Culture, Conservation, and Conflict: Assessing the Human Dimensions of Hawaiian Monk Seal Recovery

Trisha Kehaulani Watson,¹ John N. Kittinger,² Jeffrey S. Walters,³ and T. David Schofield³

¹ Honua Consulting, PO Box 61395, Honolulu, HI 96839, USA

²Impact Assessment, Inc., Pacific Islands Office, 367-C Kapaloala Place, Honolulu, HI 96813, USA

E-mail: jkittinger@gmail.com

³ Protected Resources Division, Pacific Islands Regional Office, NOAA National Marine Fisheries Service, 1601 Kapiolani Boulevard, Suite 1110, Honolulu, HI 96814, USA

Abstract

The Hawaiian monk seal (Monachus schauinslandi) is highly endangered, but relatively little is known about how human societies interacted with the species in the past. We reviewed historical documents to reconstruct past human-monk seal relationships in the Hawaiian archipelago and describe ongoing efforts to understand the significance of the species in Native Hawaiian culture. Though the prehistoric period remains poorly understood, our findings suggest that monk seals were likely rare but not unknown to Hawaiian communities in the 19th and 20th centuries. References are made to monk seals in Hawaiian-language newspapers, and oral history research with Native Hawaiian practitioners and community elders reveals new words for the species that were previously unknown. This information may prove useful in crafting culturally appropriate management plans for the species and for developing more effective outreach activities to engage with coastal communities and ocean users. Our research may also aid in establishing long-term ecological baselines that can inform modern efforts to recover the species.

Key Words: monk seal, *Monachus schauinslandi*, endangered species, recovery, human dimensions, natural resources, culture, conservation

Introduction

The Hawaiian monk seal (*Monachus schauinslandi*) is the most populous of three phocid pinnipeds that once inhabited the Caribbean, Mediterranean, and Hawaiian Islands regions (Ragen & Lavigne, 1999). The Caribbean monk seal (*M. tropicalis*) is now extinct, and only a few hundred of the Mediterranean monk seal (*M. monachus*) remain. The highly endangered Hawaiian monk seal population—comprised of approximately 1,200 individuals—is declining at a rate of approximately 4%/y (Antonelis et al., 2006; National Marine Fisheries Service [NMFS], 2007).

Hawaiian monk seals are estimated to have inhabited the Hawaiian archipelago for approximately 14 million years and thus the species has adapted to long-term geologic changes in the archipelago. Humans have occupied Hawai'i for centuries and, by this time scale, are relatively new additions to the islands. Among the primary habitats required by monk seals are shallow water reef habitat for pupping, weaning, and foraging; sandy beach areas for hauling out; and deeper reef areas for foraging (Kenyon & Rice, 1959; NMFS, 2007). These habitats are common in the varied reefs, islands, and atolls of the Hawaiian Archipelago (Juvik & Juvik, 1998). In the inhabited main Hawaiian Islands (MHI), monk seal habitat and human infrastructure and populations often overlap.

Despite the fact that the Hawaiian monk seal is an apex predator in coral reef environments, it exhibits extreme sensitivity and vulnerability to human stressors. The monk seal is a slow-reproducing, long-lived species, and its small population renders it vulnerable to local extirpation and extinction (Ragen, 1999; Ragen & Lavigne, 1999). Kenyon (1972), for example, showed that repeated disturbance by small groups of humans and dogs resulted in increased juvenile mortality and caused monk seals to desert beaches at preferred habitats in the Northwestern Hawaiian Islands (NWHI).

Currently, the majority of Hawaiian monk seals are found in the remote and primarily uninhabited NWHI, but a smaller population is growing in the MHI (Baker & Johanos, 2004) (Figure 1). Monk seals in the MHI are increasing in number, and it is this segment of the population that is most threatened by human disturbances. Monk seal recovery



Figure 1. Map showing the Hawaiian Archipelago, comprised of the inhabited high islands of the main Hawaiian Islands (MHI) (Hawai'i, Maui, Moloka'i, Lāna'i, Kaho'olawe, O'ahu, Kaua'i, and Ni'ihau) and the uninhabited reefs, banks, and atolls of the Northwestern Hawaiian Islands (NWHI), which are protected as part of the Papahānaumokuākea Marine National Monument. Map courtesy of the NOAA Papahānaumokuākea Marine National Monument Office.

is not universally supported in Hawaiian communities, and some ocean users view the species as a nuisance or threat—for example, three monk seals were recently killed by apparent intentional shooting, and foul play cannot be ruled out in the recent deaths of at least three other seals (Levine, 2009; Anonymous, 2010). Such actions are a major concern for long-term conservation and recovery planning for the species, particularly considering the continuing decline in NWHI populations.

Below, we briefly summarize the existing state of knowledge regarding historical relationships between humans and monk seals and describe ongoing research efforts to characterize the sociocultural dimensions of recovery efforts for this critically endangered species. We conclude by discussing the need for increased social science research to define the pathways toward sustainable interactions with endangered species.

Background

The Hawaiian Islands and other remote archipelagos in East Polynesia were among the last places on Earth to be colonized by humans. New estimates place the arrival of voyaging Polynesians in Hawai'i at ~AD 1250-1290 (Wilmshurst et al., 2011), and thereafter they established complex societies and resource production systems in the following centuries (Kirch, 1985; Vitousek et al., 2004). Upon arrival, the introduction of novel species and human exploitation induced major changes to both terrestrial and marine ecosystems (Burney et al., 2001; Drake & Hunt, 2008; Athens, 2009; Kittinger, 2010). As Polynesian societies grew, they transformed natural ecosystems into cultural landscapes that supported societal needs (Maly, 2001; Kaneshiro et al., 2005).

The Prehistoric Period (~AD 1250-1778)

There is little known about the historical significance of monk seals in Native Hawaiian culture and how Polynesian societies interacted with monk seals during the period prior to western contact (~AD 1250-1778). It is possible that the monk seal was distributed throughout the Hawaiian archipelago prior to the arrival of Polynesian voyagers, particularly given the available habitat in the MHI. One existing theory is that human hunters eradicated monk seals early and rapidly after human arrival in the MHI, sequestering the remaining portion of the population in the NWHI in Hawaiian prehistory. This scenario seems plausible-in the absence of land predators, monk seals would probably have exhibited little fear of humans and, thus, would have been easy to capture. Monk seals were likely considered high value prey as they would have provided a significant return on investment in terms of the meat gained per hunting effort.

The archaeological record, to date, does not indicate a strong record of human consumption of monk seals. In fact, current evidence of prehistoric Hawaiians harvesting monk seals from archaeological midden deposits is limited to a few sites in the archipelago, and many of the recovered bones date to the 19th century. The first includes the upland Lapakahi site on Hawai'i Island (Rosendahl, 1994), and other monk seal remains have been recovered in Wailuku. Maui (State of Hawai'i, n.d.) and in a site on the Kohala coast of Hawai'i Island (R. Rechtman, pers. comm., 2011). The lack of evidence in the archaeological record must be tempered by the fact that many mammal bones found in excavated middens in Hawai'i have yet to be thoroughly analyzed, and depositional processes and excavation procedures also affect recovery. For example, mammal bones in many excavated middens in Hawai'i have yet to be thoroughly enumerated by species, and bones may also have been erroneously categorized as belonging to other mammals commonly recovered in archaeological deposits (e.g., commensal pigs [Sus scrofa] or dogs [Canis familiaris]). There is also a significant amount of archaeological data that remains unpublished, including the majority of "contract archaeology" research, which is commonly difficult to access or search.

Additionally, depositional processes may have obscured seal remains in midden deposits. Monk seals, which weigh hundreds of pounds when mature, may not have been transported to permanent habitation sites before slaughter. Prehistoric hunters were more likely to butcher animals at the kill site and transport the most valuable meat portions back to habitation sites, a phenomenon known in archaeological sciences as the "schlepp effect," which serves to explain the distribution of large animal bones in midden contents (e.g., Marean et al., 1992). Evidence from New Zealand, for example, suggests that seal flesh was separated from bones prior to preservation for long distance transport (Smith, 1989). Another alternative explanation is that predepositional ravaging by Polynesian dogs or pigs raised in animal husbandry may explain the lack of monk seal remains in middens.

The lack of seal bones in the archaeological record in Hawai'i contrasts greatly with other sites in the Pacific where seals and other marine mammals are known to have been major constituents of indigenous diets in prehistory (Smith, 1989; Nagaoka, 2002; Erlandson et al., 2005; Rick et al., 2005; Smith, 2005; Etnier, 2007). Seal bones may also be rare in archaeological deposits because monk seal population size was probably naturally small prior to the arrival of Polynesians.

In New Zealand, marine pinniped populations probably numbered in the hundreds of thousands and were second only to fish as a source of meat for prehistoric human societies (Smith, 2005). The Hawaiian monk seal population, by contrast, is estimated to have numbered only "in the thousands" (Ragen & Lavigne, 1999, p. 225). A population estimate of thousands is consistent with pre-exploitation estimates for the densities of monk seals in Caribbean coral reef ecosystems (McClenachan & Cooper, 2008). In this study, McClenachan & Cooper (2008) used historical records to quantify the total population and density of monk seals in the Caribbean region and reconstruct historical changes in biogeographic distribution. Their estimated average density of seals per km² of coral reef equates to a pristine (prehuman) population size of 1,972 to 14,263 individual monk seals in Hawai'i (Mean: 8,118) (Table 1). These low and high estimates for total population size depend on which data are used for total reef area (e.g., 10-fathom vs 100-fathom estimates for reef area in Rohmann et al., 2005) (Table 1). Notably, McClenachan & Cooper (2008) found that the biomass of reef fishes required to sustain such a population density is roughly equivalent with that observed currently in remote and biologically intact coral reef ecosystems in the Pacific such as the NWHI (p. 1356).

Population estimates using data from the Caribbean should be viewed with caution given the differences in habitat, biology, geography, and history of the two regions. Nevertheless, these data provide further evidence that the prehuman population size of monk seals may have been small for a large mammal (< 15,000 individuals), which would make the species more

Table 1. Estimates for Hawaiian monk seal populations derived from average densities of pre-exploitation Caribbean monk seal populations; populations were calculated as a function of the average density of monk seals (3.71 metric tonnes) per km² of coral reef reported in McClenachan & Cooper (2008, p. 1356), using the average weight of a mature monk seal (415 lbs [0.188 metric tonnes]) reported in MacDonald (2001). Low and high population estimates were calculated using bathymetric estimates of the area of coral reef inside the 10-fathom depth (low) and the 100-fathom depth (high) reported in Rohmann et al. (2005).

Hawaiian monk seal population estimates	MHI	NWHI	Total
Low	859	1,113	1,972
High	4,652	9,611	14,263
Mean	2,756	5,362	8,118

vulnerable to extinction (Soulé & Wilcox, 1980; Fagan et al., 2001). This differs substantially from other regions where pinnipeds and human societies overlapped in prehistory (e.g., the Caribbean, New Zealand, the Pacific northwest), where pinniped populations were at least a degree of magnitude larger than Hawaiian monk seals. Thus, the naturally small population size of Hawaiian monk seals may have made this species more vulnerable to possible local extirpation in prehistory.

Yet another potentially confounding factor is the unknown effects of introduced species, particularly the Polynesian dog, which may have influenced monk seal populations in prehistory through harassment and deterrence of monk seals from haulout beaches. Though very little is known about the Polynesian dog, it was likely introduced with the cadre of commensal species that accompanied Polynesian voyagers, which also included rats, pigs, and chickens (Luomala, 1960a, 1960b). Dog remains are common in middens, and dog was preferred over pig and chicken as a food item (Titcomb & Pūkui, 1969). Ethnographic and historic anecdotal evidence confirms that dogs were common in Polynesian households, where they were fed vegetable matter and may have functioned both as food and as a sentinel species.

In other coastal settings, it has been suggested that dogs played a major role in affecting prehistoric marine mammal populations through the combined effects of harassment, hunting, and possibly introduced diseases. Rick et al. (2008), for example, have argued that dogs may have "negatively affected breeding bird and sea mammal populations on the mainland portions of the [Channel] islands, likely driving these animals to offshore islets or other isolated areas. If feral dog populations were present, as they were historically, these impacts would have been more pronounced" (p. 1083).

Observations by some of the first Westerners that reached the archipelago suggest that dogs were abundant in the Hawaiian Islands. Upon arrival in 1778, James Cook (1842) noted: "Of animal food they can be in no want as they have abundance of hogs which run without restraint about the houses and if they eat dogs which is not improbable their stock of these seem to be very considerable" (p. 249; see also Beaglehole, 1967). Similar observations of dense populations of dogs in the archipelago were made by Mariner (1818) and Ellis (1836), as summarized in Titcomb and Pūkui (1969). In addition, at least one observer in the post-contact period confirms the existence of feral dog populations in Hawai'i in the 1820s: "I saw many skeletons of some kind of animal, devoid of all flesh, but apparently not long dead, and on rejoining our guide, was informed that the wild dogs had

almost exterminated the sheep that Vancouver had brought with the cattle, pursuing them beyond the line of vegetation, where they became bewildered and died for want of food" (Macrae as quoted in Titcomb & Pūkui, 1969, p. 4).

In conclusion, very little is known about the biogeographic distribution of monk seals in Hawaiian prehistory and how Polynesian societies interacted with the species. The scant evidence recovered in archaeological deposits suggests that monk seals were consumed by Hawaiians, but it is difficult to extrapolate the few sites where bones have been found to a larger understanding of human-monk seal interactions during this early period. Archaeological deposits must also be interpreted with caution as a number of processes can alter the observed pattern in the archaeological record. These include misidentification of bone material and depositional processes (e.g., the "schlepp effect" and predepositional ravaging). Additionally, it is likely that monk seal populations were naturally small prior to the arrival of humans and that the introduction of pigs and dogs may have affected monk seal distributions in the inhabited MHI.

The Historic and Modern Periods (~AD 1778+)

The British explorer James Cook first arrived off the coast of Kaua'i in 1778 and later described Hawai'i as the most densely populated archipelago he observed in his travels through the Pacific (Kirch, 2007). A number of other explorers, traders, missionaries, and other western visitors visited the Hawaiian Islands in the decades after Cook's initial arrival, but no descriptions or references to monk seals have been found in any of their writings and descriptions of the islands. This suggests that monk seals were either rare or simply not of interest to those recording their observations. The Hawaiian Islands soon became embedded in commercial maritime industries in the Pacific region due primarily to its location in the midst of major trade routes between fur and seal grounds in Alaska, the Pacific Northwest, and the Kamchatka peninsula; markets in Canton (China); and sealing and whaling grounds east of Japan and in the Bering Sea. The strategic location of Hawai'i and its growing reputation as being abundant in resources ultimately resulted in Hawai'i becoming a major provisioning station for commercial maritime traders in the early 19th century, including the sealing and whaling industries (Miller, 1989; Beechert, 1991).

The first whalers arrived in Honolulu in the early 1800s, and major sealing expeditions were undertaken to the NWHI starting in the 1840s to 1850s, taking hundreds of seals for their furs and oil (Anonymous, 1859; Cobb, 1902; Bailey, 1952; Brooks, 1859). Cobb (1902) described some of the earliest recorded sealing voyages in the NWHI:

There are occasional notices of sealers in the maritime notes of the newspapers of the islands after this date, as in 1859, when the bark *Gambia*, 249 tons, is reported as having been sealing. She left Honolulu on April 26, and cruised among the islands to the westward of this group, returning on August 7 with 240 barrels of seal oil, 1,500 skins, a quantity of shark fins and oil, etc. (pp. 496-497)

Of these early-described voyages, it is difficult to disentangle which cargoes were derived from sealing ventures outside of Hawaiian waters (e.g., Alaska, the Pacific Northwest, and the California coast) and those which were comprised of monk seal populations from Hawaiian waters (Kuykendall, 1929). At least two voyages are believed to have targeted the monk seal in the NWHI, including the *Gambia*, which is believed to have taken 1,500 seals (Cobb, 1902; Atkinson & Bryan, 1914), and a 1893 expedition killing "sixty or seventy" on Laysan Island (H. W. Henshaw as quoted in Bailey, 1952). Additional records from these voyages and other records confirm that exploitation depleted monk seal populations by the mid- to late-1800s (L. McClenachan, pers. comm. to J. N. Kittinger, 31 January 2011; Schultz et al., 2011). For example, residents on Laysan Island engaged in guano mining at the turn of the century only occasionally saw monk seals (Unger, 2003), and sailors from the shipwreck of the Wandering Minstrel marooned in the late 1880s on Midway Atoll saw none in over 14 mo (Bailey, 1952).

Few individuals survived the sealing and whaling era and made it into the 20th century. Using genetic analyses, Schultz et al. (2008, 2010) estimated a minimum population size of 23 seals at the nadir of the population bottleneck and postulated that extremely low genetic diversity in the population may be attributed to long-term harvesting pressure. The monk seal may have survived extinction because the last remaining rookery on Pearl & Hermes Reef in the NWHI remained undiscovered until after petroleum products eclipsed marine mammal oil as the primary product for lubricants and lighting (Atkinson & Bryan, 1914; Blackman, 1941), and because decreases in whale populations in the Pacific led many of the major whaling business interests out of the Hawaiian Islands (Beechert, 1991).

By the early 20th century, monk seal populations were depleted throughout the archipelago, resulting in near extinction of the species due to historical sealing activities in the 19th century. One observer writing at the turn of the century provided evidence of Native Hawaiian harvesting of monk seals in the historic period and this observation suggests rarity at this time and location:

A sick or helpless seal was caught by the natives in Hilo Bay, Hawaii, towed ashore, killed and eaten. Unfortunately I was too late to secure any part of the animal for identification, but the natives assured me that solitary seals occurred on the coast about once in 10 years or so. They were very curious and asked many questions as to the habitat of the animal, its nature, food, and habits, about which they knew nothing. (H. W. Henshaw as quoted in Bailey, 1952, p. 5)

There is very little additional information documenting harvesting of monk seals for direct consumption, but monk seal hunting was also known to have occurred on the island of Ni'ihau in historic times (Robinson, 2011). A review of the historical sources on the monk seal shows that sightings of the species were rare in the MHI through the early 20th century (Balazs & Whittow, 1979). Kenyon & Rice (1959), for example, documented a scant seven sightings in the MHI during the early 20th century (p. 218).

The Sociocultural Significance of Monk Seals in Native Hawaiian Communities

Very little is understood about the historical and contemporary significance of monk seals in Native Hawaiian society. One Hawaiian name for the species, *ilioholoikauaua*, or "the dog that runs in the rough seas," has been found in several historical sources, including Hawaiian-language newspapers that date to the 19th century (Figure 2). Additional information may still be waiting to be discovered in extant Hawaiian literature and cultural knowledge, including in Native Hawaiian-language newspapers, mele (songs), *oli* (chants), *mo* olelo (oral tradition), and other traditional knowledge forms. This information may likely provide valuable insight into the role of monk seals in traditional Native Hawaiian culture. It also may provide historical information about behaviors or distribution of the species prior to the advent of modern scientific methodologies and surveys.

In contemporary Hawaiian communities, ethnographic research among local fishermen and community elders ($k\bar{u}puna$) in the Hawaiian Islands suggests perceived rarity among tenured ocean users (Maly, 2001; Maly & Maly, 2003a, 2003b, 2003c, 2003d, 2004). This is consistent with ongoing oral history research and with perceptions expressed by some community members at public meetings about the monk seal (ERM– West, Inc., 2011).

Our initial archival and oral history research on historical relationships between humans and monk



Figure 2. A Hawaiian-language newspaper, *Nupepa Kuokoa*, dated 19 February 1876, that makes reference to the Hawaiian monk seal; several other Hawaiian-language newspapers also contain references to the monk seal, providing evidence that the species was known to Hawaiians during the 19th century.

seals in Hawai'i has already resulted in several significant discoveries. First, we have discovered unknown terms used by Native Hawaiians in reference to monk seals. Evidence reveals that hulu, commonly known in the contemporary use of the Hawaiian language to mean feather or fur, was a rare term used for the monk seal (Pūkui & Elbert, 1971). Mo'olelo (oral stories) with community elders (kūpuna) and native language speakers have confirmed this use of the term (Office of Hawaiian Affairs, 2010). Kūpuna have indicated the use of the term nā mea hulu (the furry ones) for the monk seal species (Office of Hawaiian Affairs, 2010). The discovery of this new term led to further discovery, including the identification of the term ōhūlu meaning "a seal hunter" (Andrews, 1922). Additionally, as previously mentioned, monk seals were noted in Hawaiian-language newspapers in the 19th century (Figure 2). Though more research is needed, the existence of these terms suggests that monk seals were historically recognized by Native Hawaiians as being a natural part of their surrounding environment.

Further, the discovery of new terms used for the monk seal provides important insight into the etymology of traditional Hawaiian language and word use. Considering the rarity of human interaction in the MHI and the polyrhetoric production of knowledge in Native Hawaiian communities prior to the arrival of European settlers (Nogelmeier, 2010), it is possible that different geographically defined communities would have had different names for the monk seal. This may have contributed to the inconsistencies in oral traditions being expressed by community members regarding the use of specific terms such as *'ilioholoikauaua*. It is likely that certain terms may not have been used in certain geographic locations.

Discussion

For the Hawaiian monk seal, the evidence recovered to date makes it difficult to reconstruct historical changes in monk seal populations and the effects of human colonization and harvest on biogeographic distributions as has been done with monk seals in the Caribbean (McClenachan & Cooper, 2008) and pinnipeds in New Zealand (Smith, 1989, 2005). The lack of quantitative historical evidence makes it difficult to determine with confidence which of several competing hypotheses on the current and historical biogeographic distribution of monk seals is supported. These hypotheses include (1) pre-human rarity of monk seals in the MHI; (2) reduction of monk seals in the MHI by prehistoric Polynesian societies, sequestering the population in the NWHI; or (3) rarity in the MHI in the 20th century due to the effects of human harvesting and other pressures in the historic period (> AD 1778).

The lack of a complete historical reconstruction is impeding modern efforts to recover Hawaiian monk seal populations. As the monk seal population and presence has increased in the MHI, community concerns have emerged about the effect this increased population will have on cultural resources and subsistence activities, including fishing. An emerging premise of these concerns is the belief that the monk seal is not native to the Hawaiian archipelago or at least not native to the MHI (ERM-West, Inc., 2011). Some community members promote and perpetuate such beliefs based on (1) the lack of oral tradition transmitted within families and between generations about the monk seal, (2) a near complete absence of visual sightings of the monk seal by the fishing and ocean user community in modern times, and (3) misinformation about the etymology of known Hawaiian terms for the monk seal, including 'ilioholoikauaua.

Historical research may help to alleviate some of these beliefs and misperceptions. Yet, considering the elusive behavior of the monk seal and the documented historical events that depleted the population during the whaling era in Hawai'i, it is not surprising that the Hawaiian monk seal does not have the same prevalence in traditional resources as other species. Nonetheless, expanding research to include Hawaiian-language resources is an important and essential step to uncover cultural and scientifically valuable historical information.

Research in progress is seeking to further refine the current understanding of the pre-exploitation status of monk seals in the NWHI (L. McClenachan, pers. comm. to J. N. Kittinger, 31 January 2011), and additional research on the genetics of the species is helping to further understanding of historical and contemporary population dynamics (e.g., Kretzmann et al., 1997; Schultz et al., 2008, 2010). More historical research is needed to elucidate past population sizes and biogeographic distributions, which could help inform more appropriate recovery goals for the species.

Research efforts should also continue to explore the historical and contemporary Native Hawaiian cultural relationship with the monk seal. Relevant data sources include, at a minimum, archaeological sites and midden deposits, historical observations and other anecdotal data, ethnographic sources and traditional forms of cultural knowledge, oral history and interview data among knowledgeable community members and key respondents, and modern ecological data. For the Hawaiian monk seal, archival research is needed to further refine existing understanding of past relationships between human societies and monk seals in Hawai'i, particularly in Hawaiian-language sources and other traditional knowledge forms. The Hawaiianlanguage newspapers are an unparalleled resource in the Pacific in terms of the volume of material and richness of description (Nogelmeier, 2010). Preliminary research reveals that the Hawaiian monk seal is referenced in Hawaiian-language newspapers (Figure 2). References to the monk seal in Hawaiian-language sources and in other cultural knowledge forms may help expel myths that the species was either recently introduced to the archipelago or is not biologically endemic.

Another valuable source of cultural information is the collective knowledge of Native Hawaiian cultural practitioners and community elders ($k\bar{u}puna$) who possess extensive knowledge of endemic Hawaiian species, marine and coastal environments, and historic and contemporary cultural practices. Oral traditions are a valuable and rich pool of collective memories that encompass an inherited culture among Native Hawaiian communities (Kikiloi, 2010). Ethnographic and oral history research with $k\bar{u}puna$ may also result in new information and cultural knowledge about the significance of monk seals in Native Hawaiian culture and how it has changed through time.

Historical information about species and ecosystems can also provide valuable information about human interactions with marine environments over longer time scales than are commonly considered in conservation planning. Historically referenced ecological baselines can aid managers by helping to define the place-specific causes of species decline or recovery and thus aid in developing more appropriate recovery plans for species and ecosystems. For example, recovery plans for endangered species are often informed by estimates of pristine population size and biogeographic distribution. Such baselines provide a valuable understanding of past ecological relationships and may aid in determining appropriate and achievable targets for population recovery.

From a social perspective, understanding how humans interacted with key species in the past and in contemporary communities can also help inform modern management and conservation actions. Our research in Hawaiian-language newspapers, for example, reveals knowledge of monk seals in Hawaiian communities in the 19th century (Figure 2). This finding is significant given the rarity of monk seals during this period due to whaling and also because it provides evidence that the species was not unknown to Hawaiian cultures in historic times. Coupling additional information from archival research with oral histories and other cultural knowledge will allow for a more comprehensive understanding of the historical and contemporary significance of the species in Native Hawaiian culture.

Social science research can provide important information for engaging effectively with communities and ocean users in recovery and conservation efforts (Kellert, 1985). As Mascia et al. (2003) suggest, "The disconnect between our biological knowledge and conservation success has led to a growing sense among scientists and practitioners that social factors are often the primary determinants of success or failure" (p. 649). Identifying strategies for more effective community engagement is critically important for the management of highly endangered species like the Hawaiian monk seal. Social data on the values and perceptions of communities toward this endangered species may help managers identify ways to engage with specific stakeholder groups in a productive way (e.g., fishers) or to develop more effective education and outreach materials. Ideally, researchers should target information from a representative cross-section of individuals with different knowledge sets, resource use patterns, perspectives, and expertise.

Conclusion

In conclusion, extensive research has been conducted to understand the ecological dynamics of marine ecosystems, but comparatively little research has focused on the social dimensions of marine environments and endangered species. This is in part due to a failure to recognize humans as intrinsic to marine ecosystems (long recognized in terrestrial systems) (Curran et al., 2002; Shackeroff et al., 2009). In Hawai'i, the management of endangered monk seal populations depends in part on the ability of managers to engage productively with island communities in stewardship and recovery efforts. Social research in these communities can provide critical information on the values and perceptions of local stakeholders, and archival research can help further clarify how humanmonk seal relationships have changed through time. Understanding how societies interacted with these species in the past and in modern times may aid in the development of culturally appropriate conservation programs in contemporary Pacific Island communities and beyond.

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