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# Conservation values in marine ecosystem-based management

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ABSTRACT

Proactive ecosystem-based management represents a turning point in ocean management, because it formally recognizes the need to balance the potentially competing uses of the ocean, including aquaculture, energy production, conservation, fishing, and recreation. A significant challenge in implementing this balancing act arises from explicitly incorporating conservation in a decision-making framework that embraces assessments of trade-offs between benefits from conservation and conventional commercial uses of marine resources. An economic efficiency-based framework for evaluating trade-offs is utilized, and, for illustration, applied to assess the relative benefits and costs of conservation actions for the endangered western stock of the Steller Sea Lion (wSSL) in Alaska, USA. The example highlights many scientific and political challenges of using empirical estimates of the benefits and costs to evaluate conservation actions in the decision process, particularly given the public's large conservation values for the wSSL. The example also highlights the need to engage in stakeholder discussions on how to incorporate conservation into ecosystem-based management, and more specifically, coastal and marine spatial planning (CMSP). Without explicit consideration of these issues, it is unclear whether CMSP will better conserve and utilize ocean resources than the status quo.


## 1. Introduction

The US National Ocean Policy [1] represents a turning point in ocean governance in that the central tenet of the policy is the *proactive* application of ecosystem-based management (EBM) [2]. Advocates for EBM call for a realignment of the scale and scope of governance that is motivated by the current mismatch between jurisdictions and ecosystem processes [3], for the application of formal decision-theoretic tools to assess trade-offs both today and in the future across multiple uses and stakeholders (e.g., benefit-cost analysis, cost-effectiveness analysis, etc.) [4–6], and for the development of a unifying ecosystem objective from which to assess trade-offs [7]. Although EBM has broad and growing support, it is not immediately evident how altering jurisdictional boundaries, considering cumulative impacts, and evaluating trade-offs between energy, fishing, coastal protection, tourism, shipping, conservation, and other uses will affect the management of fisheries—one of the largest stressors on the marine system [8].

The importance of incorporating conservation as an ecosystem service into policy analysis and planning has long been recognized as a critical component of natural resource management (e.g., [9]). This recognition has resulted in decades of research to refine and apply methods to measure conservation values [10]. However, the explicit incorporation of conservation in a proactive decision-making environment is a particularly novel and potentially controversial feature of the new national policy for a number of reasons. First, since the historical record has for the most part been dominated by reactionary responses to thwart an ecological crisis (e.g., endangered species listings, seasonal or spatial closures), there is little precedent for using conservation values in an *ex ante* decision-making context that embraces assessments of trade-offs between potential benefits from conservation versus the conventional commercial uses of natural resources. This difficulty was highlighted in the US Ocean Commission Report ([11], pg. 48):

"One, ongoing challenge for policy makers has been to find the right balance between the exploitation of marine resources, whether living or nonliving, and the conservation of those resources and protection of the marine environment. Petroleum exploration, commercial fishing, and marine mammal protection are just three of the arenas where this drama has played out."

Second, the bioeconomics literature has shown that broadening the objective of fishery management to include non-market benefits (either quantified in economic terms or as constraints on potential harvest strategies) can significantly alter policy prescriptions

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from those that do not consider such benefits (see, e.g., [12] and references therein).

Third, while information on the economic returns from commercial activities is more readily available, there is a paucity of data on the benefits of conserving a wide range of US marine species, including many marine mammals (for some exceptions, see [13] and [14]). Without suitable conservation benefit information, it is difficult or impossible to determine the socially optimal level of protection to provide marine species [15].

In this paper, the endangered western stock of the Steller sea lion (wSSL) (*Eumetopias jubatus*) in Alaska is utilized as an illustrative case study to provide insights into the relative magnitude of potential marine mammal conservation benefits to the economic returns of commercial fisheries and to foreshadow some of the implementation challenges with respect to the US National Ocean Policy. Specifically, the paper illustrates a back-of-the-envelope comparison of the relative magnitude of the economic benefits of conserving the wSSL to the economic costs of restrictions on the fisheries. The specific conservation scenario evaluated is a hypothetical improvement in the wSSL population from its current size of approximately 50,000 (in 2010) to 70,000 in 60 years resulting from restrictions on commercial fishing. Given that the wSSL is protected under the US Endangered Species Act (ESA), this case does not represent a "typical" EBM decision-context since the protective actions required by the ESA remove some trade-offs from consideration by fisheries managers. The concreteness of the stylized example, however, is a useful device for highlighting the potential socio-economic research gaps and the political-economy difficulties in implementing the US National Ocean Policy (and policies similar in other countries).[1]

The appropriate choice of logical analytic framework to use for *ex ante* analysis of EBM-related actions is not immediately evident and is context dependent (see [17] for a discussion of the different economic tools and [18] for a recent example of one approach). Examples of contenders are cost-effectiveness analysis, benefit-cost analysis, and management strategy evaluation. In cost-effectiveness analysis, the decisions on the level of conservation and protection of resources are exogenous to the decision-making apparatus and the goal is to find the lowest cost way of meeting the target level. Another framework is benefit-cost analysis (BCA). BCA is a well-established and widely-used decision theoretic approach grounded in welfare economic theory for analyzing trade-offs and assessing the relative merits of alternative policies or programs (e.g., [19]). Finally, management strategy evaluation (MSE), which is a cousin of BCA that does not attempt to put all the trade-offs in the same units (e.g., dollars), is increasingly being used in the fishery context (see, e.g., [20] and [21]). An important difference between BCA and MSE, however, is that the latter framework is neither grounded in welfare economics nor does it provide a transparent method for choosing one scenario over another.

While the choice of the framework often depends on data availability and the decision-making context, our back-of-the-envelope illustrative example is framed within a BCA analysis. BCA does have an explicit goal to evaluate the economic efficiency, in terms of the net benefits (i.e., benefits minus costs), of alternative policies or actions, and can be used to select the most economically efficient policy or action. An economically efficient policy is one that facilitates the greatest level of human well-being given the available resources, and is thus the one that maximizes net benefits [21]. As applied to EBM, BCA requires accounting for all benefits and costs of management objectives, including conservation benefits. The lessons from the case study for implementation of the National Ocean Policy, however, are not unique to BCA. While interesting and important for implementation, a discussion of the pros and cons of different decision-making tools is beyond the scope of this paper (see, e.g., [22]).

## 2. The case of the Steller Sea Lion

After a precipitous decline in the population of Steller sea lions (SSL) (*Eumetopias jubatus*) from the 1970s, the SSL was listed in 1990 as a threatened stock under the US Endangered Species Act (ESA). In 1997, the SSL population in Alaska was separated into two stocks based on genetic information according to where they fell relative to the 144° W longitude. The stock to the west was designated the western stock (wSSL) and listed as endangered while the stock to the east (eastern stock) remained listed as threatened. The range of the SSL is illustrated in Fig. 1.

In 2000, disagreements between the late Sen. Stevens (R-AK) and President Clinton regarding the SSL and the Alaskan walleye pollock (*Theragra chalcogramma*) fishery almost shut down the US government [23].[2] Sen. Stevens eventually prevailed with the "Stevens rider" to the Omnibus bill for 2001 where the fishermen received $30 million in compensation to offset the expected losses from the fishery closures. Also part of the Stevens–Clinton agreement was the creation of a National Research Council committee to study the collapse of the SSL and an initial allocation of $43 million for Steller sea lion research [24,25]. From 2000 to 2004, the total research expenditures (including State and Federal activities) on the SSL were $122.76 million [24].

Table 1 summarizes the state of the science regarding the changes over time in the understanding of the major factors that contributed to the decline in the SSL populations and that remain a threat to the recovery of the SSL populations. For example, the indirect fisheries effects, including fishing withdrawals of prey populations, such as walleye pollock, Atka mackerel (*Pleurogrammus monopterygius*), Pacific cod (*Gadus macrocephalus*), and yellowfin sole (*Limanda aspera*) are currently listed as a potentially high factor that can thwart the recovery of the SSL.

Some of the current policies developed for wSSL conservation include the complete or partial closure to fishing activities in critical habitat areas (e.g., haulouts and rookeries); the harvest control rule where the pollock, mackerel, or cod fisheries are closed once biomass falls to 20% of its unfished level (see [26]); and the temporal and spatial redistribution of fishing effort in these fisheries. In light of a recent biological opinion on the wSSL [16] that led the US National Marine Fisheries Service to place additional restrictions (including closures) on fishing in the Western Aleutian Islands to protect them, and the consequent federal lawsuits brought by the State of Alaska and industry groups, it is clear that debates surrounding proposed closures in fisheries are ongoing.

### 2.1. Benefits of conservation

Economic benefits (in the form of willingness to pay (WTP)) from conservation of wSSL through fishing restrictions have been measured for particular conservation programs [27,28]. In our case study, economic benefit estimates of conservation outcomes from Lew et al. [28] are adapted for use in the assessment of the

[1] The case study is also relevant for the management of the wSSL [16], but due to uncertainty on the effectiveness of additional protection measures in achieving recovery, policy implications remain open to debate.

[2] Senator Stevens was the head of the Senate Appropriation Committee at the time and stalled passage of the US domestic budget until an agreement on this issue was resolved [20].