Chapter 11

First Nations Perspectives on Sea Otter Conservation in British Columbia and Alaska: Insights into Coupled Human–Ocean Systems

Anne K. Salomon[1], Kii'iljuus Barb J. Wilson[2], Xanius Elroy White[3], Nick Tanape Sr.[4] and Tom Mexsis Happynook[5]

[1]School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC, Canada, [2]Skidegate, Haida Gwaii, BC, Canada, [3]Bella Bella, BC, Canada, [4]Nanwalek, AK, USA, [5]Uu-a-thluk Council of Ha'wiih, Huu-ay-aht, BC, Canada

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INTRODUCTION: REGIME SHIFTS AND TRANSFORMATIONS ALONG NORTH AMERICA'S NORTHWEST COAST

> *One of our legends explains that the sea otter was originally a man. While collecting chitons he was trapped by an incoming tide. To save himself, he wished to become an otter. His transformation created all otters.*
>
> Alutiiq Museum and Archaeological Repository (2005)

Human interactions with sea otters and kelp forest ecosystems have spanned millennia (Figure 11.1; Rick et al., 2011). In fact, archeological evidence suggests that the highly productive kelp forests of the Pacific Rim may have sustained the original coastal ocean migration route of maritime people to the Americas near the end of the Pleistocene (Erlandson et al., 2007). Similarly, many coastal First Nations stories speak of ancestors who came from the sea (Boas, 1932; Brown and Brown, 2009; Guujaaw, 2005; Swanton, 1909). Yet this vast and aqueous "kelp highway," providing food, tools, trade goods, and safe anchorage for sophisticated watercraft, would have been highly susceptible to overgrazing by sea urchins had it not been

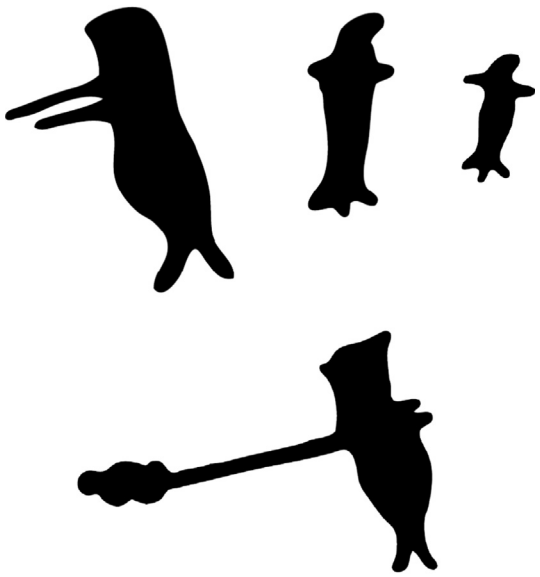

FIGURE 11.1 Sea otter pictographs from Kachemak Bay, Alaska. The origin and age of these rock paintings are not known with certainty, but ancestors of the Sugpiat are thought to have painted these images as many as 1500–3000 years ago. According to archeologists and local knowledge holders, it is thought that sea otters are among the animals depicted including this image of a sea otter struck by a harpoon. *(Originally reproduced and drawn by de Laguna, 1934; in Klein, 1996.)*

for the existence of an extremely effective urchin predator: the sea otter (*Enhydra lutris*). Highly valued, hunted, controlled, and traded by indigenous people for at least some 12,000 years (Braje and Rick, 2011a; Erlandson and Rick, 2010; Fedje and Mathewes, 2005; Fedje et al., 2001; Szpak et al., 2012), this fur-bearing keystone predator, which may have indirectly facilitated the peopling of North America, later drew Europeans to the northeast Pacific, forever transforming the coast ecologically, socially, and culturally.

The Pacific maritime fur trade of the eighteenth and nineteenth centuries had profound effects on the ecosystems, social systems, and management systems of the northwest coast, leaving a legacy we continue to observe, experience, and grapple with today. Following Bering's 1741 contact with the Sugpiat in south central Alaska, Perez's 1774 exchange with the Haida off Langara Island, British Columbia, and Cook's interactions with the Nuu-chah-nulth of Yuquot (Friendly Cove) on Vancouver Island 4 years later, came a steady stream of European and American trading vessels. The commercial trade in sea otter pelts began in earnest by the 1750s in Alaska and by the 1780s in British Columbia (Cook and Norris, 1998; Gibson, 1988; Gibson, 1992), prompting the introduction of the western economic system and opening the door to colonial settlement and laws. This transformation led to the erosion of First Nations economies and governance structures that had been in place for over 2000 years (Trosper, 2009). These structures included well-established trade networks, spatially explicit marine tenures, and complex traditional resource management protocols (Brown and Brown, 2009; Happynook, 2000; Kii'iljuus Wilson and Luu Gaahlandaay Borserio, 2011; Trosper, 2009). By the middle of the nineteenth century, sea otters were extirpated from many regions of the northwest coast as a result of the maritime fur trade (Gibson, 1988), with populations eventually declining in excess of 99% of their pre-contact numbers (Kenyon, 1969; Chapter 3). The commercial trade and subsequent extirpation of sea otters from the northwest coast irrevocably changed coastal indigenous societies and triggered a cascade of indirect ecological effects that propagated throughout coastal food webs (Chapter 2).

> *Below high water mark in some places the large urchins are very thickly strewn over the bottom. (George M. Dawson, 1878. Traveling along the coastline of Kunghit Island, in southern Haida Gwaii, British Columbia. In Cole and Lockner 1993.)*

With the elimination of sea otters from much of their former range came a release in the predation pressure they once exerted. Consequently, their herbivorous macroinvertebrate prey, such as abalone, clams, crabs, and sea urchins, expanded in numbers, size, and depth range (Tegner and Dayton, 2000). Because sea urchins are universally the most significant temperate reef herbivore, capable of controlling the distribution, abundance, and diversity of benthic macroalgae (Dayton, 1985), their marked increase caused many coastal rocky reefs in Alaska and British Columbia to shift from

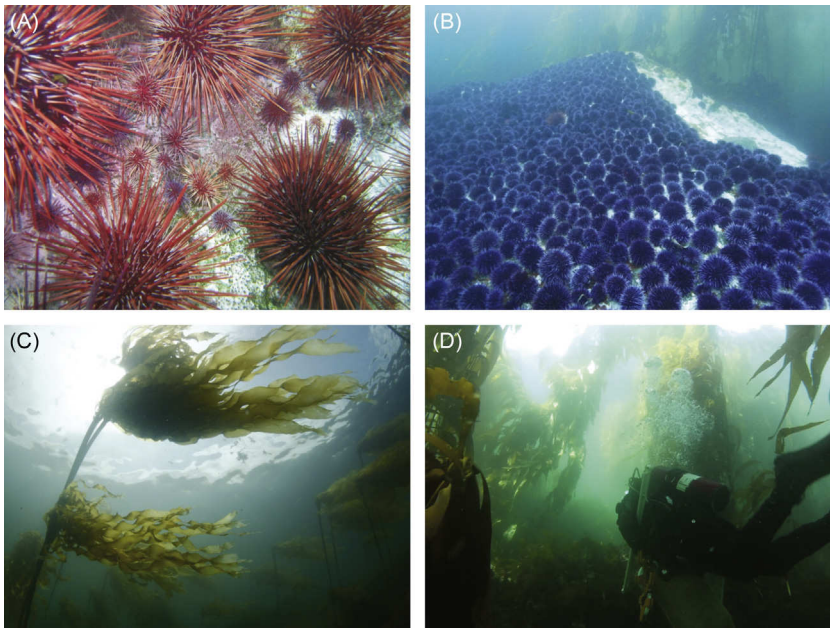

FIGURE 11.2 On Haida Gwaii, British Columbia, where sea otters have been ecologically absent since the 1850s, (A) red and (B) purple sea urchin barrens dominate subtidal rocky reefs at depths below 3–7 m. Above active feeding fronts of sea urchins, (C) early successional, fringing kelp forests, composed primarily of the short-lived annual bull kelp, exist in shallow waters. In contrast, on the central coast of British Columbia, where sea otters have been recovering for over 25 years, (D) "old growth," structurally complex kelp forests, composed of a high diversity of both short and long-lived kelp species, expand to greater depths in the sustained absence of grazing herbivores, sea urchins in particular. Along this same mainland coast further south, where sea otters have yet to fully recover, kelp forests resemble those surrounding the archipelago of Haida Gwaii. North America's kelp forests are influenced by multiple and interacting drivers of change, both predator-driven from the top-down (Estes and Palmisano, 1974; Estes et al., 1998; Lafferty, 2004; Tegner and Dayton, 2000), nutrient-driven from the bottom-up (Parnell et al., 2010), and physically driven by waves and storm events (Dayton, 1985; Dayton et al., 1984; Dayton and Tegner, 1984). Furthermore, the relative strength of these drivers varies with depth, wave exposure and oceanographic context, which itself changes dramatically with latitude (Graham et al., 2010; Steneck et al., 2002). Although the cascading effects of sea otter extirpation from Alaska, through British Columbia, down to Baja, California, may vary (Carter et al., 2007; Foster, 1990), at northern latitudes in British Columbia, these indirect effects are pronounced. *(Photos by Anne Salomon (A), Lynn Lee (B), Mark Wunsch (C) and Brittany Keeling (D).)*

predominantly kelp forest to invertebrate-dominated (Figure 11.2; Estes and Palmisano, 1974; Watson and Estes, 2011). Switches from one ecosystem state to another likely occurred at different time periods along the northwest coast, varying with local extirpation date and pre-fur trade sea otter densities. Historical records suggest these fur trade-induced ecosystem flips may have

occurred as early as the 1870s, if not sooner, along the coast of British Columbia (see quote above in Cole and Lockner, 1993) and possibly several decades earlier in Alaska following the onset of the Russian fur trade (Cook and Norris, 1998). Accompanying these remarkable switches in high-latitude temperate reefs (Figure 11.2) in the mid-1800s came several key transformations to coastal traditional and commercial fisheries.

We survived by the ocean and beach. That's what sustained us.

Walter Meganack Jr., Sugpiaq Elder, 2004 (Salomon et al., 2011)

With the increase in shellfish following the extirpation of sea otters came the expansion of shellfish fisheries. Although invertebrates were always an integral part of harvest and trade among coastal First Nations, made clear by the sheer number and depth of prehistoric shell middens up and down the coast, the ecological extirpation of sea otters by the 1850s would have enhanced shellfish harvest opportunities amongst coastal indigenous people (Sloan, 2003, 2004). Yet the subsequent commercialization of both shellfish and finfish fisheries in the early 1900s eventually restricted the ability of many indigenous people to access these resources.

In British Columbia, for example, as new commercial finfish fisheries emerged and developed along the coast, government agencies became increasingly challenged to manage this fishing effort. By the late 1960s, commercial fishing fleets were restricted through the use of vessel buy-back programs specifically designed to reduce fishing capacity. This was later followed by individual vessel quotas and area licensing policies in the 1990s. These fleet rationalization policies ended up excluding small boat operators, a high proportion of which were indigenous. With the loss of commercial salmon, halibut, and herring licenses once held by indigenous people, these policies indirectly excluded indigenous participation in what had become commercialized finfish fisheries. While salmon abundance declined through the late 1980s and early 1990s, the market demand for shellfish from Asia increased as did its market value. Individual fishing quotas for shellfish and market conditions radically raised the value of commercial shellfish licenses, making them financially inaccessible for many First Nations. Consequently, complex socio-economic forces from the late 1960s onwards posed a risk to First Nations food security, food sovereignty, and economic livelihoods, as did a looming biological force.

They came back in the late 1950s, early '60s. The population exploded in the late '70s early '80s.

John Moonin, Sugpiaq Elder, 2004 (Salomon et al., 2011)

Sea otter populations began to recover along some stretches of the northwest coast throughout the mid- to late twentieth century both naturally, owing to various government protection measures, and via intentional translocation campaigns (Jameson et al., 1982; Chapter 3). For example, recovery began along

the south central coast of Alaska, traditional territory of the Sugpiat, as early as the 1950s via natural range expansion (Salomon et al., 2007). Accompanying this recovery came the sequential decline of highly valued subsistence and commercially important shellfish, a phenomenon that has been attributed to the synergistic effects of both predation by sea otters and shellfish harvest by humans (Salomon et al., 2011). Following this came a reported increase in the spatial extent of kelp forests (Salomon et al., 2011). In British Columbia, however, between 1969 and 1972, 89 Aleutian Island sea otters were intentionally translocated, with no First Nation consultation (Osborne, 2007), to Checleset Bay on the northwest coast of Vancouver Island, traditional territory of the Ka:'yu:'k't'h and Che:k'tleset'h' First Nations, two of the 14 Nuu-chah-nulth Nations (Bigg and Macaskie, 1978). Between 1977 and 1995, population growth was initially rapid at 19% per year and has since slowed substantially to 8.4% per year (Nichol et al., 2009; Chapter 13). Along British Columbia's central coast, traditional territory of the Heiltsuk Nation, sea otters were first reported in 1989 and have been growing at a rate of 11.4% per year (Nichol et al., 2009). Recovery of this keystone predator in parts of Alaska and British Columbia's shoreline has caused some high-latitude temperate reef ecosystems to flip back from macroinvertebrate-dominated to kelp-dominated (Figure 11.2; Breen et al., 1982; Estes and Palmisano, 1974; Markel, 2011; Watson and Estes, 2011).

> *The urchins were the first to go, then crab and clams. [Chitons], they're the most recent change, now they're declining.*
>
> Richard Moonin, Port Graham, 2004 (Salomon et al., 2011)

> *In Checleset where sea otters were first transplanted in the 1960s, we have noticed declines in most shellfish. We have not been able to harvest urchins, geoduck, clams, scallops, or abalone for the last 10 years and the children have not had an opportunity to have these foods.*
>
> Peter Hansen, Kyuquot/Checlesaht Nation Treaty Manager, 2003 (Dovetail, 2003)

> *Since sea otters were introduced in Kyuquot Sound, there have been changes in kelp beds, maybe influencing rockfish, baitfish and herring spawn.*
>
> Anthony Oscar, Kyuquot Fisheries, 2003 (Dovetail, 2003)

Because their effects are often rapid, pronounced, direct and indirect, the recovery of sea otters and the trade-offs they induce have elicited complex social-ecological conflicts among coastal communities (Salomon et al., 2011). With the reintroduction of this apex predator, some parts of the ecosystem stand to gain, while others stand to lose. For example, while the return of sea otters has been shown to indirectly increase catch rates of kelp-associated fish in the Aleutian Archipelago (Reisewitz et al., 2006), enhance rockfish recruitment in

British Columbia (Markel, 2011), magnify secondary production in the Aleutians (Duggins et al., 1989), and facilitate atmospheric carbon storage along high-latitude coastlines (Wilmers et al., 2012), these indirect effects typically come at the expense of economically and culturally valuable shellfish (Salomon et al., 2007; Singh et al., 2013). Thus, sea otter recovery can pose a threat to coastal communities due to the immediate cultural and economic loss associated with reduced shellfish harvesting opportunities, as well as perceived and real threats to food security. On the other hand, the recovery of this charismatic species can often elicit tourist dollars, yet profits are rarely distributed to community members who are affected by sea otter recovery. Finally, some of these positive indirect ecological effects described above have been shown to be context dependent, occurring in some places but not others (Singh, 2010). And yet, while the recovery of sea otters has ignited controversy and will continue to do so, it also presents an opportunity for scientists and coastal communities to expand our understanding of this predator's role in kelp forest food webs and First Nations cultures, forcing us to confront our views on the role of humans in ecosystems and our notion of what is natural (Dayton et al., 1998).

> *. . .now we find that sea otters are once again playing a large role in a shifting Nuu-chah-nulth society, as we see the impacts that their increased presence is having in the nearshore marine environment. Nuu-chah-nulth are challenged to ask themselves difficult questions about the economic, social, and spiritual impacts sea otters are having on their communities.*
>
> Nuu-chah-nulth Tribal Council Fisheries, 2011 (Uu-a-thluk, 2011)

Crossing tipping points are well known to induce turmoil across coupled social-ecological systems (Gunderson and Holling, 2002). Consequently, conservation and management practices are increasingly seeking to maintain social-ecological system resilience, that is, a system's capacity to absorb shocks, learn, re-organize, and adapt (Folke, 2006; Folke et al., 2004). In the case of sea otter recovery, coastal communities are increasingly asking if they can withstand the return of sea otters and simultaneously prevent the decline of other marine resources upon which they depend. How should the limits be decided and who will be the decision makers? At the heart of these questions lie fundamental issues of food security, food sovereignty, and indigenous rights, title, and self-determination. Fortunately, archeological evidence suggests that sea otter-induced tipping points are not new to coastal communities on the northwest coast (Corbett et al., 2008; Erlandson et al., 2005; Simenstad et al., 1978) and ancient marine management strategies likely evolved to cope with some of these trade-offs (Rick and Erlandson, 2009; Trosper, 2009). Consequently, in this case as in many others, establishing well-informed reference points based on archeological and historical records (Braje and Rick, 2011b; Dayton et al., 1998; Tegner and Dayton, 2000) and learning from the vast archive of expertise accumulated in traditional knowledge

(Davis, 2009; Huntington, 2000) may offer innovative solutions to the contemporary and future conservation challenges associated with sea otter recovery.

By integrating and synthesizing evidence from archeological faunal records, historical records, oral histories, contemporary ecological data, and traditional knowledge from British Columbia and Alaska, we ask the following questions. First, to what extent, and how, were sea otters used by coastal indigenous people of the northwest coast prior to European contact? Second, how were sea otter hunting practices managed in the past and how did these ancient management practices fit within the broader governance structures and management protocols of coastal marine resource use during prehistoric times? Finally, we ask, What are First Nations' perspectives on sea otter conservation and management today and can traditional management practices be applied in an effort to balance the needs of people and nature?

SEA OTTER USE IN ANCIENT TIMES

> *People have to understand how valuable the sea otter is to our people. We have great histories. We have been with them for years and years, thousands of years. Big chiefs use sea otters to recognize a great chief amongst our people... The sea otter can bring back all the histories of people before.*
>
> Tsah-seets (Stanley Sam), Ahousaht Elder (Nuu-chah-nulth Tribal Council, 2012)

Although the magnitude of sea otter hunting by indigenous people in Alaska and British Columbia prior to European contact is not known with certainty, zooarcheological data and historical records offer some insights and alternative hypotheses. Traditionally, sea otters were highly valued and traded among First Nations for their uniquely soft and warm fur. Sea otter pelts were crafted into ceremonial robes and adornments, worn by chiefs and other high-ranking people (Figure 11.2; Drucker, 1951; Uu-a-thluk, 2011). Sea otter pelts were also used in day-to-day life as bedding and insulation by chiefs and high-ranking people who had the canoes, technical skills, and customary right to hunt sea otters (Kii'iljuus Wilson, 2012). Sea otter furs were an important trade item among coastal First Nations well before contact with European trading vessels and the emergence of the global market for sea otter fur (Murdock, 1934). Historic accounts of the maritime fur trade document that early traders were accessing substantial fur supplies already in use among well-established indigenous trade networks (Bartlett, 1925; Beresford, 1968; Hoskins, 1969). Furthermore, the occurrence of sea otter bones in archeological faunal records from Alaska and British Columbia suggest that although the magnitude of use varied spatially among coastal indigenous people (McKechnie and Wigen, 2011), sea otter hunting was a significant and widespread practice of aboriginal people in this area for at least the past 12,000 years (Corbett et al., 2008; Fedje et al., 2001; Szpak et al., 2012).

Evidence of Prehistoric Sea Otter Population Reduction

Several lines of evidence from ancient sea otter bones excavated from 10 late-Holocene (ca. 5200 years BP to 1900 AD) archeological sites in central and northern British Columbia suggest that sea otter populations were hunted and may have been reduced in numbers below carrying capacity in this area (Szpak et al., 2012). First, the chemical signature of these bones suggests that these sea otter diets may have been primarily composed of benthic invertebrates, with a very low contribution of benthic fish. Evidence from contemporary sea otter populations in Alaska suggests that fish become an important prey item only when otter populations reach very high densities (Estes, 1990; Estes et al., 1981) in response to reduced macroinvertebrate prey and increased kelp habitat which can support greater fish abundances (Bodkin, 1988; Reisewitz et al., 2006). Second, low variability in the chemical signature among these late-Holocene sea otter bones may indicate low dietary diversity, a feature common among contemporary sea otters existing at lower population densities (Tinker et al., 2008). Consequently, a lack of piscivory, in addition to evidence of low dietary variability, implies that these late-Holocene sea otters may have existed at relatively low population densities (Szpak et al., 2012). Sea otter bones represented the most common marine mammal species harvested at several of these sites and were present throughout all examined time periods. These data reveal both the importance and temporal depth of sea otter hunting among First Nations on the central and north coast of British Columbia for millennia prior to the maritime fur trade. Furthermore, sea otter reduction by hunters might have occurred down the entire west coast of North America. For example, Erlandson and colleagues (2005) postulate that the abundance and large size of red abalone shells and sea urchin tests in several early middens on the Californian Channel Islands suggest that sea otter populations were likely limited by Native American Chumash hunters beginning as early as ~8000 years before present (Erlandson et al., 2005).

It has also been hypothesized that throughout the Holocene, 12,000 years ago until early contact, sea otters in coastal Alaska and British Columbia likely occupied a patchy spatial distribution, with reduced numbers of individuals in the vicinity of village sites and greater numbers along coastlines far from centers of human occupation (Corbett et al., 2008; Simenstad et al., 1978; Szpak et al., 2012). In addition to direct mortality due to hunting, sea otters may have been suppressed in numbers near human settlements due to human avoidance behavior and competition with humans for shellfish. Evidence suggests that at least 15,000 people (Acheson, 1998; Boyd, 1990, 1999), and perhaps as many as 30,000 (Kii'iljuus Wilson, 2012), once occupied the islands of Haida Gwaii. Furthermore, it has been told by Haida Elders that no land around the islands was unknown; rather, the entire coastline was owned and managed by different family clans (Kii'iljuus Wilson

and Luu Gaahlandaay Borserio, 2011). Given the high density of village sites and indigenous populations spread throughout the coast, this would have meant kilometers of coastline that may have been otter free. Reduced sea otter abundance surrounding ancient human settlements has also been suggested for California's Northern Channel Islands (Rick et al., 2008). Consequently, the exclusion of sea otters near human habitations may have had localized cascading effects on nearshore subtidal ecosystems as early as the Holocene (Erlandson et al., 2005).

Evidence of Prehistoric Trophic Cascades

Mounting evidence suggests that harvesting by indigenous people during prehistoric times profoundly altered coastal ecosystems long before European contact (Erlandson and Rick, 2010; Jackson et al., 2001; Steneck et al., 2004). Faunal evidence from a prehistoric midden excavated on the Aleutian Island of Amchitka indicates a dramatic shift in harvested resources during 2500 years of occupation (Simenstad et al., 1978). In this archeological time series, the abundance of sea otters is positively related to the abundance of marine fish and seals, and inversely related to the abundance of sea urchins and limpets. This alternating pattern of abundance suggests that Aleuts were technically capable of locally reducing sea otters, thereby increasing the availability of harvestable macroinvertebrates and inducing a shift in nearshore community states, from one dominated by marine mammals (sea otters, harbor seals) and reef-associated fish to another dominated by herbivorous invertebrates (sea urchins, limpets, chitons, and snails). Furthermore, reconstructed size-frequency distributions of sea urchins through time were constant and encompassed large urchins, implying a nearshore species assemblage that excluded sea otters and persisted throughout much of the Aleut occupancy. Additional archeological evidence from other Aleutian Island sites suggest that urchin barrens may have surrounded human settlements while kelp forests may have flourished away from human occupations, creating a mosaic of kelp forests and urchin barrens along the coastline (Corbett et al., 2008). This mosaic hypothesis has also been invoked for British Columbia's northern and central rocky reefs (Szpak et al., 2013) and the Californian Channel Islands (Erlandson and Rick, 2010; Erlandson et al., 2005). Compared with contemporary urchin barrens, evidence from the Californian Channel Islands suggests that ancient urchin barrens were probably more localized and possibly shorter lived, with harvest of shellfish by humans in the intertidal and shallow subtidal (Figure 11.3) replacing the predatory control once conferred by sea otters (Rick and Erlandson 2009; Erlandson and Rick 2010). However, prehistoric sea otter hunting and its cascading effects during the Holocene were likely much less pronounced and more spatially constrained in comparison with the widespread cascading effects triggered by the historic extirpation of sea otters by the maritime fur trade.

FIGURE 11.3 Nuu-chah-nulth Chief Maquinna (muk^{w}ina) and his brother Callicum of the Mowachat First Nation, cloaked in robes made from the furs of sea otters (from Mears, 1790).

Trophic Cascades of the Nineteenth Century

Although ancient sea otter hunting could trigger localized trophic cascades, it was the industrial extirpation of sea otters by the maritime fur trade that had sweeping, long-term, and profound cascading effects on the kelp forest ecosystems of North America's high-latitude rocky reefs (Estes and Palmisano, 1974). Evidence from the chemical signature of rockfish (*Sebastes* spp.) bones from late-Holocene archeological sites in southern Haida Gwaii that span the maritime fur trade (ca. 1500 BP to 1880 AD) reveal that kelp-derived carbon in rockfish diets decreased in post-contact rockfish compared with pre-contact rockfish, likely due to the reduction of kelp forests associated with the extirpation of sea otters (Szpak et al., 2013). This implies an unprecedented shift in the local ecosystem following the maritime fur trade due to the cascading effects of sea otter hunting that did not occur to the same magnitude or spatial extent prior to European contact. The temporal consistency of sea otter bones recovered in British Columbian and Alaskan middens indicates a degree of continuity and capacity for sustained harvest by indigenous people during the Holocene (Corbett et al., 2008; McKechnie and Wigen, 2011; Simenstad et al., 1978; Szpak et al., 2012).

ANCIENT GOVERNANCE AND MANAGEMENT PROTOCOLS OF COASTAL MARINE RESOURCES AND SEA OTTERS

Evidence of Coastal Conservation and Management in Deep Time

> *[An] example of a stewardship practice was the design of halibut fish hooks, which were made to catch only specific sizes – not the small ones that still needed to grow or the large ones that were needed to reproduce.*
>
> (Brown and Brown, 2009)

Emerging evidence from North America's west coast suggests that its First People developed diverse technologies to conserve and manage coastal marine resources, including selective harvesting, seasonal restrictions on use or consumption, and proprietorship that was contingent on sustained productivity (Berkes and Turner, 2006; Trosper, 2009). In many cases, technologies were used to maintain or enhance coastal resource productivity. For example, traditional ecological knowledge from Heiltsuk and Haida knowledge holders suggests that the construction of stone fish traps at the mouths of rivers (Brown and Brown, 2009; Xanius White, 2006) and wooden fish weirs within streams (Kii'iljuus Wilson, 2012; Kii'iljuus Wilson and Luu Gaahlandaay Borserio, 2011) were used to selectively harvest all five species and specific sizes of salmon. It is told that knowledgeable fishers inspected the catch inside these traps during high tides and harvested fish of smaller sizes, leaving larger, more robust fish to continue up the rivers to become part of the breeding stock (Hilistis Waterfall, 2009). Ancient clam gardens, human-made intertidal rock-walled terraces recorded from Alaska through British Columbia to Washington State, were designed to increase clam yields (Caldwellet al., 2012; Williams, 2006) and contemporary experimental evidence has confirmed this (Groesbeck, 2013). Herring spawn on hemlock bows and kelp were transplanted by the Haida, Heiltsuk, and Tlingit for population restoration purposes (Boas, 1932; Brown and Brown, 2009). Estuarine root gardens at the mouths of rivers were tended to increase crop yields of northern rice root, springbank clover, and Pacific silverweed (Deur, 2005). Higher up on the shores, root gardens were cultivated by routine clearing and burning to promote the productivity of blue camas lily, one of the most widely traded food resources in the Pacific Northwest whose bulbs were also transplanted outside of their range to make them more widely accessible (Turner and Turner, 2007). Salmon and eulachon were translocated among streams to enhance production (Brown and Brown, 2009), while abalone were transplanted close to villages to increase access. The intentional reduction and exclusion of sea otters by indigenous people of the northwest coast would have greatly increased the productivity of nearshore shellfish (Dayton, 1985; Erlandson et al., 2005). Consequently, sea otters may have been merely one of numerous managed coastal species, considered the property and responsibility of particular families.

Ancient Marine Tenure System

> *"There was no land lying vacant." (Swanton, 1905) Translated and interpreted as: "Gam tluu tllgaay aa k'iixa Gang ga; There is no land strange."*
> (Kii'iljuus Wilson and Luu Gaahlandaay Borserio, 2011)

> *. . .There was clear ownership of streams and hunting areas, so that only a limited number of people had the right to fish in certain rivers or to hunt in specific areas. A song that my father sang to us was about our river, which made it clear that we belonged there and no one else.*
> Namgis Matriarch Gloria Cranmer—Webster 'Wika lalisame 'ga'
> (Brown and Brown, 2009)

> *In the old days, Ha-houlthee was very strict in terms of boundaries. You had to formally ask for permission. If there was a shortage of resources in one's territory, you made an arrangement with the chief to secure access elsewhere.*
> Wickaninnish Cliff Atleo, President Nuu-chah-nulth Tribal Council, 2012
> (Uu-a-thluk, 2012)

Indigenous peoples of the northwest coast had a territorial governance system and complex protocols that delineated access rights to the land and sea (Trosper, 2009). Unlike the contemporary notion of "property," titleholders could not sell their territories and were obligated to share its resources. Proprietorship of these territories was organized through a system of "houses" or "clans," which consisted of a number of related families who lived under the direction of a head titleholder. Each house (or clan) has a territory containing seasonal fishing and hunting sites, gardens, and berrybush picking and tending sites—in sum, areas of land and sea that produced food, trade goods, medicines, and other important resources. Among the Nisga'a and Gitxsan, the name for these houses is "wilp." Oral histories indicate that marine tenures were owned and managed by chiefs on Haida Gwaii with specific rules of ownership and responsibilities (Kii'iljuus Wilson, 2012). Similarly, on the west coast of Vancouver Island, the 'Ha' houlthee' are chiefly territories of the Nuu-chah-nulth First Nations, owned and managed by hereditary Chiefs (Ha'wiih). Every place in the entire territory of a society belonged to the chief and his clan/house (Kii'iljuus Wilson, 2012; Kii'iljuus Wilson and Luu Gaahlandaay Borserio, 2011; Trosper, 2009) and clan-based seasonal camps were distributed throughout the territory for specific species, such as abalone, salmon, halibut, and seaweed (Kii'iljuus Wilson, 2012).

Contingent Proprietorship, Public Accountability, and Reciprocity

Territorial access rights, in combination with rules about the behavior of chiefs, created a system of governance over common pool fisheries

resources that conferred resilience to societies on the northwest coast for over 2000 years (Trosper, 2009). First, proprietorship over territories was contingent on proper management, specifically defined in terms of maintaining the productivity of a territory's resources for future generations (Trosper, 2009). Second, the chief holding the territory needed to publicly demonstrate the continued productivity of resources and was accountable to the house, otherwise they could be overthrown. This public accountability created an important feedback loop that provided a strong incentive for learning how to manage for continued use. Ethnographic and historic evidence suggests that both raiding among houses and slavery occurred on the northwest coast of North America (Donald, 1997), the latter potentially providing a means for commoners to discipline titleholders by cooperating in allowing their leaders to be captured (Trosper, 2009).

> *. . . . It is necessary to give in order to receive. . . . Consequently generosity can be viewed as a natural law of reciprocity. The ancient Nuu-chah-nulth felt so strongly about the importance of the relationship between generosity and the quality of life that the opposite of generosity was equated to death.*
>
> Nuu-chah-nulth Chief UmeeK, 2004 (Trosper, 2009)

> *Each tribe owned specific resource sites, which could be shared if, for example, salmon were abundant in one area, but not in another. As inter-marriage meant extended kinship groups among several villages, those from the village experiencing a poor fishing year, would ask for permission to share in the bounty of another, with which they had some family connection.*
>
> Gloria Cranmer-Webster 'Wika lalisame 'ga', Namgis Matriarch (Brown and Brown, 2009)

> *When people from other villages ran out of smoked and dried salmon, they would come to Mauwash and ask my great-great-great grandfather to fish there. . .. When we had everything we needed — seaweed, fish, eggs etc. — we would send some to our relatives at Bella Coola, Rivers Inlet, Kitimaat, and the Nass River. When it was their time, when the eulachons and herrings started running, they would send up smoked fish and grease. This trading back and forth was the way of our people, and the First Generation. This is the reason we never knew hunger.*
>
> Angus Campbell, Heiltsuk, 1968 (Brown and Brown, 2009)

Finally, the requirement of reciprocity, clearly held by the Nuu-chah-nulth, Namgis, Haida, Heiltsuk, and most indigenous people of the northwest coast, provided two additional incentives for sustainable management. First, it provides social insurance against misfortune. Neighbors would be asked for support when resources were low (i.e., when a salmon run failed, or

when herring spawned in another's territory but not one's own), knowing that such support would be returned later if and when needed. Second, the sharing and exchange of the net returns of a territory reduces competition and any incentive to overharvest amongst resource users, thereby providing a solution to the tragedy of the commons. The enforcement of reciprocity was made legal via the potlatch system, a public governance system among coastal First Nations whose ubiquity suggests that its advantages became widely recognized. In sum, ancient marine tenure systems and governance protocols founded in reciprocity were used to conserve and manage most marine species, including sea otters.

Ancient Sea Otter Hunting Practices and Evidence for Spatial Management

> *In our history, certain people had rights to certain areas of Hesquiaht Harbour. They had licences to take sea otters for harvesting. Sea otters were hunted at certain times of the year, not every month. Certain people had rights to the pelts. The pelts were distributed to other First Nations for their regalia; these were people with hierarchy.*
>
> Hesquiaht Chief Dominic Andrews 'Matlaha,' 2003 (Dovetail, 2003)

According to oral historical accounts, sea otter hunting was a respected skill and an honored tradition among coastal aboriginal communities and only certain people had the privilege to hunt. Among the Nuu-chah-nulth, sea otter hunters were either chiefs who had access rights to the water where the hunt was to occur or a noted sea otter hunter delegated by the territory's chief (Drucker, 1951). Hunting took place with a bow made from yew wood, arrows whose shafts were carved of cedar, a spear or harpoon, a club, and specially crafted canoes whose polished hulls allowed hunters to approach soundlessly within range (Drucker, 1951). Hunters and their steersman typically set out before daybreak to kelp beds where an otter might be found asleep (Drucker, 1951). Sea otter hunting required stealth and precision, skills that were refined with much training. Adult Haida and Sugpait hunters often engaged in target practice and children played games to hone their hunting skills for precision and accuracy from an early age (Kii'iljuus Wilson, 2012; Tanape, 2012).

Like most coastal resources, it is possible that hereditary leaders who owned territories also managed sea otters spatially. It has been hypothesized that male sea otters may have been targeted to control the distribution of sea otter populations in space (Kii'iljuus Wilson, 2012). This proposed traditional management practice would have made use of an important natural history characteristic of sea otters. Rafts of sea otters are typically segregated by sex (Riedman and Estes, 1990). While both male and female rafts persist within existing core habitats, male rafts tend to occupy the periphery of the population range. Range

expansion typically occurs in growing populations when rafts of males move into previously unoccupied habitat (Garshelis and Garshelis, 1984; Garshelis et al., 1984). Female rafts then follow and establish in newly occupied areas once male rafts have left (Garshelis et al., 1984; Loughlin, 1980; Wendell et al., 1986). Thus, the targeting of roving male sea otters by indigenous hunters would have allowed chiefs to spatially manage sea otter occupation in their territories, reducing or excluding sea otters from some areas while maintaining population numbers through the persistence of male and female rafts elsewhere within their territories. Sea otter fur, and the pelts of other mammals such as ermine, were highly valued and used for chiefly regalia, bedding, and insulation and to demonstrate societal status and good standing among First Nations (Kii'iljuus Wilson, 2012). Consequently, we surmise that the incentive to maintain a viable population of sea otters in part of a chief's territory existed.

Traditional Principles of Stewardship and Sustainability

> *In the old stories, the Haidas, as with other coastal people, were taught to use all parts of whatever was hunted or gathered. If one did not treat the ocean, sky and land with respect, they would leave us without their presence in our world. Whether it is on the land or oceans, never taking more than you needed, sharing and using cyclical harvesting methods were major aspects of cultivation and conservation. For example, we cultivated and managed crab-apple orchards, berry patches, clam gardens, octopus houses, and fish traps, whether out of rock or fibre.*
>
> (Kii'iljuus Wilson, 2012)

Traditional principles of stewardship and sustainability were common amongst coastal First Nations. For example, the principles of "Gvi'ilas," laws of the ancestors, guided the marine harvest activities of British Columbia's Heiltsuk First Nation over the past 10,000 years (Brown and Brown, 2009). This was a stewardship model based on a social responsibility to the Nation's members. Coastal communities up and down the northwest coast were guided by governance protocols designating access rights to resources that were contingent on intergenerational accountability and reciprocity (Trosper, 2009). On the west coast of Vancouver Island, the Nuu-chah-nulth principle of "Hishukish tsa'walk" (everything is one, everything is interconnected) underscores that the Nuu-chah-nulth, like most coastal indigenous people, view themselves and all humans as an integrally linked component of the ecosystem (Happynook, 2000). Thus, this stewardship principle underscores the notion that sustaining species, and the ecosystems in which they are embedded, is a requirement for sustaining humanity and human well-being. Consequently, setting sea otter recovery goals based on the notion of an ideal state of nature without humans fits poorly with those whose cultural foundation is inseparable from the landscapes and seascapes within their traditional territories (Sloan and Dick, 2012).

BALANCING THE NEEDS OF PEOPLE AND NATURE: FIRST NATIONS PERSPECTIVES

Perspectives on sea otter conservation and management vary among First Nations, as they do among non-native people and even government agencies. For example, in 1987, on Haida Gwaii, where sea otters have yet to recover since their extirpation in the 1850s, the Council of Haida Nation passed a resolution supporting the reintroduction of Alaskan sea otters to the islands specifically for ecosystem restoration (Sloan and Dick, 2012). That same year, the Haida Nation and the BC Ministry of the Environment jointly applied to the provincial BC Wildlife Branch for a sea otter translocation permit. The provincial government formally proposed the notion to the federal Department of Fisheries and Oceans (Sloan and Dick, 2012). At a public meeting held in 1988 on Haida Gwaii, both support and opposition was expressed by First Nations and non-native island residents. That year, the Department of Fisheries and Oceans wrote a memo to the federal parks service, Parks Canada, which had tabled the idea of active sea otter restoration. The letter stated the department's lack of support and recommended natural reintroduction over active restoration (Sloan and Dick, 2012). Of course, First Nations perspectives on sea otter conservation and management also vary through time as sea otter population status changes and as new legal frameworks are modified to reflect this.

In Canada, as of 2009, sea otters were down-listed from "Threatened" status to "Special Concern," removing previous prohibitions and allowing some level of hunting by First Nations with an Aboriginal Communal Fishing License issued under the Fisheries Act for food, social, and ceremonial purposes. Sea otter range expansion, reintroduction, and active management is discussed today on Haida Gwaii among some Haida leaders and marine planning groups as a way to restore both kelp forest ecosystems and the relationship that the Haida had with this species (Kii'iljuus Wilson, 2012; Sloan and Dick, 2012). Conservation and active management is being addressed directly by Nuu-chah-nulth Nations, who have been coping with an expanding sea otter population since their intentional reintroduction in the early 1970s. Although sea otter recovery is a controversial topic within Nuu-chah-nulth communities (Nuu-chah-nulth Tribal Council, 2012), it has also created the opportunity to reinvigorate traditional laws and customs and engage in collaborative research.

> *The return of sea otters have opened the doors to discussions throughout Nuu-chah-nulth Ha'houlthee (chiefly territories) about the role of Nuu-chah-nulth Ha'wiih (traditional chiefs) to maintain ecosystem balance through the principles of Hishukish tsa'walk (everything is one) and Iisaak (respect with caring). In the spirit of these important principles, Nuu-chah-nulth have supported and initiated sea otter recovery efforts. Together Nuu-chah-nulth*

> *now turn to management of sea otter populations for ceremonial use opportunities for Nuu-chah-nulth First Nation communities, to re-establish the sacred relationship that once existed for the benefit of all Nuu-chah-nulth people.*
>
> (Nuu-chah-nulth Tribal Council, 2012)

In 2012, the Nuu-chah-nulth Tribal Council Fisheries Department, Uu-a-thluk, drafted a comprehensive management plan for K^{w}ak^{w}atl (sea otters) in the Nuu-chah-nulth Ha' houlthee, with the overarching goal of "maintain[ing] healthy sea resources, including a healthy and sustainable sea otter population, while providing ceremonial use[of] sea otter[s] … for Nuu-chah-nulth First Nation communities, in Nuu-chah-nulth Territories" (Nuu-chah-nulth Tribal Council, 2012). Specific objectives of this plan include the following:

- Ensuring that the management plan does not conflict with the principles of Hishukish Tsa'walk (everything is one) and Iisaak (respect with caring), the principles vested in Uu-a-thluk.
- Fully involving Nuu-chah-nulth First Nations in all aspects of sea otter management and related initiatives including Nuu-chah-nulth direct participation in any recovery and management planning processes.
- Maintaining a viable and sustainable sea otter population in the Nuu-chah-nulth area.
- Ensuring the availability of sea otters to Ha'wiih and their representatives for ceremonial use.

This detailed plan outlines the current status, range, threats, and regulatory protection of sea otters. It then presents the details of a Nuu-chah-nulth harvest including quantitative estimates for an annual allowable harvest rate, based in turn on estimates of human-caused mortality and its uncertainty from all sources that can be sustained by a population while still allowing it to grow or remain at a target level (Wade, 1998). Harvest regulations include spatial boundaries, allowable hunter designations, harvest protocols, bio-sampling, compliance monitoring, and enforcement. The management plan specifically includes annual population monitoring and a biological sampling program, as well as a standard tagging certificate form and additional measures for a communal harvest plan. Last, this plan commits to working collaboratively with the 14 Nuu-chah-nulth First Nations, the federal Department of Fisheries and Oceans (DFO), and other relevant agencies on meeting these objectives as well as research and education programs. This plan is not designed to simultaneously manage shellfish resources and traditional shellfish harvest despite their localized declines.

> *Sea otters are part of the problem. They eat everything we eat. But bidarkis [chitons can adjust to nature. It's us they can't adjust to.*
>
> Walter Meganack Jr., Port Graham, Alaska 2004 (Salomon et al., 2011)

I wouldn't blame the sea otters, it's us. Our exhaust, gas, and oil. We are the ones damaging all that. The problem now is human impact, it's a heavy impact.

Nick Tanape Sr., Elder, Nanwalek, 2004 (Salomon et al., 2011)

In south central Alaska, on the tip of the Kenai Peninsula, the Sugpiat of Port Graham and Nanwalek, who have lived with sea otter recovery and range expansion since the 1950s, recognize that sea otters are but one of many factors driving the decline in shellfish resources. In these villages, it is widely acknowledged that both local subsistence and regional commercial harvest by humans, and changing ocean conditions have a role (Salomon et al., 2011). Although Alaskan Natives are legally exempt from the marine mammal protection act and are legally sanctioned to take sea otters, no intentional culls have occurred over the past 20 years in these two villages. The Sugpiat have, however, been involved in boat-based sea otter counts in parts of their traditional territory since 1999 as active members of the Alaskan Sea Otter and Sea Lion Commission (Tanape, 2012). This tribal consortium was established in 1988 to promote Alaska Native involvement in policy decisions pertaining to sea otters and, 10 years later, Steller sea lions. Working directly with coastal Alaska Natives, the goal of this organization is to further the conservation and local management of marine mammals, as well as local research. However, like many programs, these desired outcomes are perpetually constrained by sporadic and limited funding.

It's time to call the Russians back again!

Comment at Port Graham Elder's meeting, 2004 (Salomon et al., 2011)

And yet, because people and sea otters compete for similar foods, sea otter recovery is often a source of frustration among First Nations despite the clear interest in rekindling traditional sea otter and human relationships. Management and conservation decisions pertaining to sea otters, or any resource or ecosystem for that matter, are ethical decisions, informed by scientific information but driven by citizens and their values. Consequently, people will need to draw upon a wide range of knowledge (ecological, archeological, economic, cultural, experiential) and their own ethical beliefs and worldviews when weighing the costs and benefits of co-existing with sea otters (Sloan and Dick, 2012).

Reconciling Worldviews

How can sea otters be protected from trappers and aquariums, but at the same time we do not protect the shellfish? What is the balance?... What's the cost of recovering sea otters and where's the balance to it? Man is part of the ecosystem too. The aboriginals of Hesquiaht are part of the ecosystem and also have rights.

Paul Lucas, Hesquiaht Fisheries Technician, 2003 (Dovetail, 2003)

Differences in the worldviews typically held by "Western" and indigenous people mean that native and non-native people and government agencies do not always share a common perspective on sea otter recovery (Osborne, 2007). One of the most fundamental distinctions separating these worldviews is the perspective on the role humans play in ecosystems. Indigenous societies tend to view themselves as a component of the ecosystem. This runs counter to the view of people as external disrupters of an otherwise pristine ecosystem, a view once held by many scientists and government managers. Today, non-native societies and government policies tend largely to ignore or undervalue the cultural, economic, and ecological relationship indigenous people had with sea otters and wish to revitalize. Thus, excluding or minimizing the cultural and ecological roles that indigenous people play in sea otter ecology and recovery runs counter to an indigenous worldview. As we describe above, archeological evidence and oral histories tell us that indigenous people likely played a significant role in driving the spatial distribution and population dynamics of sea otters in Alaska, British Columbia, and California, at least at small spatial scales. Sea otters were an integral part of indigenous culture and economies for millennia, well before contact. Recognizing and acknowledging the different perspectives society has on the role humans play in ecosystems and the notion of "what is natural" is an important step towards reaching a mutual understanding of different recovery objectives for sea otters held by western and indigenous communities. In both Canada and the United States, First Nations have constitutional rights and have hunted sea otters for millennia. Consequently, restoring sea otter populations should justly be followed by restoring the relationships between First Nations and sea otters.

Who Decides How Much?

> *Many of the Chiefs want to exercise their rights and authorities in areas in regard to aquatic resources and sea otters.*
>
> Ron Frank, Nuu-chah-nulth Tribal Council, 2003 (Dovetail, 2003)

The imbalance of power between native and non-native governments along the northwest coast has a deep history and legal issues of rights and title remain unresolved. In Canada, the government's outlawing of the potlatch in 1885 and removal of the authority of chiefs to manage the fisheries within their territories struck down a system of fisheries management that had persisted for more than 2000 years (Trosper, 2009). Less than 100 years later, the Nuu-chah-nulth people were not included in the Canadian government's decision to reintroduce sea otters to Checleset Bay from 1969 to 1972 (Osborne, 2007). In spite of this, recent efforts seeking reconciliation have started to take shape. After a long history of social injustice and inequity in resource access rights to coastal First Nations, reconciliation protocol agreements were signed in 2009 between provincial and coastal First Nation governments in an unprecedented move to support First Nations' rights to co-manage coastal resources (British Columbia, 2009a,b).

In the ocean, this is manifested in a collaborative, ecosystem-based, marine use planning process that is currently under way along British Columbia's northern and central coasts. This represents a remarkable opportunity to transform coastal management and implement aboriginal constitutional rights; however, how this will affect sea otter recovery targets and management plans has yet to be determined.

Restoring to What?

People's notions and perceptions of "what is natural" often suffer from the "sliding baselines" syndrome, in which a lack of information about the past can lead to misinterpretations of a species' or an ecosystem's overall status (Dayton et al., 1998; Pauly, 1995). This syndrome plagues scientists, policy makers, and the public alike. Above, we provide evidence that humans have been exploiting, modifying, and managing coastal species and ecosystems, including sea otters, for millennia. Given this, what sea otter population size is "natural"? What should our recovery targets be?

In British Columbia, the current status of sea otters, which are currently estimated to occupy 25–33% of their "historic" range, is based on a habitat-suitability model and records of pelts purchased during the maritime fur trade (Nichol, 2007). Given the archeological and oral history evidence on the extent of prehistoric sea otter population reductions, and the stockpiling of and trade in sea otter pelts throughout the Holocene, a high degree of uncertainty surrounding "pre-contact" baseline estimates of sea otters remains. However, recovery targets and baseline estimates for most species at risk appear to be based on population estimates in the absence of humans or without the explicit recognition or knowledge of the history and prehistory of human occupation of the northwest coast.

Deep into human prehistory, human–environment interactions in coastal ecosystems have spanned a continuum, from degradation to active management and enhancement (Rick and Erlandson, 2009). This blurs the separation between the natural and anthropogenic worlds. Increasing evidence on the antiquity of human alteration of marine ecosystems requires us to reassess our baselines for the long-term management, restoration, and sustainability of coastal marine species and ecosystems in which humans are included. Consequently, scientists, managers, and policy makers involved in the recovery of all species and ecosystems at risk must confront their own assumptions and worldviews in order to help define what "recovery" means to all members of society.

Can Traditional Governance and Management Practices Be Applied Today?

The concept of designating access privileges to participants in a fishery was not unique to the indigenous people of North America's northwest coast, nor is it new to contemporary fisheries management. In fact, there is a long

FIGURE 11.4 Coastal First Nations used spears and staffs to collect intertidal and shallow subtidal fish and shellfish. (A) A Nuu-chah-nulth fisherman with spear in Clayoquot Sound, BC. The notch in the top of the canoe prow was often used to rest the shaft of a spear or harpoon (Curtis, 1916). (B) A Kwakwaka'wakw First Nation gathering northern abalone (*Halitois kamtschatkana*) from the rocky intertidal with a staff in hand (Curtis, 1915). Northwestern University Library, *Edward S. Curtis's 'The North American Indian': the Photographic Images*, 2001. (see http://memory.loc.gov/ammem/award98/ienhtml/curthome.html)

history of territorial use rights for fishing (TURFs) across the Pacific Islands of Polynesia and Micronesia. Today, rights-based marine tenures are being used along the coasts of Chile, Baja, California, and Kenya as part of contemporary ecosystem-based marine management plans (Gelcich et al., 2010). Multiple examples of traditional, community-based marine resource management techniques continue to grow across the Pacific Islands, from limited entry zones, closed areas, and seasonal closures, to restrictions on damaging or overly efficient fishing methods (Johannes, 2002; Figure 11.4). Recent evidence suggests that the implementation of rights-based catch shares, specifically individual-transferable fishing quotas, can slow and even stop the global trend towards commercial fisheries collapses (Costello et al., 2008). Contemporary transformational changes in the governance of marine resources, including the establishment of community quotas and spatial allocation of user rights and responsibilities to community collectives, have been shown to

FIGURE 11.5 While sea otters have been functionally absent from the shores of Haida Gwaii since the 1830s, the occasional sighting of a lone individual, like this one floating behind a pack of Stellar sea lions off Garcon Rocks, reminds us that sea otter range expansion is just a matter of time. Unassisted recovery of sea otters to Haida Gwaii is likely within this century (Sloan and Dick, 2012). *(Photo by Nadine Schoderer, June 17, 2010.)*

prevent fishery-induced population collapses and maintain the resilience of coupled human−ocean ecosystems (Gelcich et al., 2010). If this is the case for a variety of fisheries worldwide, how can we transition back to traditional harvest methods and principles like Gvi'ilas and Hishukish tsa'walk along North America's northwest coast and what might this look like when applied to sea otter conservation and management?

The Future: Preparing for and Adapting to Change

> *Nature changes. Man changes. Is it natural? I feel that changes are more pronounced now. Change is happening at a faster pace now than before.*
>
> Walter Meganack Jr., Sugpiaq Elder, 2004 (Salomon et al., 2011)

> *Prior to all the sea-otter being extirpated, kelp was never an issue. Now with warmer water, an overabundance of sea-urchins, preferable kelp isn't always available.*
>
> Kii'iljus Barb Wilson, Haida Matriarch, 2009 (Brown and Brown, 2009)

Change was and will continue to be inevitable. Importantly, sea otter recovery and range expansion (Figure 11.5) is one change that is occurring within the context of other ecological and social changes: the decline of commercial fisheries for species such as herring, eulachon, and salmon, the rise of introduced species, global climate change, and increased public and

legal acknowledgment of indigenous rights. Because the recovery of sea otters is occurring amidst emerging reconciliation agreements between native and non-native governments in Canada and the United States, a window of opportunity exists for policy innovation and change in the governance of marine resources. We suggest that coastal communities can begin to prepare for these transformations by revisiting their old management systems and ways of thinking, while learning about and participating in the latest science examining the ecological, economic, and socio-cultural ripple effects triggered by sea otter range expansion. We cannot manage out of ignorance. Only when we know what a species does, what it eats, and what role it has within coupled human–ocean systems, can we begin to make some intelligent decisions. Dialogues among resource users, scientists, policy makers, and the public will help identify and introduce old and new pathways forward to prepare for these transformations.

NAVIGATING TOWARDS ECOLOGICAL AND SOCIAL RESILIENCE ON THE NORTHWEST COAST

[I]ndigenous science has developed over millennia providing principles which reflect an acute awareness of the necessity of including social, cultural, spiritual and economic considerations within our understanding of the ecological world.

Tom Mexsis Happynook Huu-ay-aht First Nations Ha'wiih and Chairman of the Nuu-chah-nulth Council of Ha'wiih 2013 (Happynook, 2000)

As the magnitude of our impacts on marine ecosystems intensifies and becomes more apparent, there is an increasing appreciation of the strong links between the social and ecological processes that support human well-being. This has initiated a shift in approaches to marine conservation and management, from one that is single species based and focused on optimizing yields to one that focuses on maintaining social and ecological resilience by recognizing the reciprocal relationships between interlinked systems of people and nature (Folke, 2006; Folke et al., 2004). These complex systems are often characterized by variability, cross-scale dynamics, and thresholds. This new approach aligns well with traditional ingenious worldviews and principles of stewardship and sustainability, as well as the sea otter-induced tipping points observed on the high-latitude temperate reefs of the northwest coast (Figure 11.2). The challenge is in finding compromise between appropriate levels of human use while sustaining restored coastal ecosystems which include sea otters (Sloan and Dick, 2012).

Our ancestors lived side by side with all the creatures on land, sea and air via complex and even simple guidelines and rules. Today, collaboration is a preferred method of managing our resources.

Xanius Elroy White, Heiltsuk Cultural Historian and Archaeologist, 2013

When it comes to designing coastal conservation and management policies, sea otters being one element, each coupled human–ocean system will have its unique ecological, cultural, and socio-economic features to address. However, several broad principles can be applied. First, engaging and collaborating with coastal indigenous communities to identify relevant research questions and to participate in the design, implementation, monitoring, and evaluation of alternative policy options will vastly improve their likelihood of success. Reconstructing prehistoric and historic kelp forest baselines and documenting the evolution of socio-cultural values associated with sea otter recovery will help diagnose and treat the symptoms of sliding baselines. This will allow researchers and communities to co-establish appropriate and regionally specific reference points and recovery targets based on both empirical data and human values. Invoking ethics and justice in marine conservation and management parallels indigenous beliefs of respect and responsibility. If we are to restore ecosystems to an earlier state of biodiversity, productivity, and ecosystem completeness with humans, then the ethical beliefs of First Nations are integral to this restoration (Happynook, 2000; Sloan and Dick, 2012).

To design scientifically sound conservation and management policies that are tailored to the ecological, social, and cultural nuances of each region, we recommend synthesizing data on the regional variation in the ecological and social effects triggered by sea otter recovery. Furthermore, integrating western science and local knowledge will improve our ability to determine the ecological and socio-economic drivers of coastal ecosystem change (Salomon et al., 2007) and will lend legitimacy to both parties' data and their inferences based on them. For example, predictive ecosystems models of kelp forest food web interactions (Salomon et al., 2002), based on western and traditional knowledge, will allow scientists and communities to make predictions and evaluate the trade-offs associated with alternative management policies. Integrating design features of western and traditional ecosystem-based management could be used to develop alternative experimental management strategies that address direct and indirect effects of sea otter predation on benthic fisheries. Moreover, creating responsive governance structures that support flexible and adaptive management approaches would allow these policies to be trialed as experiments through pre-existing marine planning process. These policies could then be monitored, evaluated, modified, and reassessed. Finally, equitable governance means sharing power through joint decision making and co-management. This means democratizing conservation science and management. Finally, because no coupled human–ocean system can ever be fully understood, all marine conservation and management decisions should be approached with humility (Sloan and Dick, 2012). Abiding by these principles will help coastal communities transition back to a path of sustainability and towards rebuilding resilient ecosystems and communities.

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