Global Ecology and Conservation 5 (2016) 1–11

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Original research article

Evaluating the efficacy of environmental legislation: A case study from the US marine mammal Take Reduction Planning process

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ARTICLE INFO

Article history:
Received 1 September 2015
Received in revised form 21 November 2015
Accepted 21 November 2015
Available online 9 December 2015

Keywords:
Marine mammals
Bycatch
Take Reduction Plans
Take Reduction Teams
Marine Mammal Protection Act
PBR

ABSTRACT

There have been limited efforts to evaluate the efficacy of environmental management programs, in part because environmental legislation often lacks objective, quantifiable criteria to use in such assessments. Here we evaluate the ecological outcomes of an important element of one well-known environmental statute, the US Marine Mammal Protection Act (MMPA), using take reduction planning as a case study. Take reduction planning is mandated by the MMPA as a means to reduce mortality of marine mammals in US fisheries to below statutory thresholds. We used data from formal Stock Assessment Reports to assess and rank the success of five Take Reduction Plans (Harbor Porpoise, Bottlenose Dolphin, Atlantic Large Whale, Pelagic Longline, and Pacific Offshore Cetacean) in mitigating the bycatch of 15 marine mammal stocks. In general, Take Reduction Plans have had an uneven record of meeting their statutory requirements. Successful plans were characterized by straightforward regulations and high rates of compliance. Unsuccessful plans covered marine mammal–fisheries interactions in the northeastern US, had low compliance with complex regulations and sometimes focused on very small stocks. This study emphasizes the importance of requiring legally mandated, quantitative metrics and long-term monitoring programs to evaluate the efficacy of a well-known element of an established environmental management program.

1. Introduction

Government institutions have attempted to address conflicts between the conservation and allocation of natural resources, mitigate activities that harm human and environmental health, and conserve wildlife and ecosystems by enacting and implementing environmental legislation. The US alone has passed 20 major federal environmental statutes (http://www.nrdc.org/reference/laws.asp), and is a signatory or party to 162 international environmental agreements (http://sedac.ciesin.org/entri/country.jsp). It is clear that some of these laws and agreements have been successful in mitigating the effects of harmful activities and helped to conserve natural resources but, for several reasons, there have been few attempts to formally evaluate the efficacy of such environmental initiatives. First, a monitoring program is required prior to establishing any environmental intervention to provide a baseline against which to measure impacts (Brogden, 2003;

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http://dx.doi.org/10.1016/j.gecco.2015.11.009

Koontz and Thomas, 2006; Newig, 2007; Pullin and Knight, 2009). Often such baseline data do not exist, or if they do, are not readily accessible. Second, legislation must clearly define measurable objectives that can be used in future evaluation (Newig, 2007; Dukes, 2005; Weiss, 1972). Third, to account for environmental variability, monitoring must occur over long time scales, which can be expensive (Brogden, 2003; Koontz and Thomas, 2006). Finally, ecosystem complexity and the possibility of multiple, simultaneous interventions make it difficult to attribute a change in environmental conditions to environmental variability or a particular intervention (Brogden, 2003; Koontz and Thomas, 2006; Newig, 2007).

Without a formal evaluation of the efficacy of environmental interventions, however, practitioners may not only waste time and resources (in the case of ineffective measures), but the unintended consequences of such interventions may cause more harm than good (Koontz and Thomas, 2006; Pullin and Knight, 2009; Weiss, 1972). In addition, feedback regarding ecological outcomes of environmental management is the cornerstone of adaptive management. Despite these compelling reasons, ecological evaluation of conservation management remains in the very early stages (Pullin and Knight, 2009).

With regard to conservation, national and international laws and treaties seldom specify objective, measurable criteria against which we may evaluate the efficacy of protective measures. For example the European Union's Habitats Directive, the principle legislation for wildlife conservation throughout the EU (together with the Birds Directive), lists in its Annexes the protective status of species (endangered, vulnerable, rare, or endemic). It does not, however, specify any objective criteria used to classify these species or how a species' classification may be changed once it is listed (Cardoso, 2012). Similarly, the US Endangered Species Act (ESA, 16 U.S.C.1531 *et seq.*) includes five qualitative benchmarks for listing a species as endangered ("in danger of extinction", 16. U.S.C. 1532(6)) or threatened ("likely to become endangered", 16. U.S.C. 1532(20)), but does not stipulate any quantitative measures (*e.g.,* probability of extinction in a certain number of years) to assign listing status. Although the ESA requires recovery plans to incorporate "objective, measurable criteria" for removal from the list or a change in classification (16 U.S.C. 1533(f)(1)(B)(ii)), many species lack recovery plans or the specificity of the criteria for down-listing or de-listing vary considerably within and among species (Gregory et al., 2013; Gerber, 1998; Gerber and DeMaster, 1999; Gerber and Hatch, 2002). Thus it is difficult to evaluate the effectiveness of these recovery plans, or the conservation actions contained within them.

In contrast, the International Union for the Conservation of Nature (IUCN) employs specific, quantitative criteria to evaluate the status of species on its Red List. The Canadian Species at Risk Act and the Australian Environment Protection and Biodiversity Conservation Act 1999 draw on these same, measurable criteria (Mooers et al., 2007; TSSC, 0000; COSEWIC, 0000). Unfortunately, some of the criteria are not easily applicable to some taxa. For example, it is especially difficult to measure habitat fragmentation, the extent of occurrence, and areas of occupancy of long-lived marine animals that travel over great distances (Gerber, 1998; Gerber and DeMaster, 1999; Gerber et al., 2000).

1.1. Case study

An important section of the US Marine Mammal Protection Act of 1972 (MMPA, 16 U.S.C. 1361 *et seq.*) provides a unique opportunity to evaluate its efficacy. It contains quantifiable metrics that aim to reduce the incidental mortality of marine mammals in fisheries, a process known as bycatch. Marine mammal populations are vulnerable to bycatch mortality because of their life history characteristics and demography (Lewison et al., 2004; Read, 2008; Read et al., 2006; Soykan et al., 2008). These species exhibit long lifespans, late ages of maturity, low fecundity, and high survival rates (Heppell et al., 2000, 2005) and, consequently, are vulnerable to even moderate rates of mortality (Lewison et al., 2004; Heppell et al., 2000, 2005). High bycatch rates can cause marine mammal populations to decline over very short timeframes (Lewison et al., 2004; Taylor et al., 2000; Wade, 1998).

For small populations of marine mammals, bycatch can be particularly pernicious (Lewison et al., 2004; Read, 2008). Under these circumstances, even rare bycatch events can adversely affect population viability, especially if the mortality includes reproductively active females (Read and Wade, 2000). In a large fishery that interacts with a small population of marine mammals, each fishing vessel's contact with individual animals will be extremely rare, so protective measures can be both expensive and politically unpopular (Read, 2008).

Here we present a case study in which we evaluate the ecological outcomes of a process implemented to reduce marine mammal bycatch in US waters through the development of Take Reduction Plans. Geijer and Read (2013) described an overall decline in marine mammal bycatch in the US since the implementation of these plans, suggesting that they have been generally successful in reducing the scale of bycatch in the US. This evaluation builds on the analysis of Geijer and Read (2013) by comparing ecological outcomes following the implementation of these plans to the criteria mandated under the MMPA. We create a simple, objective method to evaluate the ecological efficacy of several plans by comparing their outcomes to the mandates contained in the statute. By examining the history and attributes of each plan, we also propose a suite of factors that may contribute to their ecological outcomes.

2. Methods

2.1. Theory—case study background

In the US the National Marine Fisheries Service (Service) is charged with protecting cetaceans and most species of pinnipeds by implementing the MMPA. A unique feature of the MMPA is a formula for estimating the maximum allowable