POLICY PERSPECTIVE

# Managing for extinction? Conflicting conservation objectives in a large marine reserve

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## Abstract

Establishment of the Papahānaumokuākea Marine National Monument (PMNM) in 2006 was heralded as a major advance for marine conservation. The PMNM is one of the largest no-take marine reserves in the world (36,207,439 hectares) and includes all of the Northwestern Hawaiian Islands (NWHI). Despite the protection, within its boundaries one of Hawaii's most charismatic marine species, the endemic Hawaiian monk seal (*Monachus schauinslandi*), is declining towards extinction. In contrast, monk seal abundance is increasing in the largely unprotected Main Hawaiian Islands. High juvenile mortality in the NWHI has been identified as the demographic factor responsible for the population decline. The ecological drivers of the dynamic are unknown. We evaluate an intervention proposed by the Pacific Islands Fisheries Science Center within the PMNM in a situation in which there is little or no precedent of theory to support management decisions, and then examine the conflicting conservation mandates that pose challenges for monk seal conservation. Benefits of intervention include the potential to maintain subpopulations in the NWHI, and therefore preserve the metapopulation structure, and it will provide additional time for management agencies to continue studies to understand factors limiting population growth. If conditions inside the PMNM do not improve, however, juvenile seals will continue to experience poor survival and subpopulations in the NWHI will continue to decline in spite of intervention. The long-term success of any intervention requires the underlying ecological reason for the NWHI population decline, which is currently unclear. The failure of the PMNM to conserve endangered Hawaiian monk seals highlights conflicting goals of different conservation agendas, the need to understand ecosystem function and large-scale ecosystem interactions, and the necessity of adaptive management.

Protected areas are widely embraced as a strategy for conserving marine biodiversity (Gerber *et al*. 2003; Lubchenco *et al*. 2003; Lester *et al*. 2009). In particular, big areas are required for the preservation of large, mobile predators (Soulé & Terborgh 1999) whose trophic interactions strongly influence community structure (Terborgh & Estes 2010). The world's oceans present a dilemma of scale in which large animals move great distances but are typically protected in relatively small areas.

Establishment of the Papahānaumokuākea Marine National Monument (PMNM) in 2006 was heralded as a major advance for marine conservation. The PMNM is one of the largest conservation areas in the world, spanning 105,564 square nautical miles (36,207,439 hectares) and including all of the Northwestern Hawaiian Islands (NWHI). Within the PMNM, most human activities, including all commercial and recreational fisheries, are prohibited. Despite almost total protection, one of Hawaii's most charismatic marine species, the endemic Hawaiian monk seal (*Monachus schauinslandi*), is declining toward extinction within the monument boundaries. In contrast, monk seal abundance is increasing in the largely unprotected Main Hawaiian Islands (MHI). The failure of this large no-take marine reserve to conserve endangered Hawaiian monk seals highlights the incompatibility of different conservation agendas, the need to understand ecosystem interactions, and the importance of adaptive management. Here, we review proposed interventions in a situation in which there is little or no precedent or theory to support management decisions.

The National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), and Pacific Islands Fisheries Science Center (PIFSC) are considering a novel intervention program, in addition to ongoing conservation and management efforts, to recover the endangered Hawaiian monk seal. The proposed intervention involves translocating weaned monk seal pups from areas of low juvenile survival to areas of high juvenile survival within the entire Hawaiian archipelago and the return of these animals to their donor subpopulations several years later, once they are old enough to experience a greater probability of surviving. There is demonstrated success for the first stage, where translocated seals survive at rates comparable to those of seals native to the release site (Jason Baker, NMFS, unpublished data), and weaned pups exhibit high fidelity to release sites. Under current conditions, the present proposal would involve moving animals from the NWHI to the MHI and then back to the NWHI several years later. There is little precedent for the second stage (i.e., moving translocated juveniles back from the MHI to the NWHI).

The Society for Conservation Biology (SCB) was contracted by PIFSC to provide an independent assessment of the scientific justification for the proposed intervention, and specifically the merits of the translocation program. This assessment was conducted by the authors of this article. It is important to note that our review was based on the scientific merit of the proposal given the data, not on other important considerations that may influence success, such as availability of funding resources and potential user-group (e.g., fishers; tourism; etc.) conflicts. Those issues are equally important and are being assessed by PIFSC in a different forum. As a basis for our assessment, NMFS prepared a white paper (PIFSC 2010) summarizing the demography and population biology of Hawaiian monk seals, and describing the proposed translocation program. The proposal to translocate monk seals is based on assessment of population trends among subpopulations and concomitant spatial variation in juvenile body condition and foraging success. The PIFSC aims to mitigate the current population decline in a proactive manner.

The demography of Hawaiian monk seals in the NWHI has been studied in detail for decades and is well described. The species exists as a single metapopulation (Schultz *et al*. 2010) with 85% of the remaining 1,100 animals located in the relatively pristine NWHI. Despite complete protection within the PMNM, monk seals in the NWHI are declining at approximately 4% per year (Baker *et al*. 2011), a decline that is driven by low rates of juvenile survival (Baker & Thompson 2007; Baker 2008; Figure 1). In contrast to the situation in the NWHI, a small subpopulation of monk seals in the densely human-populated MHI is growing at an estimated rate of 7% per year (Baker *et al*. 2011), despite a myriad of anthropogenic impacts, including intense fishing pressure, coastal habitat modification and frequent harassment (Figure 1). Juvenile seals in the MHI exhibit excellent body condition, rapid body growth and much higher rates of survival (Baker *et al*. 2011). Hence, the seemingly counterintuitive difference in population trajectories of monk seals between the NWHI and MHI is likely due to reduced interspecific competition and reduced predation experienced by juvenile seals in the MHI, where other large predators (sharks and jacks) have been depleted through past and ongoing harvest (Baker *et al*. 2011). The proposal to translocate weaned female pups from areas of low juvenile survival in the relatively pristine NWHI to areas of high juvenile survival in the more heavily impacted MHI is a bold management action (PIFSC 2010). The translocation proposal, as well as other monk seal research, monitoring, and enhancement activities, were recently published in the draft programmatic Environmental Impact Statement (NOAA 2011).

For the short-term interests of monk seal conservation, the proposed intervention makes sense. The primary benefit of the plan is its potential to maintain the subpopulation structure of the species in the NWHI, and therefore preserve the integrity and resilience of the metapopulation (Schultz *et al*. 2010). Animals that are eventually returned to their donor population will bolster the number of reproductive females in the NWHI where conditions are currently unfavorable to population growth. However, this intervention will only be successful in the long-term if conditions improve for juvenile seals in the NWHI. If conditions do not improve, the offspring of translocated females will experience poor survival and subpopulations in the NWHI will continue to decline. The long-term success of monk seals requires the

 

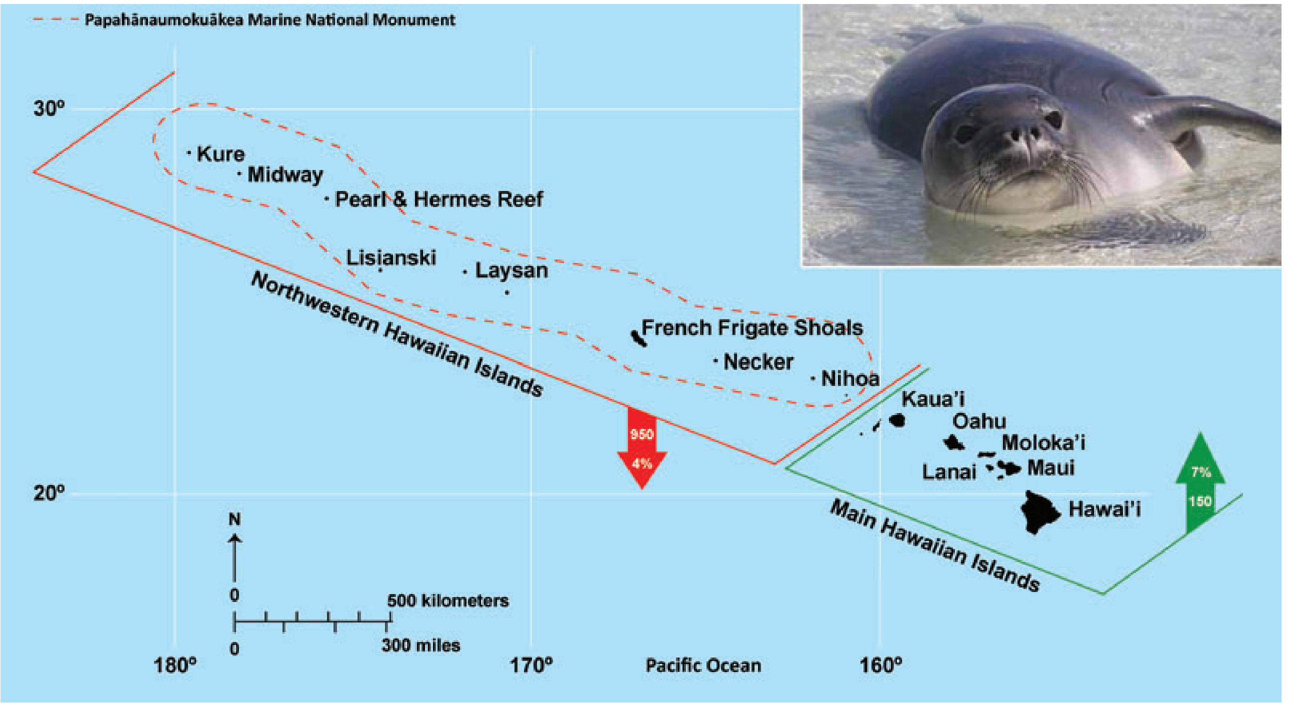


**Figure 1** Range of endangered Hawaiian monk seal, showing the declining subpopulation in the protected northwestern Hawaiian Islands ($N = 950$) and the increasing population in the main Hawaiian island ($N = 150$).

underlying ecological reason for the population decline to change. There is scientific agreement that high juvenile mortality in the NWHI is the demographic factor responsible for the population decline (Baker & Thompson 2007; Baker *et al*. 2007; NMFS 2007; Baker 2008; PIFSC 2010; Baker *et al*. 2011). Although it is evident juveniles in the NWHI are being compromised by interactions with other large predators, the specific mechanism(s) of this phenomenon are unknown as are the factors that have caused this dynamic to change over time. In general, we think it is unreasonable to try to change the long-term trajectory of a species by engineering a solution when the underlying cause of decline is uncertain.

Ideally, management of Hawaiian monk seals should strive to support population growth in the MHI while maintaining viable subpopulations in the NWHI. However, these are two distinct and separate objectives. Thus, we urge PIFSC to consider undertaking this program in two phases, the first of these focusing on building a larger population in the MHI and the second directed toward rebuilding subpopulations in the NWHI. The first phase will require significant effort in protection and monitoring of translocated seals in the MHI. The second phase should only be initiated when the MHI population is of sufficient size and if environmental conditions in the NWHI change sufficiently to enable an increase in juvenile survival. It is unlikely that rebuilding the MHI population will ensure the persistence of monk seals. Thus, the long-term viability of this species will be contingent on a change in environmental conditions in the NWHI.

If a two-stage translocation is undertaken, we recommend that a more limited experimental translocation of older juveniles first be undertaken to assess the likely success of this operation. Available data provide reasonably strong support for the translocation of recently weaned pups from areas of low to high juvenile survival. Translocated pups appear to develop a sense of place after translocation to new habitats (Jason Baker, NMFS, unpublished data). However, there is very little experience with the translocation of older juveniles and reason to believe that these translocation efforts may not work as well as hoped. An unfamiliar new environment, reduced food availability, and a potential naïveté to the increased risk of predation may compromise the success of these animals once translocated back to the NWHI. Such an experiment should consider the relative state of the foraging habitat and predator/competitor density in the donor and recipient populations. For instance, a small number of juveniles might be translocated across islands in the NWHI to determine whether the simple movement of these animals into an unfamiliar environment has any detrimental influence on their behavior and survival. A lack of effect would signal no substantial intrinsic difficulty in the translocation of subadult seals to a new place that is similar to their natal environment. Under this circumstance, the experiment might be expanded to include a preliminary translocation of subadults from the MHI to the NWHI. Further, monitoring environmental conditions will allow a clear assessment of whether the translocation program can work to ensure survival of the species in the long-term. Regardless of the outcome of these preliminary studies, it is important to reiterate that the success of the two-stage translocation as proposed, or arguably any engineered intervention, will require a fundamental change in the NWHI ecosystem. Without such a change, the second stage of the proposed translocation is unlikely to have a significant beneficial effect on monk seal recovery.

When President Bush created the PMNM in 2006, he stated, "Our duty is to use the land and seas wisely, or sometimes not use them at all." The designation of one of the largest no-take marine reserves was intended to protect and preserve the fragile coral reef ecosystems of the NWHI in perpetuity. The PMNM, designated under the Antiquities Act (1906), is likely to achieve this purpose, as long as current protective measures remain in place. It is less certain, however, whether monk seals will continue to function as part of this ecosystem in coming decades. The question remains: Why is one of the world's largest marine protected areas not adequate to promote the conservation of this iconic species? The underlying ecological cause of the current decline of monk seals in the NWHI is unclear and there does not appear to be any *direct* anthropogenic reason, although anthropogenic factors have been important in the past (e.g., historical monk seal hunting and prey depletion through harvest) (Baker *et al*. 2007; Baker & Thompson 2007; Parrish *et al*. 2008; Baker *et al*. 2011). It is possible that populations of competitors and predators (jacks and sharks) were augmented by food supplementation created by discards from past fisheries (e.g., lobster) in the NWHI, thus enhancing their population size to the detriment of monk seals (Parrish *et al*. 2008). Alternatively, large-scale changes in oceanographic processes (e.g., El Niño Southern Oscillation; Pacific Decadal Oscillation) may have modified patterns of productivity and food availability in ways that are unfavorable to juvenile monk seals (Baker & Thompson 2007; Schultz *et al*. 2011). Or it may be that the problem is not a result of altered external drivers to the system, but rather caused by internal processes (e.g., nonlinear dynamics, alternate stable states, and hysteresis (Scheffer *et al*. 2001). Schultz *et al*. (2011) suggested Allee effects (e.g., inbreeding depression) and interspecific interactions (e.g., competition) as possible reasons for lack of monk seal recovery within the PMNM.

Monk seals have persisted for many thousands of years in the NWHI through a variety of ecological conditions and in the face of past direct and indirect removal by humans. Perhaps the marine reserve is too young to have had the desired impact for monk seals. Although it has only been officially protected as a reserve for five years, some argue that the remoteness of the NWHI has ensured its relative *de facto* marine reserve status for decades, if not more. Given available data, large time-scale natural population and/or system fluctuations cannot be ruled out at this time. Elucidating the historical context and dynamics of the monk seal population may refine, or redefine, this problem.

This case study provides several lessons for developing effective policies for conserving the world's oceans. First, we highlight the difficulty of reconciling the conflicting goals of different conservation agendas, namely single-species and ecosystem management. The Endangered Species (1973) and Marine Mammal Protection (1973) Acts mandate the recovery of monk seals, with specific demographic targets laid out in the Recovery Plan for this species (NMFS 2007) under a single-species management paradigm. Some of the actions that have been proposed to assist in the recovery of this species, such as the removal of a small number of sharks that prey on seal pups, and perhaps even the proposed translocation program (PIFSC 2010), might be viewed as either supporting or inconsistent with the ecosystem management goals of the PMNM, depending upon one's understanding of those goals. How should the priorities of monk seal recovery be weighed against the mandates of the PMNM? Such conflicts are common in large-scale conservation efforts; their *a priori* identification will assist in the design of multistrategy management plans (e.g., designation of marine protected areas in combination with fishery management reform (Costello *et al*. 2008; Costello *et al*. 2010; Gaines *et al*. 2010)). For example, within the context of the reserve there may be a mosaic of management activities that allow for prioritization of species such as the monk seal over other species in particular habitats. Such an approach will require (1) long-term time series data to understand ecological interactions over space and time, and (2) an adaptive management framework for understanding the relevance of biological change to inform effective policy change (e.g., Edwards *et al.* 2010).

Second, we note the importance of understanding ecosystem interactions and how they influence function for conservation purposes, even in areas where current human impacts appear negligible. Simply creating a large protected area does not guarantee that all the species in it will be saved from local extinction. The dire status of monk seals in the NWHI underscores the need to understand ecosystem processes and functional linkages even in completely protected areas. The manner in which species interact with each other and with their habitat, and the consequences of these interactions for ecosystem processes, are complex. This case study demonstrates the importance of data collection prior to the establishment of a reserve (e.g., the long-term data set on monk seal demography), the need to understand the complexities of ecosystem function such as oceanographic drivers of productivity and biological interactions, and to monitor how these dynamics interact and change over time.

Finally, we emphasize the need for adaptive management, even in situations in which the direct impacts of most human activities are minimized (Walters & Hilborn 1978; Hilborn *et al*. 1995; Walters 2007; Grantham *et al*. 2010; Keith *et al*. 2011). The PIFSC proposal for monk seal translocation is an example of such adaptive management as it entails a decision framework that accommodates accumulating knowledge and allows for adjustments to management activities as conditions and understanding of the system evolves. Furthermore, the success of the proposed translocation will depend not only on a well thought out plan based on existing data but also on the ability to adjust the details of that plan as new information is obtained in the future. Regardless of the fate of PIFSC's translocation proposal, it is highly likely that some intervention will be required within the PMNM to improve the conservation status of monk seals. In light of the uncertainties associated with our understanding of processes and species roles within this ecosystem, any intervention will require a well-designed monitoring system to provide feedback to managers so that its success or failure can be evaluated and modifications can be made when necessary. For multi-objective reserves, Management Strategy Evaluation (MSE) may offer a useful approach to specifying and prioritizing measurable reserve objectives and management options (Murray *et al*. 1999). Intervention may also be required for the conservation of other less charismatic species in the NWHI and in other no-take marine reserves (Schultz *et al*. 2010). For some conservation problems, the establishment of large protected areas will not be sufficient to prevent local extinction.

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