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Incorporating Historical Perspectives into Systematic Marine Conservation Planning

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Historical perspectives are highly relevant to marine conservation, yet rarely integrated into ocean planning efforts. By its nature, marine conservation planning is forward looking—concerned with measures that should be taken in the future. It usually focuses on mitigating anticipated adverse changes caused by current and future human activities, with the implicit assumption that present or recent conditions should be maintained. In this chapter, we show that without incorporating historical data and analysis, such approaches will, in the best case, cause us to aim too low; and in the worst case, they can result in inappropriate targets for planning and management. We review the role that historical perspectives can provide in marine conservation planning, highlight planning exercises in which this has occurred or has been discussed, and provide recommendations for researchers and planning practitioners. Using the systematic conservation planning framework, we show that each planning stage can greatly benefit from a historical perspective and illustrate that failure to consider historical information reduces the effectiveness of marine conservation planning. We posit that historical perspectives may shift the conservation focus from restoring previous ecosystem states to recovering critical ecosystem functions and processes that maintain resilience. Historical perspectives can fundamentally change the conservation vision for a region, providing a window into possibilities for the future.

INTRODUCTION

> The charge to restore commits us to a state of permanent irony. We will never decide to what point in the past we should restore the land—and can never, in any event, actually get back there.
>
> FIRE ECOLOGIST STEPHEN J. PYNE, 1999

Marine historical ecology has revealed striking declines in abundance and biodiversity (e.g., Jackson et al. 2001, Pandolfi et al. 2003, Sala and Knowlton 2006, Willis et al. 2010, Cardinale et al. 2011), prompting global concern and efforts to implement conservation measures (Convention on Biological Diversity 2010). Many conservation measures focus on designating places in the ocean where human activities are restricted or prohibited—for example, marine managed areas and marine protected areas (MPAs). Other conservation approaches include gear restrictions, changes in fisheries management (e.g., individual transferable quotas), and alternative livelihood strategies. In this chapter, we focus primarily on MPAs because conservation planning has focused on such spatial tools and, hence, historical marine ecology has the potential to contribute greatly. MPAs encompass a range of spatial measures, from limited restrictions of human uses to fully protecting areas from all extractive human uses (also known as no-take zones and marine reserves; Kelleher and Kenchington 1992). Although MPAs, especially no-take areas, have been shown to be effective for increasing the size and biomass of exploited species (Halpern and Warner 2002, Stewart et al. 2009) and supplement fished areas (Harrison et al. 2012), only ~1% of the ocean is currently protected (Wood et al. 2008, Mora and Sale 2011). There is a clear need to expand MPAs and explore other conservation strategies to curb further biodiversity declines and preserve critical ocean ecosystem services (Pauly et al. 2002, Worm et al. 2006).

The favored approach for protecting marine biodiversity is through creating networks of MPAs, which, unlike individual MPAs, can be managed in a broader spatial context as a system (Roberts et al. 2003, Fernandes et al. 2005, University of Queensland 2009). The network approach is preferred because it considers emergent properties of systems, including complementarity, redundancy (Margules and Pressey 2000), and connectivity (Almany et al. 2009). Planning networks can ensure that known aspects of biodiversity are represented and that species and ecosystems can persist.

A framework for implementing a network approach in MPA design has emerged out of terrestrial and marine conservation planning, called “systematic conservation planning” (Margules and Pressey 2000). Systematic conservation planning comprises a planning model in stages for practitioners to implement conservation actions in a target region. Systematic conservation planning allows practitioners to develop quantitative conservation objectives and then facilitates the design of priority conservation areas and actions to achieve those objectives. Additional advantages include efficient use of limited resources to achieve explicit conservation objectives (e.g., related to biodiversity, ecosystem services, and livelihoods), defensibility and accountability in the face of competition for natural resources, and flexibility in accommodating opportunities and constraints (Margules and Pressey 2000). This approach also allows for incorporating a portfolio of management strategies and spatial approaches into planning, rather than focusing only on no-take areas.

The systematic conservation planning approach is increasingly being used by conservation practitioners—for example, by governments and nongovernmental organizations (NGOs). In a review of conservation planning by conservation NGOs, Pressey and Bottrill (2009) found that many of the stages in the systematic conservation planning framework were implemented by practitioners. Perhaps the best example of the use of the systematic conservation planning framework is the rezoning process of the Great Barrier Reef (Fernandes et al. 2005). Other marine examples of the framework's application include MPA design in the Channel Islands, California (Airamé et al. 2003), and in Kimbe Bay, Papua New Guinea (Green et al. 2009).

Conservation planning is, by nature, forward looking, yet it needs to be grounded to have a chance of success. Thus, it must also engage with the past, for example by understanding the trajectory the planning region is on, and the historical factors that have influenced the current state in that planning region. Without a long-term historical perspective, planning will include only a basic understanding of the systems they seek to protect and enhance. Including long-term data can help planners and managers better identify the direct and underlying causes of decline in natural features and the real rates of ecological change.

The purpose of this chapter is to illustrate the important role that historical perspectives and information can play in marine conservation planning and highlight how such perspectives might benefit planning. Our focus here is conservation-oriented planning, although the insights presented may also be applied to other planning initiatives. Marine conservation planning usually focuses on mitigating impacts of human activities and, thus, assumes that present or recent ecological conditions should be maintained. However, this assumption will often cause us to aim too low, limited by shifting baselines that lack historical context (shifting baselines syndrome; Pauly 1995). Many of the classic examples are from fisheries, where today's "good day of fishing" produces catches that are many times smaller and less abundant than those a few generations ago (Rosenberg et al. 2005, McClenachan 2009). We provide an overview of the stages of systematic conservation planning and highlight how each can benefit from historical perspectives and data, drawing on examples from planning practice. By "historical perspectives," we refer to a diversity of ways in which history is considered and cognitively incorporated by people, considering qualitative, quantitative, formal, and informal data and information (e.g., ranging from people's internalized perceptions of history to quantitative reconstructions of marine biomass). We use the terms "historical information" and "historical data" interchangeably to refer more specifically to quantitative characterizations of change over time as well as the diverse information sources used to produce them.

HISTORICAL PERSPECTIVES IN MARINE CONSERVATION PLANNING

The stages of systematic conservation planning serve as a useful framework for examining the utility of historical perspectives. We group the framework's eleven stages (Pressey and Bottrill 2009) into five categories: setting the stage (scoping, involving stakeholders, identifying context), vision (defining goals), data (collecting social and biodiversity data and determining quantitative objectives), actions (gap analysis, selecting actions, and applying actions), and review (monitoring) (for a description of each stage, see Figure 10.1 and Table 10.1). The stages are linked and feed back to one another, and planning is meant to occur iteratively, through 5- or 10-year revisions of a conservation plan. The framework is

TABLE 10.1 Eleven Stages in the Process of Systematic Conservation Planning

Stage	Description
1. Scoping and costing the planning process	Decisions are necessary on the boundaries of the planning region, the composition and required skills of the planning team, the available budget, and how each step in the process will be addressed, if at all.
2. Identifying and involving stakeholders	Stakeholders (those who will influence or be affected by conservation actions arising from the planning process) need to be identified and involved in appropriate ways throughout the planning process.
3. Describing the context for conservation areas	The planning team describes the social, economic, and political setting for conservation planning, identifying the types of threats to natural features and the broad constraints on, and opportunities for, conservation actions.
4. Identifying conservation goals	A broad vision statement for the region needs to be drafted and progressively refined into qualitative goals about biodiversity (e.g., representation and persistence), ecosystem services, livelihoods, and other concerns.
5. Collecting data on socioeconomic variables and threats	Relevant spatially explicit data will include variables such as tenure, extractive uses (i.e., threats), costs of conservation, and constraints and opportunities to which planners can respond.
6. Collecting data on biodiversity and other natural features	The planning team will collect spatially explicit data on biodiversity that include habitat types, focal species, and ecological processes.
7. Setting conservation objectives	Goals need to be interpreted as quantitative conservation objectives for each spatial feature, and, where necessary, qualitative objectives need to be related to configuration, past disturbance, and other criteria.
8. Reviewing current achievement of objectives	Remote data, and perhaps also field surveys, are used to estimate the extent to which objectives have already been achieved in areas considered to be adequately managed for conservation.
9. Selecting additional conservation areas	With stakeholders, this stage requires decisions about the location and configuration of additional conservation areas that complement the existing ones in achieving objectives.
10. Applying conservation actions to selected areas	Application of conservation actions requires a variety of technical analyses and institutional arrangements to ensure that areas are given the most feasible and appropriate conservation management.
11. Maintaining and monitoring conservation areas	Activities ensure that individual areas are managed to promote the long-term persistence of the values for which they were established, including monitoring the effectiveness of management actions.

Source: Adapted from Pressey and Bottrill (2009).

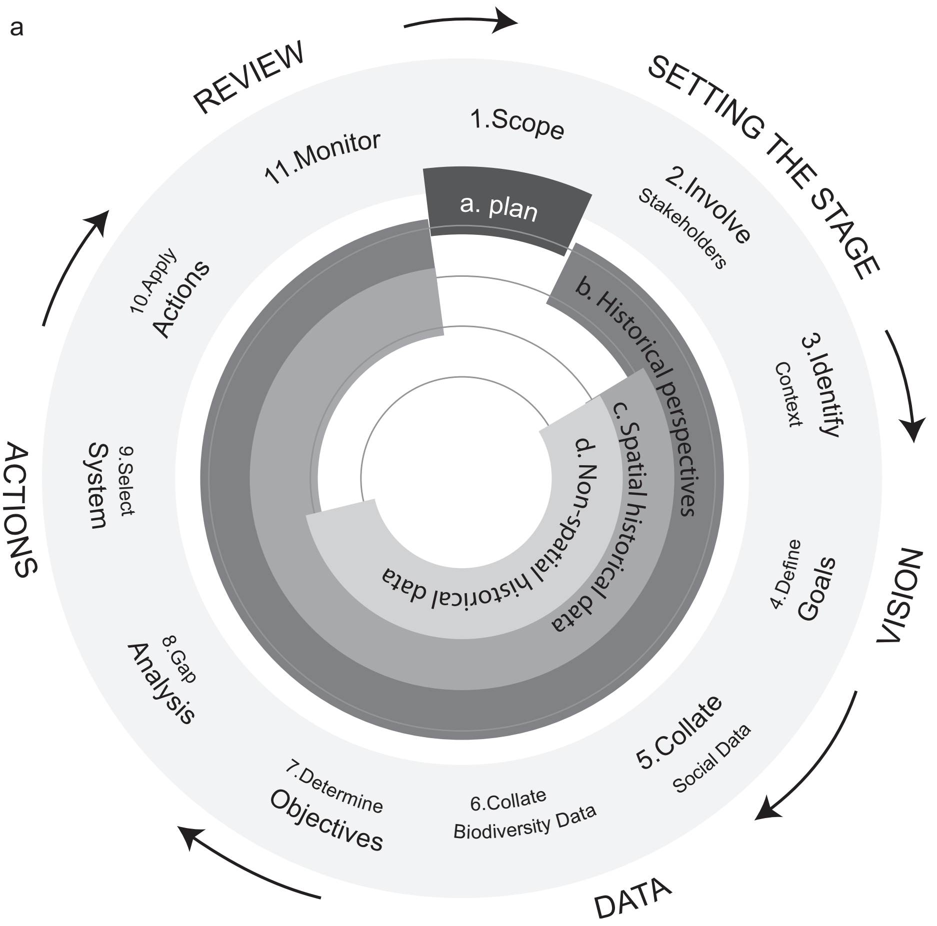

FIGURE 10.1 Systematic conservation planning and historical perspectives. Different ways to consider historical perspectives in conservation planning are organized by planning stage. (A) The scoping stage needs to plan for inclusion and collection of historical information. (B) Historical perspectives (i.e., all the ways in which history is considered and cognitively incorporated by people, qualitative and quantitative) influence all the ways in which history can be considered in the planning process. (C) Spatially explicit historical data are useful throughout the planning process, starting with the context. (D) Nonspatial historical data (e.g., historical catch records for a region that cannot be traced back to specific places and, thus, cannot be mapped) can be incorporated into the vision and data phases but do not directly influence the spatial selection of new marine protected areas.

adaptable and constantly evolving to improve planning practice, and, hence, opportunities exist for historical perspectives to inform future versions. The stages serve as a guide for conservation planners; in practice, planning efforts can use only some of the stages and change the order in which some or all are addressed. Furthermore, conservation planning must weave together ideas and techniques from different disciplines and areas of expertise and, ideally, would also use historical perspectives in each of its stages, as we discuss here. There is also increasing recognition of the importance of dynamic aspects of ecosystems and

TABLE 10.2 Examples of How Different Sources of Marine Historical Ecology Data Could Be Used to Set Goals for Conservation Planning

Case Study Location (Reference)	Description of Study	What Conservation Goals/Objectives Could Come from the Study?	What Might Be Missing if Historical Data Were Ignored?
Palaeontology			
Moreton Bay, Australia (Lybolt et al. 2011)	Dead corals were used to record historical ranges of variation in the extent, water depth, and species composition of coral reefs in Moreton Bay during the Holocene. The study found that reef development was episodic during the Holocene, fluctuating with environmental variations, and that Moreton Bay was inhospitable to coral reefs for about half of the Holocene. A significant change in coral species composition, from branching *Acropora* to massive corals, occurred after European transformation of the bay's catchments. There is limited potential for Moreton Bay to serve as a refugium for coral species pushed south by climatic warming, because of ongoing anthropogenic impacts and the natural historical instability of reef formation in Moreton Bay.	Goals: (1) Include existing coral reefs and suitable substrata in no-take or no-use zones to create potential for them to persist or recolonize. (2) Use increasing abundance of *Acropora* as a guide to the success of catchment management.	Goal without this historical information would be to restore coral communities as massive, slow-growing communities instead of the fast-growing acroporid-dominated communities that characterized the past, and to protect living coral reefs and past reef substrata as a refugium for species shifted south by climate change, the feasibility of which was questioned by this study.

Genetics			
Global whale study (Roman and Palumbi 2003)	Mitochondrial DNA sequence-variation models were used to reconstruct the genetic diversity of North Atlantic whales (humpback, fin, and minke). Genetic diversity was found to be higher than expected, indicating that past population sizes of North Atlantic whales were much greater than previous historical estimates suggested. These results indicate that past fin and humpback whale populations could have been 6 and 20 times larger, respectively, than populations present today.	Goals: (1) Prevent increases in hunting quotas and/or maintain current protection of whale populations to enable further recovery. (2) Monitor additional sources of mortality (e.g., boating strikes and pollution) and determine whether these are inhibiting recovery rates or are likely to reduce population persistence in the future. (3) Implement management zones that protect breeding or nursery grounds with management of fishing, boating, and tourist activities.	Without these data, it would be assumed that populations of North Atlantic whales were closer to their prewhaling baselines; hence, decisions regarding exploitation or levels of protection might not be accurate, or goals might not be ambitious enough to ensure long-term persistence of populations.
Historical photographs			
San Francisco Bay (www.sfei.org/he)	Historical source materials (i.e., coastal survey maps, past descriptions of habitats, past activities and land use) were collated to describe the extent of transformation of habitats and ecosystem linkages and to provide tools for restoration and protection of San Francisco Bay wetlands.	Goals. (1) Help scientists and managers develop strategies for more integrated and functional landscape management. (2) Establish coastal protected areas that represent habitat linkages and processes between land and sea. (3) Protect or restore fragmented habitats that were once more extensive, to enable recovery to former conditions.	Without this information, conservation planning might not recognize past landscapes or lost processes and their potential for restoration.
Florida (McClenachan 2009)	Historical photographs were used to measure changes, from 1956 to 2007, in size and composition of recreationally fished species landed by fishers around Key West, Florida. Results show that catches during the 1950s were dominated by large predators such as groupers and sharks, but that by 2007 this had shifted to smaller species such as snapper, while the average length of sharks had declined by 50%.	Goals: With this historical information, goals may become more ambitious as stakeholders and managers realize the potential for recovery of predatory species. (1) Establish large protected areas that encompass spawning or nursery grounds for groupers and coastal shark species. (2) Complement spatial management by managing recreational and commercial fishing activities for recovery of groupers and sharks.	Without this information, goals might set inappropriate or unambitious targets for restoration that do not allow recovery of higher-level predators.

(continued)

TABLE 10.2 *(continued)*

Case Study Location (Reference)	Description of Study	What Conservation Goals/Objectives Could Come from the Study?	What Might Be Missing if Historical Data Were Ignored?
Historical descriptions			
Caribbean (Jackson 2001)	Historical accounts indicate clearly that green sea turtles have been massively reduced in numbers in the Caribbean. The decline of turtles could have predisposed seagrasses to extensive mortality from a wasting disease in the 1980s, with losses of associated species. Grazing by turtles reduces factors associated with the disease, including sulfide toxicity and hypoxia in sediments, self-shading, and infection by slime mold.	Goal: Establish extensive management areas that would have dual purposes: (1) no-take zones for the recovery of ecological functional groups associated with seagrass and other ecosystems; and (2) large-scale experiments, with outside control areas, to establish the role of grazing by turtles in reducing the incidence and extent of wasting disease of seagrass.	Goals without historical information: (1) lower abundance and distribution of both herbivore and seagrass communities; and (2) management of disease as predominantly a climate change issue—recovery through physiology instead of trophodynamics.
Fisheries catch records			
Global (Zeller et al. 2007)	Small-scale fisheries catches were estimated for island areas in the western Pacific between 1950 and 2002, using a combination of small-scale reports and catch series for specific areas, interpolation of reported catches between periods, and expansion of local catches to island- or country-wide estimates where data were missing. Results showed that catches for all islands combined declined by 77%, in contrast to reported data, which showed increasing trends over time but covered only a limited number of commercial fisheries.	Goals: (1) Set management goals that aim to recover fish abundances to earlier states. (2) Integrate local restoration actions with objectives for the broader region. (3) Provide alternative income strategies to reduce dependency on coastal resources in order to enable fish population recovery and, hence, improve the food-security outlook for coastal communities.	Without this information, managers have only commercial-catch trends data to implement conservation measures. Without a historical baseline, major declines would be missed entirely and the marine environment managed for status quo, thus increasing the likelihood of future fish population collapses.

Multiple methods combined (including archaeology and oral history)			
Global reef assessment (Pandolfi et al. 2003)	Records were compiled, extending back thousands of years, of the status and trends of seven major guilds of carnivores, herbivores, and architectural species from 14 coral reef regions from around the world. Large animals declined before small animals and architectural species, and Atlantic reefs declined before reefs in the Red Sea and Australia. However, the trajectories of decline were markedly similar worldwide. All reefs were substantially degraded long before outbreaks of coral disease and bleaching and global climate change.	Goal: Utilize trajectories of change in managing local reefs, because different drivers may be occurring in different places. Managing for local stressors is important because global climate change is just one of many factors influencing the degradation of these reefs. Management goals can be informed by historical data at specific sites, and historical scales of change provide measures of success for management actions (Pandolfi et al. 2005).	Goals without historical information: Recently bleached or diseased reefs would be managed for the impending climate change only, which could be seen to override any local stressors. Management is conducted in the absence of historical ecosystem states, so success of management actions is provided only by a much shifted baseline.
Hawai'i (Kittinger et al. 2011)	Ecological changes to coral reefs since the arrival of Polynesians were reconstructed, using archaeology, ethnohistory, anecdotal descriptions, and modern ecological and fishery data. The results indicated both reduction and recovery of ecological functional groups, with reefs around the main Hawaiian islands mostly degraded and those around the northwestern Hawaiian islands mostly in good condition or recovering currently.	Goals: (1) Establish an integrated system of marine management zones, including extensive no-take areas, to represent the variety of ecosystems related to coral reefs, with the aim of promoting recovery of all seven ecological functional groups, toward prehuman levels. (2) Complement marine management zones with management of catchments to limit the adverse impacts of terrestrial runoff on coral reefs.	Goals without this historical information might have focused on regions, functional groups, or species that might not need management as much as others.

human uses in planning (Pressey et al. 2007, Lybolt et al. 2011, Ban et al. 2012, Levy and Ban 2013). Here, we discuss how different kinds of historical perspectives and data are relevant throughout the planning process (Figure 10.1 and Table 10.1) and show how a range of methods exist to gather historical information (e.g., Table 10.2).

Setting the Stage for Planning

Conservation planning begins when the need for planning for biodiversity conservation in a specific region is recognized. Often the motivation for a planning process is provided by a sense that biodiversity generally, and harvested natural resources specifically, have been lost or reduced in comparison to some past date. Sometimes a catalytic event of some kind, such as a natural disaster or ecological catastrophe, causes initiation. Other times it is the gradual and cumulative degradation of a site or habitat type that motivates the change. This first stage is perhaps where historical perspectives are most commonly considered in the current practice of conservation planning, because historical processes often motivate the need for action.

Three stages characterize the initial phase of the conservation planning process. First, scoping and costing the process involves deciding on the boundaries of the planning region, building a planning team, determining the budget, and deciding how each subsequent stage will be addressed. Second, stakeholders need to be identified and a strategy developed for their involvement throughout the planning process. Third, the context for MPAs needs to be described, including the social, economic, and political setting as well as the constraints on, and opportunities for, conservation actions (Pressey and Bottrill 2009).

Scoping and Costing the Planning Process

Historical perspectives should be considered at the beginning of a conservation planning process so that subsequent stages can be designed to collect and consider relevant historical information (Figure 10.1 and Table 10.1). In particular, members of the planning team might need to be dedicated to collecting or synthesizing historical data, and a budget and timeline will be needed for data collection so that the information is available at relevant stages. Considering historical perspectives early on is important, because often the planning process is initiated as a result of some historically based issue (i.e., long-term degradation). Understanding this is critical if the goal is to recover the system, or at least to protect the remaining processes so that the system does not collapse. For example, historical data on the declining state of the Great Barrier Reef (Pandolfi et al. 2003) were used to raise awareness of adverse changes and help clarify the need for greater levels of protection (Fernandes et al. 2009). Information about past states and trajectories, and the spatial extent of ecosystems, can help define the boundaries of the planning region. If an effort is made to incorporate historical perspectives, some members of the planning team should spearhead this effort and set aside a suitable budget to enable integration of historical perspectives and data. This will also help outline how historical perspectives can be built into the subsequent planning stages.

Identifying and Engaging Stakeholders

Conservation planning processes must also grapple with strategies to effectively identify, engage, and build productive relationships with stakeholders. A historical perspective can help shape who should be engaged and how. Stakeholders include a diverse set of actors and organizations who will affect or be influenced by planning processes. There are many approaches to stakeholder identification (Mitchell et al. 1997, Ravnborg and Westermann 2002), analysis (Pomeroy and Douvere 2008, Reed et al. 2009), and engagement (Lynam et al. 2007, Reed 2008). Although systematic conservation planning outlines a sequential process, it recognizes that stakeholder engagement is an ongoing and iterative process that permeates the planning process, and that different people will be involved in different ways throughout (Pressey and Bottrill 2009).

A historical perspective not only shapes stakeholder engagement but can help make it more comprehensive and effective. Understanding past human uses of a region might, for example, help identify stakeholder groups. For example, long-term residents often hold a rich reservoir of information on social and ecological changes and could help influence planning goals and aspirations for recovery based on long-term baselines (for an example describing how the historical perspectives of commercial fishers and other stakeholders were instrumental in establishing the Tortugas Ecological Reserve, see Box 10.1). Further, documentation of long-term changes that emerge from resource users themselves, rather than government agencies or other institutions, can also be perceived by some stakeholders as more valid and trusted. For example, Kittinger documented stark declines in habitat quality and fisheries catches through participatory, community-led survey efforts with elders in Hawaii (Kittinger 2013). This information formed the basis for a community-based fisheries planning effort and was perceived by community members as more reliable and legitimate than other information. Similarly, holders of historical information can be asked to select areas they think are important for conservation. Such an approach was taken on the north coast of British Columbia, Canada (Ban et al. 2008), where indigenous people identified key areas they thought were important for conservation (Ban et al. 2009).

Describing the Context for Conservation Areas

Historical perspectives can play a critical role in characterizing the social, political, and economic setting for conservation planning and threats to natural features (e.g., species and ecosystems) of conservation interest (Pressey and Bottrill 2009, Ban et al. 2013). For example, as part of a stakeholder-led process to designate a network of marine conservation zones throughout England, the background report described hundreds of years of degradation and encouraged the incorporation of historical information to help set conservation and recovery objectives for marine ecosystems (Natural England and JNCC 2010, Thurstan et al. 2010). Similarly, providing historical context for conservation planning may also engender greater support for conservation among stakeholders if the need for action is articulated in a clear message or story of decline. Stories are important motivators for action (Leslie et al. 2013), BOX 10.1 Viewpoint from a Practitioner: The Historical Perspective—A Key to Success in the Florida Keys

Billy Causey

NOAA's Florida Keys National Marine Sanctuary (FKNMS) learned an important lesson about incorporating the historical perspectives of its users into resource management. In 1990, NOAA was mandated by the U.S. Congress to "consider temporal and geographical zoning, to ensure protection of sanctuary resources." This phrase had different meanings to different stakeholders and created an air of suspicion, mistrust, and hostility that continued throughout the conservation planning process. As such, when the FKNMS Final Management Plan was implemented in July 1997, its marine zoning scheme did not truly represent the perspectives of the Keys' waterfront community. More than 6,000 written comments were received on the plan, the majority of which supported far more protection than was established with the new zoning design. In response, sanctuary managers made a commitment to undertake an inclusive public process to design the (Dry) Tortugas Ecological Reserve. The Tortugas 2000 Working Group, which included members of the FKNMS Sanctuary Advisory Council and representatives from a wide range of waterfront professions, was established to develop the reserve. The input of commercial fishermen, who were the primary users of the Tortugas area, was given equal importance to that of scientists and managers on the working group. Oceanographic, biological, and ecological information provided a compelling case for establishing a marine reserve in the Tortugas, but it was the socioeconomic and historical perspectives that allowed the working group to identify the most environmentally and economically significant areas for protection. For example, commercial fishermen shared their past experiences and observations of incredible fish-spawning aggregation sites, such as Riley's Hump, where, historically, different species of fish would congregate on certain moon phases to spawn in mass. The comprehensive planning process was a success that culminated with the implementation of the 151 square-nautical-mile (518 km^2), fully protected Tortugas Ecological Reserve in 2001. The ecological reserve and adjacent Dry Tortugas National Park Research Natural Area (also designed by the working group) have provided enormous conservation and fishery benefits. An analysis of socioeconomic and scientific information published in February 2013 found that after the ecological reserve was designated,

- Overfished species increased in abundance and size inside the reserve and throughout the region;
- Annual spawning aggregations, once thought to be wiped out from overfishing, began to recover inside the reserve;
- Commercial catches of reef fish in the region increased, and continue to do so; and
- No financial losses were experienced by local commercial or recreational fishermen.

These positive trends would not have been achieved without the historical perspectives provided by fishermen and other users of this unique area. The protection of the ocean wilderness known as "the Tortugas" for future generations is a testament to their dedication.

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and those that are embedded in historical context can be quite powerful (see chapter 12, this volume).

While historical information is commonly used or alluded to in describing declines of ecosystems or resources, it could also be used to provide context about the social, political, and economic setting (e.g., demographic changes to human coastal populations, and improvements to fisheries vessels that allow areas farther offshore to be harvested). Such information provides planners with the ability to project future trajectories of change or to identify emerging threats. Similarly, historical information can be used to describe past conservation efforts and ascertain whether conservation outcomes have been achieved. Important questions for conservation planners might include the following. Which past conservation efforts have been successful, and why? What is the historical interest of different stakeholder groups in the region, and how has it changed over time? What kinds of conservation measures are culturally appropriate, and how have these changed over time? If historical information is not readily available at this stage to answer these questions, the data collection phase provides the opportunity for collating it, and for feeding it back into this part of the process.

Developing a Vision for the Planning Region

A broad vision for the planning region needs to be agreed upon for refinement into qualitative goals about biodiversity (e.g., representing all habitat types and ensuring persistence of species), ecosystem services, livelihoods, and other concerns (Pressey and Bottrill 2009). Conservation planning is, by its nature, forward looking—concerned with measures that should be taken in the future (see Box 10.2). Conservation planning is also typically focused on mitigating anticipated adverse changes caused by current and future human activities. This emphasis points to an important implicit assumption in the visions that underpin planning efforts: given the present or recent conditions of ecosystems and populations, are these conditions environmentally or socially adequate? Our argument here is that this assumption will often cause us to aim too low, limited by shifting baselines that lack historical context (Pauly 1995, Knowlton and Jackson 2008; for examples, see Table 10.2). Historical perspectives can fundamentally change the conservation vision for a region, providing a window into possibilities for the future (Jackson 2001; Table 10.2).

Goals are important because they define the data that should be collated in subsequent stages and form the basis of the quantitative objectives for planning. Like visions of the region, goals are better informed and more ambitious when based on historical perspectives (see Table 10.2). The most obvious role of historical perspectives in shaping goals is to shed light on past losses of biodiversity and other features that can help identify previous attainable baselines for at least some species or ecosystems (Kittinger et al. 2011, Lybolt et al. 2011). Other contributions of historical data to defining goals are to demonstrate the potential benefits of effective management of marine ecosystems (Jackson 2001) and, by recording cycles of loss and recovery of species or assemblages, indicate at what level modern recovery is possible (Kittinger et al. 2011). In Table 10.2, we summarize examples of goals drawn from

BOX 10.2 Viewpoint from a Practitioner: Back to the Future—Integrating Past, Present, and Future

Charles (Bud) Ehler

If we do not learn from history, we shall be compelled to relive it. True. But if we do not change the future, we shall be compelled to endure it. And that could be worse.

ALVIN TOFFLER, *Future Shock,* 1970

Most strategic planning, including marine spatial planning, boils down to four simple questions: (1) Where are we today? (2) Where do we want to be? (3) How do we get there? and (4) What have we accomplished?

Time is as important as space in marine spatial planning. As the authors of this chapter point out, we need better knowledge of the past to know where we have come from and why we are where we are today—the first fundamental question of any planning process. However, more questions await.

We also need to understand the past and present to anticipate the future—where do we want to be?—the second fundamental planning question. Planning is about taking decisions today to get where we want to be tomorrow, however "tomorrow" is specified—5, 10, or 25 years. A number of different trajectories into the future are possible—and should be consistent with historical data. Natural scientists can help describe where we might be by extrapolating existing trends into the future. But we cannot "observe" the future, so scientists are usually reluctant to advocate for futures that are not data driven or value free and that are often highly uncertain. Identifying alternative futures and choosing which one (the vision) we want to move toward—a social and political choice—is most effectively done in cooperation with stakeholders and politicians, not only planners or natural scientists.

The next question is how do we get there. What management measures do we need to put in place to achieve the desired vision? What incentives do we need to change the behavior of individuals and institutions over time? What institutional arrangement has the authorities that are required to implement appropriate incentives to change behavior? These are questions that need be addressed in a management plan for the marine area. We want to achieve through planning a sustainable future, while acknowledging that finding and striking that balance will never be easy and will always involve both high uncertainty and social values.

The development and implementation of integrated marine spatial plans has been limited. Only a handful of plans have been approved and implemented so far—Belgium, the Netherlands, Germany, Norway, Australia, and a few coastal states in the United States. Of these, only the Netherlands and Norway have analyzed historical data and then attempted to look forward by constructing alternative scenarios while developing management plans for their marine regions. None of the plans have laid out a clear process for answering the last fundamental question—what have we accomplished?—but that question is too soon in almost every case. Clearly we have come a long way in learning how to manage marine areas, but we have a very long way to go toward implementing practical planning processes and techniques that integrate the past, present, and future.

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historical data and give examples of how these goals would have been less effective had they not considered historical perspectives. Of course, conservation goals need not necessarily strive to recreate a particular past state, because such a state might no longer be attainable or even desirable (e.g., changes in climate might make it impossible to attain past abundances). Inevitably, shaping goals with historical information requires a choice by the planning team and stakeholders about which historical state is appropriate or achievable. Such decisions are inherently based on stakeholder values and may vary depending on which species and ecosystems are being considered. Importantly, historically informed goals should not be too easily dismissed as infeasible until all views and potential management approaches have been discussed.

Gathering Data for the Planning Process

Spatially explicit data on social and economic characteristics and biodiversity of regions, along with explicit objectives (below), are basic requirements of systematic conservation planning. Social data include variables such as demography, socioeconomic conditions, institutional arrangements, data on extractive uses and other activities, costs of conservation, and constraints on, and opportunities for, conservation actions. Biodiversity data include representation units, special elements, focal species, and ecological processes (Pressey and Bottrill 2009). Below, we discuss how these data-provisioning stages can be enhanced by including historical information.

Collecting Social Data

Social information includes current and past social attributes of human communities within and adjacent to a planning region. Commonly sought information in marine conservation planning includes human use patterns (e.g., where fishing occurs), socioeconomic data on livelihoods and ocean industries (e.g., employment rates and economic contribution of ocean industries), and demographic and cultural profiles of coastal communities. Social assessments provide valuable information to planners and managers seeking to evaluate potential impacts of proposed conservation actions. For example, in the public process to design the Tortugas Ecological Reserve in the Florida Keys, historical perspectives provided by fishermen and other users of this unique area were key in developing a management plan (Box 10.1). Such assessments can provide historical context on how human uses—and, by extension, ecosystem goods and services—have changed through time. These assessments often include historical context on changes in livelihoods, industries, and ocean use patterns (e.g., Levine and Allen 2009, Pomeroy et al. 2010).

Historical data on human activities can guide the planning process in at least three ways. First, historical reconstructions can help define the array of activities to which planning must respond, including the history of specific threats (and those that might be emerging), their current intensity in temporal as well as spatial contexts, and insights into direct versus indirect drivers of change. For example, Kittinger et al. (2011) characterized human threats and their underlying social drivers in coral reef ecosystems in the Hawaiian archipelago.

This reconstruction revealed the linkage between social drivers, direct human threats, and resultant ecological outcomes, thereby informing appropriate responses. Second, historical information can help determine the extent of threats, including whether specific threats are external or internal to the footprint of a planning region. For example, Roff et al. (2013) found that local stressors associated with changing water quality had large impacts on nearshore coral communities in the Great Barrier Reef region, long before the effects of climate change were documented, and similar results were found in Panama (Cramer et al. 2012). Third, historical reconstructions of human activities and threats can be coupled with assessments of ecological outcomes, providing information on current trajectories of specific features of interest, in turn refining conservation objectives and decisions about specific conservation actions.

Collecting Data on Biodiversity and Other Natural Features

Biodiversity data can be grouped into two categories: (1) fine-scale data on distributions of key focal species and subpopulations; and (2) coarse-scale information such as habitat types, bioregions, or ecozones that serve as surrogates for species or subpopulations when those data are not available. These data are typically synthesized from a broad array of sources, including available ecological survey data, models, or surrogate data that predict spatial distribution patterns. Historical perspectives can contribute to fine- and coarse-scale data in several ways. For fine-scale data, historical estimates of previous abundance of selected species can be used to reconstruct past biomass, diversity, or long-term changes (e.g., reef sediment cores; Rosenberg et al. 2005; Table 10.2). Historical data may also provide information on species that may otherwise be overlooked because present low abundances are erroneously perceived to be normal. For example, Roman and Palumbi (2003) used genetic analyses to show that pre-exploitation North Atlantic whale populations may have been underestimated nearly tenfold compared with previous estimates from historical logbook records (Roman and Palumbi 2003; Table 10.2). Similarly, genetic and historical analyses of dugong populations along the east coast of Australia suggest that past populations were significantly larger than current ones (Jackson et al. 2001, Marsh et al. 2005, McDonald 2005).

Historical data can also be used to determine the previous types, past distribution, and conditions and trajectories of change of communities and habitats in the planning region (Pandolfi and Jackson 2006), all of which can elucidate the recovery potential for existing habitats and ecosystems (Egan and Howell 2005, Beller et al. 2011, Whipple et al. 2011). For instance, data on historical extent, type, and linkages between wetland habitats around San Francisco Bay were gathered by the San Francisco Estuary Institute to enable planners to produce feasible goals and objectives for restoration and conservation (Grossinger et al. 2005).

Historical data can go beyond identifying baselines for species or habitats by also providing critical information on natural variability of ecosystems and the ecological processes relevant for maintaining biodiversity and resilience of ecosystems. This can help differentiate natural variability from changes that have occurred as a result of human impacts (e.g., Guzman et al.

2008, Lybolt et al. 2011). Taken together, historical data allow planners and managers to realize the past condition and the future recovery potential for marine ecosystems.

Translating Vision and Data into Actions

When the context is understood and the data have been collected, the marine conservation planning process needs to be realized. This can happen in several ways. First, the goals for the planning region ought to be converted into quantitative conservation objectives for each conservation feature (e.g., each species or habitat type). Such objectives might be, for example, to protect, in an MPA, 500 ha of eelgrass in three separate locations, or 23,000 individuals of a species. Next, a gap analysis is needed to gauge the extent to which existing MPAs or other conservation actions are already achieving the objectives. Then the location and configuration of additional MPAs or other conservation actions need to be vetted through a stakeholder engagement process. Finally, the MPAs need to be implemented, considering appropriate and feasible actions and institutional arrangements.

Developing Quantitative Conservation Objectives

Objectives describe goals for specific components of ecosystem patterns (e.g., species occurrences and marine habitat distributions) or processes (e.g., connectivity between reefs, and maximum extent of disturbance over some time frame; Pressey et al. 2007).

Objectives should ideally be set in relation to estimated historical extents or abundances of features of interest. For example, objectives can be pinned to historical estimates for the recovery of marine habitats or to the recovery of abundances for key species. Objectives set as percentages of historical distributions automatically compensate for losses by representing proportionally larger percentages of current distributions, depending on the extent of loss (Pressey et al. 2003). Considering a potentially perverse outcome of setting objectives as percentages of current distributions or population sizes is also important: objectives might become smaller and more easily achieved even as the features of interest experience further declines.

An example from the terrestrial realm illustrates the value of objectives being formulated in relation to historical distributions. In the Cape Floristic Region of South Africa (Figure 10.2), objectives for protection are larger, and more realistic in terms of conservation needs of the target species, for habitats that have undergone more loss of native vegetation. Thus, when historical distributions are taken into account, restoration objectives might be necessary, and these can be directed at species (Didier et al. 2009), habitats (Bryan et al. 2011), or, with minor adaptations to protection objectives, processes (Pressey et al. 2007; for more detailed discussion of restoration, see chapters 8 and 9, this volume).

Reviewing Achievement of Objectives

In its basic form, this stage represents an analysis of gaps (Caicco et al. 1995), or a tallying of the extent to which each objective has been achieved through existing management actions, thereby indicating the need for additional management measures. Even nonspatial

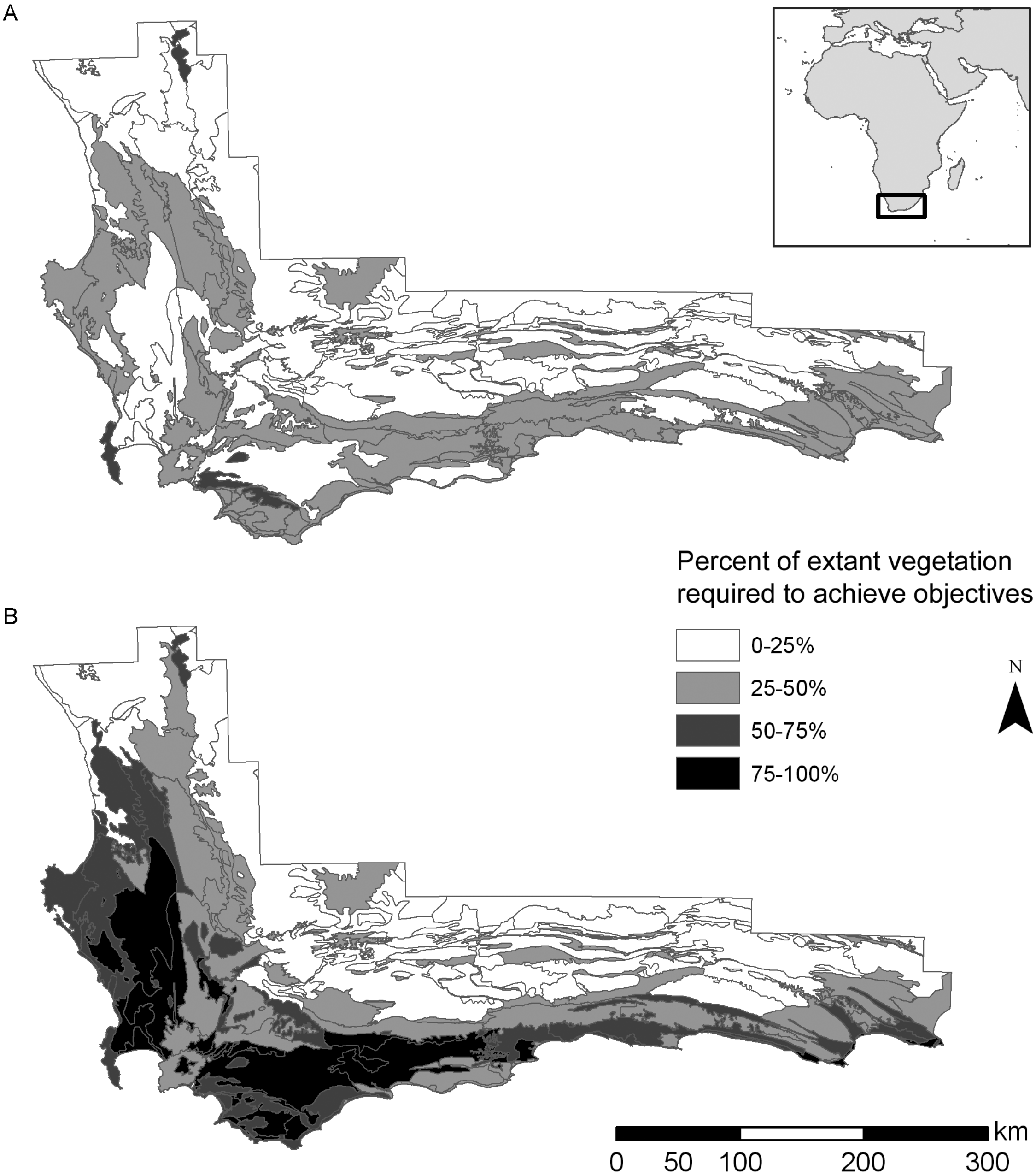

FIGURE 10.2 Terrestrial example of the difference that historical baselines can make to assessment of conservation requirements. The figure shows the Cape Floristic Region of South Africa, a global biodiversity hotspot, with outlines of 102 broad habitat units (BHUs) defined by vegetation and physical variables. Quantitative conservation objectives for BHUs were taken from Pressey et al. (2003). Conservation planning requirements are shown (A) without and (B) with historical baselines. (A) Percentage objectives applied only to extant vegetation cover in BHUs, reflecting the hypothetical lack of historical baselines of preclearing extent of BHUs. This plan is flawed because the original pre-European extent of native vegetation was not considered, especially for areas that were extensively cleared. (B) Percentage objectives applied to the original pre-European extent of native vegetation in BHUs, informed by historical baselines, then expressed as percentages of extant native vegetation required. Conservation requirements for many BHUs are larger in panel B, especially for BHUs that have been extensively cleared (shaded black).

information could be important in this stage. For example, historical information can be extremely valuable in assessing the effectiveness of past and current conservation measures, and information on the relative contributions of different management actions (either positive or negative in terms of their success) can be integrated into gap analysis (e.g., Mills et al. 2011). For instance, Lotze (see chapter 2, this volume) has shown that conservation efforts for coastal seas and estuaries over the past century have enabled partial recovery of some animals (i.e., pinnipeds, otters, and birds) but that these successes did not extend to recovery of ecosystem structure and function.

Selecting Additional Conservation Areas and Applying Conservation Actions to Selected Areas

Once it is clear what the gaps are, additional conservation areas need to be identified and implemented. Historical information can inform the selection of conservation actions in several ways. First, spatial information on the previous distributions of habitats and species will indicate candidate areas to achieve conservation (or restoration) objectives. Second, historical information can highlight management potential of areas that might not otherwise have been considered for conservation. For example, paleoecological data indicate that some subtropical waters once supported coral reefs (Greenstein and Pandolfi 2008). As the oceans warm under climate change, such areas might once again become important habitats for corals, including those for which conditions elsewhere might have become less favorable. Third, the historical significance of some areas can facilitate conservation management that might be difficult elsewhere. For example, Midway Atoll in the northwestern Hawaiian Islands was protected as a national wildlife refuge prior to the establishment of the Papahānaumokuākea Marine National Monument. The historical significance of Midway Atoll as the site of an important World War II battle resulted in additional protections and a special management plan for the atoll that was nested within the larger site-management plan (U.S. Fish and Wildlife Service et al. 2008).

Ensuring That the Expanded Conservation System Is Maintained, Monitored, and Reviewed

MPAs and other conservation actions instigated through the planning process have to be managed to achieve the objectives for which they were established (Pressey and Bottrill 2009). Through monitoring and evaluation, practitioners can ensure that the conservation actions they are implementing are effective and, if not, can adjust their strategies. This adaptive management framework depends on careful review of progress and a plan to adjust strategies as needed.

Maintaining and Monitoring MPAs

Probably the main role of historical information in supporting maintenance and monitoring of marine MPAs is assessing current progress in relation to historical context. When monitoring is undertaken in specific areas, whether they are preexisting management sites or new areas implemented as part of the planning process, new information will inevitably come to light that was not apparent from initial data. Historical information in the form of systematic field surveys, opportunistic field sampling, or archival photographs could indicate whether current characteristics such as coral cover are different from previous characteristics (Hughes et al. 2011). This information, in turn, could inform managers about the extent to which return to historical conditions is feasible by managing the area itself, or whether restoration depends on external factors beyond their control, such as supply of sediment and nutrients from catchments. Archival remote sensing and aerial photographs could also provide information on previous conditions within and around management areas to guide management responses.

Barriers to Incorporating Historical Data into Conservation Planning

Historical data are fundamental to our perceptions of what was natural in the sea. However, despite the stated aim of conservation planning to articulate goals and set priorities, relatively little attention has been given to use of historical data in planning. Several reasons help explain this disparity. First, conservation planners may not be familiar with the data or methods of historical ecology and, hence, may place low priority on the extra effort and cost needed to include historical information. Marine historical ecology is a relatively new research field, and scholars working in this area use a variety of multidisciplinary techniques that differ from traditional approaches and datasets more familiar to planners. Concerns might exist over the quality or type of the data, which are often anecdotal, qualitative, or nonspatial in nature.

Another impediment to using historical information is that societal values can shift over time, and conservation planners and some stakeholders may not be interested in the past or may be unwilling to fully consider the enormity of past decline. In some cases, specific stakeholders may not want to restore ecosystems or resources to previous states, even if it was possible (though usually it is not). For example, in the lobster fishery in Maine (USA), centuries of intense fishing have extirpated most apex predators, resulting in the development of a profitable lobster fishery. To the communities involved in this fishery, the past state may be less desirable than the current profitable one (Steneck et al. 2011). Similarly, given urbanization and migration to coastal areas, some coastal communities have changed so quickly that the collective social conceptualization of the past, and their relationship with the environment, has also changed. Such change can result in the perception of multiple baselines for the same resource among stakeholders, a problem that is compounded when recovery is longer than human generation times.

While we recognize these barriers, we believe that the advantages of incorporating historical perspectives outweigh the potential downsides. Integrating historical perspectives will allow planners to better understand the social and ecological dynamics that have led to the current state of a planning region and hence, we believe, will increase the likelihood of successful conservation efforts. Marine conservation planning is gaining momentum as countries and regions try to achieve global and regional conservation targets, providing ample opportunity to integrate historical information into these processes. Furthermore, the field of marine historical ecology, though rapidly expanding, is relatively new and is not yet part of conservation planning practice. As conservation planning and historical ecology become more connected, best practices and innovative methods will need to be developed to integrate these fields.

OPPORTUNITIES

As we have shown in this chapter, information on historical changes in marine ecosystems and human communities has the potential to be integrated into all of the stages of systematic conservation planning (Figure 10.1 and Table 10.1), with substantial opportunities to improve the effectiveness of conservation planning processes. Below, we outline significant opportunities for marine historical ecology to improve planning practice and conservation outcomes.

Historical data can inform our understanding of changes in the state or condition of ecosystems or a particular set of ecosystem constituents (e.g., species and habitats), but it can also provide substantive information on changes in ecological processes that are key to the structure and functioning of healthy ecosystems (Figure 10.3). Radical changes in ecosystem state are often referred to as "regime shifts," the transitions between which can be sudden and unexpected but are often the result of long-term processes best identified through historical analyses. For planners and managers, one of the major implications of regime shifts is defining the "safe operating space"—that is, the suite and intensity of human actions that can be accommodated without tipping an ecosystem into an undesirable state. Historical data on population declines and habitat losses can help characterize the current state, but thresholds are difficult to define (McClanahan et al. 2011), and hence it is prudent to avoid pushing this envelope and instead plan for maintaining ecological processes that are known to be critical for ecosystem resilience (Figure 10.3).

Retrospective analyses of historical changes in ocean systems can also provide some guidance on the state of key processes. For example, the regime shift from coral- to algal-dominated states in Caribbean coral reefs were the result of long-term declines in the abundance and diversity of herbivores (Hughes 1994, Jackson et al. 2001). Habitat loss, coupled with loss of functional diversity and intensity of herbivory—a key ecological process for reef resilience—resulted in collapse of coral reef ecosystems (Figure 10.3B). Other systems that have exhibited worrying trajectories but have avoided catastrophic regime shifts can also provide lessons on how to avoid thresholds. For example, the decline of Pacific pinniped communities resulted in major loss of kelp forest along the west coast of North America, but species protections enabled recovery (Estes et al. 1998). In this case, it is possible that a permanent regime shift was avoided by the availability of suitable pinniped habitat (coastal rocky reefs), which provided the ecological building blocks necessary for the recovery of pinnipeds and kelp forest ecosystems (Figure 10.3C; Steneck et al. 2003).

Marine historical ecology also allows planners and stakeholders to develop more realistic conservation goals and objectives that are grounded in reasonable reconstructions of the

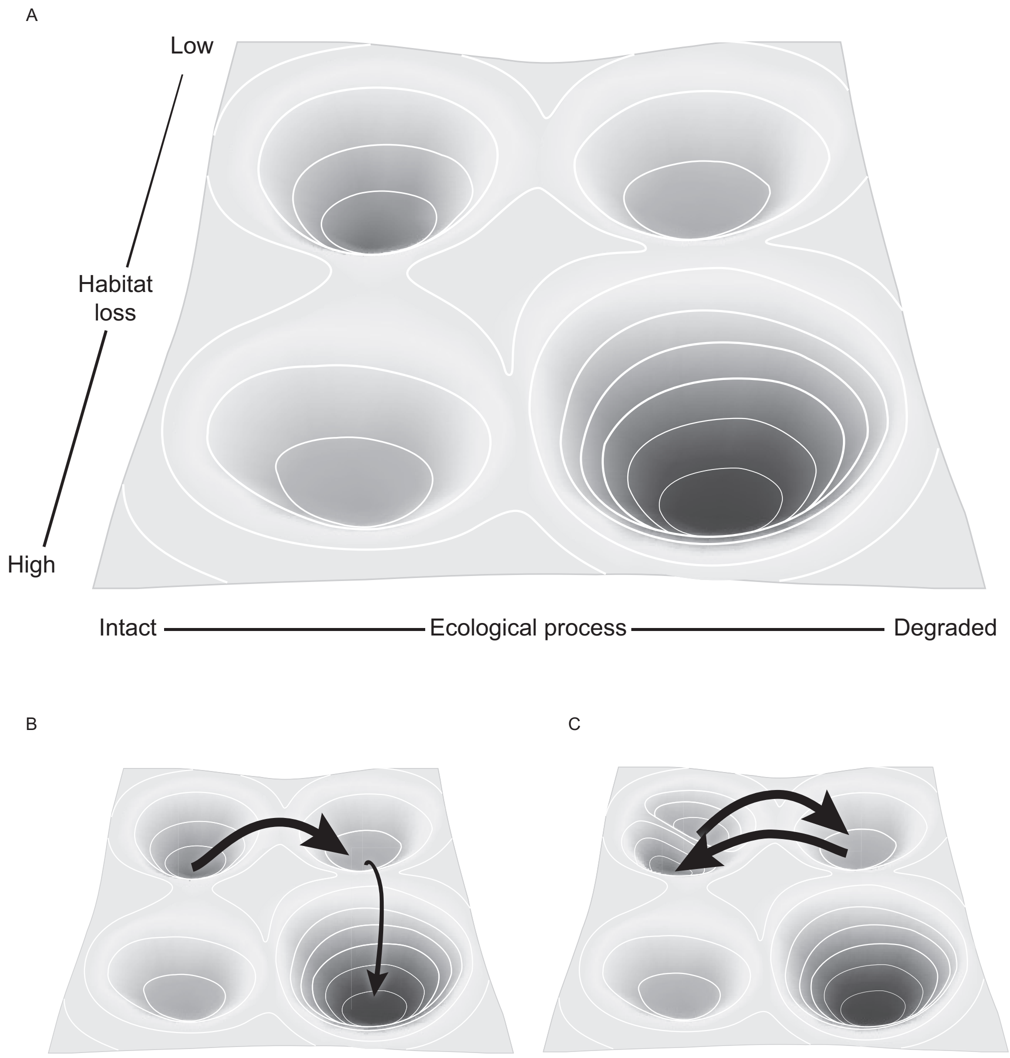

FIGURE 10.3 A heuristic model describing the relationship between habitat loss and ecological processes. (A) Different basins of attraction illustrate different stable states of ecosystem condition. In the upper left, habitat loss is low and ecosystem processes are intact. As a managed population or habitat degrades, management actions that stop or reverse this decline will enhance system resilience, but those that fail to stop loss of habitat or ecosystem processes will place the system in jeopardy of converting into a degraded state. (B) An example of a historical trajectory of degradation: herbivore populations in Caribbean coral reef ecosystems declined because of centuries of human impacts (arrow from left to right), resulting eventually in a rapid loss of herbivory (arrow from top right to bottom right) and an eventual change from a stable coral-dominated to a stable algal-dominated system. (C) An example of recovery: pinniped populations in nearshore kelp forest ecosystems along the west coast of North America were decimated during the sealing and whaling era of the nineteenth century, resulting in loss of predation and increases in herbivores that grazed kelp forest systems intensively (arrow from left to right). Protection of pinnipeds in the twentieth century resulted in restoration of predation, reduction in herbivory, and the subsequent return of kelp forests (arrow from right to left), although a novel pinniped community emerged as a result of this recovery, as indicated by a bifurcated basin in the upper left.

past. Historical data can be used not only to develop qualitative goals grounded in historical understandings but also, in some cases, to develop quantitative objectives based on historical trajectories and measures of success to track progress toward these objectives. Without a historical perspective, planning processes may proceed on a superficial understanding of current conditions or, worse yet, may establish arbitrary objectives that are either not grounded in reality or cannot feasibly result in the desired changes, given the trajectory of the target system. Objectives based on long-term perspectives can allow for more accurate scenarios of future changes and more prescriptive management approaches. In this way, planners and managers will be equipped to develop conservation strategies better attuned to ongoing and expected environmental and social changes.

Finally, incorporating historical data does not represent a fundamental departure from current conservation planning practice. As we have illustrated, historical data are already being used and have the potential for increased use to improve conservation planning practice and social and ecological conservation outcomes. The techniques and methodologies in marine historical ecology are growing in familiarity, and datasets are growing in number, type, and complexity (Lotze and Worm 2009). Further, regional coverage is expanding and more refined trajectories of change at spatial scales better suited for conservation planning are growing in number. Moreover, marine historical ecology is increasingly being oriented to facilitate uptake by conservation practitioners (Lybolt et al. 2011, Rick and Lockwood 2013).

CONCLUSIONS

Without a long-term historical perspective, planners, managers, and stakeholders will have only a rudimentary understanding of the systems they seek to protect and enhance. The danger of excluding long-term data is that planners and managers may misdiagnose the direct and underlying causes of decline in natural features and the real rates of ecological change. Conservation strategies based on the limited perspective of recent observations alone may limit understanding about the achievable goals for restoration and management of ocean environments (Jackson et al. 2001). Furthermore, historical perspectives—which invoke the living memory of stakeholders with intergenerational knowledge—can provide a powerful mechanism to engage all stakeholders in developing a shared vision in a conservation planning process. Thus, marine historical ecology has much to offer to marine conservation planning and should be considered in all conservation planning exercises.

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