Recovery of Pacific sea turtle populations requires a holistic approach that addresses all sources of mortality. In the Pacific, populations of some species of sea turtles face extinction unless the recent dramatic declines are reversed. This issue has become so pressing that fisheries management must now address incidental takes of sea turtles, and in some fisheries this issue is driving fishery management. Recovery efforts have historically focused solely on nesting site conservation, whose aim is to protect eggs and breeding females. However, as marine creatures, sea turtles spend most of their life at sea, and by concentrating conservation effort on the nesting beaches, mortality from coastal and high-seas fisheries is not addressed. The continuing decline of Pacific populations, especially of leatherbacks and loggerheads, despite over a decade of nesting site conservation, illustrates the limitations of the current approach to conservation. In the past five years, conservation efforts have widened to include technological fixes to reduce incidental mortality of sea turtles at sea during fishing. This technological approach shows promise for reducing fishery-related mortality, but it has become increasingly clear that, by itself, a piecemeal approach will not produce recovery of the severely depleted populations.

Recovery of Pacific sea turtle populations is complicated by the transnational nature of sea turtles, whose migrations span the entire ocean and bring them in and out of exclusive economic zones and the high seas. The
breeding sites are often thousands of miles away from the foraging and developmental habitats, and it may take decades for turtles to reach sexual maturity. During that span, turtles transit through multiple habitats and international jurisdictions. As a consequence, unilateral conservation by single nations, although helpful, is fragmentary and is unlikely in itself to allow recovery of the populations. Instead, multilateral and cooperative efforts by nations, international organizations, communities, fishers, environmental groups, and other interested parties are required.

Given the urgency of the problem and recognizing that a multilateral and holistic approach is needed to effect recovery of populations of Pacific sea turtles, a meeting was convened at the Rockefeller Bellagio Conference Center in Bellagio, Italy, in November 2003. This meeting was convened to explore new directions that would shift the paradigm from conservation and piecemeal and unilateral efforts to a paradigm of population recovery from a holistic and multilateral approach. The meeting brought together an interdisciplinary group of 25 that included policy makers, biologists, economists, game theorists, legal scholars, fishers, diplomats, and environmentalists. This meeting was the first time that people from these diverse disciplines and viewpoints were brought to bear on developing a holistic and multilateral approach to population recovery.

The key outcome of the meeting was *The Bellagio Blueprint for Action on Pacific Sea Turtles*, which is hereafter referred to as the *Bellagio Blueprint* (Bellagio Conference on Sea Turtles Steering Committee 2004, see chapter 2 this volume). The *Bellagio Blueprint* concisely synthesizes the outcome of the meeting and lays out a holistic and multilateral approach for recovery of Pacific sea turtles. The *Bellagio Blueprint* calls for: (1) the protection of all nesting beaches; (2) reducing turtle take in at-sea and coastal fisheries; (3) stimulating Pan-Pacific policy actions; and (4) encouraging the sustainability of the traditional use of sea turtles. The tables in the *Bellagio Blueprint* (see chapter 2) present the ongoing and required policy actions.

This book is organized around the *Bellagio Blueprint*. It is not, however, intended as a proceedings. Instead, the content of this book draws on the key issues presented and discussed at the meeting, which have in part been developed further here. We also do not attempt to provide a complete and current review of the biology and status of sea turtles here. The state of knowledge is constantly progressing, and there are excellent seminal reviews elsewhere (Chaloupka et al. 2004).

Turning to the parts and their chapters in greater detail, the balance of Part 1 (Introduction) contains three chapters. Chapter 2 presents the *Bel-
lagio Blueprint, which calls for a massive mobilization of effort to protect the 10 remaining leatherback turtle nesting sites around the Pacific from human take, predation, and habitat degradation. It notes that protecting nesting sites has been proven to work in restoring sea turtle populations.

Chapter 3, “A Holistic Strategy for Pacific Sea Turtle Conservation,” by Peter H. Dutton and Dale Squires, discusses the holistic approach to reconciling sea turtle recovery with continued fishing within the context of the Bellagio Blueprint (chapter 2). It covers the elements of the Blueprint in more detail and provides a framework for integrating the rest of the book. It also discusses events since the Bellagio meeting and looks to the future. Fishing will continue under any likely policy scenario, so that reconciling sea turtle biodiversity conservation with continued exploitation of fish populations is in a broad sense one of the keystones for any policy. The holistic approach extends beyond merely reducing fishery bycatch of sea turtles to include (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, which is perhaps the most intractable component. Because sea turtles are highly migratory across the exclusive economic zones of many nations and even the high seas, this transboundary nature of the resource must also be addressed by bilateral and multilateral coordination or cooperation; unilateral approaches simply fail to effectively conserve in this setting.

Chapter 4, “Can We Improve Our Conservation Bang for the Buck? Cost-Effectiveness of Alternative Leatherback Turtle Conservation Strategies” by Heidi Gjertsen, discusses how to obtain the most cost-effective conservation benefit for actions designed to increase sea turtle populations. Because society has limited resources to undertake actions that promote recovery of populations of endangered species, efficiency in the allocation of scarce economic resources requires decisions about how to prioritize these conservation actions. The chapter presents an analytical framework and empirical measurements for three alternative conservation strategies, nesting site protection in Papua Barat, Indonesia; regulations in the Hawai’i-based pelagic longline fishery for swordfish; and a time-area closure in the California/Oregon drift gillnet fishery. The results indicate that under current conditions, nesting beach conservation can, up to some level of protection, be the most cost-effective means of achieving increases in leatherback populations.
Part 2, “Nesting Beaches,” begins with chapter 5, “Nest Relocation: A Necessary Management Tool for Western Pacific Leatherback Nesting Beaches,” by Manjula Tiwari, Donna L. Dutton, and Jeanne A. Garner, which examines and documents a case study from St. Croix, U.S. Virgin Islands, and discusses the importance and the inevitability of adopting a nest-relocation strategy for western Pacific leatherback beaches. Recent evidence shows that nesting of the St. Croix leatherback population, which was once depleted, has now increased dramatically in response to an aggressive program of beach protection and egg relocation initiated over 25 years ago. Despite the labor involved and the potential for lower hatching success compared with in situ undisturbed nests, nest relocation may be one of the most important management tools among a repertoire of other management initiatives in the recovery of leatherbacks on nesting beaches where nesting has dropped to discouragingly low numbers. The success story of St. Croix; the initial success observed in relocated nests in Papua Barat, Indonesia; as well as the pressing need to address extensive nest loss to beach erosion and inundation and optimize hatchling production make nest relocation an important management tool and a necessary condition in the recovery of leatherbacks on the nesting beaches of the western Pacific.

Chapter 6, “Tragedy of the Malaysian Leatherback Population: What Went Wrong,” by Hock-Chark Liew, reviews and examines why beach conservation failed in Malaysia for leatherback sea turtles. The Malaysian leatherbacks may be the first major rookery to disappear in modern times. One of the earliest research and conservation efforts ever introduced for a turtle population was for the Malaysian leatherbacks. When conservation efforts started in 1961 with the establishment of a hatchery at Rantau Abang, population numbers were still in excess of 5,000 nests per year, but they have declined to only a handful of nests per year. The chapter presents a discussion of some of the suspected causes of decline, including egg exploitation, sex ratio biases, fishing impacts, coastal development, and tourism, and tackles the question of whether the Malaysian leatherback rookery can be saved.

Chapter 7, “Conservation Project on Yakushima Island: The Biggest Nesting Site in Japan,” by Kazuyoshi Omuta, examines the threats to the primary loggerhead nesting population in Japan and factors that have contributed to the recovering trend in that population. All North Pacific loggerheads nest in Japan, and about one-third of these nests are found on Yakushima Island. By the mid-1980s, the once-pristine beaches of Yakushima Island had been degraded by beach armoring, sand mining,
and development. Tourism and development have continued to impact the island, and the growing human population has led to deforestation in the mountains. Numbers of nesting females began to increase beginning in 2000, due to (1) cessation of sea turtle egg consumption since 1973 as a result of enforcement of the Nature Protection Law on Yakushima Island, and (2) the cessation of local pound-net and gillnet fisheries in 1999, thereby eliminating local bycatch. The chapter concludes with suggestions for sea turtle conservation on Yakushima Island.

Chapter 8, “Importance of Networks for Conservation of the Pacific Leatherback Turtle: The Case of ‘Proyecto Laúd’ in Mexico,” by Adriana Laura Sarti and Ana Rebeca Barragán, documents the current conservation effort in Mexico for a severely depleted population of leatherbacks. The concern caused by the low nesting numbers in 1993–1994 motivated several researchers from different institutions to join forces, and in 1995 a new coordinated conservation effort took shape as “Proyecto Laúd” (Leatherback Project). Through a summary of the results of Proyecto Laúd, the chapter discusses the project’s importance in the conservation of the eastern Pacific leatherback turtle. Of all of the scientific and conservation achievements made by the project, the most important lesson from Proyecto Laúd may be that no single organization or activity will provide recovery of Pacific leatherbacks. Only coordinated efforts, with the active participation of all stakeholders and a global perspective of the problem, will offer a chance for this magnificent reptile.

Chapter 9, “Reconciling Dual Goals of Leatherback Conservation and Indigenous People Welfare: Community-Based Sea Turtle Conservation Initiative in Papua Barat, Indonesia,” by Creusa Hitipeuw, examines a community-based approach to nesting site conservation for the last remaining sizable leatherback rookery in the Pacific. Conservation began in the early 1990s with a field-based program working in partnership with a local government agency in Sorong. The on-site activities focused on working with communities at the main 18 km nesting beach called Jamursba-Medi, where there is a particularly large aggregation of nesting leatherbacks subjected to a variety of threats, both natural and anthropogenic. Activities to date include community-based beach patrols and control of feral predation, which have resulted in a substantial reduction of human-induced threats, especially egg harvest and habitat disturbances. The chapter presents the benefits and challenges of involving local communities in leatherback conservation actions in Papua Barat.

Chapter 10, “Projeto TAMAR-ICMBio: Sharing Sea Turtle Conservation Experiences,” by Maria Angela Marcovaldi, presents a community-
based success story from Brazil that successfully integrates local fishing communities into sea turtle conservation. The Brazilian government initially established the National Marine Turtle Conservation Program (Projeto TAMAR) to gather basic sea turtle information for the country, but TAMAR has since expanded to include a network of 23 stations and associated conservation and monitoring activities to protect sea turtles and their eggs. Conservation activities focus on major nesting and feeding grounds distributed along 1,100 km of coastline and associated with oceanic islands. Coastal fishing villages are fully integrated into the program, with fishermen and local villagers composing the majority of paid personnel who work for TAMAR. Besides providing direct employment, the program has also developed an intense environmental education program, as well as social and community activities. This chapter presents the details of projects and outreach activities and shares the success and strategies of TAMAR.

Chapter 11, “Direct Incentive Approaches for Leatherback Turtle Conservation,” by Heidi Gjertsen and Todd C. Stevenson, examines conservation incentives and the role of economics at the local level for nesting beach conservation of leatherbacks. Although turtle protection is perceived as a benefit to conservationists, it may also represent a loss to villagers in terms of foregone protein or income. As basic economic needs are not met in many of the areas hosting nesting beaches and foraging grounds, the economic sacrifice required to protect sea turtles may hamper the acceptance and sustainability of these projects. If economic needs are not met by supporting sea turtle conservation programs, people may be forced to choose alternatives that do generate economic returns. This chapter discusses indirect and direct incentive approaches to conservation and presents a case study using direct payments for nesting site preservation of Pacific leatherback sea turtles in Solomon Islands.

Part 3, “Fisheries-Related Conservation,” begins with chapter 12, “Fisheries Impacts on Sea Turtles in the Pacific Ocean,” by Christina C. Fahy. This chapter provides a general summary of the impacts of various fisheries on Pacific sea turtle populations. Sea turtles are incidentally captured in commercial and recreational fisheries throughout the Pacific, including areas adjacent to nesting beaches, in foraging grounds, and along migratory pathways. They are vulnerable to both gear in use and abandoned gear. Fishing gear taking sea turtles includes longlines, pots, traps, weirs, gill nets (both set and drift), trawls, purse seines, and troll gear. However, data on incidental take are not readily available for many fishing fleets because observer coverage may be very low or unknown, the capture may be a rare
event, or details of the capture may be approximate. This chapter provides insight on the likelihood of encounters, potential mortality rates, and some ongoing conservation efforts undertaken in some fisheries, regional fisheries management councils, and/or countries.

Chapter 13, “Managing Marine Turtles and Pelagic Fisheries on the High Seas,” by Kitty M. Simonds, highlights current management and conservation issues on high-seas fisheries. Holistic conservation must consider all life phases of marine turtles and recognize that humans have become a part of the ecosystems of this ancient group of animals. Human impacts have aggravated natural stresses on marine turtles, but it is human interest that will ultimately shape a political, economic, social, and cultural context in which conservation can succeed. Incidental capture and mortality in pelagic longline fisheries is one of many threats to marine turtle populations in the Pacific. This chapter offers a plan that could potentially reduce longline bycatch by hundreds of turtles per year without causing massive economic disruption to Pacific basin fisheries, diets, and nutrition. The plan centers on a technology standard by demonstrating, verifying, and widely transferring longline gear and tactics modifications that significantly reduce interactions with these animals. Because the turtle “take” rate is 10 times higher in shallow-set longline sets than in deep sets, the first priority for bycatch reduction should be shallow-set fisheries. Although the Hawai‘i longline fishery and its impacts on marine turtles are insignificant in comparison with the overall international longline fishing effort in the Pacific Ocean, Hawai‘i has a pivotal role in proving the effectiveness of bycatch-reducing measures and in conducting outreach programs to train other Pacific longline fishermen in these techniques.

Chapter 14, “Which Commercial Swordfish Fishing Gear Is Best for Balancing Protected Species Conservation and Fishing Opportunity?,” by Stephen M. Stohs and Craig Heberer, examines the choice of technology standard for fishing gear that reduces bycatch of sea turtles and other protected species when targeting swordfish. The ultimate choice of which fishing gear(s) to permit for swordfish harvest directly impacts the levels of protected species and nontarget species bycatch, with implications for economic profitability and the efficacy of ecosystem-based management. Thus, the chapter addresses the question of which commercial swordfish gear is the least invasive (cleanest) in regard to bycatch and proposes a framework for measuring the economic efficiency of three different swordfish gear types in the U.S. west coast subject to the constraint of bycatch quotas. By controlling for allowable levels of bycatch, such a comparison is a step toward making an objective determination of which swordfish gear is cleanest.
Chapter 15, “Sea Turtle Conservation in Peru: Limitations and Efforts,” by Joanna Alfaro-Shigueto and Jeffrey C. Mangel, highlights the importance of coastal fisheries in mortality of sea turtles and the consequent policy challenges that follow when dealing with impoverished coastal communities in developing countries in which the population often has no other viable alternatives. Threats to marine turtles in Peru consist of not only their capture and use in fisheries but also the absence of dedicated monitoring of this exploitation and its close link with the socioeconomic background of coastal communities. Taken together, these are the main impediments to sea turtle conservation in Peru. The chapter summarizes field research among Peruvian artisanal communities and in eight ports on the level of sea turtle bycatch and to assess the communities’ needs. The chapter suggests that future efforts in sea turtle conservation in Peru should focus on (1) establishing a sound monitoring program of turtle bycatch, (2) increasing the level of education on marine conservation in fishing communities, and (3) establishing realistic conservation measures that include alternatives for fishing communities.

Chapter 16, “Sea Turtle–Fisheries Interactions in Coastal Fisheries: A Case Study of the East Coast of Peninsular Malaysia,” by Bee Hong Yeo, Dale Squires, Kamarruddin Ibrahim, Heidi Gjertsen, Syarifah Khadiejah Syed Mohd. Kamil, Rahayu Zulkifli, Theodore Groves, Peter H. Dutton, Meen Chee Hong, and Chun Hong Tan, examines sea turtle–fishery interactions for coastal fisheries and perceptions of local fishers about sea turtle issues in Terengganu and North Pahang on the east coast of Peninsular Malaysia. Previous studies on sea turtle–fishery interactions have focused on characterizing gear type and fishing practices and estimating turtle interactions. However, few have systematically documented and highlighted primary information on the perception and understanding of local communities, particularly of fishers, of sea turtles. This chapter addresses this information gap and provides a summary of results from a socioeconomic study and survey of sea turtle–fishery interactions in Malaysia. The study was carried out as one of the priorities identified at the 2004 Workshop on Charting Multidisciplinary Research and Action Priorities for Sea Turtle Management in Malaysia that resulted from the 2003 Bellagio Conference on Sea Turtles.

Chapter 17, “Can Coastal Fisheries Bear the Cost of Sea Turtle Conservation? Evidence from the East Coast of Peninsular Malaysia,” by Bee Hong Yeo, Dale Squires, Kamarruddin Ibrahim, Heidi Gjertsen, Syarifah Khadiejah Syed Mohd. Kamil, Rahayu Zulkifli, Theodore Groves, Peter H. Dutton, Meen Chee Hong, and Chun Hong Tan, examines the complexity
introduced by poverty in developing countries to the conservation of sea
turtle biodiversity. Drawing upon the same survey described in chapter 16
(this volume), this chapter assesses the ability of artisanal and small-scale
fishers to absorb the indirect cost of foregone income (i.e., the opportu-
nity cost) borne for conservation of sea turtle biodiversity if conservation
affects their catch, effort, and productivity, which in turn subsequently
reduces their daily income. This chapter examines this issue through a case
study of the socioeconomic profiles of the artisanal and small-scale net
fisheries and the small-scale and medium-scale commercial purse-seine
and trawl fisheries on the east coast of Peninsular Malaysia. The results
suggest that these coastal fishers without other substantial opportunities
are unable to adopt conservation measures if these more than minimally
affect their catch, effort, and productivity, thereby reducing their daily
income. Conservation measures that simply impose costs on coastal fishers
can substantially impact household incomes, are unlikely to garner serious
support, and are likely to generate adverse rather than positive incentives.

Chapter 18, “Performance and Technology Standards in International
Environmental Agreements: Potential Lessons for Sea Turtle Conservation
and Recovery,” by Dale Squires, Mahfuzuddin Ahmed, and Bee Hong Yeo,
examines the role of performance and technology standards that are often
key policy tools used to conserve public goods and common resources in
international environmental agreements (IEAs). Many such standards have
been applied in IEAs, including the conservation of dolphins in the eastern
Pacific Ocean, polar bears in the Arctic, fur seals in the North Pacific,
and seals in the Antarctic. Lessons can be learned for the recovery of sea
turtle populations from the application of performance and technology
standards for other conservation and environmental issues in IEAs. Perfor-
mance standards for sea turtles are quantitative limits on incidental takes
and/or mortality of sea turtles incidentally taken during harvests of fish or
shrimp, such as quotas and extending to outright bans on any mortality.
Technology standards refer to mandatory design and equipment require-
ments and include operating standards. This chapter discusses the advan-
tages and disadvantages of applying these standards for the recovery of sea
turtle populations.

Chapter 19, “Policies to Reduce Stochastic Sea Turtle Bycatch: An
Economic Efficiency Analysis,” by Kathleen Segerson, considers bycatch
options for individual shallow-set pelagic swordfish vessels of a larger scale
that fish in coastal waters or on the high seas, such as the Hawaiian, Chil-
ean, or Northeast Asian fleets. These vessels can reduce the incidence of
bycatch through their decisions regarding gear, fishing location, set depth,
and number of sets. However, absent any government policy, owners of these vessels face little incentive to undertake costly avoidance activities. The overarching question is whether policies can be designed to provide incentives for individual vessel owners to take appropriate actions that reduce bycatch and at the same time recognize the benefits that stem from harvest of the target species. This chapter summarizes the salient elements and conclusions from a model of the pelagic longline fishing industry whose vessels harvest swordfish in shallow sets and jointly take sea turtles as incidental bycatch. The model is used to evaluate economic efficiency of alternative policy instruments that can affect the decisions of individual firms or vessel owners about fishing and avoidance activities. As the model shows, the stochastic nature of bycatch increases the challenge of designing policies to reduce bycatch (or, more precisely, to reduce the likelihood of bycatch).

Chapter 20, “The Conservation of Sea Turtles under the Law of the Sea Convention, the UN Fish Stocks Agreement, and the WCPF Convention,” by Martin Tsamenyi and Joทยishna Jit, discusses the legal framework for sea turtle conservation. The Law of the Sea Convention (1982) is the principal international legal instrument governing all aspects of ocean use and contains many provisions, which in theory provide the basis for effective policy and legislation to protect sea turtles throughout their range of migration at the national and regional levels. However, the absence of specific conservation and management obligations under the Law of the Sea Convention has promoted a legal and policy vacuum in many countries with respect to the conservation of sea turtles. In 1995, the UN Fish Stocks Agreement was negotiated to provide a practical framework for the implementation of some of the fisheries provisions of the Law of the Sea Convention. The Western and Central Pacific Fish Stocks Convention was negotiated in 2000 to implement the UN Fish Stocks Agreement in the western and central Pacific Ocean. The implementation of the UN Fish Stocks Agreement and the Western and Central Pacific Fish Stocks Convention could provide an effective framework to minimize the incidental catch of sea turtles in longline and purse seine fishing operations in the western and central Pacific Ocean, which is currently the largest tuna fishing ground in the world.

Chapter 21, “Trade and the Environment: Implications for Sea Turtle Conservation and Management,” by David F. Hogan, discusses international trade agreements and trade restrictions as tools for implementing sea turtle conservation policies. Production from commercial fisheries plays an increasingly large part in sustainable development and remains an underpinning of the economies of many coastal developing countries,
as well as an important component of international trade. In light of this, the international community is challenged to reconcile the economic and food-security value of such production in the context of the impact commercial fishing is having on marine ecosystems. One particular result of the growth of commercial fishing is that the incidental bycatch of nontarget species, including sea turtles, has increased and become an issue of growing concern as populations of these endangered species continue to decline in some areas. This chapter provides background for the discussion of how the use of trade-restrictive measures to deter fishing activities that threaten sea turtles might be considered for continuing efforts to increase protection and conservation of sea turtles in capture fisheries on a regional or global basis. Specifically, the chapter examines a case study of the United States’ statutory program that restricts the U.S. market to shrimp that is produced only in ways that are not harmful to sea turtles.

References