Obstacles to gathering conservation evidence from the monitoring of nature reserves: a spatial solution?

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Abstract

This paper identifies a range of obstacles to gathering evidence from the monitoring of nature reserves that can subsequently be used to evaluate and guide future management. The key obstacles are: (1) monitoring is difficult to fund, (2) many conservation NGOs do not have a tradition of being science-led organisations, (3) dominance of descriptive and rapid assessment approaches to reserve monitoring, (4) lack of analytical capacity, and (5) linking data to outputs and outcomes. A spatial grid-mapping solution is proposed and described in a case study of heathland restoration.

Introduction

In the UK, Wildlife Trusts are typical of NGOs that undertake land management at a variety of reserves and statutory protected sites. Limited organisational resources and the sense of urgency associated with protecting species and habitats, has led to a focus on the immediate need for management action. However, this can lead to less emphasis on the site-site appropriateness of actions and how the effectiveness of actions can be measured and evaluated. Some Wildlife Trusts are trying to redress this by committing to becoming 'evidence-based' (Sutherland *et al*., 2004). Evidence-based approaches attempt to increase conservation efficiency and ensure that nature reserve management is achieving its stated conservation goals. This paper identifies five commonly encountered obstacles to generating evidence of the effects of management actions and provides a case-study of a possible spatial solution.

Obstacle 1: monitoring is difficult to fund

Detecting and measuring ecological change at spatial scales appropriate to provide evidence for developing and evaluating conservation action, generally takes longer than the funding cycles typical of many project-based initiatives. Furthermore, monitoring is often not within the scope of funders that support ecological research, and NGOs rarely qualify for such funding without a major academic partner (Lindenmayer & Likens, 2010). Monitoring

therefore often needs to be funded through internal financial mechanisms or as part of larger voluntary 'schemes'.

Obstacle 2: many UK conservation NGOs do not have a tradition of being science-led organisations

Although often informed to some degree by research outputs, delivering a truly evidence-led conservation approach would be a cultural step-change for many NGOs in the UK (Sands 2013). Much reserve management has been based on the assumption that 'traditional' management methods (e.g. hay cutting, coppicing, grazing, *etc*) that influence the physical structure and composition of vegetation will succeed in conserving key species (Ausden, 2007; Hurford & Schneider, 2007). These approaches have continued during periods of considerable landscape and environmental change e.g. reduction in protected area extent and isolation, agricultural practices, climate change, *etc* (Hambler & Speight, 1995; Thomas *et al.* 2006). Further research is required to demonstrate the relative efficacy of management practices and their relationship with altered environments.

Obstacle 3: dominance of descriptive and rapid assessment approaches to reserve monitoring

In the UK, the government's responsible agencies must regularly report on the status (condition) of sites with statutory designation (JNCC Common Standards Monitoring). For *Sites of Special Scientific Interest* (SSSIs) in the UK, this involves the audit of over 4000 sites. Unsurprisingly, this has led to the development of pragmatic, optimised and rapid assessment methods. In the case of SSSIs, this involves a structured 'walkover' survey with pseudo-random survey points called *Condition Assessment* (CA). CA scores SSSI sites against set of habitat specific criteria and relies substantially on the taxonomic skills of an experienced surveyor. The habitat specific criteria might be, for example, the presence of a threshold number of key vascular plants in the sward, the apparent ratio of these herbs to grasses, or the amount of standing deadwood. Site condition is then scored as favourable, unfavourable-recovering, unfavourable-no change, or unfavourable-declining. A range of other descriptive habitat assessment methodologies are also in widespread use e.g. National Vegetation Classification (Rodwell 2006) and Phase 1 habitat mapping (JNCC 2010). These broad-brush methods allow national level auditing of designated sites and landscapes, but consequently have little practical use to a reserve managers. In other words, the data they produce might be able to indicate some degree of general change in the condition of a site (e.g. the estimated ratio of grasses to wild flowers), but they are too descriptive to provide information upon which site management can be developed and evaluated (Nichols &

Williams 2006). Site managers need spatial information about changes i.e. *where* have changes occurred on the reserve, over what area, and can they be linked to either management or an external environmental factor such as climate.

Obstacle 4: lack of analytical capacity

In the drive for establishing biodiversity monitoring at sites, the development of in-house or collaborative capacity for subsequent data analysis and presentation can be an overlooked element of the wider monitoring process (Spellerberg, 1991; Schmeller *et al.*, 2008). And whilst analytical skills can be taught at undergraduate level or through continuing professional development, much of this training will focus on specific skills (e.g. use of software, field collection techniques, *etc*) rather than the knowledge and experience required for the *application* of those skills to overcoming real-world problems. There is also the issue of skill maintenance where acquired skills are lost or become outdated due to infrequent use.

Obstacle 5: linking data to outputs and outcomes

Conservation ecologists are often unfamiliar with thinking about how monitoring and analytical outputs can be made accessible and useful for the non-specialist practitioners i.e. the site managers who are tasked with actually interpreting and delivering conservation actions based on monitoring results. A part of this issue stems from the preceding four problems and from monitoring drives where the specific question to be addressed by the monitoring process has not been sufficiently articulated (Legg & Nagy, 2006; Nichols & Williams, 2006; Lindenmayer & Likens, 2010).

Methods: overcoming the obstacles

The authors have been developing a 'grid-mapping' technique that allows changes in the distribution of habitats and species to be monitored, evaluated and visualised. This is achieved by overlaying grids of different dimensions (scale-relevant to taxonomic groups being studied), and then undertaking fieldwork to assess/score the features of interest in each grid square. The quantitative data can be rapidly processed using available GIS software (e.g. QGIS. Quantum GIS Development Team, 2017), to produce intuitively understandable and jargon free maps. These are easily produced (minimal associated skill set) and can be updated by trained volunteers. Most importantly, the monitoring maps can be assimilated by time-pressured staff and a wide non-specialist audience.

Results: a case study

An example of this spatial grid-mapping approach (from baseline through to post management monitoring) is shown in Figure 1. It illustrates detected change after three years of heathland restoration. An expansion in Ericaceous shrubs (heathers) was predicted as a result of management by cattle grazing accompanied by Bracken *Pteridium aquilinum* control in management zones. A 42% increase in the number of squares occupied by heather species (mostly rapid colonisation by Cross-leaved Heath *Erica tetralix* and a lesser expansion in Common Heather *Calluna vulgaris*) was detected. The site managers were able to use this evidence to evaluate how management actions had met their targets. Taken in combination with maps of other key species (including negative indicators such as Bracken), the maps can be used to plan and budget for future actions in an iterative process of management, review and re-survey.

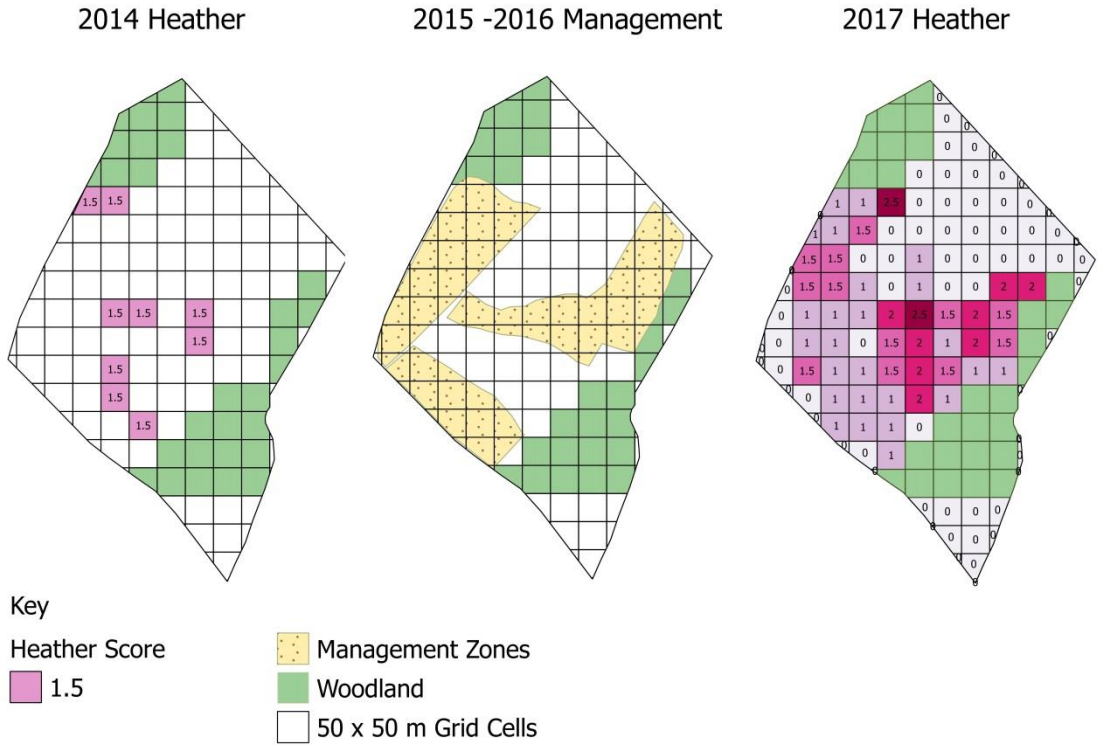

Figure 1. Monitoring heathland restoration at Poor's Allotment, Tidenham Gloucestershire. Three year repeat survey showing an increase in heather distribution against baseline after management. An increase of 38 50x50 m heather grid squares, from 10% to 52% of heathland habitat squares. Heather density/abundance scores: 0 absent, 1 rare, 2 common/ patchy, 3 dominant, 1.5 and 2.5 intermediate classes denoting local increased density/abundance within a square.

Grid-square mapping can be implemented at multiple scales to suit the attribute(s) in question. After the initial start-up costs of training and developing the bespoke elements of GIS needed, the process of survey to initial map for internal review takes on average three person-days (depending on site area). With additional interpretation, selected maps have

been published for education and outreach. Management review based solely on proportional change of indicators in quadrats can also be achieved without mapping the results, provided the area of focus is sampled to produce a 'regular' pattern of sample points. This is often more suitable for small sites (Debbie Lewis, personal communication).

Discussion

Monitoring management outcomes in relation to pre-agreed aims and targets should be regarded as a core activity of NGOs responsible for important wildlife sites. Our case study suggests that after an initial investment to develop and refine a simple, consistent methodology for detecting ecological change, the process of gathering quantitative conservation evidence on the condition of nature reserves is relatively inexpensive and time efficient. More published case studies (accessible to a practitioner audience) could change the current funding culture and address the key issues often posed by senior managers and budget holders in NGOs: auditable ecological evidence has not been produced, the value has not been seen, and therefore monitoring is not worth funding. Grid-mapping shows that project-specific, contextual evidence of conservation gains can be achieved and is cost efficient. Importantly, publishing and publicising results and evaluations will help monitoring to become a project *expectation* of funding agencies and stakeholders.

Most UK NGOs pre-date conservation as an evidence-based activity and have their origins in a time when only 'expert opinion' was available to decision makers. Many people across the conservation sector now have a science background (graduate and post-graduate ecological qualifications), and this has led a drive towards a more applied science approach. But evidence-based applications need to be evaluated, and for a cultural step-change to occur in the conservation sector, meaningful science must be shown to be deliverable within the organisational frameworks. Importantly, grid-mapping has been developed by NGO staff, specifically to address an NGO needs. But NGOs will also need to address associated capacity needs and outreach to the wider research community.

Confidence in data analysis is probably the biggest single obstacle to the individual practitioner ecologist in an NGO. Most NGOs cannot afford a dedicated data officer so it falls to ecologists employed for field skills to develop secondary skills in data analysis. Often working in isolation, with no peer support, time-pressured, multi-tasking practitioners are unable to see the application or transfer new analytical skills into their routine procedures and are invariably thrown back on descriptive techniques simply to complete their allotted tasks on time and within budget. Although the GIS element to establish grid maps takes a level of training and practice, proportional changes in the attribute scores for grid-squares is

a simple calculation that can be performed by hand. The spatial data are available for more advanced analysis at a later date as skills develop.

The heathland restoration study described in this paper specifically links management output (grazing and Bracken control) to the outcome (increased ericaceous shrubs). The resulting map met an organisational need for practical information and serves as an audit of conservation progress that can be shared with a diverse audience.

Lastly, Communication between land managers and ecologists is essential if management outputs are to be linked to biodiversity outcomes. Using ecological expertise to predict the outcomes of management (e.g. the length of time to restore a heathland) would be greatly aided if comparable studies were available across a range of sites. To this end it is to be hoped that publishing grid-maps of proportional species and habitat change becomes widely adopted.

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