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How practitioners integrate decision triggers with existing metrics in conservation monitoring

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ABSTRACT

Decision triggers are defined thresholds in the status of monitored variables that indicate when to undertake management, and avoid undesirable ecosystem change. Decision triggers are frequently recommended to conservation practitioners as a tool to facilitate evidence-based management practices, but there has been limited attention paid to how practitioners are integrating decision triggers into existing monitoring programs. We sought to understand whether conservation practitioners' use of decision triggers was influenced by the type of variables in their monitoring programs. We investigated this question using a practitioner-focused workshop involving a structured discussion and review of eight monitoring programs. Among our case studies, direct measures of biodiversity (e.g. native species) were more commonly monitored, but less likely to be linked to decision triggers (10% with triggers) than measures being used as surrogates (54% with triggers) for program objectives. This was because decision triggers were associated with management of threatening processes, which were often monitored as a surrogate for a biodiversity asset of interest. By contrast, direct measures of biodiversity were more commonly associated with informal decision processes that led to activities such as management reviews or external consultation. Workshop participants were in favor of including more formalized decision triggers in their programs, but were limited by incomplete ecological knowledge, lack of appropriately skilled staff, funding constraints, and/or uncertainty regarding intervention effectiveness. We recommend that practitioners consider including decision triggers for discussion activities (such as external consultation) in their programs as more than just early warning points for future interventions, particularly for direct measures. Decision triggers for discussions should be recognized as a critical feature of monitoring programs where information and operational limitations inhibit the use of decision triggers for interventions.

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Table 1
Definitions and categories of measures, goals and decision triggers practitioners used to conceptualise their monitoring programs.

Term and categories	Definition
Measure	An attribute of an ecosystem (biotic or abiotic factor) that is monitored to provide information. *Similar terms used in other studies*: variable, metric, indicator
Direct measure	An ecosystem attribute measured to make inferences about that aspect of the ecosystem (see Lindenmayer and Likens, 2011).
Surrogate	An ecosystem attribute measured and used to make inferences about another, different aspect of the ecosystem (the attribute of interest or target attribute) (see Lindenmayer et al., 2015; Hunter et al., 2016). *Similar terms used in other studies*: proxy, indicator
Goal	A desired outcome of undertaking a monitoring and management program. *Similar terms used in other studies*: targets, objectives
Decision trigger[a]	A point or zone in the status of a measure indicating when management action is required to maintain a desired ecosystem state or address undesirable ecosystem change (see Addison et al., 2016; Cook et al., 2016). Decision trigger is formalized within a program (i.e. stated in program documents and consistently applied), with quantitative thresholds, and pre-determined responses. *Similar term used in other studies*: decision threshold
Potential trigger	A decision trigger that has not been fully realised. The point or zone in the status of a measure indicating when management action is required to maintain a desired ecosystem state or address undesirable ecosystem change is not explicitly identified (see Addison et al., 2016; Cook et al., 2016). Decision trigger has been used in the recent history of the program but is not formalized (i.e. not recorded and consistently applied). May have less defined quantitative thresholds, and/or rely upon the expert knowledge, experience and actions of individuals.
Activity	The management action or activity that is undertaken in response to the point or zone in the status of a measure being reached.
Intervention	Activity triggered is an on-ground management intervention (e.g. invasive species control, vegetation restoration) that is activated in response to a pre-defined point in a measure being reached.
Discussion	Activity triggered is anything other than on-ground management intervention, typically a pre-defined meeting, evaluation, consultation or review activity with internal staff or external stakeholders (e.g. review of management action, review of monitoring, planning, policy evaluation, reporting, engaging with researchers).

[a] Practitioners classified each decision trigger and each potential trigger as either an 'intervention' or 'discussion' meaning four specific types of triggers are considered in our study; Intervention Decision Trigger, Discussion Decision Trigger, Intervention Potential Trigger, and Discussion Potential Trigger.

1. Introduction

Conservation monitoring programs are needed to assess trends in biodiversity, evaluate management effectiveness, and detect ecosystem changes (Lindenmayer et al., 2013; Nichols and Williams, 2006). These programs play a critical role in informing decisions about when to intervene to conserve the things we value (Nichols and Williams, 2006; Westgate et al., 2013). However, programs often do not clearly articulate how monitoring information will prompt management actions, an oversight that can contribute to further biodiversity loss (Lindenmayer et al., 2013; Woinarski et al., 2017). Recently, significant focus has been placed on integrating decision triggers (see Table 1) into monitoring programs to facilitate evidence-based management (Addison et al., 2016; Cook et al., 2016; de Bie et al., 2018). Decision triggers represent a point, zone or threshold in the status of a measure that indicates when management is required to maintain or reinstate a desired ecosystem state (see Addison et al., 2016; Cook et al., 2016). Similar to other threshold and reference point concepts in evidence-based management, there are many technical and non-technical approaches for identifying decision triggers (e.g. Martin et al., 2009; Morrison, 2008).

The benefits of adopting decision triggers for facilitating timely management actions are widely recognized (Addison et al., 2016; Cook et al., 2016; Nichols and Williams, 2006), and methodologies for fitting decision triggers into existing management frameworks have been detailed (de Bie et al., 2018). Although practitioners view decision triggers as a valuable management tool (Cook et al., 2016), there can be substantial financial, political, and scientific barriers to implementation (Addison et al., 2016; de Bie et al., 2018). This means practitioners will adapt new tools to fit with existing programs, rather than substantially modify programs to fit with new management tools (Lindenmayer et al., 2011). While others have discussed approaches for developing indicators for decision triggers (see Addison et al., 2016; Cook et al., 2016; de Bie et al., 2018), there has been little exploration of how practitioners integrate decision triggers into the structure of existing monitoring programs where the variables being monitored are already established. Addressing this knowledge gap is necessary to enable researchers to better support practitioners to incorporate decision triggers into monitoring programs, potentially leading to important benefits for biodiversity conservation.

A key aspect of monitoring programs that could influence the application of decision triggers is the types of variables that are measured and how these are used to indicate progress towards, or away from, program goals (Duelli and Obrist, 2003; Siddig et al., 2016). Indicators are evaluated based on how accurately they represent a goal (Driscoll et al., 2018), and can either be a direct measure, or a surrogate that is used to make inferences about the goal (see Table 1) (Lindenmayer and Likens, 2011). Monitoring programs may use a combination of surrogates and direct measures as indicators of their program goals. For example, vegetation structural features might be measured as a surrogate for the presence of a threatened species known to rely on those features, and/or used as a direct measure to inform a management objective related to vegetation restoration (Lindenmayer et al., 2014; Pierson et al., 2015). Existing work suggests that both surrogate measures and the indicators that underpin decision triggers must be representative of the attribute of interest, responsive, and cost-effective to monitor (Addison et al., 2016; Lindenmayer et al., 2015). Surrogate measures may therefore be more easily adapted to use with decision triggers than direct measures. However, uncertainty in the relationship between surrogates and the target could also discourage practitioners from using surrogates to inform management interventions (O'Loughlin et al., 2018).

The aim of this study was to understand how practitioners integrate decision triggers into existing monitoring programs, and whether the application of decision triggers was associated with the types of variables being monitored. We held a workshop between conservation practitioners and researchers from Australia and New Zealand that addressed three questions: (1) To what extent do practitioners use decision triggers in their monitoring programs? (2) What kinds of measures and goals are commonly associated with decision triggers? and (3) What factors have limited the successful implementation of decision triggers, both for surrogates and for directly measured variables? We synthesise the outcomes of our workshop and highlight the difficulties often associated with integrating decision triggers for on-ground interventions into existing monitoring programs. We discuss how formally setting threshold points for discussion activities (e.g. review of