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Are we missing the boat? Current uses of long-term biological monitoring data in the evaluation and management of marine protected areas

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ABSTRACT

Protected area management agencies are increasingly using management effectiveness evaluation (MEE) to better understand, learn from and improve conservation efforts around the globe. Outcome assessment is the final stage of MEE, where conservation outcomes are measured to determine whether management objectives are being achieved. When quantitative monitoring data are available, best-practice examples of outcome assessments demonstrate that data should be assessed against quantitative condition categories. Such assessments enable more transparent and repeatable integration of monitoring data into MEE, which can promote evidence-based management and improve public accountability and reporting. We interviewed key informants from marine protected area (MPA) management agencies to investigate how scientific data sources, especially long-term biological monitoring data, are currently informing conservation management. Our study revealed that even when long-term monitoring results are available, management agencies are not using them for quantitative condition assessment in MEE. Instead, many agencies conduct qualitative condition assessments, where monitoring results are interpreted using expert judgment only. Whilst we found substantial evidence for the use of long-term monitoring data in the evidence-based management of MPAs, MEE is rarely the sole mechanism that facilitates the knowledge transfer of scientific evidence to management action. This suggests that the first goal of MEE (to enable environmental accountability and reporting) is being achieved, but the second and arguably more important goal of facilitating evidence-based management is not. Given that many MEE approaches are in their infancy, recommendations are made to assist management agencies realize the full potential of long-term quantitative monitoring data for protected area evaluation and evidence-based management.

1. Introduction

Management effectiveness evaluation (MEE) has gained global recognition as an important framework to promote the continual improvement of conservation efforts in protected areas (Coad et al., 2013; Leverington et al., 2010). MEE involves an assessment of the complete management process: beginning with clearly defining the management context, through to measuring conservation outcomes to determine whether management objectives are being achieved (Fig. 1; Hockings et al., 2006). In response to the growing societal demand for environmental accountability, there is a focus on publicly reporting MEE results to demonstrate the value for money of conservation efforts (Ferraro and Pattanayak, 2006). But ultimately MEE is designed to facilitate evidence-based management to ensure the best conservation outcomes for protected areas (Hockings et al., 2006; Leverington et al., 2010).

MEE should draw on the best available evidence, using both qualitative and quantitative data to support assessments (Cook and Hockings, 2011; Hockings et al., 2009). Whilst qualitative data are most appropriate for some aspects of management (e.g., measuring stakeholder engagement), other aspects (e.g., measuring ecological condition) should ideally be based on quantitative data sourced from monitoring or research (Hockings et al., 2009). However, a lack of quantitative data often necessitates reliance on qualitative information, such as expert judgment, in MEE (Cook et al., 2010; Hockings et al., 2009).

Outcome assessment is the final stage of MEE, where the condition of important attributes is assessed to determine whether management objectives have been achieved or if management

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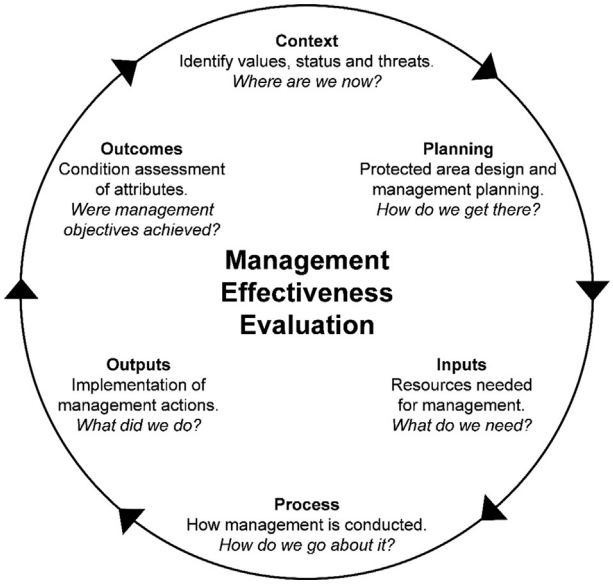

Fig. 1. The management effectiveness evaluation cycle, designed to enable assessment of the complete management process and facilitate evidence-based management. Adapted from Hockings et al. (2006).

should be adapted (Fig. 1; Hockings et al., 2006). This requires an assessment of the condition of indicators, such as the abundance of a threatened species. When monitoring data are available, these should be assessed against condition categories that have been defined numerically (Hockings et al., 2006; hereafter "quantitative condition assessments"). Quantitative condition categories are commonly based on an acceptable range of natural variation of an indicator (e.g., Hockings et al., 2008; Parks Canada, 2011; Parrish et al., 2003). For example, the United States National Parks Service uses historic long-term monitoring data to define quantitative condition categories for average forest patch size to reflect landscape fragmentation due to anthropogenic stressors, as: Good (>50 ha); Caution (10–50 ha); and, Significant Concern (<10 ha) (Tierney et al., 2009). Quantitative condition assessments can enable more transparent and repeatable integration of monitoring data into MEE, and when condition categories represent thresholds that trigger management action promotes evidence-based management (Lindenmayer et al., 2013). In addition, condition rating scales can help simplify complex information about natural systems for public reporting (Hockings et al., 2006).

In cases where monitoring data are lacking, managers default to using expert judgment to assess condition using qualitative statements of outcomes (hereafter "qualitative condition assessments"; Cook et al., 2010; Hockings et al., 2009). Qualitative assessments typically use a simple rating scale, but instead of having a numerical basis condition categories are defined using broad statements such as "*Good—Populations of a number of significant species…have declined significantly…*" (State of the Environment Committee, 2011). These qualitative condition categories can be subject to differences in interpretation by experts, thus can seriously compromise the accuracy and repeatability of condition assessments (Burgman et al., 2011; Cook et al., 2014).

Long-term quantitative monitoring can yield data that are ideal for quantitative condition assessments of environmental indicators in MEE (Hockings et al., 2006; Tierney et al., 2009). Such data can reveal both the current condition and the temporal dynamics of indicators (Magurran et al., 2010; Sergeant et al., 2012). These two vital aspects assist managers in interpreting environmental condition, to determine when a system is moving beyond the desirable bounds of natural variability, and decide when to adapt their management approach (Nichols and Williams, 2006). Whilst rigorous long-term monitoring programs potentially enhance protected area management, monitoring data can be of limited use when programs are not targeted to address management needs (Field et al., 2007; Lindenmayer and Likens, 2010; Nichols and Williams, 2006). Commonly cited reasons for the lack of targeted monitoring include that monitoring programs are led by scientist who are independent of management agencies (Legg and Nagy, 2006; Lindenmayer et al., 2012), and management and monitoring objectives are often not adequately aligned (Kemp et al., 2012; Lindenmayer and Likens, 2010). The cost and expertise required to establish and maintain long-term monitoring programs can be major impediments for management agencies (Lindenmayer and Likens, 2010; Lindenmayer et al., 2012). The reality is that well designed long-term monitoring programs are a rare but valuable resource for MEE and evidence-based management.

Evidence-based management involves the use of the best available evidence to inform a management decision and can take a variety of forms. The most highly structured approach to evidence-based management is adaptive management, which involves an extensive decision-making process to develop, trial and select among multiple potentially effective management options (Nichols and Williams, 2006; Westgate et al., 2013). The MEE process also facilitates evidence-based management, and in contrast to adaptive management, is being increasingly used by protected area management agencies to ensure the best available evidence informs management decisions (Coad et al., 2013; Hockings et al., 2004; Leverington et al., 2010). However, the implementation of MEE is still evolving, with managers citing difficulties associated with data availability and "closing the loop" to ensure evidence-based management (Jacobson et al., 2008, 2014; Parr et al., 2009). Given the existing challenges in implementing MEE, we focus on investigating cases where best-practice MEE could be achieved: where long-term quantitative monitoring data are available to inform evaluations. We specifically focus how these data are being used to inform: i) outcome assessments for MEE of protected areas; and, ii) evidence-based management.

2. Methodology

To understand the current use of long-term biological monitoring data in protected area management we interviewed protected area managers and scientists in Australia with access to long-term monitoring programs. We targeted monitoring programs within similar ecosystems that occur in protected areas under similar management contexts. We focussed on long-term monitoring programs from Australian marine protected areas (MPAs), as they are some of the world's longest running monitoring programs, significantly contributing to the scientific understanding of the long-term effects of MPA protection (e.g., Babcock et al., 2010; Barrett et al., 2009; De'ath et al., 2012). Australia's MPAs are established for biodiversity conservation and many were gazetted more than ten years ago (State of the Environment Committee, 2011). These MPAs fall under either state or federal jurisdiction and all management agencies aspire to regularly monitor, evaluate and report on management effectiveness of MPAs (ANZECC, 1999). Like other parts of the world, long-term monitoring programs in Australian MPAs predominantly assess the effect of protection on subtidal coral and rocky reef communities (Babcock et al., 2010; Kemp et al., 2012; Lester et al., 2009).

2.1. The long-term monitoring programs

To identify long-term monitoring programs capable of informing MEE, we used the following criteria: i) monitoring is conducted