns and leverage points that are linked to sustainable transitions in specific fisheries. The analysis is grounded in the concept of *responsive governance*. Governance is responsive when actors and decision makers respond to environmental problems rather than trying to prevent them proactively. Furthermore, because fisheries are complex social-ecological systems, synthesis across fields and disciplines is important, and the analysis extends well beyond the infamous "tragedy of the commons" to the wealth of research on fisheries governance and on social-ecological systems more broadly. This interdisciplinary lens reveals that, over the long run, fisheries governance cycles between periods of ineffective and effective governance. I call this pattern the *management treadmill*. The historiography presented here demonstrates how endogenous and exogenous forces can either slow down or speed up the cycles of economic expansion and political response that shape the management treadmill for specific fisheries.

Throughout the literature, unregulated marine fisheries are consistently treated as tragedies of the commons. G. Hardin (1968) introduced this term in the context of pasturage on common land in medieval England. He proposed that as long as access to common land was available to all, none would have an incentive to conserve the resource because any pasturage

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not used by one individual could be taken by another. People would therefore place too many cattle on the common pasture, and overgrazing would result. As the grass on the commons disappeared, the number of animals that could be pastured there would decline substantially. Thus, "tragically," the number of animals in the village would be reduced well below the level that could be maintained if the common land was managed collectively or even turned over to private owners. This story struck a chord with researchers studying the use of natural resources. Fisheries experts in particular recognized that Hardin's tragedy of the commons fit well with what Graham (1943, 14) described as "the general tendency of free fishing to become unprofitable" and with Gordon's (1954) work showing that the level of effort in a commons fishery would be much greater than the economic or biological optimum. This realization quickly made Hardin's tragedy the primary focus of social science research on fisheries, and it is still central to academic inquiry and policy making today.

Although most authors accept Hardin's underlying logic, many argue that his conclusions are skewed because his analysis is apolitical. The need to consider governance is well established in the extensive literature on collective action epitomized by Ostrom (1990). This critique can be illustrated by comparing Hardin's pasturage metaphor with the reality of commons management in medieval England. As Buck ([1985] 2010) established through extensive historical research, there were in fact many rules and norms that governed access to the commons in the Middle Ages. Furthermore, observed overgrazing in the period was actually driven by economic development, technological change, and the resultant appropriation of the commons by powerful outsider elites who had little interest in maintaining the resource, rather than by competition among local users. In fact, the enclosure of common lands in England and the related Highland clearance in Scotland ushered in the greatest period of environmental degradation in Britain's history—a tragedy not of the commons but rather of power disparities, myopic decision making, and the externalization of environmental costs (Fraser 2007). These problems also affect fisheries. Indeed, the pattern described for cattle in medieval England will sound familiar to anyone who has studied collective action in a fisheries context. In case after case, longstanding, sustainable institutions disintegrate in the face of new markets, new technologies, and powerful new entrants (Munro and Bjørndal 1999).

Given this, the tragedy of the commons is important but insufficient as an explanation for fisheries overexploitation globally. The nature of the tragedy—indeed, the potential to avert or escalate overexploitation—depends on many other factors besides competition under open access.

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Hardin himself recognized the importance of the size of the human population relative to the resource base as a determinant of the scale of resource exploitation. In fact, his 1968 paper is actually an argument for curtailing population growth in the face of global environmental limits; calls to restrict access to specific commons resources were ancillary. Similarly, economic growth, globalization, and technological change can worsen the tragedy of the commons by increasing individual-level incentives to use the common resource (Young, Lambin, et al. 2006). On the other hand, the tragedy can be amplified politically when structures of power favor resource appropriation by a few individuals rather than collective management by communities that are dependent on the resource. This was true in the specific case of the medieval commons described above; it is also well established as a persistent problem in both private and common property regimes. Many authors also point out that negative externalities, defined as costs not included in the price of a good or a service, can increase overexploitation regardless of ownership structure (Daly 1987, 1996; Berkes et al. 2006).

On a more positive note, although Hardin advocated coercive approaches in his 1968 essay, there are more collaborative governance structures that can mitigate the tragedy of the commons. Cooperation occurs in many commons systems and is often spurred by the social-psychological characteristics of individuals such as innate cooperativeness and deeply held beliefs regarding fairness and equity (Schindler 2012). As Acheson (1997) established for lobster fisheries, through experience resource users can internalize a "conservation ethic" that ensures their adherence to conservation-based rules and norms that are perceived to be beneficial. There are many other examples of minimally coercive solutions to the tragedy of the commons in the literature on social practice. Some even argue that social practice has an effect on international management of the global commons by sovereign states (Young 2001). Moreover, research on the legitimacy of environmental governance shows that coercive methods of solving the tragedy of the commons can be counterproductive, destroying social norms and psychological attributes that support cooperative approaches (Hawkshaw, Hawkshaw, and Sumaila 2012).

The analysis presented in this book combines the insights described above, including the tragedy of the commons and its many extensions and exceptions, with the concept of responsive governance. Webster (2009) defines responsive governance as a trial-and-error process in which decision makers and other actors respond to problem signals by first applying the most expedient measures and then gradually ratcheting up their response

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if problem signals persist or intensify. Thus, rather than expecting proactive governance that ensures sustainable resource use, we can expect that action will occur only in response to signals of overuse such as biological depletion or economic recession. Although this runs counter to the common assumption of perfect rationality in economics and in public choice theory, it is well supported in several other literatures, including a wide array of research in political science, policy and organizations studies, and economic psychology.[1]

Figure 1.1 shows how responsive governance might work in a tragedy-of-the-commons situation. As long as management measures are weak and ineffective, the resource becomes less plentiful, which generates economic losses because of increasing marginal costs of production and other dynamics described below. This, in turn, increases political concern that amplifies pressure on decision makers to implement the most expedient management measures. If these measures are insufficient, the cycle continues, political will grows, and decision makers will try more and more costly measures, which may also be more effective. This cycling continues until there is a switch to an effective cycle of biological rebuilding and economic rebound, as depicted on the right-hand side of the figure. It is also possible that switching does not occur in time to prevent system collapse (the "too little, too late" scenario). When switching occurs early enough, management dampens exploitation, which allows the stock to rebuild, reducing costs and increasing profits. Ultimately, economic rebound reduces the political will to maintain effective management.

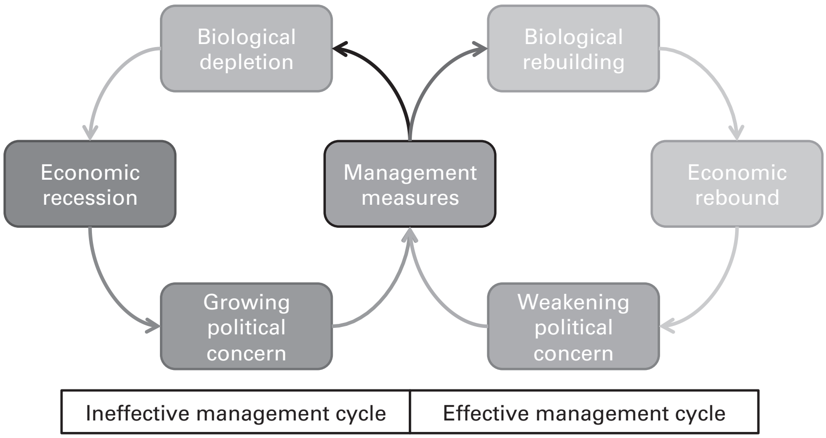

Figure 1.1
Ineffective and Effective Cycles in Responsive Governance.

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Webster tested the theory of responsive governance using a fairly simple vulnerability response framework to understand variations in the international management of tuna and similar species in the Atlantic Ocean. Although Webster found much support for the concept generally, the process of responsive governance proved to be more complicated than the simple feedback loops depicted in figure 1.1. Indeed, though it was generally predictive, the vulnerability response framework did not work well in cases where endogenous or exogenous factors altered management cycles, or where non-commercial interest groups wielded significant influence. The vulnerability response framework also was highly specialized to international fisheries management and did not allow for heterogeneity of fishing interests within states. The Action Cycle/Structural Context (AC/SC) framework presented in section 1.2 below allows for a more holistic approach to understanding responsive governance. It has the tragedy of the commons at its core, but it incorporates multiple actors, a wide array of private and public responses, and both endogenous and exogenous signal disrupters.

Exogenous factors are particularly important when one is considering the current overexploited state of many of the world's fisheries. As will be described in greater detail in section 1.3, fundamental theories in resource economics such as those described by Clark (2005) and Conrad (2010) posit that marginal costs should increase with stock decline, reducing net revenues[2] and thereby limiting entry into a fishery at the point where total revenue equals total cost under open access. However, a growing body of theoretical and empirical work shows that bioeconomic factors, including the schooling behavior of fish (Bjørndal and Conrad 1987) and technical innovation by fishers (Hannesson, Salvanes, and Squires 2010) can negate the increasing costs associated with declining stock size, dampening economic signals of biological problems. When a fishery is large relative to a market, all else equal, an increase in supply associated with overfishing can also be expected to result in a decline in price, which should reduce normal profits, limiting total effort and related overexploitation. This price effect is often omitted from bioeconomic models, but empirical work shows that investment in cost-cutting technologies and in market expansion through advertising can be used to counter the profit effects of declining prices associated with increasing supply in a tragedy-of-the-commons situation (see, e.g., Campling [2012] on the tuna commodity frontier).

Profit disconnects like those described above occur whenever bioeconomic signals drive resource exploitation above sustainable levels.[3] This is different from the tragedy of the commons, in which resource users ignore economic signals because of collective action problems. However, a wider

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profit disconnect does result in a higher "equilibrium" level of effort and so can exacerbate the CPR dynamic. Even without the tragedy of the commons, a profit disconnect can occur when there is a gap between the privately efficient level of production and the sustainable level of production because of market failures such as negative externalities.[4] Another profit disconnect is called temporal myopia, or the more extreme hyperbolic discounting, in which decisions are made based on short-run profits and future revenue flows are heavily discounted. Although the term "profit disconnect" is not used, all of these problems are already well known in economics but are mainly considered under equilibrium conditions where the *ceterus paribus* or all else equal assumption holds. However, there are many factors that constantly alter economic conditions in fisheries, so it is necessary to consider changes in the signals received by fishers when *ceterus paribus* fails and equilibrium shifts are common and can be continuous.

As an overarching concept, the profit disconnect allows for this type of dynamic analysis. The wider the profit disconnect, the longer users can continue to profit while overexploiting the resource. When the profit disconnect is increasing—that is, when the economic "equilibrium" level of production is being pushed further away from the sustainable level of production—the biological depletion depicted on the left-hand side of figure 1.1 is occurring, but it is not matched by corresponding economic recession, because profits do not diminish (and may increase) in spite of declining biomass and expanding supply. Without the economic costs of overexploitation, political will to engage in effective management remains weak and switching from ineffective to effective cycles is not expected. In contrast, if the profit disconnect is stable or is shrinking, then economic recession will occur sooner, strengthening political will to improve management more quickly.

The above analysis of the profit disconnect assumes homogeneity among fishers, but in reality actors are seldom equal. Thus, the effects of the profit disconnect usually are filtered through political systems and can be skewed by political factors. Indeed, a *power disconnect* occurs in responsive governance when the individuals or groups that experience the costs of overexploitation are politically marginalized. When power rests with a group of actors that is also insulated from problem signals by the profit disconnect, it will further delay switching from ineffective to effective governance, because the political signals received by decision makers will favor continued high levels of fishing effort. In such cases, the politically powerful segment of the industry continues to profit as a result of the lack of

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effective regulation, while others languish.[5] Because of the power disconnect, it is important to understand both the economic and the political structure of a fishery. Industry groups are economically heterogeneous and receive different problem signals depending on factors like the size of their operations, the availability of alternative sources of revenue, competitive pressures from other producers, consumer demand, and marketing structures, as well as management policies and governance institutions. Noncommercial interests usually respond to biological rather than economic problem signals and so may develop political will earlier than commercial interest groups. Which groups ultimately influence decision makers depends on a wide array of factors, but political power and the ability to form coalitions are important in almost any governance system.

Though signal disconnects are important, in responsive governance even weak signals may evoke successful and relatively early response when effective solutions are politically, economically, and technically expedient. However, solutions to environmental problems are usually politically difficult, economically costly, and technically challenging (Young 1999). This is particularly true for marine systems, which are highly volatile and complex. The tragedy of the commons does play a role, as it is typically more difficult to manage open-access resources than private property. However, scientific knowledge, management technologies, civil society institutions, and the general efficacy of government bodies are also major determinants of response options. The distribution of power also affects the set of politically feasible solutions. Effective solutions are easier to implement when the costs are borne by marginalized populations. This creates practical and normative tensions. Political empowerment is an important element of environmental justice and can increase the strength of problem signals; however, empowerment restricts the set of solutions available to decision makers.

Over the long run, responsive governance can produce several different outcomes, but the management treadmill is most common. When relatively effective response occurs before biological collapse or ecological shifts, renewable resources may rebuild to sustainable levels. As the problem signal dissipates, the political pressure to engage in management declines, and a gradual return to overexploitation can be expected unless institutions are in place to prevent it. The historical record shows that this oscillation between effective and ineffective management occurs in many of the world's fisheries. However, this *crisis rebound effect* is not the only driver of the management treadmill. All the factors that dampen problem signals, particularly those associated with the profit disconnect or the power disconnect, can also "reset" the management treadmill by changing

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the political economy of response. In a small percentage of cases, a reset has a positive influence on resources, as when changes in environmental conditions increase biological productivity. However, in the vast majority of cases, management becomes more difficult as endogenous and exogenous factors widen the profit disconnect, weakening political resolve and increasing incentives to ignore regulations. This is a fundamental problem that cannot be explained by the tragedy of the commons alone—but it can be understood through the responsive governance lens.

This book traces the evolution of the governance of marine fisheries from early times to the present, showing how responsive governance works—or fails to work—in settings ranging from small-scale coastal fishing communities to international fisheries that span entire oceans. This introductory chapter provides a general overview of the state of the world's fisheries before describing the AC/SC framework and methods used in the historical analysis. The chapters in the first part of the book examine forces like the profit disconnect that disrupt economic problem signals, document the expansion of fishing effort in scope and scale, and show how the industrialization of fishing created hierarchies within the industry as those with access to capital invested in larger and larger fleets while those without such access struggled to compete in smaller niches. The chapters in Part II explore how governance institutions coevolved with the economics of fisheries expansion. Specifically, they show how the power disconnect increased through history as larger commercial operations with greater economic and political power eclipsed small fishing communities. These chapters also explain how problem signals are processed by decision makers in many different regions and how the set of actors and management solutions changed, ultimately altering the process of responsive governance. Chapter 9 concludes the book with an evaluation of the results presented in the earlier chapters, identifying leverage points that can generate earlier, more effective responses, and calls for greater attention to exogenous forces that increase the speed of the management treadmill.

1.1 An Overview of Global Fisheries

The world's fisheries are important social-ecological systems that provide food, jobs, and economic development to many people. At the same time, fishing substantially alters inland and marine ecosystems in ways that can be difficult to understand. Overfishing can deplete specific species, disrupt ecosystems, and cause related socioeconomic losses as fishers struggle to adapt to declining harvests. By-catch—the incidental catch of non-targeted

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organisms—can also severely affect marine systems. Both targeted and non-targeted fishing mortality can alter ecosystems, sometimes causing irreversible shifts in the species composition of a particular area. This section provides an overview of the current biological, economic, and legal context for fisheries globally. It also defines various technical terms that will be used throughout the book and serves as a brief primer on fisheries science and management.

1.1.1 Production

Commercial fishing is a vast, lucrative, and highly differentiated industry. In 2010, total reported production of fish and other living marine and aquatic resources reached 148 million tonnes worldwide. The value of this harvest was estimated at US$217.5 billion (FAO 2012d, 3). Fish are also an important source of foreign exchange in developing countries, surpassing many traditional cash crops such as coffee, cocoa, and bananas. About 86.5% of the 2010 harvest was destined for direct human consumption, amounting to 6.5% of the world's consumption of protein from both animal and plant sources.[6] The rest of the harvest was used for consumer products such as cosmetics and pharmaceuticals as well as for industrial and agricultural uses such as animal feed, silage, fertilizer, and landfill. Approximately 54.8 million people earned a living as fishers or fish farmers in 2010; ancillary jobs in areas such as fish processing and distribution, production or maintenance of boats, gear, and other supplies, and research and development, supported between 660 million and 820 million people (10).

Overall production can be divided between capture fisheries and aquaculture and also between inland and marine systems. Figure 1.2 shows the growth in both capture production and aquaculture production in marine and inland waters from 1950 to 2010. For reasons that will be described in detail in Part I, capture production grew rapidly until 1990. Since then, capture production has leveled off while the rate of growth of aquaculture production has increased. Currently, capture production is about 59.7% of total production and aquaculture is 40.3%. Much of the increase in aquaculture occurred in inland waters (69.7% of the 2010 total), but marine aquaculture or mariculture has also grown slowly (30.3% of the 2010 total). The pattern is reversed for capture fisheries, with the majority occurring in marine waters (87.4%) and some slight growth in production from inland waters (12.6% of the 2010 total, as calculated from table 1 on page 5 of FAO 2012d). In the rest of this section and most of the rest of the book, the focus is on marine capture production.

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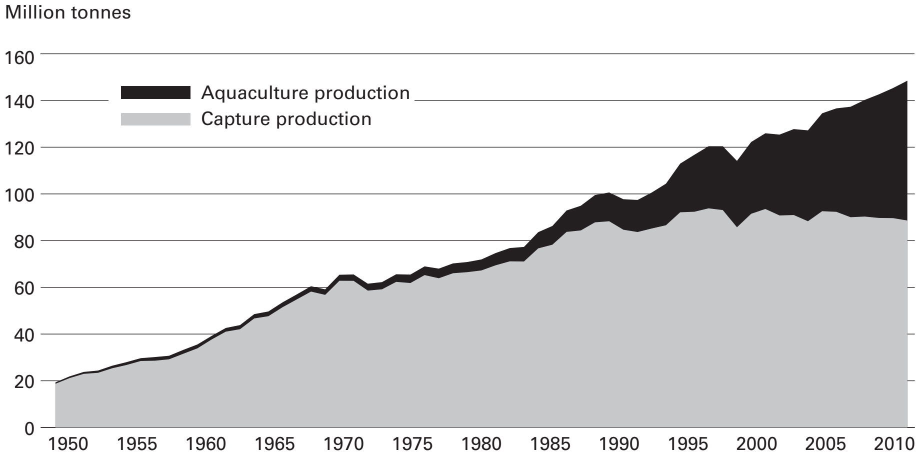

Figure 1.2
Global Fisheries Production 1950–2010. Source: FAO 2012d.

Capture production is the harvesting of wild species of aquatic organisms, including many species of fish but also aquatic plants, mollusks, crustaceans, and mammals. Throughout the rest of this book, I follow the example of the Food and Agriculture Organization of the United Nations (hereafter referred to as the FAO), simplifying the text by using the generic term *fish* to refer to all aquatic organisms harvested in fisheries. The majority of total capture production (84%) is made up of the primary group Pisces, or fish, mainly either cartilaginous fishes (Chordata Chondrichthyes) or bony fishes (Chordata Osteichthyes). Mollusks (phylum Mollusca) and crustaceans (Arthropoda Crustascea) are the second largest component of global landings at 7.4% and 6.8%, respectively. Plants (PlantaeAquaticae) and invertebrates (Invertebrata Aquatica) are 1% and 0.6% of capture production. Mammals (Mammalia), like the combined group of Amphibians (Amphibia) and reptiles (Reptilia), are a miniscule proportion of the total landings (0.0006% and 0.004%, respectively). Although absolute landings of each major group changed historically, these relative percentages are fairly stable over the period for which data are available (1950–2010; FAO 2011).

In contrast, at the species level the composition of landings has changed considerably over the last 60 years. In 1950, Atlantic cod and Atlantic herring were the most important species. At over 41 million tonnes, these two species made up about 22% of total landings. Their dominance waned in the 1970s, however, partly because landings of these stocks declined and partly because landings of other species increased. Now the top three species are

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anchoveta (Peruvian anchovy), Alaska pollock, and skipjack tuna. Together those species made up only 10% of total landings in 2010. Atlantic herring is now the fourth-largest component of landings and Atlantic cod comes in tenth. In fact, the top ten species in 2010, which included chub mackerel, European pilchard, Japanese anchovy, yellowfin tuna, and the aptly named largehead hairtail, made up only 21.5% of the total harvest, even though landings of these species are about five times as large as the combined landings of Atlantic herring and cod in 1950. Annual harvests of most of the top ten species exceed 1 million tonnes (FAO 2012a).

Thousands of other species are harvested in smaller amounts. Examples range from Atlantic mackerel (887,314 tonnes, 0.99% of global production in 2010) to a deep-water species called snaggletooth (1 tonne, 0.00000011% of global production in 2010). The FAO currently has landings data on 1,480 known species of fish, of which only ten accounted for more than 1% of global production in 2010, 96 for between 0.1 and 1%, and 1,374 for less than 0.1%. The FAO also keeps track of 296 "not elsewhere included" ("nei") groups consisting of fish that cannot be identified at the species level; examples include "marine crabs nei," "various squids nei," and "sardinellas nei." Two categories contain even less information on the type of fish landed: "marine fishes nei," (about 12% of total landings in 2010) and "freshwater fishes nei" (about 7%). In total, about 40% of the world's fish harvest consists of fish not identified at the species level (FAO 2012a).

It is important to note that the FAO dataset used here provides measures of "landings," "production," or "harvests," all of which indicate the proportion of the catch that is actually brought to land and (usually) sold at market.[7] In capture fisheries, catches can be larger than landings because of by-catch. Species by-catch occurs when a non-targeted species is caught incidentally with targeted species because the gear used is not selective. Size-group by-catch occurs when fishers catch fish of the target species that are too big or too small to sell. Size can matter either for legal reasons or because of processor or consumer preferences. Less valuable by-catch is often discarded at sea in a process known as high grading. When discarded, by-catch is often either dead or too weak to survive, and so incidental catches can still contribute to fishing mortality—or the amount of fish killed by fishing activities, which is usually measured in biomass rather than number of fish. Davies et al. (2009) estimate that the volume of global by-catch is equal to 40% of total landings. The composition of this catch is even more varied than that of targeted species, and the resulting fishing mortality can drive non-targeted populations to very low levels.

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Even if corrected for by-catch, the FAO data would still underestimate total production because they record only reported landings, and therefore do not include harvests by fleets from countries with limited data-collection capacity or production by illegal, unreported, and unregulated (IUU) fleets, which fish in contravention of international and domestic regulations. At present, countries (technically, "states") have responsibility for management of living marine resources in the water column up to 200 miles off their coastlines. Defined by the United Nations Convention on the Law of the Sea (UNCLOS), this area is called the Exclusive Economic Zone (EEZ). Some states are able to enforce their domestic management programs within their EEZs; others lack the capacity to do so, and there may be considerable illegal and unreported landings in their EEZs. Furthermore, although most commercial fishing boats are privately owned, they are supposed to be regulated by national governments. Thus, according to UNCLOS, a fishing vessel should carry the flag of its home country ("flag state")—the state that is responsible for ensuring that the vessel abides by all international maritime and fisheries laws on the high seas (outside of EEZs). Most of the data on fisheries landings described here were collected by flag states from legal fishing operations and then reported to the FAO. IUU harvests are not included in these datasets. Good data on IUU landings are not available, but it is clear that these fleets can have substantial affects, particularly on high priced fishes[8] such as bluefin tuna, Patagonian toothfish, or orange roughy. Management capacity is also important, as weaker regulations or a lower likelihood of getting caught increase the benefits of fishing illegally (Sumaila, Alder, and Keith 2006).

Figure 1.3 shows the distribution of reported landings by flag state in 2009. It is a cartogram—a map that has been transformed by an algorithm so that the size of each country reflects the relative value of an associated variable. One can see that Asian countries landed the largest portion of the world's harvests, followed by Europe (including the former Soviet bloc), South America, North America (including the Caribbean), Africa, and Oceania. Asia's landings increased rapidly over the last 60 years and now account for about 55% of all capture production in the world. Over the last two decades, most of this growth occurred in China, which currently supplies 17.5% of world fisheries production. Africa also shows slow but steady growth in production over the entire period 1950–2010, but European and North American harvests peaked in the late 1980s, South American landings peaked in the early 1990s, and production by fleets registered in Oceania peaked in the early 2000s (FAO 2012a).

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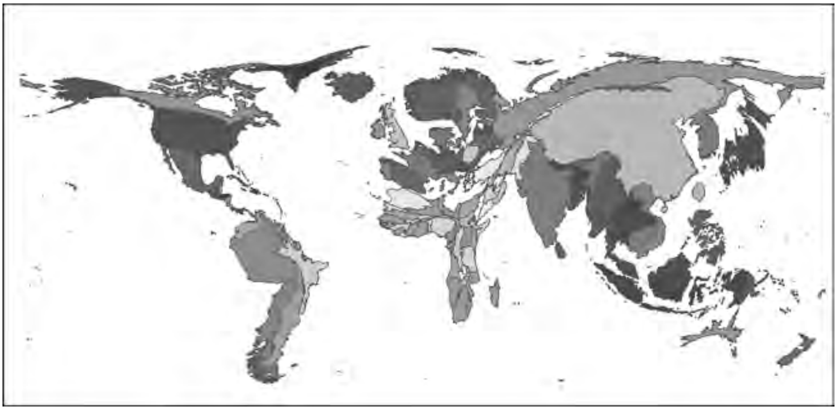

Figure 1.3
Cartogram of global capture production in 2010. Source: FAO 2012a.

At the country level, variation in capture production is substantial. The FAO has data on 240 states and other "fishing entities" (for instance, island groups that are protectorates of former colonial powers). At present, landings by the top ten fishing states account for about 60% of the world's capture production. The top 15 countries harvest about 69% of total production, and the top 25 are responsible for 80%. As has already been noted, China is the largest producer in global capture fisheries. Landings by Chinese fleets rose rapidly from about 3.1 million tonnes in 1980 to 15.5 million tonnes in 1998 and have been fairly steady since. Other top fisheries producers include the EU member states, Indonesia, India, the United States, Peru, Japan, and the Russian Federation. Some countries, including Thailand, Chile, Myanmar, Norway, and the Republic of Korea, land large harvests in some years but not others (FAO 2012a).

In general, production by developing countries increased since 1950. Production by developed countries, which were historically dominant, began to decline around 1990. Though most of the growth in production over the last three decades occurred in developing and emerging economies, even so-called least developed countries have increased production in recent years. As a result of these trends, countries like Canada, Germany, Norway, Spain, and the United Kingdom, which were in the top ten in 1950, were gradually replaced by countries like Chile, Thailand, the Republic of Korea, and Myanmar (each of which was in the top ten for at least a year in the 1990s or the 2000s). Other countries, like Japan, the United

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States, and the USSR/Russian Federation managed to stay in the top ten but were eclipsed by China, India, Indonesia, and Peru.

1.1.2 Consumption and Trade

In addition to varying in their levels of capture production, countries around the world vary in their volume of trade in fish products, in their consumption of fish, and in the number of livelihoods supported by the fishing industry. Fisheries are a major source of food, providing 16.6% of the world's protein intake in 2009 (FAO 2010a). Figure 1.4 maps the global distribution of fish consumption for food (kilograms consumed per person per year). In some countries, like Portugal, Spain, Norway, Myanmar, Malaysia, the Republic of Korea, and Japan, per capita fish consumption exceeds 40 kg/person/year. In much of Africa and Central Asia, consumption is less than 10 kg/person/year. Per capita fish consumption tends to be lower in developing countries and higher in developed or emerging economies. This is somewhat surprising, because fish is a more important source of protein in developing countries (19.2% of animal protein intake) and in "least developed" countries (24.0%; FAO 2012d, 5).

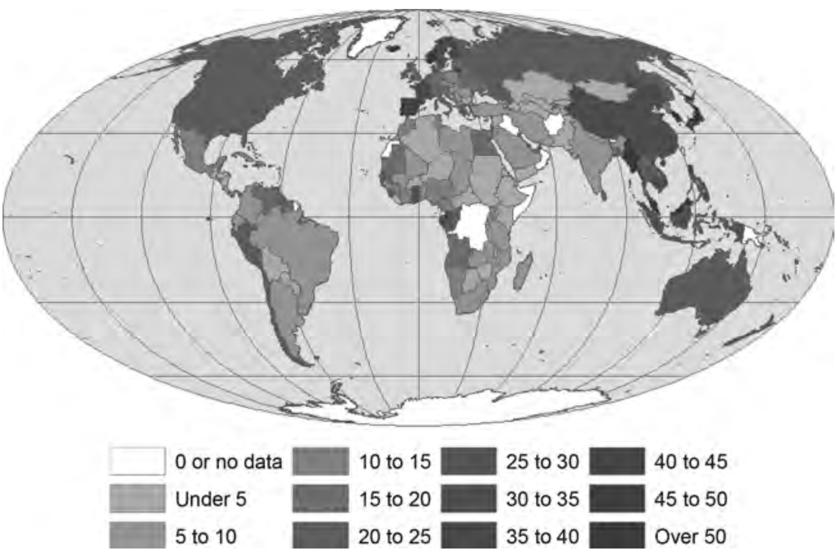

Figure 1.4
Reliance on fish as a source of protein in 2009 (kg/person/year). Source: FAO 2012b.

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At the local level, fish consumption depends on geographic and cultural factors, as well as income and access to transportation. In general, people who live in coastal communities are often heavily dependent on fish as a primary source of nourishment, and people who live inland consume less fish. This is particularly true in countries where the transportation infrastructure cannot accommodate fresh fish and in countries where processed fish products are expensive imports rather than cheaply produced domestic goods. Conversely, when coastal communities have greater access to food from other parts of the country or the rest of the world, they can diversify their diets and need not depend so heavily on fish from local waters. Thus, in developed countries more people eat fish but fewer depend on fish for survival, and in many developing countries fewer people eat fish but more depend on fish as a major component of their diet.

About 40.5% of the fish obtained through capture production are consumed fresh or chilled, with little post-capture processing. The remainder is processed into food products (45.9 %)—including canned tuna, breaded fish sticks, and frozen bluefin tuna carcasses that will eventually become sushi or sashimi in high-end restaurants—and non-food products (13.6%), such as animal feed pellets, fish oils, and beauty products (FAO 2012, 13). Processing adds value to fish by either making products more desirable to consumers or allowing landings to be transported to areas where the price for the product is higher than in the region of capture. However, fish are not necessarily processed in the same part of the world in which they are captured. Fleets from the Americas produce more than twice as much raw material as European fleets, but Europe (including the former Soviet bloc) processes much more fish than North America and South America combined. In addition, Asia's output of processed fish products is slightly larger than its contribution to capture production, even though China is globally dominant in both. Africa and Oceania, whose fisheries rank low in capture production, rank even lower in output of processed fish products.

As might be expected from these levels of consumption and these variations in production, trade in fisheries products is also distributed unevenly around the world. Figure 1.5 contains two cartograms, one illustrating the value of imports of processed fish products and the other illustrating the value of exports. It is clear that Asia is the largest exporter of processed fish products by value, followed by Europe, North America, and South America. Africa, the Middle East, and Central Asia export very little processed fish by value. Western Europe imports the most processed fisheries products by value, followed by the United States and Japan. Africa, the Middle East,

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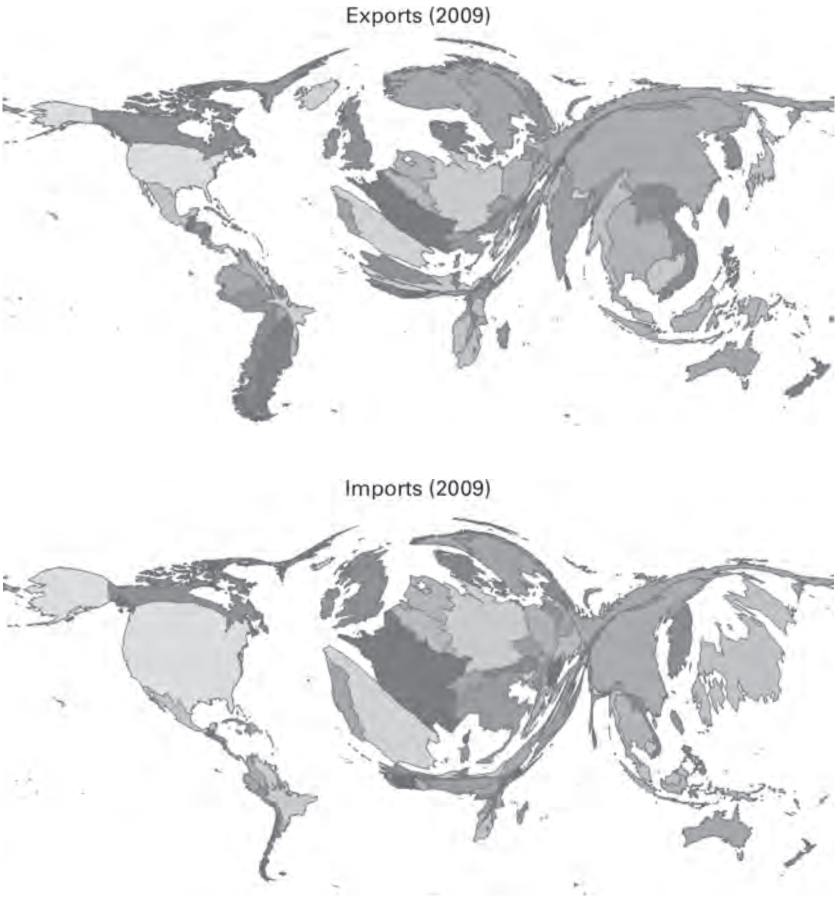

Figure 1.5
Cartograms of value of world trade in fisheries products in 2009. Source: FAO 2012a.

Central Asia, and Central and South America import very little processed fish by value.

These aggregate numbers hide considerable variation. The world's fishing fleets range from small-scale inland and coastal fleets that target a wide range of species to highly specialized distant-water fleets that target the same species throughout the oceans. Furthermore, the fishing industry has many sectors, including boat builders and gear manufacturers, the fishers themselves, fish-processing corporations, product marketers, importers, exporters, wholesalers, and retail distributers of fisheries products. All these sectors provide livelihoods for their workers. Those involved in processing,

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marketing, and distributing fisheries products can also add value to basic capture production. The economic benefits of fishing are not evenly distributed across these groups, and conflicts often arise among segments of the industry because each has different interests. For instance, processors prefer to keep ex-vessel prices (the amount they pay fishers for their landings) relatively low, whereas fishers would prefer to be paid more for their harvests. Alternatively, fishers using different gear but targeting the same species often clash over rights of access to the stocks. These differences in interests are complicated by variations in economic and political power, which shape responsive governance.

1.1.3 Sustainability

Concern about the sustainability of marine fish stocks and ecosystems is increasing. Perceptions regarding the current state and future potential of marine fisheries depend on beliefs regarding both human and natural systems. As will be described in chapter 8, there are multiple perspectives on what constitutes a healthy fishery or what is acceptable as effective fisheries management. In this subsection, I will review assessments of effectiveness based on three primary management standards from the fisheries literature: the single-stock maximum sustainable yield (MSY) benchmark, fisheries-centric ecosystem approaches, and ecosystem-focused approaches to management.

First, based on the MSY approach, the UN's Food and Agriculture Organization began assessing the state of the world's marine commercial fish stocks in 1974. Figure 1.6 shows changes in the level of overexploitation since that time. Though fully exploited stocks (at biomass that will support MSY) remain relatively stable at around 50% of assessed stocks, stocks not fully exploited (that is, biomass above that which supports MSY) declined from 40% to just over 10% in the period, while overexploited stocks (biomass below MSY levels) climbed from 10% to about 30%. From these estimates it appears that overexploitation of marine fisheries is increasing around the world, but at a decreasing rate—particularly for overexploited stocks.

Representing the fisheries-centric perspective, Hilborn et al. (2005) recognize that fisheries around the world are in crisis, but they view pockets of successful management, such as the individual transferable quota (ITQ) programs of Iceland and New Zealand, as signs that improvement is possible if appropriate measures are implemented. While accepting that ecological risks are present, fisheries-centric authors assert that most of the worst stock collapses are not caused by single-stock MSY-based management *per se*. Instead, they blame insufficient management for fishery failures. From

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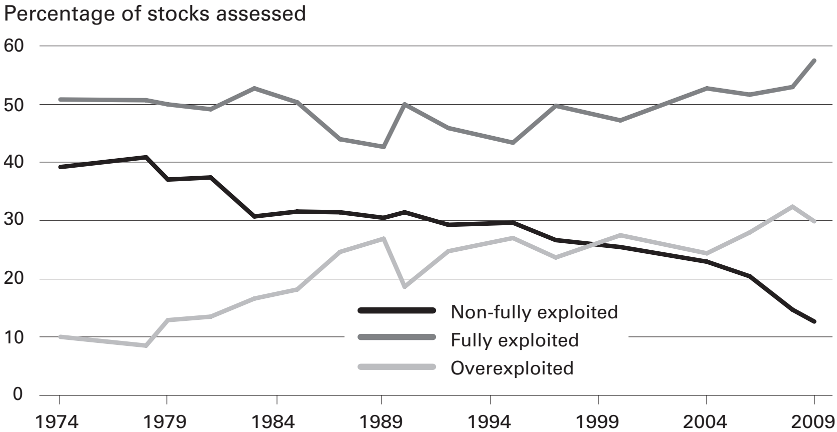

Figure 1.6
Global trends in the state of world marine fish stocks since 1974. Source: FAO 2002a.

a fisheries-centric perspective, this means that technical solutions to the management problem are already sufficient, but that political and economic factors prevent effective implementation.

In contrast, proponents of the ecosystem-focused perspective paint a much bleaker picture of the current state of fisheries resources. Indeed, some scientists and conservationists believe that world fisheries are on the brink of collapse. Like the contributors to Sumaila and Pauly (2011), some authors assert that MSY approach to management underestimates problems associated with overfishing because effects on ecosystems are ignored. They argue that drastic reductions in fishing mortality and extensive efforts to restore habitats are necessary to prevent ecosystem collapse around the world. Because they focus on the potential for catastrophic and irreversible shifts in ecosystems caused by trophic cascades and other complex feedback processes, these authors are risk averse and highly sensitive to the ecological repercussions of fishing. On the other hand, while they recognize the importance of fishing communities, ecosystem-focused researchers tend to downplay the current costs of their proposed management schemes—which are often quite high—in favor of future economic and ecological benefits. This makes sense from an ecological perspective; however, it can be counterproductive politically, since short-term costs often ignite fishers' opposition to management.

These political concerns are very important. In view of the scientific uncertainty surrounding marine fisheries, it is not likely that the debate between fisheries-centric and ecosystem-focused epistemic communities

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will be settled any time soon. However, since all sides agree that action needs to be taken sooner rather than later, it makes sense to focus on finding ways to remove political roadblocks to each type of management. This does not mean that fishers' voices should be excluded from political processes or that the industry should be marginalized. In fact, quite the opposite is true. Without industry acceptance, management tends to fail spectacularly. Yet there are ways to reduce political opposition to management without excluding key participants. The historical record shows that there are a number of switching mechanisms that precipitate transition from a downward spiral of depletion under ineffective management to an upward cycle of rebuilding under effective management. The AC/SC framework helps to identify both factors that delay response and factors that facilitate switching.

1.2 Responsive Governance and the AC/SC Framework

Responsive governance is a simple concept that is analytically challenging. Empirically, governments are demonstrably responsive in many issue areas, including environmental management. There is a considerable literature on responsiveness related to various types of crises, issue attention cycles, and interest-group activities (Higgs 1987; Downs 1972; Baumgartner et al. 2009; Grossman and Helpman 2001; Hilborn and Walters 1992). Research on learning and organizations also supports a trial-and-error model, although true learning goes beyond experience to the internalization of ideas and norms (Simon 1955; Newell and Simon 1972; Sprout and Sprout 1979). The literature on economic psychology further underlines the responsive nature of decision making when individuals are faced with complex problems, information is limited, transaction costs are high, and causal connections are difficult to identify. Temporal myopia is a well-known phenomenon, and heuristics (mental short-cuts) often bias action toward responsive rather than proactive behavior.[9] For instance, the availability heuristic usually skews action toward local-scale problems that are easily imagined (vivid) and perceived to be important (salient) in day-to-day life (Kuran and Sunstein 1999; Sunstein 2006; Finucane et al. 2000). Surveys also show that direct experience with environmental costs is a necessary precursor to political action, even when individuals acknowledge risks (Moser and Tribbia 2006; Moser 2007; Brody et al. 2008; Zahran et al. 2006). Thus, there is ample evidence that individuals and decision makers are responsive, at least in the area of environmental governance.

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Responsiveness among fishers, processors, and other economic actors is also supported in the literature. The tragedy of the commons itself fosters short-run decision making, and this effect is amplified by high levels of uncertainty about future prices and the size of the fish stock (Clark 1973). Even when property rights are well defined by policies like individual transferable quotas, fishers often have fairly short time horizons and high discount rates, so investment calculations are heavily weighted toward current catch and profit levels (Asche 2001). In this fishers do not differ much from other business entities. *Short-termism* occurs when businesses invest only in projects with high expected payoffs in the short run (Cooper et al. 2002; Dallas 2012). Whether for the fishing industry or for other businesses, these short-term outlooks lead to behavior that is more responsive than proactive.

Although responsive behavior is ubiquitous in the issue area covered here, response for any given issue and time period is shaped by the context of decision making and by the existing institutional structures. In addition to learning, each political response to problem signals builds up new institutions, constituencies, and capacities that alter the problem structure for future decisions. Decision makers, defined as those individuals, governments, or states that have direct control over the formal rules and norms of exploitation, can establish new formal institutions that change incentive structures and power relationships (see subsection 1.3.3). Other actors can also alter the strength of problem signals, present new solutions, pressure decision makers, and change the informal rules and norms of governance (Sabatier 1987; Ellickson 1991; Wilson, Yan, and Wilson 2007). These actions may be directly spurred by the use of the resource (endogenous) or generated by external forces (exogenous). Lastly, the aggregation of these different attributes depends on the politics of power and on broader governance structures, such as the form of government (e.g., democracy vs. authoritarianism) and the scale of the problem (local, regional, national, or global).

With this complexity, it is useful to have a framework that delineates the different aspects of responsive governance and demonstrates how these factors fit together (Collier 2011). This is why I developed the Action Cycle/Structural Context (AC/SC) framework to guide the analysis presented in this book. It is inspired by Giddens' (1979) concept of *structuration,* which states that the actions of individuals and those of groups can affect institutional structure even as structure affects actions. This was Giddens' answer to the agency-structure debate in sociology. It contrasts with theories that focus only on the role of actors and with theories that view structure as the sole determinant of outcomes. The AC/SC framework also draws on

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work from the literature on domestic and international governance, on bioeconomics, and on social-ecological systems (SESs; also called coupled human and natural systems). It fits into a growing literature on middle-path approaches to the action-structure debate and also engages multiple disciplines, which is important when one is analyzing environmental issues (Clapp 2011).

Like most other frameworks for understanding social-ecological systems, the AC/SC framework comprises broad categories and relationships rather than the more detailed specifications of a model or a theory. It is not a replacement for existing theories and models. Instead, it provides a set of unifying concepts that encompass multiple inter-disciplinary and intra-disciplinary ideas. Although this limits specificity, it provides flexibility and allows for accommodation of variation between different contexts, which is necessary because of the interdisciplinary scope of the analysis and complexity of SESs (Anderies, Janssen, and Ostrom 2004). The primary difference between the AC/SC framework and other frameworks in this area of the literature is the theory of responsive governance and related treatments of change, including the potential for learning, institution building, and cycling between ineffective and effective periods in the management treadmill.

Much of the AC/SC framework, including the structural context and the linkages between actions and problems, is designed to synthesize multiple theoretical perspectives. In this, the AC/SC framework is similar to other frameworks in the field, including the well-known framework proposed by Ostrom (2009; see also Ostrom 2007). All the factors listed in Ostrom's framework, including resources units, resource systems, resource users, governance systems, and feedbacks can be accommodated in the AC/SC framework. The primary distinction between the two frameworks is that the framework of Ostrom assumes decisions based on expected costs and benefits, whereas the AC/SC framework is based on the paradigm of responsive governance. Another distinction is that there is little discussion of power relationships in Ostrom's (2009) interactions, which include self-organization, networking, and lobbying, as well as related outcomes in terms of various social and ecological indicators but neither power nor politics are discussed. Young et al.'s (2006) portfolio approach to analyzing complex human and natural systems can also be applied using the AC/SC framework. However, the purpose of that approach was to improve institutional design rather than explain institutional change. In contrast, explaining institutional change is the primary focus of the AC/SC framework, although evaluating effectiveness is also an essential component of the

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analysis. Indeed, the point is not just to define variables and processes that generate changes in fisheries governance but to understand how social-ecological systems evolve in response to those forces. Though such evolution is not based on random mutation, trial and error are crucial components of the system, and actors' responses can be both adaptive and maladaptive. In all, the analysis comes down to the linkages between the social construction of context (action), the effect of context on actor behavior (structure), and the interactions between humans and the environment that shape both action and structure.

Giddens developed the theory of structuration for sociological studies of closed communities, but the AC/SC framework is a tool for parsing the political economy of responsive governance in open systems. It is therefore quite different from Giddens' original formulation. Intellectually, it is closely related to iterative approaches in political science such as that of Cohen, March, and Olsen (1972) and that of Kingdon (2011). First, I associate agency with problem solving through an *action cycle*. Actors choose how to respond to signals they receive about some underlying problem, such as an economic recession, a terrorist threat, or the overexploitation of a stock of fish. The nature of both the individual response and the aggregate response depends on the *structural context* in which decisions take place. Over time, however, responses in the action cycle can alter the structural context and thereby affect the behavior of the system as a whole. Figure 1.7 illustrates these points by embedding the action cycle in the structural context, indicating that action is constrained by the structural context but that the context is itself created by the compounding of actions. Exogenous forces also drive, catalyze, or limit the action cycle, and they may operate at different "speeds" than the action cycle itself, as per the panarchy concepts put forth by contributors to the volume edited by Gunderson and Holling (2002) and further advanced by various authors including Liu et al. (2007), who systematically investigate cyclical and spatial characteristics of coupled human and natural systems.

First, the Action Cycle consists of a *problem* (or multiple problems) that generates *signals*, which, in turn, trigger *responses* by actors. For instance, pollution (a problem) can cause negative health effects (a signal) which then generate political action (primary response) and, where governance favors those harmed, regulatory action (secondary response). Responses may help to solve problems but can also simply dampen signals, allowing problems to become worse in later periods. As is discussed by Webster (2009), it is assumed that actors generally prefer expedient responses that have low political and economic costs. However, when a response is

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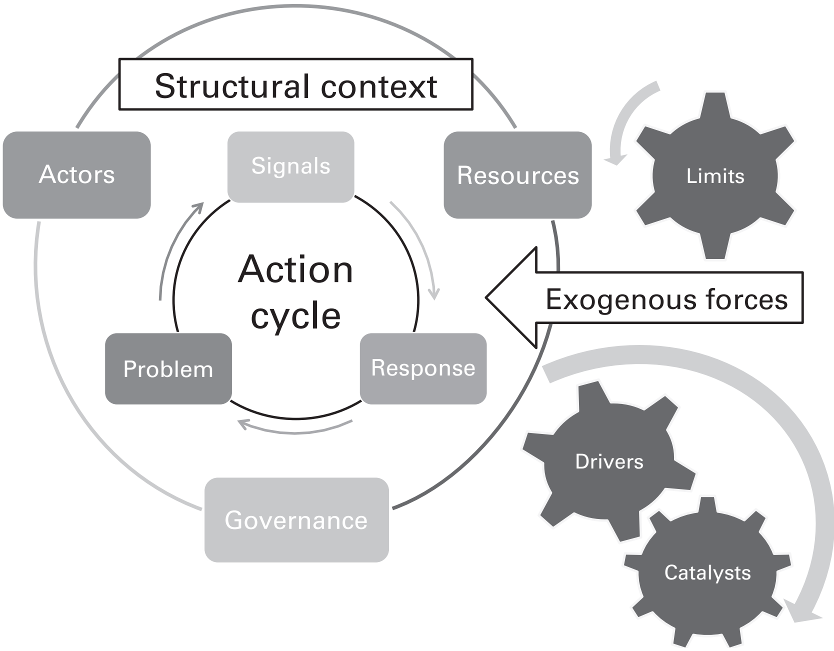

Figure 1.7
The Action Cycle/Structural Context (AC/SC) framework

institutionalized, the structural context of the system is altered and the response to a problem can accelerate. Specifically, the formation of institutions or agencies modifies the governance mechanisms that circumscribe the system. For instance, the US Environmental Protection Agency was created in part as a response to several well-publicized pollution events, but was not disbanded once those problems were solved. Rather, it remains the central agency for pollution regulation in the United States. It is important to remember that responses can be both adaptive and maladaptive, in that some increase the long-term resilience of the system and others hasten the system's collapse.

Turning to the structural context, according to Young (1994), *governance* factors include formal laws, regulations, and agencies, as well as informal rules and norms governing the behavior of actors. The AC/SC framework is designed to accommodate all levels of analysis and to highlight points of similarity or difference when used comparatively, as in the historiography presented in this book. *Actors* themselves play a part in the structural context because institutions circumscribe the roles and resources available to them. Though some actors may work to change their roles in the system, this

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behavior is driven by the action cycle. Furthermore, actors may be individuals, groups, governments, or states, depending on the case under consideration and the needs of the researcher. *Resources* include natural resources, capital goods and finance, technological and managerial capacity, and political power bases. As with other structural components, resources regulate the action cycle but they can also be altered as actors work to achieve solutions to signaled problems. Where resources are limited, the system as a whole is limited, unless actors can find a viable substitute.

All of the above factors are considered to be endogenous to an AC/SC system. However, other factors can change the action cycle or alter the structural context exogenously. These factors generally fall into two major categories: *limits* and *drivers*. The latter can be further broken down into direct drivers and catalysts of change. Exogenous limits are forces that prevent growth in a system. They may be related to governance, economics, or natural systems, and they may include institutional interplay, macroeconomic factors, and biophysical factors such as finite reserves of non-renewable resources and the potential for exhaustion of renewable resources. Ecosystem effects are particularly important limits when one is dealing with living resources such as fish and other marine fauna. Exogenous drivers are forces that increase the speed and intensity of the action cycle. Like limits, these drivers can be related to governance (as when governments choose to subsidize industries), to economics (as when economic development drives increasing production), or to the environment (as when changes in oceanographic conditions improve the productivity of a stock of fish). Technological innovation that is not directly associated with the action cycle can also catalyze sudden change in the cycle and/or in the structural context. Catalysts do not work independently; rather, they amplify existing drivers, as represented by the interlocking gears in figure 1.7. Sometimes these shifts mitigate the underlying problem, as with renewable energies and climate change, but more often technology increases environmental problems by reducing the costs of production; hence the association of catalysts with drivers rather than limits.

Temporal cycling is a common characteristic of complex social-ecological systems, and timing can be an important determinant of resilience (Folke et al. 2005). When dealing with time in the AC/SC framework it is important to differentiate between the speed of the action cycle itself and the speed of transition from the "ineffective" to the "effective" cycles shown in figure 1.1. Speeding up the action cycle means that problems worsen more quickly than they would otherwise, so that problem signals should escalate faster. This can generate a response that occurs earlier in time but later relative to

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the severity of underlying problems. Speeding up the switching response entails ensuring that "solutions" are in place when problems are relatively small and manageable. Thus, in a system in which the action cycle is slow (for instance, a small artisanal mining operation), effective response may occur after many years of exploitation but still be "early" if environmental problems remain small. Alternatively, in a system where the action cycle is fast (such as one dominated by large industrial mining corporations), switching that occurs after a few years may still be "later" than in a slower action cycle because the amount of pollution or degradation produced in the ineffective portion of the action cycle is greater, even though the period of ineffective management is much shorter.

According to Young (1999a) and many others, institutions are effective only when there are direct causal connections between rules and norms, human behavior, and related change in the resource level or environmental condition. Furthermore, these changes must be sufficient to meet predetermined institutional goals. However, tracing and testing these causal connections is very difficult in SESs, and in many instances perceived effectiveness differs from actual effectiveness (which usually is not determined until much later). For instance, if changes in environmental conditions cause the size of a fish stock to increase just after management measures are implemented, these measures are usually perceived to be highly effective; however, if environmental conditions cause the size of a stock to decline after implementation, the measures are usually perceived to be ineffective. This dynamic can either reinforce or undermine management, depending on the direction of the difference. Because of these complications, I treat the action cycle of responsive governance as "ineffective" as long as the underlying bioeconomic problem persists and as "effective" when that problem is mitigated, even if mitigation is caused by non-governance factors. This can be thought of as *relative effectiveness*, with governance evaluated on the basis of its effectiveness relative to the underlying environmental conditions. Moreover, it is also possible to evaluate response on the basis of criteria such as the level of monitoring and enforcement or the level of compliance with scientific advice. This will be discussed more in the introduction to chapter 7.

1.3 Applying the AC/SC Framework to Fisheries

Because the AC/SC framework is cyclical, the analytical process is iterative. For any given topic or case, the first step is to outline the scope of the analysis and identify a beginning or "start point" for the study. Defining

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the core problem helps in this process. If the focus of the analysis is a single event or case, the start point should coincide with the initial human action contributing to the core problem in that case. For instance, if one is interested in the collapse of a specific stock of fish, a logical start point is the initiation of the fishing activities that eventually led to the collapse. The next steps are to articulate the primary endogenous drivers generated by the core problem, to describe the structural context, and to show how the action cycle functions at that start point. With this foundation, the analysis moves "forward" in time as responses are observed and as effects on the action cycle and on the structural context are documented. This method is known as process tracing and may be a purely descriptive exercise or may be combined with hypothesis testing.[10] In either case, it is also necessary to anticipate and account for exogenous factors throughout the analysis. This includes description of external influences and their effects on the structural context, on the action cycle, or on both the structural context and the action cycle. In this section, I provide a generic overview of the fisheries application of the AC/SC framework with a focus on explaining the economics of expansion and the related co-evolution of the structural context through responsive governance.

1.3.1 Core Economic Problems and the CPR Driver

Three core economic problems characterize any application of the AC/SC framework to fisheries: overfishing, overcapitalization, and ecosystem disruption. *Overfishing* (also known as overexploitation) occurs when the level of catch exceeds the maximum sustainable yield (MSY)—the most that can be sustainably harvested. Furthermore, a stock is overfished (overexploited) when the size of the stock (usually measured as "biomass") is reduced below the level that will support MSY. *Overcapitalization* occurs when fishers invest more than the economically optimal amount of time and money in their fishing operations. A fishery is *overcapitalized* when the total amount of capital invested in the fishery is greater than the level that will produce the maximum economic yield (MEY)—the most profitable level of production that can be sustained (Clark 2005). Both of these problems are based on single-stock perspectives, but fishing can also cause *ecosystem disruption* through extraction of targeted species, by-catch mortality, and habitat destruction (Pikitch et al. 2004). Most marine systems are highly resilient, and can recover from substantial levels of disruption, but a number of cases of long-term fishing-induced shifts in the species composition of ecosystems are known (Bakun, Babcock, and Santora 2009; Lindegren, Diekmann, and Möllmann 2010; Edwards et al. 2013). These ecosystem shifts will be

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discussed further in the next two subsections. The simpler model described here covers a closed, single-stock fishery, so overfishing and overcapitalization are the only pertinent problems.

The primary driver of these core problems in most fisheries is the tragedy of the commons, or, more formally, the common pool resource (CPR) dynamic. CPRs have two specific qualities. First, they are *rival*: if one user extracts a unit of the resource, that unit is no longer available for capture by other users. For instance, if a fisher catches a fish it is no longer available to other fishers, whereas if a photographer takes a picture of the fish it will still be available to other photographers—at least until it swims away. Thus, fishing is rival and photography is non-rival. Second, CPRs are *non-excludable*, so there is no simple way to limit the number of resource users or assign property rights to a user who could then have a greater interest in maintaining the resource. In theory, the combination of rivalness and non-excludability leads to overfishing and overcapitalization as users invest large amounts of time and money to capture as many fish as they can as fast as they can, rather than leave any to be taken by others (Barkin and Shambaugh 1999).

Figure 1.8 shows how this basic CPR model of a fishery looks through the AC/SC lens. In the structural context, fishers are the only actors.[11] Here "fishers" refers to individuals in the fishery who make decisions regarding the level of fishing effort. Though labor markets certainly contribute to the effort decision, captains and vessel owners are the more pertinent actors in most analyses. The generic fishers represented in this basic CPR model are assumed to be homogeneous and independent actors. Their resources are limited to time available for fishing, existing technology, and a single fish stock. Fish population dynamics and exogenous economic factors are stable; for example, growth rates and prices are fixed. The only outside influence is the entry of new fishers, who are drawn in by the CPR dynamic; exogenous forces are omitted. In this model there are no institutions governing the behavior of fishers except the norm of non-cooperation, which is inherent in the CPR dynamic.

In the action cycle, the CPR dynamic is the core driver and overfishing and overcapitalization are the core problems. Short-run profits (total revenue minus total costs)[12] are the primary signal in this system, and the only response available to fishers is a change in the level of fishing effort. Since technology is constant, the only way to change effort is to increase or decrease the amount of time spent fishing. For any individual fisher, time available for fishing is limited by human physiology, personal preferences about leisure, and the economic constraint that total revenues must cover

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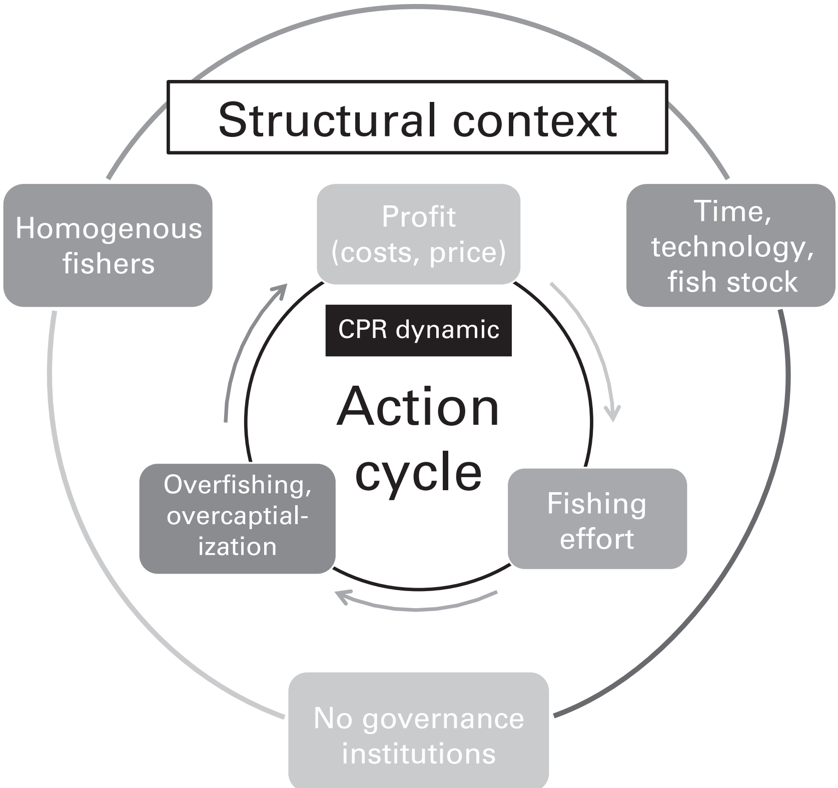

Figure 1.8
AC/SC for a basic common pool resource.

total costs. Since fishers are homogeneous, all will choose the same level of fishing effort, which is the maximum possible in a specified time period. However, new fishers may enter the system, and are expected to do so as long as total revenue per fisher is greater than total costs and profits are positive.

The start point for this model occurs just as the first fisher enters the fishery. The stock is large relative to the resources available for the fish, and there are few fishers. Working forward through the model requires understanding how the action cycle affects the core problem and the structural context. In this closed model, the only changes in the structural context occur with the entry of new fishers (who are drawn in by potential profits) and with the depletion of the stock of fish (which alters the resources available). In the most basic CPR models, profit initially increases with higher levels of effort because the fish stock is large and fishing actually reduces competition among fish over scarce resources, increasing the sustainable

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yield. However, with each turn of the action cycle, if profits are positive, effort increases, catch increases, and the fish stock declines further.

As fishers deplete the stock, catch per unit effort declines because the fish are harder to find. Clark (2005) refers to this as the *stock effect*. Though costs per unit of effort may be fixed in the short run, fishers must use higher levels of effort to catch fewer fish when the stock is small, and thus the marginal cost of catching fish is increasing above the point known as *maximum economic yield*. This is one component of the profit signal and can be thought of as the *cost signal*. It is directly linked to the population biology of the fish stock, which, as a resource in the structural context, acts as an internal limit on the system.[13] Similarly, costs may increase with the entry of new fishers, owing to the crowding effect noted by Wilson (1982). These two aspects of the cost signal can be divided into *appropriation externalities* and *technological externalities* (Schlager 1994). If the fishery is large relative to the market, a second economic limit arises because, all else equal, price should decrease with the increased supply of fish (Clark and Munro 1975). This *price signal* is another component of the profit signal, because total revenue is equal to the product of the price and the quantity supplied.[14] With increasing marginal costs and declining prices, profits decrease even more quickly than they would if the fishery were small relative to the market and prices were assumed to be exogenous and stable.

In either case, effort continues to increase as profits decline, but it increases at a decreasing rate. One reason for this is that fishers cannot afford to invest as much time in fishing when profits are low as they did when profits were high. Also, lower profits entice fewer new entrants into the fishery. Even though effort is increasing at a decreasing rate, continued entry will still result in a smaller stock biomass, further decreasing profitability in the fishery. However, because of the CPR driver, effort will continue to increase until total revenue is equal to total costs and profits are equal to zero. At that point, the system reaches an equilibrium level of effort and the action cycle effectively stops. In most cases, this equilibrium is greater than the bioeconomically efficient and sustainable level of effort, but this is not a profit disconnect per se, because profit signals are experienced but are largely ignored due to concerns about competition. All else equal, the downward spiral generated by the CPR driver ends in either stagnation or collapse (Conrad 2010). When costs of production are high and/or prices are low, the open-access level of production tends to be closer to the bioeconomic optimum (a narrow profit disconnect).

Economists note that open access fisheries are highly inefficient because of the potential for scarcity rent. Technically, rent can be thought of as

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any profit that is not dissipated by competition.[15] There are many types of rents, including monopoly rents, political rents, and resource rents. Scarcity rent exists when production depends on a scarce resource that is owned by some producers and not others. For instance, a landlord can charge more for a lakeside home than for an identical home without access to a lake because the number of lakeside homes is limited by the size of the lake. In an open-access fishery this scarcity rent is dissipated because no one owns the resource—the tragedy of the commons again. Because rents can be identified only over the long run, it is often difficult to differentiate between rents and profits,[16] particularly when the all-else-equal assumption does not hold. Furthermore, rents are a subset of profits, so I use the latter term in its inclusive sense throughout the book, referring to rents only when the distinction is analytically important.

As Clark (2005) points out, the basic model described above is deficient because it is based on normal costs rather than opportunity costs, which include the losses from the second-best opportunity forgone when a fisher chooses to work in one fishery rather than another. Economic profits account for these opportunity costs; normal profits do not. Where private ownership is in place, economic profits are usually calculated using the net present value function—that is, the discounted sum of the expected flow of net revenue over a specified period of time.[17] High levels of uncertainty regarding environmental conditions and future changes in both economic and biological factors in the profit function undermine long-term planning in fisheries. In the 1970s, economists and fisheries scientists began to model investment decisions by fishers under open access as a dynamic optimization process in which expectations of future revenues are heavily influenced by recent and present flows of net revenue. Clark and Munro (1975, 99) refer to this as a *myopic* rule, because fishers' decisions are based almost entirely on current information. These decisions may also be constrained by fishers' need to remain economically solvent despite high variability in the size of the stock and large fluctuations in prices. In response to these risks, fishers invest during times of high profit and save or diversify during times of low profit in a fishery (Lane 1988; Holland and Sutinen 1999). Thus, most fisheries economists accept a high degree of responsiveness by fishers and key profit disconnects in fisheries due to considerable uncertainty regarding future conditions.

1.3.2 Cycles of Economic Expansion and the Profit Disconnect

Even with the addition of opportunity costs and discounting, the basic CPR story is completely unrealistic. There are many stagnant and collapsed

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fisheries around the world, but most small, isolated communities find ways to manage the marine commons sustainably. We see stagnation and collapse much more often in open fisheries in which overexploitation is driven by powerful exogenous forces that override local institutions. Furthermore, many lucrative fishing operations manage to maintain high levels of profitability in spite of the CPR dynamic. Indeed, the fishing industry as a whole frequently employs economic strategies to circumvent the local bioeconomic limits of the traditional tragedy-of-the-commons model, something that widens the profit disconnect by allowing profits to increase even as the core fisheries problems worsen. As a result, we see cycles of expansion in the scope and the scale of fishing operations throughout history. This process ultimately transformed a relatively uniform system of small, isolated fishing communities into a highly stratified industry that spans the seas and harvests myriad varieties of fish and other marine organisms. The economic implications of a more realistic application of the AC/SC framework help to explain the cyclical process of economic expansion in fisheries.

Options for Economic Responses First, to explain the current scope and scale of the world's fisheries, it is important to recognize that fishers have a wide array of response options. As figure 1.9 shows, fishers may still respond by changing the level of fishing effort, but three other broad categories of economic response are possible: (1) explore in order to find new fishing grounds, (2) innovate and invest in more efficient and larger-scale vessels and gear, and (3) work to open new markets. The first two options are usually undertaken in response to the cost signal associated with the stock effect and with crowding, although they may also be triggered by changes in the size of the catch. Indeed, for subsistence fishers who harvest fish for their own consumption, catch is the primary problem signal of overfishing or ecosystem disruption. When prices are volatile, catch is an important problem signal for commercial fishers as well, and many view the amount of targeted fish caught as a strong indicator of the health of a stock, even if this is not the case. For instance, when the adult population is small it may still be possible to harvest large quantities of juvenile fish. In a number of cases, fishers clearly indicated that these deceptively large harvests of juveniles signaled that the adult population must still be healthy, in spite of scientific evidence to the contrary (see, e.g., Mason 2002 or Boerma and Gulland 1973). In general, catch signals do not trump profit signals, but they can increase concern if both point in the same direction.

Exploration to find new fishing grounds—either in response to a decline in catch or in response to a decline in profits—is common in the fisheries action cycle. As the opportunity cost of remaining in an overfished fishery

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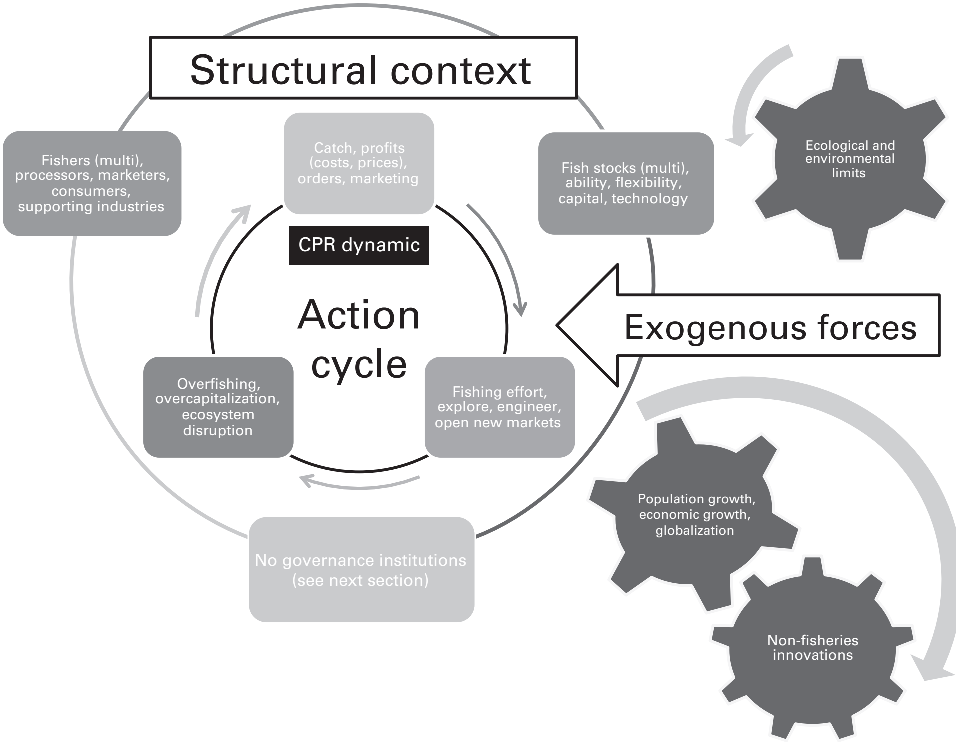

Figure 1.9
Expanded AC/SC application, economics only.

increases, fishers who have the option usually choose either to move to new fisheries or to exit the industry. Clark (2005, 75) refers to this as a *switching time* in the fishery, although when fishers are heterogeneous each will have his or her own individual point at which the opportunity cost of remaining in a fishery is negative and may therefore choose to switch to another option. Because of self-selection by fishers and the highly specific nature of fishing skills, there is considerable stickiness in the labor and capital markets for fisheries, so exit is not common (77). Transition to new fisheries or diversification of targeted species is a more frequent response to declining profits associated with overfishing. Fishers are heterogeneous in their preference for local exploration (same area, more species) over geographic diversification (more areas, same species), and this has had a profound effect on the evolution of fisheries economics and governance (Christensen and Raakjaer 2006). Finding new stocks alters the opportunity costs of fishing in all existing fisheries and can trigger rapid changes in the distribution of fishing effort.

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Exploration is risky but can yield great rewards.[18] If fishers can find unexploited stocks of fish, either locally or at a distance, they effectively increase the biomass available in the structural context. Because effort is low and biomass is large on the new fishing grounds, all else equal, catch will be higher, costs of production will be lower, and profits will be greater because the stock is not yet overfished or overcapitalized. Many of the most successful captains begin to explore for new fishing grounds fairly early in the action cycle, when profits just begin to decline, and then move on to new locations as soon as catch or profits start to fall more quickly. These leaders usually strive to keep their new locations secret but are eventually followed. As long as they can prevent others from discovering the new fishing ground, leaders are able to capture entrepreneurial rents (sometimes called quasi-rents; see Schumpeter [1942] 1976). Exploration increases the resources in the structural context by expanding the set of known fishing grounds or the set of targeted species, but it does not halt the action cycle. Rather, this response simply leads to the proliferation of exploited fisheries and generates cycles of geographic expansion. This is an important prediction from the AC/SC framework. Evidence of these cycles of geographic expansion will be provided in chapter 2.

Fishers also respond to catch signals and cost signals by innovating to increase harvests and to reduce cost per unit effort in an attempt to negate the stock effect. They do this by investing in bigger and faster vessels, more efficient gear, and better fish-finding technologies (Squires 1987; Squires and Vestergaard 2013). Bigger and faster vessels enable them to exploit a larger number of stocks and reduce costs through economies of scale. For instance, large distant-water vessels cost millions to purchase and operate, but, because they harvest so much on each trip, the cost per metric ton of catch can be as low as a few hundred dollars. Efficiency improvements allow fishers to catch more fish every time they deploy or "set" their gear, thereby countering the stock effect. In this way, even small changes can add up to large savings. Lastly, better fish-finding technologies reduce the time and the amount of fuel spent in the search process. By reducing costs and increasing catch through innovation, fishers dampen the cost and catch signals, widening the profit disconnect. In formal language, innovation reduces marginal costs at a given stock size, shifting the supply curve out and increasing the distance between the open-access level of effort and the optimum sustainable level of effort. In AC/SC terms, investing in innovation intensifies the CPR dynamic and speeds up the action cycle.

Both of the above cost-reducing responses shift the supply curve out, triggering a price signal when affected fisheries are large relative to the

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market. In fact, there are many examples in which technological change or geographic expansion led to spikes in supply and related sudden drops in prices for specific fish products. Though these dynamics drive some fishers out of business, they drive others to respond by opening up new markets through advertising and improved preservation or transportation technologies. Advertising allows fishers to create new markets by convincing consumers to buy novel species or products. Of course, advertising can only go so far; fishers also must ensure that their products appeal to consumers. Better preservation and transportation technologies facilitate market expansion by allowing for sales of a highly perishable product at long distances from the fishing grounds. Without these technologies, inland areas would have little access to fish, and distant-water fisheries would not be feasible because fish would be inedible by the time the vessel returned to port. In fact, the scale of modern fisheries would not be possible without international markets and the ability to convince consumers to try new fish products. However, this response dampens the price signal for fishers and thereby increases the profit disconnect, further exacerbating core problems identified when using the AC/SC framework.

Table 1.1 summarizes the possible responses available to fishers and their effects on the core problem and related signals. Only one possible response—reducing effort—actually helps to counter the core problems of overexploitation and overcapitalization. This is also the least likely response, as fishers usually resist exiting the industry or switching to non-fishing alternatives. Instead, when only economic factors are considered, fishers usually choose to pursue one or more of the other responses listed in the table, all of which dampen problem signals without providing any long-term solution to the underlying problems in the action cycle. Exploration provides short-term relief from these problems by increasing the biomass available for exploitation, but this ultimately increases the scale of the core problems as more and more fisheries become overexploited and overcapitalized. Engineering and marketing can have similar effects when they bring new species into the mix but merely exacerbate the core problems in existing fisheries. These responses are palliative, in that they dampen problem signals but do not solve the problems themselves.

Consider the application of this extended economic model to a small-scale subsistence fishery. The start point for analysis occurs as the first fisher enters the system. Initially profits are high, so more fishers enter, driving up effort and driving down stock size. However, once the cost and catch signals set in, instead of reducing effort, fishers explore for new fishing grounds and engineer better technologies, thereby increasing catch while reducing the

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Table 1.1
Expanded economic responses and expected effects

Possible responses	Effects
Reduce effort/exit fishery	Reduce and/or limit overexploitation
Explore for new fishing grounds	Expand biomass available for harvest, ↓ cost and catch signals, ↑ price signal (without new markets)
Engineer bigger and better capture technologies	Speed up/increase overexploitation, ↓ cost signal and catch signals, ↑ price signal (without new markets)
Open new markets	Speed up/increase overexploitation, ↓ price signal

costs of production as the geographic scope of fishing effort expands, the total biomass declines, and the threat of ecosystem disturbance increases. As long as markets remain small, the system is still limited because as supply increases, price should decrease, causing profits to decline. However, if fishers are able to open new markets, they can neutralize the price signal. All of these responses allow fishers to overcome local biological limits; they are able to increase the scope and scale of effort as much as possible given the constraints of current technologies and capital availability. Thus, with each "turn" of the action cycle—or, more generally, with the passage of time—the core problems get worse while fisher response dampens the problem signals. This is a widening profit disconnect. The *ceteris paribus* (all else equal) assumption does not hold, and fisher response consistently shifts the open-access level of effort farther and farther away from the optimum sustainable level of effort. This can have profound effects in closed systems, especially if complemented by exogenous drivers and secondary actors.

Limits, Drivers, and Catalysts Although fishers have more economic options in this expanded application of the AC/SC framework, their responses are still limited by the structural context. Specifically, resources circumscribe fisher response at any given point in time. In fisheries, resources include exploitable fish stocks, existing technologies, capital available for investment, potential new markets, and the costs of inputs. Exploration increases the number of exploitable fish stocks, but it is closely tied to innovation, since remote or deep-water stocks require fairly advanced vessels and fishing gear. Innovation itself is limited by existing technologies and availability of capital, and all three, in combination with population size and the level of affluence in the economy, regulate the potential for new markets. The costs of production are also closely tied to broader economic systems, such as markets for labor, fuel, steel, nylon, and related inputs. The state of

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global trade is a key determinant of both cost and price signals, as greater trade opens up new markets but also allows fishers to shift their operations away from high-cost locations to regions where costs of production are lower. Secondary actors and exogenous drivers can increase the resources available to fishers and thereby speed up the action cycle. In fact, without these factors fisheries would still be relatively small-scale, isolated operations in most of the world.

Though fishers receive the majority of attention in most fisheries models, other economic actors are also important. Secondary economic actors include all individuals and groups who make economic decisions based at least in part on signals generated by the fisheries action cycle. They are "secondary" because they do not interact directly with the fish stocks but rather receive indirect signals from fishers and related supply chains. These actors include processors, marketers, and supporting industries, which, together with fishers, make up the fishing industry as a whole. Consumers are also secondary actors, insofar as their willingness and ability to pay for fish products defines demand and therefore has a substantial effect on the price signal. However, the problem signals that consumers receive tend to be quite weak, because they are usually separated from the fish and the fishers by several layers of processors and marketers. Indeed, because of the resourcefulness of the industry as a whole, most consumers rarely receive any information about the state of the stocks that are raw inputs for the fish products they purchase. Information on the health of related ecosystems is even less accessible to consumers (Burger et al. 2004; Jacquet et al. 2009). They have no direct effect on the system, except to the extent that their willingness to accept new products—their response to the marketing signals sent by the fishing industry—limits the types of species and products that can be exploited. So far, such limits tend to be temporary, as processors and marketers refine their product lines to suit consumer tastes.

The specific interests of fishers and other industry actors are often at odds, largely because a price charged by one group is a cost to another, but all of these actors have a vested interest in the expansion of the industry as a whole (Campling, Havice, and Howard 2012). Thus, supporting industries, processors, and marketers often work with fishers, boosting their capacity for response in several ways. On the cost side for fishers, supporting industries like boatyards and gear manufacturers often cooperate with innovative fishers to produce new, lower-cost technologies. This benefits both groups, providing fishers with new technologies and supporting industries with new products to sell. Processors and marketers may also provide loans to fishers for vessel and gear improvements to keep their

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own costs of production low, and may even invest in new vessels, thereby encouraging growth in landings and exploitation of new stocks to maintain or increase the flow of raw materials for their businesses. For them, multiple sources of fish are necessary to stabilize production or sales in spite of the high level of variability in most fisheries (Prochaska 1984).[19] This type of diversification is common in many large-scale corporations. Processors and marketers also invest in transportation and preservation technologies and product marketing to open new markets, ensuring high wholesale or retail prices. This allows them to push out what Campling (2012) calls the *commodity frontier* in fisheries, expanding beyond the local, short-term limits in the traditional tragedy-of-the-commons story.

The impact of these secondary actors can be substantial because they have highly specialized knowledge of vessel, gear, and processing technologies, as well as marketing methods, and they build up substantial reserves of financial capital compared to the vast majority of fishers. Yet because of their size and diversification, these industry actors are distanced from the problem signals in the action cycle and so are even more susceptible to the profit disconnect. As with fishers, considerable uncertainty, high discount rates, and short time horizons reinforce responsive practices by secondary actors, who may make decisions based on a few years of profit forecasts rather than on the entire expected income stream from exploitation of a fishery.[20] Thus, when profits are high for secondary actors—usually when new fishing grounds are discovered through exploration, but also when new markets are opened—investment by secondary actors also tends to be high, and excess investment in processing or ship-building capacity is common during boom periods in fish production (Campling 2012). When processing firms are numerous, there is also a well-known coordination game that acts very much like the tragedy of the commons even though ownership is well established. Olson (1971) describes how profits in an open market with numerous firms are rapidly driven to zero because no subset of firms has sufficient incentive to curb production in order to keep prices high. As he points out, this is the inverse of Cournot's theory of oligopolistic competition.

Even with the assistance of secondary actors, expansionary fisher responses would still be limited if not for exogenous drivers (see the bottom right-hand corner of figure 1.9). These include both demand-side and supply-side factors. Population growth and economic growth are major demand-side factors. Population growth increases demand even if the consumption of fish per person remains stable. Economic growth generates higher levels of income per capita, which generally increases demand per

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person. Thus, these two factors combined cause rapid rightward shifts in the demand curve as more people are willing and able to pay more for larger amounts of fish products. This dynamic counteracts the price signal, as greater supply is met by greater demand. The resulting price signal trickles down from consumers to retailers to processors/marketers, and finally to fishers through the ex-vessel price. These exogenous forces, which are powerful disruptors of the price signal, drive economic expansion in fisheries.

On the supply side, exogenous drivers include globalization of trade and finance and technological innovation, which works primarily as a catalyst (Young, Berkhout et al. 2006). Globalization is a difficult concept to pin down, but here the word refers to increasing economic interdependence among national economies as the extent and the volume of trade and financial transactions increase around the world. As Ricardo ([1821] 2004) pointed out, trade allows for the reduction of costs of production because producers in different regions can specialize in areas in which they have comparative advantage. Globalization of finance facilitates the increasing availability of capital around the world, though unevenly, thereby contributing to the economic and technological stratification of fisheries. The implications of globalization are highly contested, but in fisheries it is clear that this force increases access to capital and lowers the costs of production, dampening the cost signal in the CPR action cycle. Thus, we can expect that globalization will tend to make overexploitation, overcapitalization, and ecosystem disruption occur more rapidly, while mitigating problem signals and delaying response.

Technology is an important determinant of fishing effectiveness and, therefore, of the costs of production and the profit disconnect more broadly (Dercole, Prieu, and Rinaldi 2010). In general, exogenous technological changes work as catalysts in the AC/SC framework. New technologies developed for military or commercial applications, such as petroleum engines and sonar arrays, can be rapidly appropriated by fishers who have access to sufficient capital, causing a swift transition from one technological state to another. This contrasts with purely endogenous technological change, which is usually gradual, although some big leaps have occurred almost completely within the fishing industry, such as the development of fish aggregating devices.[21] Which groups of fishers and other economic actors appropriate new technologies depends on their existing resources. Capital is normally a constraint, but some innovations, such as outboard motors and nylon netting, are cheap enough for appropriation by subsistence and artisanal fishers who generally have little access to capital. These new technologies are also readily adaptable to existing technologies among

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these groups. Nevertheless, appropriation of new technologies in any group usually depends on a few entrepreneurial individuals who are willing and able to accept the risk of trying something new. If they succeed, others will quickly imitate them if they have the capital and ability to do so (Orbach 1977).

For the most part, both secondary economic actors and exogenous forces contribute to the expansion of fisheries worldwide. However, global limits on the system do exist in the form of endogenous and exogenous biophysical boundaries. Endogenous limits were described above. Exogenous limits relate to the carrying capacity of the oceans more broadly and can be linked to both environmental and ecological conditions. Changes in ecosystem structure and productivity can have multiple causes, including human activities such as pollution, coastal development, and climate change. Non-anthropogenic factors such as currents and long-term cycles in oceanographic conditions can also affect productivity. Under favorable environmental conditions, stocks can grow rapidly, sometimes in spite of high levels of fishing effort. In such cases, these factors act as drivers rather than limits. However, highly favorable conditions are often short-lived, and most anthropogenic effects are detrimental to existing ecosystems; thus, for the most part, ecological and environmental factors can be viewed as limits on the productivity of targeted stocks.

In other words, fishers, the fishing industry, and consumers will eventually run out of new fisheries to exploit. Furthermore, although reducing the costs of production dampens the cost signal temporarily, it increases the core problems in this fisheries application, which means that more and greater innovations may be required to reduce costs with each turn of the action cycle. Similarly, opening new markets can dampen price signals associated with increasing supplies of fish, but this leads to higher levels of overexploitation, overcapitalization, and ecosystem disruption. If exogenous factors cause the global profit disconnect to widen further, capture production will eventually decline world-wide and fish may become a luxury good in the future, as it was in the past. Aquaculture is often seen as an answer to the problem of biophysical limits in fisheries, but to date fish farming is still highly dependent on capture fisheries for provision of feed, and also harms wild stocks through escapement, habitat destruction, and transfer of parasites and disease (Naylor and Burke 2005). In view of all this, governance is the only way to counter the economics of expansion, ensuring prosperity for fish, fishers, and secondary actors well into the future. Yet governance is no panacea; it can exacerbate these economic problems even as decision makers strive to provide solutions.

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1.3.3 Co-Evolution through the Politics of Response and the Power Disconnect

Nearly every fishery has some sort of governance structure. Even small, isolated fishing communities usually have local institutions that govern use of marine resources. Modern commercial fisheries are governed by complicated sets of formal and informal institutions at multiple levels of analysis. For instance, lobstermen in the Gulf of Maine adhere to local sharing arrangements on which they agree collectively without government involvement. But state and national regulations also regulate the minimum and maximum size of lobsters that may be landed, protect egg-bearing females, and prohibit poaching, damage to other fisher's equipment, and the taking of life or property (Acheson 1997). The many different fisheries governance institutions currently in existence co-evolved with the cycles of economic expansion described above as decision makers responded to the competing claims of multiple interest groups. When governance mechanisms are included in the application, the AC/SC framework can help to explain this process and the key role played by the power disconnect. Because the economics of resource exploitation has a profound effect on the political responses of fishers and the fishing industry, the power disconnect parallels and is directly linked to the profit disconnect.

The concept of responsive governance is central in any analysis in which the AC/SC framework is used. Decision makers do not prevent problems; they respond to problem signals that they receive from fishers and other interest groups in a fishery system. Furthermore, decision makers prefer to implement those responses that are politically expedient first, and to try more costly measures only if problem signals persist or worsen. This assumption is based on Simon's 1955 work on *satisficing*—that is, selecting an option that is satisfactory rather than optimal under conditions of imperfect information—but could be modified to include more complicated models of adaptive decision making, such as those described by Payne, Bettman, and Johnson (1993). In view of the importance of expedience, it is necessary to understand the cost and benefits of potential management measures, which can be thought of as resources in the structural context, as well as the strength of the political signals received by decision makers (Kingdon 2011). In particular, the profit disconnect will induce fishers to resist attempts to reduce catch or effort and thereby postpone switching response until the economic costs of overexploitation and overcapitalization are manifest in profit signals. Furthermore, the power disconnect is much greater when the structural context favors interest groups that

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are less sensitive to the underlying problems of the action cycle and have vested interests in maintaining economic expansion.

Figure 1.10 is a modified illustration of the AC/SC application from subsection 1.3.2 which includes governance. The relationships between the boxes are the same as in figure 1.7, but are not represented due to space constraints. New elements associated with the governance application are indicated in boldface. Furthermore, I distinguish between attributes and actions associated with fishers and other interest groups (lighter areas in each box), those associated with decision makers (darker areas), and factors related to both groups (indicated by asterisks). The topmost set of boxes shows the expanded structural context. In addition to the economic actors described above, the model now includes non-commercial interest groups (recreational fishers, environmental groups, scientists, the media, and the public) as well as decision makers (individuals, governments, or states that control established institutions in the governance segment of the structural context). Where they self-regulate, fishers themselves fall into the category of decision makers, but more often decision makers are local elites, bureaucrats, and politicians. At the national level, "governments" may be treated as decision makers; at the international level, "states" are decision makers. However, the AC/SC framework can be used in nested applications in order to capture interactions between these levels of analysis.

New resources are also available to actors when governance is added to the analysis. Fishers and other interest groups wield political power and influence and may benefit from the formation of social capital such as education and civil society organizations. Decision makers can use similar political power sources, but they also have a legal monopoly on the use of force (although historically fishers also have used violence to protect their access rights). On the other hand, their work can be assisted or constrained by the management options, the budgetary resources, and the enforcement capacity available to them.

Governance Institutions and Political Response The box furthest to the right in the topmost row of figure 1.10 contains six categories of governance institutions that are common in fisheries. *Endowments* are essentially use rights that specify which actors are allowed to engage in fishing. *Entitlements* indicate which individuals have rights to benefit from that fishing effort (Kreuzer 1978a). The basic applications presented in previous sections of this chapter all assume that fishers own both endowments and entitlements. That is, anyone who chooses to become a fisher has a right to physically appropriate the resource and a right to retain all benefits from

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Structural context		
Actors	**Resources**	**Governance institutions**
Fishers	Fish stocks	**Endowments (access rights)**
Other industry	Ability	**Entitlements (rights to benefit)**
Consumers	Flexibility	**Expansionary measures**
Scientists	Capital	**Restrictive measures**
Environmental groups	Technology	**Enforcement mechanisms**
Recreational fishers	**Political power***	**Policy/decision processes**
Media/journalism	**Social capital***	
The public	**Violence***	
Decision makers	**Management options**	
	Enforcement capacity	

Action cycle		
Problems	**Signals**	**Responses**
Overfishing	Catch	Fishing effort
Overcapitalization	Profits	Exploration
Ecosystem disruption	Costs	Innovation
Conflict over access rights	Prices	Open new markets
Harm to charismatic species	Marketing	**Demand/protest exclusion/access rights**
Threat to political power	**New entrants/cheating**	**Demand/protest expansionary management**
	Scientific reports*	**Demand/protest restrictive management**
	Media reports*	**Exit/refuse to comply**
	Voting	**Alter governance institutions**
	Lobbying	**Alter policy/decision processes**
	Campaign contributions	

Exogenous forces		
Limits	Drivers	Catalysts
Ecological	Population growth	Non-fisheries innovation
Environmental	Economic growth	Non-fisheries science
	Globalization	**Political/economic norms**
	Food security policies	**Institutional interplay**
	Employment policies	**Environmental movements**
	Development policies	

Figure 1.10
AC/SC application with governance.

that exploitation. This is a logical extension of the open-access attribute of the CPR dynamic. However, in many governance systems endowments and entitlements restrict open access (Wilson 1982; Schlager 1994). In sea-tenure systems, specific fishers or fishing groups are granted exclusive rights of access to particular areas or particular stocks of fish. Similarly, licensing programs and permit systems that restrict access are types of endowments in fisheries. On the entitlements side, norms allocating a share of the catch

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to a fishing community, rules about paying tribute to local elites, and fees or taxes collected by governments are all institutions that divide up the benefits of fishing between fishers and decision makers. Thus, even when fishers have the right to appropriate the resource they seldom have the right to retain all benefits from their labor.

By establishing endowments, fishers or other decision makers create a new problem in the action cycle: conflict over access rights, or, in formal terminology, *assignment problems* (Schlager 1994). This problem can be signaled by the entry of new (outsider) groups of fishers or by observed cheating on established rights of access by insiders. Unlike economic signals, these political signals can occur at any point in the action cycle, as long as existing fishers believe that they have established rights of access to the stock or area.[22] Fishers respond to these signals by escalating their attempts at exclusion, which is one of the earliest and most widespread responses observed in fisheries action cycles around the world. Where institutions are scarce, violence is a common method of excluding outsiders and establishing access rights. Where broader governance institutions exist and prohibit such violent conflicts, fishers must engage with local elites or legal authorities to safeguard their endowments. Decision makers often claim entitlements in exchange for protection of endowments, although rights to benefit may also be ingrained in wider political power structures. Public violence may be used to enforce fisheries regulations or to contest fishers' access to resources (Hart and Pitcher 2001; Platteau 1992). Chapter 5 of this book describes how exclusionary institutions rise and fall with cycles of economic expansion and related conflicts over access to fish stocks.

Whereas endowments and entitlements govern the allocation of scarce resources, management measures are explicitly designed to control the level of fishing effort. Expansionary management measures include all actions that support fishers economically without forcing equal reduction in catch or fishing effort. The most common are subsidies, or direct payments from the government or local elites to fishers (Sumaila et al. 2010a). Guaranteed loans and other assistance raising capital also fit in this category, as would community-funded or government-funded investment in the culture of targeted species to increase populations (and therefore the amount that can be harvested sustainably). As will be discussed in chapter 6, the vast majority of these measures are purely palliative. By reducing costs of production, increasing access to capital, and even ensuring fairly high prices, these measures all increase the profit disconnect and exacerbate the cycles of economic expansion predicted by the AC/SC framework. However, as the first US Fish Commissioner, Spencer Fullerton Baird, pointed out in

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the 1870s, expansionary measures are usually popular with the industry and with decision makers, many of whom are concerned with issues such as food security, employment, and economic development. Indeed, this is why Baird called these measures "positive" in contrast to "negative" management measures, which require some reduction in either catch or fishing effort (Allard 1978). I refer to the latter as *restrictive measures*.

Because expansionary management measures are politically expedient, we can expect that decision makers will use them fairly early in the action cycle. When profit signals are relatively strong, fishers often demand expansionary measures from government. In these cases, subsidies or related interventions can be classified as *supporting* because they keep struggling fishers afloat during hard times. Decision makers may also use *developmental* measures that are designed to build up new fisheries (Royce 1987). Developmental measures are usually implemented in response to exogenous factors such as food shortages or economic development programs. Both types of expansionary measures have also been used by governments to solidify claims of rights of access to marine resources as part of contestation and negotiation of international law regarding ocean use and management. Whereas expansionary management measures tend to be quite popular, non-commercial interest groups and even the public sometimes protest this governance approach, because it exacerbates problems in fisheries and because the burden of these measures increases with the worsening crises associated with the economics of expansion. That is, expansionary measures actually drive fishing effort higher, exacerbating the profit disconnect and the related downward spiral of overexploitation and overcapitalization such that subsidies or related measures must increase in order to maintain the same level of "profitability" in a fishery.

In contrast, restrictive management measures in fisheries are designed to limit either catch or effort. These measures include size limits, catch limits, area limits, licenses, and fees, as well as ecosystem-based management and other more advanced regulations (Caddy and Cochrane 2001). Some of these measures are observed in informal governance systems, but for the most part such limits are associated with modern practices of formal management by government agencies. Most people, like Commissioner Baird, expect that fishers and industry actors will necessarily resist the application of restrictive management measures, but this is not always the case. Certainly, when management threatens to diminish a fisher's livelihood that fisher—and all others who are so affected—will probably protest the new rule. However, there are three situations in which fishers are likely to demand restrictive management measures: (1) when such measures exclude

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other fishers but have little effect on the group demanding regulation; (2) when one type of management is seen as the lesser of two evils, as when fishers demand size limits as a less painful option compared to catch or effort limits; and (3) when all other response options are exhausted and the fishery is clearly in great economic and biological distress. Of course, which measures are selected depends on the broader political context.

Any given restrictive regulation usually creates both winners and losers among groups of actors as defined in the structural context. For instance, a minimum size limit for landings of a certain species will hurt fishers who target fish of that size, but will benefit fishers who catch bigger fish of the same species because more small fish will survive to grow to the larger size. Alternatively, a restriction on the type of gear that can be used in a fishery will force some fishers to exit because they cannot afford to acquire different equipment, leaving more fish for those who use the permitted gear. Fishers, who are well aware of the differentiated effects of management measures, often organize into groups and make demands on decision makers accordingly. Thus, Lasswell's ([1936] 2011) depiction of politics as contestation over resources is highly relevant to fisheries governance, even when the structural context favors norms of open access rather than systems of endowments and entitlements. Indeed, conservation is often used as a rationale for the adoption of restrictive management measures that exclude "outsider" groups of fishers or other secondary actors. Since exclusion signals usually occur much earlier than economic problem signals, demand for exclusionary regulations often precedes other political responses. Indeed, modern fisheries management has its roots in this political dynamic.

New Political Actors When groups of fishers demand restrictive management measures that are less onerous than other proposed policies, they may be defending themselves against attempts at regulatory exclusion by other groups of fishers or against calls for conservation-based restrictive regulation by recreational fishers, environmental groups, the scientific community, or other non-commercial actors. As will be explained in chapter 8, non-commercial actors and fishers respond to different problem signals. Non-commercial actors are usually much less concerned with the catch or profitability of fishing fleets. Recreational fishers, however, pay attention to their own catch, and particularly to the abundance of large trophy fish of preferred species. There is a long and fairly successful history of political action by recreational fishers to exclude commercial and even artisanal and subsistence fishers from inland waters, but until recent times recreational

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fishers were less active and less influential in marine fisheries (Aas 2007). Environmental groups are also recent arrivals in the actor category. These groups include preservationists, who lobby for bans on the killing of any animal in a preferred species group, and conservationists, who are mainly concerned with the sustainable management of marine species and ecosystems more broadly (Stoett 2011). Recreational fishers, conservationists, and preservationists all tend to rely on scientific assessments as the primary biological signal that species or ecosystems are overfished, and usually respond by demanding restrictive management measures on commercial fishing. Recently some non-commerical interests have started to appeal to consumers and the public at large to pressure the industry by avoiding products derived from overfished stocks, endangered species, or charismatic megafauna (e.g., dolphins, whales, and sea turtles).

Wittingly or not, scientists, or more broadly, epistemic communities of experts are also political actors in the structural context for modern fisheries (Haas 1989). Their research is frequently problem driven and has profound effects on the management options available in the "resources" component of the structural context. In fact, the institutions of fisheries science were built largely in response to cycles of growth and collapse in several key fish populations and the resultant socioeconomic costs in fishing communities and related sectors. These cycles escalated with the rapid expansion of fishing effort that began in the 1800s, causing increasing conflicts among groups of fishers and leading to growing demands for exclusionary management interventions. In response, governments increased funding for fisheries science aimed at understanding the causes of biological changes in stocks in order to settle conflicts between fishers. This response was influenced by exogenous forces associated with the upsurge in positivist philosophy at the time, and by the belief that government regulation should be based on the best scientific evidence available. Nevertheless, because of power dynamics that will be described below, even government-funded scientific advice often went unheeded.

The media and the public can also wield significant influence in the fisheries action cycle. Indeed, although other interest groups play important roles in agenda setting and in the development of policy alternatives, public pressure—often inspired by media coverage—can tip the balance in action cycles where commercial and non-commercial interests are at loggerheads. This is what Olson (1971) referred to as mobilization of a latent interest group. However, in general both the media and the public respond only to sensational or highly salient events, rather than engaging in prolonged monitoring and engagement on policy issues. Furthermore,

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novelty is important, and these groups loose interest quickly if crises are prolonged or problems stagnate (Baumgartner and Jones 2009). Fisheries are not of much interest in most regions, although the topic of fisheries may be closely watched by the media and the public in areas where the fishing industry is a major employer or where marine tourism is an important source of revenue. We can expect to see fairly continuous public engagement in these areas but expect only sporadic engagement triggered by well-publicized events at larger scales. Even when charismatic megafauna are involved, media attention and public outrage are not usually triggered until biological signals are very strong and stocks are near collapse or extinction. For fisheries more generally, public response often occurs after major collapses, driving retrospective responses in the action cycle. Of course, the influence of the public and that of the media depend greatly on governance in the structural context.

Power and Politics In view of the political divisions within the fishing industry and the interests of other actors, it is important to understand how the structural context shapes decision making. At any given time, selection of new management measures and institutions depends on existing (baseline) institutions that govern fisheries and underlying decision processes that shape the roles and political resources of different actors. Incremental behavior can be expected, as described by Lindblom (1977), but there is also evidence of large-scale revolutionary change in response to crises, as expected by Higgs (1987) or in response to vertical and horizontal interplay as explained by Young (2002).

Structural factors also affect the power disconnect and thereby alter responsive governance. When actors who are sensitive to problem signals have political influence, political response occurs earlier in the action cycle and is often more effective, although much depends on the management capacity available in the structural context. This helps to explain why sustainable management regimes are often observed in small, relatively isolated fishing communities in which both the profit disconnect and the power disconnect are minimal. However, the cycles of economic expansion described above disrupted most of these collective-action regimes and exacerbated the power disconnect through positive feedbacks between the economic scale of fishing operations and the political power of the fishing industry. Increasingly, the actors who receive early, strong problem signals are marginalized politically, while those who engage in economic responses that dampen problem signals become more and more powerful.

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Before looking into the power disconnect further, it is important to understand how structural factors affect political influence. In combination with the political resources available to interest groups, including their political power, policy positions, and the set of management measures available, decision processes are major determinants of governance outcomes. There is considerable literature on this issue area, and a researcher using the AC/SC framework has many options. In general, public choice theory does not fit the framework because of the focus on maximization, but constructivist (Wendt 1992), behavioralist (Bendor et al. 2011), game-theoretic (Olson 1971, 2000; Ostrom, Gardner, and Walker 1994; Hardin 1995), cultural (Almond and Verba [1963] 1989), organizational (March and Simon [1958] 1993), institutionalist (Ostrom 1990; Haas, Keohane, and Levy 1995), and regime (Young 2002, 2010) perspectives all can be accommodated. Here, I describe the approach that I use throughout this book. It is a hybrid drawn from all of the aforementioned approaches, but it is most firmly based in the literature on environmental governance and fisheries management (see e.g., Wilen and Homans 1998; DeSombre 2002; Finley 2009; Webster 2009; Hilborn, Orensanz, and Parma 2005).

At the domestic level, the nexus between actors, resources, and governance structure can be broken down into three major aspects: access, alignment, and leverage. *Access* refers to the interest group's ability to make its arguments to decision makers, either directly or through an intermediary. If one group has access and others do not, that group is more likely to affect governance. On the other hand, *alignment* between decision makers' goals and interest groups' goals is also important. Many commercial fishing interests, including processors and marketers as well as fishers, have been able to influence government regulation because their interest in expanding the industry aligns well with policy makers' exogenous goals (e.g., high employment, food security, and economic growth), at least in the short run. However, interest groups with considerable *leverage*, defined as the ability to threaten a decision maker's power base, may be able to gain access to decision makers and force changes in governance goals.

Access, alignment, and leverage are all affected by the broader governance context. In more democratic societies, access to decision makers depends on lobbying as well as on the ability to mobilize votes and/or campaign contributions. Petitions, strikes, and protests can further contribute to leverage. Of course, no democracy is perfect, and access is often asymmetrical among interest groups, but decision makers must at least appear to represent the public interest. Thus, public-relations campaigns are often crucial elements in democratic decision processes, as is the relative power

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of regional representatives (e.g., members of Congress or Parliament from districts with large commercial fishing interests). Just as with any other issue area, more senior or more adept representatives are usually better able to influence legislation—particularly on fisheries topics—which are seldom of great interest to the wider public (Kingdon 2011). This is why political power is represented as a resource for both interest groups and decision makers in figure 1.10. In litigious systems, like the United States, interest groups can also sue the government to force the implementation of laws that are already on the books (Perkins and Neumayer 2007). Similarly, where they are accountable to multiple, competing interests, decisions makers often agree on legislation that vaguely promises to meet the demands of all groups, leaving interpretation up to bureaucratic decision makers who may be more closely aligned with some interest groups than with others.

In authoritarian systems or similar regimes, power depends on access and alignment, and leverage can be wielded only through drastic measures, such as blackmail, coup d'états, and civil war. Fisheries rarely cause such upheavals in modern times, but were regularly cause for military conflict in the past. More often, either fisheries are ignored in authoritarian systems, and fishing communities govern themselves, or else endowments and entitlements are used to reinforce existing power structures (see e.g., Muscolino 2009). Because these systems are usually more closed than democratic systems, in which open access tends to be the norm, they may produce more sustainable outcomes. On the other hand, authoritarian and centrally planned governments like the Soviet Union may view fisheries as a major source of economic development, leading them to invest heavily in large-scale industrialized fleets, which, in turn, creates vested interest in economic expansion within the government itself (Armstrong 2009). Much depends on the specific details of the hierarchical structure, particularly the role played by fishers and other industry interests. Hypothetically, an authoritarian government that is captured by non-commercial interests might also implement more sustainable management measures, but this has not yet been observed.

In both types of systems, the AC/SC framework predicts positive feedbacks between economic growth and political power that widen the power disconnect. That is, as fishers accumulate greater amounts of capital, produce larger amounts of fish, and provide more jobs or other economic benefits, their ability to affect the political process usually increases as well. In a more democratic system, this translates into more votes and more campaign contributions, whereas in all types of government a larger fishing

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industry means greater political rents for decision makers (Krueger 1974). Therefore, it is not surprising that cycles of economic growth coincide with political cycles of delayed response, no matter what type of government is in charge of fisheries management. The power disconnect widens the profit disconnect through expansionary and exclusionary management measures, while the profit disconnect widens the power disconnect by making politically powerful actors less sensitive to problem signals and more influential over management decisions. Furthermore, these determinants of the power disconnect are important at multiple levels of analysis.

A major benefit of the AC/SC framework is that it can be used to link domestic policy processes to outcomes at international negotiations by examining how the domestic power processes described above affect access, alignment, and leverage at the international level. Governments are expected to base their international policies on domestic concerns in conjunction with considerations regarding their influence in the structural context for negotiations (Putnam 1988). In this application, states are not unitary actors as per collective-action approaches to international relations; rather, they are strategic representatives of domestic interest groups. Nevertheless, I use the term *states* in international applications of the AC/SC framework to distinguish between the government as an arbiter in domestic political decision making and the government as a representative of national interests in negotiations with other states. In this context, national interests can be driven endogenously by the political process described above and exogenously based on the geopolitical goals of states. They may also be influenced by the logic of appropriateness, or social norms at the international level, as well as the logic of consequences, or pure interest in the costs and benefits of negotiation outcomes (Young 2001).

International sources of state influence can be divided between *soft power* (the ability to persuade others through argument or social pressure) and *hard power* (the ability to alter other states' behavior through the threat or use of military force or economic sanction; Keohane 1977). In modern international negotiations, there is a general norm against use of military power to control marine resources. Use of economic sanctions or the power of pursuasion can be enhanced by access to more powerful states or institutions, by alignments with other states that facilitate coalition formation, and by leverage, which can take the form of side payments or issue linkages. Side payments involve provision of some reward for cooperation, such as economic development aid or special trade status. Issue linkages occur when states make their position on one issue contingent on another state's action on a different issue (Barrett 2003). Because many international

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treaties are based on the norm of consensus, states may also use their *de facto* veto power to block measures that they do not like. The threat of blocking a measure may also be used as leverage to force changes in a proposal. Peterson (1995) provides an exhaustive analysis of the institutional strategies used by "leaders," "followers," and "laggards" in international fisheries negotiations. Webster (2009) describes responsive governance in the same context. Lastly, where there are strong social norms at the international level, states may use the logic of appropriateness to advocate their preferred international management measures.

As shown in the bottom right-hand corner of figure 1.10, both domestic and international decision processes can be affected by exogenous changes in international law and by widespread philosophical shifts related to political economy and governance (Young 2002). For instance, the rise of capitalism had profound effects on the economics and politics of fisheries governance. With the establishment of the rule of law in much of the world, use of private violence to exclude outsiders and punish non-compliance with informal institutions became illegal in many countries. Similarly, the expansion of democracy altered both the ways in which fishers could affect governance and the involvement of government in fisheries management. In addition, institutional interplay between fisheries-management institutions often occurs, as when measures developed by the International Pacific Halibut Commission proliferated rapidly during the 1930s and the 1940s because of perceived successes (horizontal interplay) or when states chose to extend their claims over marine resources first to three miles and then to 200 miles from shore (vertical interplay). Though these legal changes affected all fisheries, they were driven by complicated political processes tied to multiple issues, many of which had no links to fisheries. At the national level, decision makers often choose to invest in expansionary management measures because of broader macroeconomic goals. Shortages during the two world wars drove much of the concern regarding food security and control over resources more broadly. More recently, the upsurge in environmental concern in some countries increased the power of environmental interest groups and profoundly altered the management of marine fisheries around the world.

Details of the elements described above and of the institutions created by the fisheries action cycle will be covered throughout the rest of this book. For present purposes, it is important to point out that political responses can eventually switch an AC/SC system from cycles of depletion to cycles of rebuilding. Moreover, these responses lead to the creation of institutions that can foster more rapid response to future crises. This is how many of the most

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successful management regimes in existence today originated. However, as long as the endogenous and exogenous drivers of economic expansion persist, the task of fisheries management becomes more difficult. On the one hand, the rebuilding of the stock reduces costs associated with core problems and also diminishes political will to maintain restrictive management. On the other hand, with higher profitability due to declining costs of production and increasing prices, incentives for fishers to lobby against restrictive management or simply refuse to comply with regulations increase. Where stable regimes existed for centuries in isolated fisheries, the expansion of industrialized fleets and market access can rapidly undermine existing institutions. All of these factors create the management treadmill. Rather than stable, long-term governance solutions, the AC/SC application to fisheries predicts cycling between effective and ineffective management and suggests that governance is a chronic problem with many underlying causes rather than a permanent solution to the tragedy of the commons.

1.4 Methods and Organization

In view of the two primary goals of this book—to explain the current scope and scale of global fisheries and to explore how responsive governance works in a wide array of situations—the analysis presented is an exercise in synthesis rather than hypothesis testing. In the tradition of classical political economy, I use a historiographical approach, guided by the AC/SC framework. Historiography involves *process tracing*—that is, documenting how systems change over time. According to Collier (2011), process tracing allows researchers to identify and analyze causal connections between events. Collier further argues that this approach should be guided by some conceptual framework and that it may be used to establish "recurring empirical regularities" in different spatial-temporal contexts (824). The AC/SC framework provides the necessary expectations regarding prior knowledge and the primary purpose of the analysis is to identify regularities in the functioning of responsive governance given the various endogenous and exogenous forces detailed above. The research conducted is global in scope and extends from the archeological record through modern times. This is in part to determine if responsive governance is indeed ubiquitous and in part to advance our understanding of change in the profit disconnect, the power disconnect, and the management treadmill given a wide range of structural contexts and exogenous conditions.

As a method, historiography has a long and somewhat mottled history, particularly among social scientists. In his historiography of historiography,

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Breisach (2007) argues that the approach evolved from a means of reinforcing existing hierarchies and cultures via constructed association with divinity to a means of critically examining the nature and origins of power. Most classical political economists used historiography. Smith ([1776] 1976) used an inductive approach; Karl Marx ([1887]1977) used the dialectical lens to describe history as a deterministic process. By the turn of the 20th century, the primary focus of historiographies in political economy was the explanation of continuity and construction of "driving forces" in history. With the crises of World War I and World War II, attention shifted from continuity to change, as scholars could not ignore the major political and economic shifts of the times. Finally, in the post-war period, a new wave of historiographies that described history as a cyclical process of stability and change united these perspectives (Breisach 2007). Knutsen's 1999 work on the rise and fall of world orders is a good example, as is the historiography presented in this book. Particularly because of the action cycle, the focus throughout this book is on cycles, whether they are cycles of economic expansion (Part I) or related cycles of governance response (Part II).

Breisach (2007) also documents shifts in historiography from highly subjective narrative approaches to the positivist focus on empiricism and the post-positivist acceptance of the subjectivity of knowledge. This pattern parallels similar trends in many fields, particularly political science and policy analysis, in which constructivist approaches were developed in response to the lack of realism in the rationalist worldview. However, Lejano (2006) and others note that both schools are in fact deficient, the rationalists focusing too much on structural elements (e.g., game-theoretic constructs) and the constructivists giving too much power to the actions of individual policy makers. The AC/SC framework fits well with what Lejano calls the *experiential approach*, which allows for both action and structure to affect decision making, but it also crosses levels of analysis and so is not focused only on policy makers. As such, the process tracing that I conducted for this book connects the experiences and actions of individuals, decision makers, and states. It is post-positivist insofar as all actors are assumed to be boundedly rational—indeed, responsive rather than proactive in their decision making—but does not abandon structure entirely. Rather, as has already been noted, the AC/SC framework is designed to provide a middle path between these extremes, so I cite empirical evidence wherever possible but I also accept the subjectivity of actors' experiences and related effects on outcomes.

The AC/SC framework serves as a guide for this exploration of the historical evolution of cycles of responsive governance in three primary ways.

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First, when I researched specific fisheries in a given time period, I used the iterative process described above and summarized here: (1) identify elements of the structural context at a logical start point and (2) use process tracing to document how this base-line context changed with revolutions of the action cycle and pressures from exogenous forces. This analysis also involved identifying connections between fisheries (e.g., when overexploitation in one fishery generated exploration and eventual exploitation of a new fishery) and allowed me to sketch out larger patterns of geospatial change. During the initial phase of the analysis, I also looked for deviations from the expectations established in the framework. For instance, while conducting a broad, general search of the literature on global fisheries, I also searched specifically for cases in which governance was proactive rather than responsive, or in which the behavior of actors deviated from the AC/SC expectations. Although I did not find many exceptions, those that were identified are detailed in the text. Because of the extensive scope of the analysis, other fisheries described here are either representative of a large number of similar cases or are important turning points in the historical narrative, such as the development of a new technology or a systemic shift in global institutions.

Second, I used the AC/SC framework to compare the cases available within each period and to identify commonalities or differences. This coincides with Collier's (2011) "identifying empirical regularities". In this analysis I grouped fisheries on the basis of similarities in the structural context, including actors, resources, and governance institutions. Although I found great variation in the specifics, many of these factors could be classified fairly easily into broad typologies. For instance, although fishers in different parts of the world use very different types of gear, they can still be classified by scale, technological advancement, and capital requirements. Similarly, governance institutions can be categorized on the basis of broad decision processes, management capacity, and the types of regulation available. I also compared the speed of the action cycle and the predominance of specific exogenous factors in different eras. For example, for much of human history population growth was the primary exogenous driver of expansion of fishing effort (typology 1), with the exception of ancient kingdoms such as Sumer, where economic growth and technological advancement also played important roles (typology 2). This early historical period lasted for millennia; the action cycle was extremely slow because fisheries technologies and related resources were limited. The process of typology identification allowed me to recognize meso-scale trends and counter-trends in the

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historiography. It was also useful organizationally, as it helped me to identify the most representative cases for use as illustrations in the text.

Third, I used the AC/SC framework to identify broader patterns of change over time in order to develop theoretical insights into the evolution of fisheries governance. Practically, the theory-building process reveals important levers for improving fisheries management, but it also shows that management tends to cycle back and forth between downward spirals of overexploitation and positive cycles of rebuilding, as shown in figure 1.1. I call this dominant pattern in fisheries governance the *management treadmill*. Furthermore, there can be cycles within cycles. When fisheries are isolated, the treadmill displays a pattern of dynamic equilibrium, either because of the crisis rebound effect, in which the rebuilding of the stock relieves political pressures for restrictive management, or because of natural cycles in fish population dynamics. When fisheries are open to the exogenous drivers described in Part I, the treadmill follows a *growth cycle* pattern in which expansion of governance institutions is followed by an escalation in fisheries problems, reducing the effectiveness of fisheries governance and causing a return to bioeconomic depletion. In a growth cycle treadmill, waves of change propagate across fisheries, speeding up the action cycle and reducing switching response time. Drivers can be endogenous or exogenous, and can fit into political-economic and environmental categories.[23]

This book is loosely organized around key periods in the evolution of global fisheries management, with parallel segments that cover the economics of expansion (Part I) and the politics of response (Part II). In Part I, chapter 2 describes how population growth and other factors drove exploration throughout history, expanding the area subject to exploitation from small, coastal zones to almost all of the oceans. This extended the amount of exploitable biomass, increasing the sustainable level of production. Chapter 3 covers responses that widen the profit disconnect by reducing the marginal costs of production relative to stock size. These responses include investment in engineering to reduce costs of production and increase the technological efficiency of fishing fleets. It shows how this key fisher responses combined with exogenous technological changes to increase the scale and composition of production. Chapter 4 focuses on price signals and the profit disconnect. It describes the responses associated with opening up new markets, through improvements in processing and transportation technologies and advances in marketing strategies. These responses negate the price signal and further allow the open access level of effort to increase beyond the sustainable level of effort.

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Chapters 2–4 are closely intertwined, and the responses discussed in them are heavily interdependent. For instance, expanding production would not have been as successful without improvements in processing and marketing, because demand would have been stagnant while supply increased, driving prices down and thereby amplifying the profit signal. Furthermore, all responses are deeply dependent on exogenous factors, such as technological innovations from other sectors, population growth, economic development, and globalization. Combined, these forces generate cycles of economic expansion that constantly widen the profit disconnect because increases in the sustainable level of production due to exploration are substantially outweighed by factors that dampen cost and price signals, causing exponential increases in the open-access equilibrium level of production.

Part II uses the AC/SC framework to show how political systems coevolved with these cycles of economic expansion through the process of responsive governance described above. Chapter 5 shows how incentives to exclude outsiders shaped management at the local and global levels. This includes collective action associated with endowments and entitlements as well as lobbying for government protection of access rights, which ultimately required the establishment of the rule of law and led to international negotiations regarding the Law of the Sea. Chapter 6 discusses the application of expansionary management measures globally, whether driven by demands from fishers or by exogenous political concerns with economic development and food security. This response widens the profit disconnect, ratcheting up fishing effort and exacerbating problems associated with the tragedy of the commons. Chapter 7 covers fishing industry lobbying on restrictive management measures that are put in place for either conservation or for exclusion. It shows how lobbying tends to delay management as long as fishing is profitable for the more powerful sectors of the fishing industry, but can also speed up management when the price signal is clear and profits are down. It links the profit disconnect to the power disconnect, showing how modern fisheries governance was shaped into a process of managed overexploitation. Exogenous changes in demand are important here, along with environmental changes, whether caused by fishers or by other forces.

Most of Part II focuses on fishers and decision makers. Until recently, few other actors were involved. However, in keeping with the AC/SC framework, chapter 8 describes the rise of new actors, including environmental activists, recreational fishing interests, and interdisciplinary groups of scientists, toward the end of the twentieth century. Environmental

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movements started to protect charismatic megafauna, and then expanded to encompass overfishing of commercial species in response to the collapse of major fisheries in different parts of the world. The overall effect of non-commercial interests is difficult to gauge because their efforts could incite considerable opposition from fishers, thereby delaying response. However, when fishers and non-commercial interest groups worked together, they often achieved improvements in management.

Finally, chapter 9 synthesizes the lessons learned from analyzing the economic trends covered in Part I and the growth of political institutions documented in Part II. It describes the management treadmill and its multiple variations. Insofar as climate change and other drivers of the management treadmill are largely exogenous to fisheries governance, one can conclude that good fisheries management is necessary but not sufficient for sustainability. That is, management is necessary for grappling with the endogenous factors that drive fisheries expansion, including but not limited to the CPR problem, but it is not sufficient to rein in the exogenous drivers identified in the AC/SC model. Therefore, long-term sustainability in global fisheries depends on a worldwide transition to sustainable development. In the concluding section of chapter 9, I highlight important parallels between the literature on sustainable development and the lessons learned from application of the AC/SC framework to fisheries case studies. From this perspective, the tragedy of the commons is less important than broader exogenous drivers of overexploitation and fisheries are shown to be much more closely related to other environmental issue areas than is usually acknowledged in the literature. Furthermore, some of the lessons learned from the case studies, particularly regarding the effect of the profit disconnect, the importance of legitimacy, and the need for accountability, are also key components in the search for sustainable development in the global economy.

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