CHAPTER 3

A Holistic Strategy for Pacific Sea Turtle Conservation

PETER H. DUTTON AND DALE SQUIRES

Reconciling sea turtle conservation in the Pacific with continued fishing is essential for recovery of critically endangered sea turtle populations, such as eastern Pacific leatherbacks, because fishing will continue under any likely policy scenario. From a broader perspective, turtle recovery coupled with fishing can be viewed as reconciling biodiversity conservation with continued commercial use of marine resources. A holistic approach that extends beyond merely reducing fishery bycatch mortality of sea turtles is required if sea turtle populations currently in crisis are to recover or stabilize in the long-run (Dutton and Squires 2008).

This holistic approach includes (1) effective beach conservation to protect nesting females, their eggs, and critical breeding habitat to maximize hatchling production; (2) enhancement of at-sea survival of juveniles and adults at critical foraging areas and as they move into different developmental habitats by dealing with large-scale, commercial fishing fleets; and (3) reduction of subsistence, small-scale and artisanal coastal fishers' takes of turtles, perhaps the most intractable component. The current level of conservation effort appears to be inadequate to reverse the decline of leatherback turtles in the Pacific. If fishing is to continue, these efforts must be greatly enhanced by integrating fishery management into a holistic sea turtle recovery strategy and within a multilateral context to account for the transboundary nature of the sea turtles.

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The holistic strategy outlined in this book is an outcome of the multidisciplinary approach at the 2003 Bellagio meeting. The individual components of this strategy are not necessarily new, but their combined application to sea turtle conservation offers a new way forward to address the challenges of sea turtle recovery in a world increasingly impacted by humans. This chapter introduces the components of this holistic strategy, some of which are further explored in subsequent chapters, and integrates these elements within the framework of the original *Bellagio Blueprint for Action on Pacific Sea Turtles* (Bellagio Conference on Sea Turtles Steering Committee 2004; chapter 2, this volume). Finally, we review what has happened since the original 2003 conference and look ahead to the future. Although we focus primarily on leatherbacks, the approaches and case studies presented offer a paradigm for other species of marine turtles and possibly other highly migratory species with complex life histories impacted by human activities on land and at sea, and, even more broadly, of biodiversity conservation in a transboundary context.

Components of a Holistic Strategy

Elements of a holistic sea turtle conservation strategy draw from approaches that have been developed to address global issues of ocean, atmospheric, climate, and biodiversity changes. Important building blocks of a holistic recovery strategy for sea turtles include mitigation measures and conservation investments, such as nesting site and other habitat protection; addressing the transboundary context through multilateral cooperation and coordination; community involvement in conservation; and adoption of technology standards to reduce incidental takes of sea turtles by swordfish, tunas, and shrimp fishing fleets. Additional ingredients include the formation of positive and even negative incentives for conservation, which include positive incentives from, for example, side payments to increase participation and compliance and perhaps negative incentives arising from trade measures and other forms of sanctions;[1] to equitably distribute the burdens; and to finance mitigation and conservation investments and adoption of technology standards in developing nations. In addition, taxes and fees, including in-kind contributions, deserve consideration as a "double dividend" means of raising revenues to fund mitigation measures and side payments to those bearing the costs of conservation while helping producers and consumers to bear some of the external costs generated by their activities (Dutton and Squires 2008). Performance standards or some

form of individual or group use or property right, as discussed by Segerson in chapter 19 (this volume), are also potential components of a broad-based strategy. Use rights—"Turtle Mortality Limits (TML)"—comparable with Dolphin Mortality Limits in the purse seine fisheries for tropical tunas of the eastern Pacific Ocean that are individually held, face the problem that turtle interactions are often rare events and the overall TML for a depleted population may be insufficient in numbers to assign even one right to take a turtle to each vessel (Segerson, chapter 19). Under these circumstances, group use rights may be preferred, which may also be consistent with group forms of rights in parts of the Pacific.

Conservation investments and mitigation can form an important component of any holistic strategy (Bellagio Conference on Sea Turtles Steering Committee 2004; Dutton and Squires 2008; Janisse et al. 2010). Sea turtles provide a unique opportunity because they return to nesting sites, thereby providing a cost-effective focal point for conservation. Higher-income producers and consumers of seafood that entail the external cost of sea turtle mortality can mitigate their activities through financing conservation investments such as nesting site protection or cleaner gear in coastal fisheries.

Direct conservation payments, especially to local communities for nesting site and habitat preservation and to coastal small-scale and artisanal fishers for adoption of technology standards or perhaps curtailing fishing during nesting seasons, may well make a surprisingly effective but currently underappreciated contribution to sea turtle population recovery. Direct conservation payments of this kind would address two of the three anthropogenic sources of sea turtle mortality. One example of direct payments for leatherback turtle nesting site conservation occurs in Rendova, Solomon Islands, as discussed in chapter 11 (this volume). As another example, in Peru, coastal artisanal gill nets are responsible for most of the mortality of leatherbacks in that country, and the fishery responsible is generally confined to one area in the north of Peru, even though there are similar gillnet fisheries along the entire coast (Alfaro-Shigueto et al. 2007; see also chapter 15, this volume). Targeting conservation efforts on this northern fishing community in Peru alone would substantially reduce leatherback mortality in the eastern Pacific and can be viewed as one important piece of a multilateral whole. In general, however, reducing mortality in these fisheries is likely to prove more complex than in large-scale fisheries or nesting site protection for a number of reasons, as discussed in the next section and in chapters 15, 17, and 18 in this book.

What Is Effective Nesting Beach Conservation?

The priority on protecting nesting beaches, especially for leatherbacks, was highlighted in the *Bellagio Blueprint* (Bellagio Conference on Sea Turtles Steering Committee 2004; chapter 2, this volume), as well as in other regional forums and recovery plans, and is a necessary component of any sea turtle conservation strategy. The basic goal of sea turtle conservation actions taking place on nesting beaches is to optimize reproductive success of nesters. These actions have primarily been directed at protecting nesting females and their eggs from harvest or predation, and nests from destruction by tidal inundation and beach erosion. These actions, if sustained long enough, have been shown to be effective in reversing population declines (Dutton et al. 2005; Chaloupka et al. 2008; see also chapter 5, this volume). However, simply protecting nesting females during the time they haul out on beaches and preventing their eggs from being taken at the time they are laid is not effective conservation if those eggs do not produce hatchlings at the end of the two months or so they must incubate in the sand.

Recent studies show that the western Pacific leatherbacks consist of a metapopulation comprising scattered small aggregations nesting on islands and areas throughout the region, with a dense focal point on the northwestern coast of Papua Barat, Indonesia (Dutton et al. 2007; Hitipeuw et al. 2007). The western Pacific harbors some of the last remaining leatherback nesting aggregations of substantial size. Although there are still hundreds of turtles nesting, 75% of these occur in one area on the northern coast of Papua Barat, Indonesia (Dutton et al. 2007), and researchers are concerned by new information indicating that the majority of nests do not produce hatchlings, despite the elimination of egg harvest over a decade ago (Tapilatu and Tiwari 2007). Some community-based beach and nest protection procedures have been developed to improve hatch success, creating hope that applying these techniques now will ensure that populations are sustained in the future.

Protecting nesting habitats and nests is a simple and necessary condition as well as the most cost-effective way to ensure the long-term survivability of leatherbacks (see chapter 4, this volume). Many examples in the Atlantic Ocean (including South Africa, Brazil, Ascension Island, and Costa Rica) show that sea turtles do recover through simple beach protection. Tiwari, Dutton, and Garner in chapter 5 (this volume) explore the potential for nest relocation as a management tool that may be important to prevent collapse of the last remaining leatherback nesting population in the Pacific at Jamursba-Medi. The Malaysian case study presented by Liew

in chapter 6 (this volume), however, serves as a cautionary tale illustrating the need to improve egg husbandry techniques if hatcheries are to be used as an effective conservation tool and that although a necessary condition, nesting site protection is one component of a holistic process due to the multiple sources of mortality and transboundary nature of the resource.

Currently, Jamursba-Medi and Wermon beaches in Papua Barat (Indonesia) host the largest nesting population in the Pacific, with between 1,800 and 3,600 nests laid per season in Jamursba-Medi and approximately 2,500 nests at Wermon (Hitipeuw et al. 2007). Local villagers monitor and patrol the beaches, but additional efforts are needed to increase the number of hatchlings that can enter the water each year. The Huon coast of Morobe Province hosts 50% of leatherback nesting in Papua New Guinea, but nesting beach impacts are severe due to egg harvesting by villagers, beach erosion and wave inundation, and predation by village dogs. In Solomon Islands, egg collection and the killing of turtles for food have drastically reduced the leatherback nesting population. However, important nesting sites still occur at Isabel Island and at Rendova and Tetapare in the Western Province, and thus population recovery is still possible through dedicated conservation actions directed at boosting hatchling production (Dutton et al. 2007).

Ultimately, the long-term success of these programs depends on the degree to which local communities incorporate practices compatible with sustainable sea turtle populations into the socioeconomic and cultural fabric of their societies. It is important to take into account the complexity of tribal and village politics and a colonial "cargo culture" legacy pervasive in many parts of Melanesia as factors that can determine the success of conservation (Foale 2001). Gjertsen and Stevenson review this in detail in chapter 11 (this volume) and present a case study for Solomon Islands that employs direct conservation payments that can serve as a model for other comparable countries in the region. The need to integrate anthropology and socioeconomics into sea turtle conservation work was recognized in the 2003 Bellagio meeting and *Bellagio Blueprint* and subsequently incorporated into the nesting beach conservation program funded by NOAA Fisheries and the Western Pacific Regional Fishery Management Council that resulted in insightful recommendations for inclusion in regional action plans (Kinch 2006; Bellagio Sea Turtle Conservation Initiative Steering Committee 2008).

A final ingredient of effective beach conservation is ensuring that the breeders (both male and female) do not perish as a result of fishing activity adjacent to nesting beaches and that hatchlings are able to enter the water

and swim offshore. This important area immediately adjacent to the nesting beach is often overlooked as focus is placed on high-seas and coastal fisheries that interact with turtles on distant foraging areas. National parks and other boundaries designed to protect nesting habitat are being extended to include the adjacent waters in Papua Barat, Indonesia, and off the key leatherback nesting beaches in Mexico and Costa Rica (see chapters 8 and 9, this volume). Omuta (chapter 7) ascribes the sudden increase in numbers of loggerheads nesting on Yakushima Island in Japan in part to the disappearance of the local pound-net fishery that drowned females intercepted before they reached the resting beach.

Beyond the Beaches

The *Bellagio Blueprint* identified the need to reduce fishery interactions on the high seas and in coastal waters. This need has long been acknowledged in the scientific literature and sea turtle recovery plans (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998a,b; Alfaro-Shigueto et al. 2010; Gilman et al. 2010; Wallace et al. 2010). However, there have been many obstacles to implementation of effective measures due, among other things, to competing economic interests and the transboundary nature of sea turtles' life history (Dutton and Squires 2008). Where conservation resources are limited, it is easier and cheaper to focus on the tangible outcomes of nesting beach conservation than to address the complex challenges of at-sea conservation (see chapter 4, this volume). In addition, uncertainty on the status and biology of sea turtles on the remote high seas and on the relative impact of different fisheries on sea turtle populations has contributed to the controversy and litigation that have characterized the policy debate. However, there are ways forward, and the intent of this book is to identify and explore elements and approaches that could enable better integration of at-sea conservation into a broad-based, holistic, and multilateral recovery strategy that enhances the effectiveness of nesting beach conservation. Since the 2003 Bellagio meeting, many countries have begun testing fishing technologies expected to reduce sea turtle interactions and mortality in high-seas pelagic longline fisheries, and some have adopted the use of better gear and handling procedures to release turtles with minimum harm (see chapters 13 and 18, this volume). More information is required about the interactions of leatherbacks, loggerheads, and other sea turtles with coastal fisheries, particularly in the vicinity of nesting beaches, where the high density of breeding turtles increases the likelihood of interactions, or in other areas of concentration, such as those at forag-

ing areas off Baja California, Mexico, discussed by Peckham et al. (2007). Models of sea turtle population dynamics clearly show the critical role that protection of the adult reproductive segment of the population has in the conservation of the species. Breeding adults come into contact with coastal fisheries as they migrate to and from the nesting beaches, during nesting, and in the internesting habitat. In addition, the impact of climate change on oceanic conditions could alter fishing patterns, turtle movements, and the physical characteristics of nesting beaches.

The Need for a Multilateral Approach

The holistic recovery strategy faces the transboundary nature of most sea turtles and their encounter with a gauntlet of fisheries in the exclusive economic zones of multiple countries and on the high seas. As a consequence, the holistic strategy must address the transnational externality arising with shared resources in which the outcome that any one country can realize depends not only on its own actions but also on what others do (Barrett 2003).

Leatherbacks, for example, are probably the most migratory of marine creatures, putting to shame even the sojourns of tunas and billfish. A nesting turtle may deposit its eggs in equatorial Papua Barat (Indonesia), swim all the way to the temperate waters of the North Pacific to forage off the Californian coast, return to Papua Barat to nest several years later, and then either make a return migration to California or go off wandering elsewhere to the South China Sea off Malaysia (Benson et al. 2007). In doing so, a leatherback passes through the convention area of two Pacific tuna fishery management conventions (IATTC, WCPFC)[2] and several other smaller subregional associations concerned with fisheries science and management (SEAFDEC, FFA, SPC–OFP).[3] It also passes through the geographical competences of three regional conservation instruments or organizations (IOSEA, IAC, SPREP).[4] Further, because of their terrestrial nesting habitat and aquatic life history, turtles are often the dual responsibility of several national government departments dealing with fisheries, environment and conservation, forestry, and national parks.

This transboundary setting and transnational externality mean that unilateral approaches to sea turtle population recovery are often ineffective. Unless a population remains in a single nation's exclusive economic zone, unilateral conservation simply makes more sea turtles available for interactions with other nations' fishing fleets, whether in coastal waters or on the high seas, with imports of fish filling consumption gaps created

through unilateral conservation. When the population resides within the exclusive economic zones of one or two of the parties involved, bilateral binding agreements or coordinated policies between the two nations can help the population recover (Dutton et al. 2002). Bilateral agreements are easier to develop than multilateral agreements due to lower numbers and the necessity that participation by both is needed to sustain a mutually satisfying outcome and nonparticipation by one country is far easier to deter (Barrett 2003). In many instances, however, population recovery in this transnational setting may require, or be accelerated by, cooperation among multiple nations in a self-enforcing multilateral agreement, such as the Inter-American Convention for the Protection and Conservation of Sea Turtles. Such a binding multilateral agreement needs to be self-enforcing because there is no third party to enforce agreements due to the constraint imposed by national sovereignty, even though the agreement is binding under international law (Barrett 2003; Tsamenyi and Jit, chapter 20, this volume).

Nonbinding multilateral agreements may be all that are possible, including coordination among nations, such as in The Memorandum of Understanding on the Conservation and Management of Marine Turtles and Their Habitats of the Indian Ocean and South-East Asia (IOSEA MoU). In other situations, informal coordination among nations may provide an effective contribution to conservation, such as the development and use of circle hooks for pelagic longline fishing and the coordination between the United States and Japan, where interests align, or the more directly coordinated efforts between the Inter-American Tropical Tuna Commission (IATTC) partners and Latin American nations. In the Pacific, this complex geopolitical mosaic of national, subregional, and regional entities can militate against effective turtle conservation through uncertainty about which organizations should lead the turtle conservation programs. This highlights the international coordination among the parties involved that is necessary for an effective conservation strategy, as discussed in the *Bellagio Blueprint.*

Coordinated behavior can be very appropriate with such technology standards, as discussed in chapter 18 (this volume). Because coordination is nonbinding and does not require ratification by member parties to enter into force, it can also be organized relatively easily and quickly, which can be critical for endangered populations. Coordinated behavior can also be more easily narrowed to only those parties with a genuine interest, helping to sidestep the potential problem of "broad but shallow" agreements that can arise with larger numbers of participants, especially in formal mul-

tilateral cooperative agreements (Barrett 2003; Victor 2006). Nonbinding agreements that coordinate behavior also allow inclusion of a broad swathe of states into loosely coordinated behavior and norms, such as the MoUs. Nonbinding agreements in some circumstances may also outperform binding agreements and can be more flexible and less prone to raise concerns about noncompliance, thereby allowing governments to adopt ambitious targets and far-ranging commitments (Victor 2006). Binding cooperative agreements can evolve from coordination and "soft law" because the nonbinding instruments allow for a process through which governments commit to more ambitious courses of action as they learn what works (Skærseth et al. 2006; Victor 2006).

Success requires that a self-enforcing multilateral agreement ensure that every party is better off with the program than without it, but to succeed the program also needs to ensure that each party would lose by not participating (Barrett 2003). That is, free riding through nonparticipation in a self-enforcing treaty must be addressed by some credible means, through a negative incentive such as a credible trade measure, as discussed in chapter 21 (this volume), or a positive incentive that creates an aggregate gain by participation for all parties and an individual gain for each party. As discussed earlier, such a gain may require side payments (transfers from one party to another), which help create a sense of fairness, and hence legitimacy, and ensure that no party is worse off. Such side payments (along with a credible trade restriction) were instrumental in ensuring the success of the Northern Fur Seal Treaty (Barrett 2003).

Coastal Fisheries

Attention is increasingly focused on incidental bycatch in coastal fisheries as a major contributor to sea turtle mortality (Arauz 1996; Cheng and Chen 1997; Kinch 2006; Koch et al. 2006; Peckham et al. 2007; Dutton and Squires 2008; Alfaro-Shigueto et al. 2010; Gilman et al. 2010). The *Bellagio Blueprint* (see chapter 2, this volume) highlights the importance of addressing bycatch in coastal fisheries; however the chapters in this book illustrate that coastal fisheries are far from homogeneous and in fact are both extensive and complex (Alfaro-Shigueto and Mangel, chapter 15; Yeo et al., chapters 16, 17; Segerson, chapter 19). Many of these Pacific coastal fisheries, but not all, as witnessed by the California/Oregon drift gillnet fishery and the Japanese coastal fisheries (chapter 7), are found in the waters of Latin America, Southeast Asia, and the Indo-Pacific. These fisheries include artisanal drift gillnet and other net, trap, and line fisheries and small- to

medium-scale commercial fisheries using purse seines, longlines, bottom trawls, drift gillnets, and shrimp trawls (Fahy, chapter 12).

A number of issues arise when addressing bycatch and direct takes of sea turtles in coastal fisheries of low- and medium-income countries. Most broadly, the biodiversity conservation issue cannot be neatly separated from the management of these common renewable resources and from the issues of poverty, economic development, coastal zone management, and sometimes even ethnicity (Wilkie et al. 2006). Tackling the sea turtle bycatch and biodiversity issues in these fisheries promises to be an even more challenging "Tragedy of the Commons" because it largely occurs in low- and medium-income countries. The difficulty is compounded because the benefits of biodiversity conservation are public goods that are nonmarket and enjoyed not by those bearing the costs but by relatively wealthy populations throughout the world.

The standard fishery management policies—especially for bycatch—developed in temperate-water and high-income countries for the medium- and large-scale commercial coastal and high-seas fishing vessels are much more difficult to transfer to the complex multispecies ecosystem of the tropics, which is compounded by the less-developed conservation and management infrastructure (Ahmed et al. 2007). For these reasons, the policy prescriptions of Segerson (chapter 19, this volume) for stochastic sea turtle bycatch in the Hawai'i pelagic longline fleet on the high seas are likely not applicable in most low- and middle-income country settings. The conservation and management challenge is magnified for the artisanal and small-scale vessels that may not even be licensed, where entry into the fishery may be open, no landings records are kept, vessels are small and operate out of small estuaries and even beaches scattered along a long coastline, and enforcement is uneven at best or more usually absent.

The low incomes and limited employment opportunities facing many coastal fishers, their families, and their communities limit their collective ability to absorb the costs of conservation, such as direct gear costs and indirect or opportunity costs through any incomes foregone from reduced catches following bycatch reduction measures and reduced direct takes for consumption (Alfaro-Shigueto and Mangel, chapter 15; Yeo et al., chapter 17). Moreover, important differences in wealth and income can appear among fishing populations—they can be heterogeneous in fact along many dimensions—and the impact of biodiversity conservation upon them and their responses to the conservation imperative can differ markedly even within the same locality for any given gear type and scale of fishing.

Technology standards (gear-technology-handling approaches) can

reduce bycatch of turtles in some coastal (and high-seas) fisheries, as discussed in chapters 13 and 18. Turtle excluder devices can be effective in reducing turtle incidental takes in coastal shrimp fisheries. Widespread anecdotal evidence suggests that turtle excluder devices are not consistently used, however, because of inconvenience or higher trip costs or lower catches and revenues. In some, but not all, longline fisheries the replacement of J-hooks by circle hooks and changes in bait can reduce incidental takes of sea turtles and posthooking mortality without apparently compromising catches and revenues from target species in most fisheries (see chapters 13 and 14). Artisanal gillnet fisheries are more problematic, with few or no off-the-shelf technological changes that can lower incidental takes of sea turtles, although a limited number of opportunities may exist and might be employed with other turtle bycatch mitigation approaches (Gilman et al. 2010). Positioning and timing of gillnet placements can impact turtle interception rates but might also reduce catches and incomes. Abandoned nets or ones left out overnight in violation of regulations can catch turtles coming for nesting. Changes in mesh sizes might reduce entanglement but are almost impossible to effectively enforce on a broad scale. All approaches are likely to confront the opportunity costs of artisanal fishers who live close to margins of poverty and whose current fishing practices are likely to maximize their net returns on at least a short-term (and myopic in terms of long-term resource sustainability) basis. Local fishers know most about their gear, fishing practices, and turtle interactions, and innovations are most likely to come from within the fisheries.

Further research is necessary on technology standards for the gear used by artisanal and small-scale fishers, and some of the advances may simply entail changes in timing and handling of gear and posttake practices. Nonetheless, short of switching or banning usage, some gear, such as artisanal drift gillnets, may have fewer options entailing technology standards. Instead, the focus may shift to postentanglement monitoring and handling and substitution of other gear with lower rates of interaction and less induced sea turtle mortality, such as handlines, during peak periods of inter nesting aggregation or in other critical times and places of sea turtle concentration. This would keep fishers employed and provide a supply of fish for petty traders and other distributors and consumers (who are also impacted and who may offer resistance to conservation measures that inhibit fishers' adoption). Compensation and even more successful direct compensation payments and agreements are likely required that at least cover fishers' opportunity costs through any forgone net returns from reduced catch rates or changed species compositions, timing into markets,

higher operating costs, forgone opportunities that may be reduced, and other factors.

Finally, an option that bears further consideration is some form of territorial use right centered upon exclusive use and conservation stewardship by a group and the nesting site and waters immediately offshore, creating a conservation zone.[5] These rights extend beyond simply a closed area or marine protected area. These territorial rights might simply recognize or reinforce existing rights, such as those found in the Indo-Pacific (and often called customary marine tenure [see Ruddle 1988; Cinner 2005; Cinner and Aswani 2007]), or establish new ones. These rights might range from the quasi ownership of specific localized sites by families, clans, other small social groups, or communities to more complex state legal systems (Ruddle 1988). These rights may be granted to specific locations, during particular seasons, to specific species such as turtles, or for a specific gear type. These rights can even be less concrete and may include such concepts as exclusion mechanisms and first-comer rights. Such rights for a group can be expected to be defined with reference to proximity to its settlement(s) and to lateral and seaward boundaries. These territorial rights effectively become a form of common property or use right and form the basis for well-defined groups to tackle the biodiversity conservation issue subject to parameters established by higher governmental authority in a comanagement relationship. Considerable research has shown that under certain conditions common property can form an effective basis for resource management (Wade 1988; Ostrom 1990; Baland and Platteau 1996; Seabright 1997; Cinner 2005; Cinner and Aswani 2007). Because collective action is more likely to occur where the common resource is critical to local incomes (not the case with sea turtles) and when its privatization appears to be unfeasible (the case with sea turtles), some form of economic incentives coupled with social norms may be required (Wade 1988).

In sum, there is not a single, highly effective way to reduce sea turtle bycatch and direct takes in artisanal and small-scale line, trap, and gillnet fisheries and medium- and larger-scale bottom trawl and purse seine coastal fisheries. The heterogeneity between and even among these fisheries is considerable, and one single approach does not work across all fisheries. Production standards are likely not in play because of the monitoring and enforcement issues, so that other approaches relying on technology standards and economic incentives are necessary. The conservation program may well consist of a package of several alternatives and vary by fishery.

Social Norms and Economic Incentives

The conservation of marine biodiversity, such as sea turtles, depends on strong incentives rather than simply social norms[6] (Jackson 2007). Economic incentives align individual behavior with social goals for biodiversity conservation and inhibit opportunities for free riding. Economic incentives punish undesirable behavior through a variety of means, centering on sanctions, and reward desirable behavior. The clarion call is sometimes made that fishers should conserve because that is the morally correct thing to do, but simply relying on such a social norm cannot adequately serve as the sole basis to conserve biodiversity in the long run. The effectiveness of social norms for conservation diminishes as migration and movement of peoples increase and markets and trade increasingly become global, the heterogeneity and size of social groups increase, and the ability to observe individuals' actions by each member of the group erodes. Shifts in norms are also often (but not always) a slow process, whereas economic incentives generally change behavior more rapidly.

If the evidence increasingly shows that environmental social norms by themselves are insufficient for the conservation of marine biodiversity, what is left as a driver of behavior favoring conservation? The evidence points to the increasing importance of backing up social norms with economic incentives that align individual behavior with social conservation goals, that induce conservation of biodiversity, and that inhibit incentives and opportunities for free riding (Ostrom 1990; Baland and Platteau 1996). These incentives can be positive ("carrots"), rewarding desirable behavior, or negative ("sticks"), such as sanctions (a negative economic incentive) targeting noncooperative behavior and have been shown to prevent overexploitation of common local resources (Wade 1988; Ostrom 1990; Baland and Platteau 1996; Seabright 1997). Social norms without sanctions are likely to be situations where resources are either not very scarce or not very important to local economies (Jackson 2007), such as sea turtles in most cases.

Market-based approaches for biodiversity conservation are increasingly used across a wide range of species, including nesting sites for sea turtles (Ferraro 2007a,b; Ferraro and Gjertsen 2009; see also chapter 11, this volume). Biodiversity conservation and ecosystems and their services are public goods, one for which existing markets and prices do not exist, thereby requiring other market-based approaches to provide economic incentives and to account for their indirect use and existence values.

Direct conservation payments to fishers are one of the most important market-based measures to establish positive economic incentives and specifically to compensate for their opportunity cost of lost incomes and direct costs of changing gear or times and places of fishing during nesting seasons or in hot spots.[7] Direct payments, coupled with performance goals, can also establish economic incentives for postinteraction handling. Possibly even customary or formal use rights might be purchased and then leased back to resource users. An effective and well-defined zonal limited-entry scheme during nesting season, encompassing the internesting forage areas, is another consideration. Comanagement through engagement of fishers in gear modification/design, its deployment, and enforcement and monitoring is a necessary condition.[8]

One of the few sea turtle bycatch payment schemes for coastal fisheries (as opposed to nesting site protection) occurs in Watamu, Kenya, where there is a small but nationally important nesting population of green turtles in the Malindi/Watamu Marine Park and Reserve complex (Ferraro 2007a,b). Since 1997, the local, nongovernmental Watamu Turtle Watch has run a conservation program that implements a community conservation education program, pays villagers performance payments for nest protection, and pays fishers to release live turtles from fishing gear and to participate in a tag and recapture study. Payments are made directly for releasing turtle bycatch rather than subsidies for using gear that reduces turtle bycatch (Ferraro 2007a).

The turtle bycatch release incentive program began informally in 1998 as a compensation program for fishing-net damage from turtle interactions (Ferraro 2007a). When fishers catch a live turtle they remove it, return with it to one of a small number of landing sites, and report the turtle to Watamu Turtle Watch (fishers are trained to reduce the stress on the turtle during transport). Fishers receive 500 Kenyan shillings (KSH) (approximately US$6) for a turtle greater than 70 cm CCL (curved carapace length), which corresponds to adults and subadults, and KSH300 for a smaller turtle, after which the turtle is measured, tagged, and released.

Although payments were not initially made for releasing previously tagged turtles, environmental social norms or goodwill were an insufficient motivation, and economic incentives were instead implemented. Initial concerns that the payment would create incentives for fishers to deliberately set nets on turtles to receive the incentive payment were unfounded in that there is no evidence of the same turtle being caught repeatedly by an individual fisher, although this observation does not preclude an increase in deliberate net setting. The payment structure does not provide an incentive for fish-

ers to reduce turtle-gear interactions by changing their gear or the location of their fishing activities. Schultz (1975) described a payment scheme for bycatch reduction in Surinam. Alternatives that generate such incentives, such as those discussed by Segerson in chapter 19 (this volume), require observers, which as discussed earlier is prohibitively costly in most countries.

Economic incentives, such as payment schemes, tend to grow in importance as market economies widen and deepen and the size of a group expands from small and homogeneous into larger and more heterogeneous social structures but are nonetheless not divorced from social norms. In fact, economic incentives and cooperative behavior are enhanced by social norms. For example, a payment program for sea turtles can harness social norms of reciprocity and disapproval to enforce property rights and payments (Ferraro 2007b). These social norms, for example, can take the form of neighbors respecting their fellow citizens' property rights, community members fearing that someone would observe them harvesting eggs and notify the nest's "owner," concern over entangling or hooking turtles, or concern over postentanglement or posthooking handling and mortality. All of these events could potentially lead to undesirable conflict. Performance payment schemes may not work well in areas in which there are weak social norms among villagers or coastal fishers.

Expanding Pan-Pacific Policy Actions

Initiatives like the Bellagio conference are required to provide a forum and mechanism to develop a comprehensive conservation program that seeks not only to identify threats but also to develop strategies for what needs to be done to counter them and plans for sourcing funds to support long-term effective conservation. Since the first Bellagio meeting in 2003, many countries have started testing mitigation measures expected to reduce leatherback interactions and mortality in high-seas pelagic longline fisheries, and some have adopted the use of better gear and handling procedures to release turtles with minimum harm. In 2004, the Food and Agriculture Organization of the United Nations (FAO) convened a technical consultation on sea turtle conservation and fisheries in Bangkok and subsequently published guidelines on sea turtle bycatch under the Code of Conduct for Responsible Fisheries (Food and Agriculture Organization [FAO] 2005). Over the same period, longline and other fishery observer programs have improved, as has reporting of accidental turtle catches. Despite these advances, gaps still remain in our knowledge and, more important, in the global implementation of these methods.

The *Bellagio Blueprint* emphasizes the valuable potential that exists within regional fisheries management organizations such as the Inter-American Tropical Tuna Commission (IATTC) and the new Western and Central Pacific Fisheries Commission (WCPFC) to develop a capacity and facilitate the advancement of effective programs to reduce fisheries-related sea turtle bycatch and mortality. In the western Pacific, programs have been developed through fisheries management and research agencies such as the Western Pacific Regional Fishery Management Council and the National Marine Fisheries Service. Active programs have also been initiated by national governments, such as the turtle breeding and conservation efforts by Malaysia, and by intergovernmental agencies such as the Convention on Migratory Species and the Secretariat of the Pacific Regional Environment Programme (SPREP).

Several programs in Indonesia, Papua New Guinea, and Solomon Islands are jointly supported by governments and international and local nongovernment agencies, such as Conservation International, World Wide Fund for Nature, and The Nature Conservancy. These three countries recently signed a MoU on leatherback conservation. The action plan developed through the Bellagio conferencesupports such existing regional conservation schemes (e.g., the Bismarck Solomon Seas Ecoregion [BSSE] Tri-National Partnership between Papua New Guinea, Solomon Islands, and Indonesia; the Sulu-Sulawesi Marine Ecoregion [SSME] Action Plan involving Malaysia, the Philippines, and Indonesia; and the Secretariat of the Pacific Regional Environment Programme [SPREP]).

Next Steps: Taking Action

The plight of Pacific leatherbacks has provided a focal point for operationalizing the *Bellagio Blueprint* by developing a more detailed regional action plan and exploring options for long-term financing of these actions. The last remaining nesting population of substantial size is found in Papua Barat, Indonesia (Safina 2006; Dutton et al. 2007). Although relatively large numbers of leatherbacks are still found nesting along the Bird's Head Peninsula in Papua Barat, there are warning signs that a failure of hatchling production may have increased the extinction risk of this population (Tapilatu and Tiwari 2007). However, there is still an opportunity to implement a holistic strategy outlined in this book before that population collapses, following the fate of the once-abundant leatherback populations in Malaysia and the eastern Pacific.

Conservation and recovery of Pacific leatherbacks require coordinated

efforts on a number of fronts. Some threats can be addressed through immediate, short-term actions (e.g., short-term research projects, publicity campaigns of finite duration, new regulations). Others will require making sustained conservation efforts over many years. For example, addressing threats on nesting beaches requires sustained efforts in the form of beach monitoring, moving nests, enforcement, and in some cases providing community benefits in exchange for conservation. Currently, most western Pacific nesting beach projects are dependent on minimal short-term funding that must be raised each year and is vulnerable to budget shortfalls of funding agencies. Some critical nesting beaches do not currently have funding for conservation efforts. Some projects have enough funding to collect data but lack the funds to undertake necessary actions such as moving nests or providing incentives to communities to protect nests. This financial uncertainty makes it difficult for stakeholders to engage in long-term planning. In addition, there is a substantial risk that conservation investments made in some years will be lost in others when funding is low. In some cases, years of conservation efforts may ultimately be wasted if a lack of funds means that actions cannot be taken to deal with emerging issues such as sand temperatures that are too high or communities that have lost interest in conservation. The long-term success of the conservation actions outlined in this book relies on steady financial support over time to provide continuity to conservation activities and finance recurrent costs.

The need to secure long-term financing to implement priority conservation actions was recognized at the 2003 Bellagio meeting, and a recommendation was made to explore establishment of a sea turtle conservation fund. In July 2007, a Bellagio-style workshop was held in Terengganu, Malaysia, to consider options for creating such a fund. A detailed action plan was written for the last remaining leatherback nesting beaches in the western Pacific (Bellagio Sea Turtle Conservation Initiative Steering Committee 2008; see also Appendix, this volume). Working group participants recommended that a business plan be developed to assess the needs and costs and design the appropriate conservation fund. Based on the critical conservation needs and their estimated costs, the Terengganu workshop initiated a Pacific leatherback fund-raising strategy called "Come Back Leatherback" that would be applied to the entire Pacific range of the leatherback and address both at-sea and terrestrial conservation measures. This is an exciting and important step toward operationalizing the *Bellagio Blueprint* and implementing the holistic recovery strategy. Preliminary estimates indicate that the costs of saving the leatherback are modest rela-

tive to the long-term value of this charismatic and iconic species. The fund will likely include a partial endowment, and the complete assessment and estimates will be refined in the business plan.

There is still a need to address the other components of the holistic strategy outlined in this book, in particular the more intractable problems related to coastal fisheries bycatch. The 2007 workshop in Malaysia also took steps toward outlining an action plan for coastal fisheries and recognized the need for follow-up work with a broader group of experts to further explore and develop a detailed plan that builds on the ideas presented in this book (Bellagio Sea Turtle Conservation Initiative Steering Committee 2008). The reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSRA) passed by the U.S. Congress in 2007 contains a number of new provisions for both domestic and international fisheries stewardship that will shape the focus of fisheries management in the coming years. The Act pays an unprecedented level of attention to international fisheries. The Act calls for the United States to work bilaterally with other countries and multilaterally through various forums, such as regional fishery management organizations (RFMOs), to address illegal, unreported, and unregulated (IUU) fishing and bycatch of protected living marine resources (LMRs). The MSRA is designed to foster international cooperation and assistance by the United States to help foreign nations adopt equivalent conservation measures enacted upon domestic U.S. fisheries for adopting appropriate fish harvesting plans and conducting cooperative research to develop less-destructive harvesting techniques. For sea turtles, this currently means transferring technologies that reduce sea turtle bycatch, such as the circle hooks and baiting techniques for longline fishing, but the MSRA is broad enough to encompass other conservation measures that are part of the holistic strategy described in this book.

In conclusion, there are opportunities to immediately implement the multilateral holistic recovery measures described in this book under existing international sea turtle and fisheries treaties. Moreover, existing agreements might be augmented through additional formal or informal bilateral or multilateral agreements. There could also be coordinated actions by individual nations, nongovernmental and industry organizations, and others acting in tandem that are not formal cooperative agreements but that are nonetheless effective and quicker to establish. National action plans can also play a role. The window of opportunity to effectively implement conservation measures may soon close as some sea turtle populations in the Pacific teeter on the brink of extinction. Integrating fisheries management into a holistic recovery strategy in the short run may help tip the balance in

favor of recovery for loggerheads and leatherbacks and in the long run help reconcile fishing with biodiversity conservation.

Notes

1. For example, side payments (transfers in money, in kind, or in technology) might be made from higher-income consumers of biodiversity conservation and fishers with turtle bycatch to low-income artisanal and small-scale fishers for sea turtle bycatch avoidance or for nesting site protection. Such payments financing conservation investments can provide formal mitigation projects (*Bellagio Blueprint,* chapter 2, this volume; Dutton and Squires 2008). Side payments serve to redistribute the social surplus from biodiversity conservation (measured by willingness to pay) so that no individual is made worse off (say from participating in conservation activities), giving individual rationality, and that no group or community is collectively worse off (given that many low- and middle-income fishers in particular live in distinct communities, and community cooperation is required), contributing to collective rationality. Side payments also help to restructure coastal fisher incentives toward participating in the conservation investment and cooperation, including compliance and as much self-enforcement without sanctions as feasible. Side payments can also make biodiversity conservation seem "fair," so that it is perceived as legitimate and consistent with social norms by the parties involved (e.g., implicit recognition of property or use rights held by fishers or traditional users of sea turtles by higher-income consumers of biodiversity conservation).

2. Inter-American Tropical Tuna Commission, Western and Central Pacific Fisheries Commission.

3. Southeast Asian Fisheries Development Council, Forum Fisheries Agency, Secretariat of the Pacific Community—Offshore Fisheries Program.

4. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and Their Habitats of the Indian Ocean and South-East Asia supported by the United Nations Convention on Migratory Species, Inter-American Convention for the Protection and Conservation of Sea Turtles, Secretariat of the Pacific Regional Environment Programme.

5. Territorial (spatial) use or property rights allocate exclusive use to a specified area of the ocean to a single user, most often a group. The group in turn informally or formally allocates use rights to its members (Christy 1982).

6. Social norms are customs, conventions, and accepted rules of behavior. Social norms of behavior can sustain cooperation when people care about the future benefits of cooperation because it is in everyone's interest to follow the norm as long as others are expected to do likewise. Cooperation is mutually enforced rather than through external enforcement (Ostrom 1990; Baland and Platteau 1996; Sethi and Somanathan 1996). Social norms change an individual's private payoff by adding an extra cost in the form of shame, guilt, dislike, disapproval of others, and so forth, through a process of education or culture. Norms differ from customs in

that an individual would not automatically follow the norm merely because of the expectation that others would follow it; instead, the extra cost is essential. Norms also differ from sanctions because others do not take explicit actions to punish when there is a violation of the norm; that is, sanctions are external and norms are internalized. Obedience to the norm will occur when the sanctions or discomfort are sufficiently great and certain to make disobedience less immediately attractive than obedience.

7. These payments, especially for a transboundary resource or global public good such as sea turtles, can be in the form of side payments from high-income consumers of biodiversity benefits to lower-income producers who must bear the cost of conservation.

8. Comanagement of fisheries refers to a system of shared responsibility and authority between a local group of fishers and a government having he constitutional mandate (Baland and Platteau 1996).

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