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Evidence-based vegetation management: prospects and challenges

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Abstract

The effect of applied vegetation science on society has the potential to increase by adopting an evidence-based approach. However, this would require a shift in focus towards effect size and results suitable for meta-analyses, a focus on practitioners as potential readers, more emphasis on practical problems rather than mechanism, and an acceptance of all well-executed experimental studies, even if confirmatory. Thus, the prevailing editorial policies need to be reconsidered, as well as the methods of analysing, reporting and evaluating research, for our research efforts to be of better use within society.

Background

Some of us work in applied research, but what does “applied” actually mean? I prefer to think of “applied research” as being of more direct interest to society and that there are – beyond fellow researchers – two potential groups targeted by such research (Cook et al. 2013)¹. The first group is *policy makers*, a group that consists of people who prepare and make new laws, as well as government or company officials who set up rules for activities in society or within their organisation. The second group is *managers*, which consists of people who make operational decisions and their advisors (e.g., medical doctors, teachers, foresters, farmers, extension officers). It is our hope that the managers within our field regularly read *Applied Vegetation Science* and similar journals.

However, the process of knowledge transfer from applied research to practice is often disappointing (e.g. Nutley et al. 2007, Braun & Hadwiger 2011, Rojek et al. 2012, Dagenais et al. 2012). Poor or slow knowledge transfer indicates missed opportunities and a waste of resources, both in science and society. But there are ways in which we researcher, the “donors” of knowledge, can facilitate this process.

In our field, managers who are potentially interested in our work are often highly educated. However, do we have them in mind when we write our papers? Or is it that

¹ Research also has an educational role towards the general public, but this role is a joint role of both applied and basic research.

our focus has gradually shifted from the potential end-user of our findings to a concentration on the continuously tightening requirements by the scientific community to pass the editorial and review processes?

A reform in the way we think about, analyse and present our applied research is welcome, and it would affect authors, referees and editorial policies. With such a reform, our research might have a greater impact in society, and this is what applied research should strive to achieve.

An example of the failure to communicate

I recently experienced how my own research and that of others was ignored (or not known) by policy makers and practitioners, a notion that I believe not to be uncommon among applied researchers (Cook et al. 2013). Moreover, I realised that the fault was not entirely theirs: nice ordination analyses do not communicate well with busy managers. Furthermore, the results that I had published did not provide any estimate of effect size, which is often the main focus of a manager. Or put another way, a significant p-value is of much less interest than a number showing how much two treatments differ (di Stefano et al. 2005, Cumming 2012). It is only with an effect size that a manager can properly weigh the costs against benefits. I should have considered practitioners when publishing, but seem to have forgotten that anyone outside academia might be interested. As a minimum, I could have formulated clear and explicit recommendations for practitioners (Memmott et al. 2010, Simonetti 2011). So, I have no reason to blame the policy makers and practitioners that failed to find my study in the vast ocean of published research.

Learning from reforms in other fields of applied research

Other fields of applied research have embraced evidence-based management (Hansen & Rieper 2009). In short, management (or policy) should be based on the best available knowledge. This might appear as a rather trivial statement, but new findings often take considerable time before translating into action, thereby wasting the resources society has invested in research. For example, Gilbert et al. (2005) estimated that if a recommendation (sleeping position of infants) had been changed when the evidence was available, rather than after 25 years, 10,000 lives could have been saved in the UK alone. In another example, a systematic review showed that costly methods used (to increase salmonid fish abundance by in-stream structures) for 80 years was of rather doubtful value (Stewart et al. 2009). Within medicine, all parties including taxpayers, insurance companies and patients' next-of-kin, expect doctors to make a well-informed decision. The medical field is also where the evidence-based movement has experienced its greatest achievements: evidence-based medicine was voted among one of the ten most important medical advancements during the last centuries (Ferriman 2007). Aided by meta-analyses, systematic reviews are the foundation of evidence-based medicine. In such a review, which focuses on a specific question rather than a conventional review, a literature search is performed systematically, and studies are selected for inclusion according to predefined criteria and, most often, the published numbers are entered into meta-analyses. Thus, all relevant information can be quantitatively summarised, and doctors can base their treatment alternatives on such reviews.

Not all fields have such simple outcome variables as medicine, and might involve more complex decisions by managers. Furthermore, meta-analysis and systematic reviews has meant new challenges (Kueffer et al. 2011, Lindenmayer & Likens 2013). However, this does not preclude benefits to society by adopting an evidence-based approach within an area (e.g. Hattie 2009). Furthermore, within the last several years, evidence-based movements within environmental management have emerged (www.environmentalevidence.org, www.cebc.bangor.ac.uk, www.eviem.se). In fact, there are already a number of published systematic reviews focused on vegetation management (e.g. Newton et al. 2009, Kettenring & Adams 2011, Humbert et al. 2012).

The New Statistics

Importantly, a “statistical reform” is currently underway, where a shift away from p-values to a focus on effect sizes can be observed (Fidler et al. 2004, McCloskey & Ziliak 2009, Cummings 2012). This is a cornerstone in evidence-based management and goes hand in hand with meta-analyses. As an indication of how far this reform has come in some fields, *Epidemiology*, a major journal in its field, already in 1998 stated in the instructions for authors that “When writing for *Epidemiology*, you can also enhance your prospects if you omit tests of statistical significance... In *Epidemiology*, we do not publish them at all” (Rothman 1998). In contrast, ecologists seem to continue to think that null hypotheses and p-values are essential for publication.

Neither meta-analyses nor “statistical reform” is new to ecology (e.g., Fidler et al., 2004, Koricheva et al., 2013, Vetter et al. 2013). The use of meta-analyses among ecologist, however, has not been within the context of evidence-based management, but rather to support reviews primarily aimed for other researchers. So time should be ripe for its usage also for management-related questions, with a focus on (i) “what works best” (rather than on processes and mechanisms) and on (ii) practitioners as potential readers (rather than on researchers only). Another new consideration, that has bearing on all research published, is to ensure that your data presentation allows inclusion in future meta-analyses (i.e. a focus on effects sizes rather than p-values). Imagine the horror when you realise that all of your research effort is nullified by being excluded from the next systematic review. Thus, the presence of systematic reviews has resulted in greater conformity in how the medical researcher decides to design and particularly analyse and present data from clinical trials (and more recently, also in placing data in data repositories). In contrast, ecologists seem to strive for diversity in analysis and presentation.

New tools needed to enable meta-analysis of vegetation data

Vegetation is complex, often species-rich, and thus complex to analyse, and our field has a long history of relying on various multivariate methods of analysis (e.g. Kent & Ballard 1988, Masing 1994). However, because the vegetation composition varies over sites and situations, it is not always easy to analytically compare results of experiments from different studies with multivariate methods. Of course, there are other methods to simplify data that might be more appropriate for meta-analysis (e.g. Diekmann 2003, Milberg et al. 2014), and which can be used to supplement more conventional multivariate analyses. A substantial challenge for evidence-based vegetation management is the development of a “common currency” suitable for meta-analysis. It

might involve increased effort in classification of species into desired/undesired for particular management goals (Milberg et al. 2014).

A reform has formidable enemies

It is somewhat paradoxical, that despite the existence of more journals and excellent literature search facilities, the standards for publication have considerably tightened and rejection rates have increased (Hochberg et al. 2009, Jackson 2009). A few years ago, 75% of papers were rejected by *Applied Vegetation Science* (Chiarucci et al. 2010; *Journal of Vegetation Science* is presumably even higher), and this would be a typical value of an ecological journal (Pautasso & Schäfer 2010). The increasing rejection rates, noted by many (e.g. Jackson 2009, Statzner & Resh 2010), indicates that much more effort has to go into a study than it used to (Campos-Arceiz et al. 2013). There is also a risk that sound trials conducted remain unpublished (Scherer et al. 2007).

When editors have many manuscripts to choose from, the key for a successful manuscript in most journals is no longer whether a study is well conducted and with justified conclusions, but the somewhat subjective and elusive “novelty factor”. Thus, if a study is merely confirmatory, as judged by referees, or with non-significant results, then it is less likely to be published (Dwan et al. 2008, Hopewell et al. 2009). In the history of scientific publishing, this can be seen as a shift in focus from documenting research (“anything that is well described and with conclusions that are justified is OK”), to publishers and editors trying to maximise profit and bibliometric outcomes, respectively (e.g. Wellcome Trust 2003, Falagas & Alexiou 2008, Statzner & Resh 2012). Considering the enormous volume of published literature per year, we as readers might welcome this filtering of findings. However, knowledge is not well built if only based on novelty and the extraordinary or when there is a strong bias towards “significant” results (e.g. Ioannidis 2005, Knight 2006, Moonesinghe et al. 2007, Ridley et al. 2007, Fang et al. 2011, Giner-Sorolla 2012, Fanelli 2012, Brodeur et al. 2013, Schoenfeld & Ioannidis 2013).

Evidence-based management works best when all well-executed studies are published and without delay. In reality, there is a bias favouring exceptional results while punishing “uninteresting” ditto. Thus, a reform would need a resurrection of the value of confirmatory studies (Asendorpf et al. 2013). In addition, we need to find a way to document non-significant results (e.g. Kotze et al. 2004) which are of interest, at least if a study appears to have been properly replicated.

Reform for both applied vegetation science and *Applied Vegetation Science*?

Taken together, to enable the emergence of evidence-based vegetation management, researchers need the following: (i) a shift in focus towards effect size and results that are suitable for meta-analysis; (ii) to consider practitioners as potential readers; (iii) more focus on practical problems rather than mechanism, and (iv) acceptance of well-executed confirmatory studies.

These points above have implications for editorial policies of all journals claiming to be a source for applied research. So if *Applied Vegetation Science* wants to fully live up to its name, why not an editorial demand, for papers with practical relevance, to present results in a manner that enables future meta-analysis and to allow space for

confirmatory studies? Both *Journal of Applied Ecology* and *Ecological Applications* claim practitioners as a target audience, why should *Applied Vegetation Science* be different? And it would be excellent if *Applied Vegetation Science* aimed to be an avenue for publication of systematic reviews, as do the journals *Biological Conservation* and *Environmental Evidence*.

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