Conservation practice could benefit from routine testing and publication of management outcomes

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SUMMARY

Effective conservation requires a step change in the way practitioners can contribute to science and can have access to research outputs. The journal Conservation Evidence was established in 2004 to help practitioners surmount several obstacles they face when attempting to document the effects of their conservation actions scientifically. It is easily and freely accessible online. It is free to publish in and it enables global communication of the effects of practical trials and experiments, which are virtually impossible to get published in most scientific journals. The driving force behind Conservation Evidence is the need to generate and share scientific information about the effects of interventions.

WHY WE NEED SMALL CONSERVATION EXPERIMENTS

In medicine, synopses that collate published evidence on the effects of interventions are routinely published and regularly updated. These are available at 'point-of-care', so they can underpin decisions in clinical practice (Moja & Banzi 2011). Conservation science differs from medical research in that its subjects are far more varied, ranging from populations and species to habitats or ecosystems (Pullin & Knight 2001). As a result, the evidence base for any given intervention generally consists of a set of relatively small studies of its effects, carried out in a range of different contexts, with little standardisation of methods between studies. Whilst the number of replicates used in medical trials is often high (thousands of individuals), practical constraints mean that the number of replicates in conservation and ecology trials is usually low. Therefore, the informative value of each individual study is typically small. So there is an even greater incentive in conservation than in medicine to compare results across an accumulation of multiple cases.

The completion of the first two global synopses of evidence for biodiversity conservation, on wild bees (Dicks *et al.* 2010) and birds (Williams *et al.* 2013), provides the opportunity to review the state of conservation research as it applies in practice, and to identify examples of widely practised interventions whose effectiveness is uncertain. It is striking that for many commonly practiced interventions there seem to be few available scientific studies. For example, there were 59 interventions listed in the Bee Synopsis. For 15 of them we captured no studies at all providing direct evidence of effectiveness. These included widely advocated interventions such as connecting areas of semi-natural habitat and protecting 'brownfield' (derelict urban or commercial) sites with high invertebrate diversity.

CONSERVATION PRACTITIONERS AS EXPERIMENTERS

Experimental design and data collection should not be restricted to the realm of scientists as conservation practitioners themselves could routinely document the effectiveness of interventions, sometimes at a minimal cost. This would require selecting interventions of interest for which different treatments could be carried out easily, such as comparing two means of treating patches of an invasive plant, and there is a component of the consequences that would be reasonably straightforward to measure, such as the number of plants surviving.

There are a few elements of inquiry, taken from experimental design principles, which are missing from the majority of conservation projects that we suggest could transform effectiveness, evaluation and monitoring standards in the conservation field. These are:

1. Identify a question that could change practice if solved (for example is it better to treat a particular invasive plant species in April or July or does placing signs asking visitors to stay on the path reduce or increase the probability of them doing so). This question should be something practitioners are specifically interested in, yet there is insufficient existing research.
2. Either compare two treatments (for example treating the invasive plant in different months) or compare one treatment with a control that is equivalent but without the treatment (e.g. comparing a path with signs and a similar

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path without signs). An alternative is to compare outcomes before and after the treatment.
3. Replicate, and if possible randomise replicates. Without replication and randomisation the observed difference could be due to another reason. For example, the invasive plants in the patch treated in July could by chance have been trampled by deer.
4. Quantify the results of the test. These measurements can be simple, such as comparing the average height of a sample of the invasive plants between treatments or counting the proportion of visitors each day who leave the path along a given section.
5. Disseminate the results. The sharing of information between practitioners is capable of making a considerable difference to global practice by encouraging implementation of successful interventions and avoiding the repeated use of ineffective treatments.

There are a range of options for publishing such results, but we obviously encourage publication in the peer reviewed open access journal, *Conservation Evidence*. Our aim is to ease the task of publication for practitioners, by providing a journal that does not require each study to have an extensive introduction, literature review or discussion. In 2012, the acceptance rate of papers into *Conservation Evidence* was 50%. The basic demands of a paper in *Conservation Evidence* are a description of the problem and question, a detailed account of exactly what was done and a quantification of the consequences (more detailed instructions on how to submit a paper are included on the *Conservation Evidence* website www.conservationevidence.com). We hope to entice practitioners who are interested in contributing to the scientific knowledge of conservation, through the simplicity of the journal's content and format.

Our objective of providing a means for publishing the test results of interventions by conservation practitioners has been successful. To date *Conservation Evidence* has published 240 papers from 27 countries, including 214 papers with authorship from non-academic organisations. We have recently produced two special issues associated with publication of the Bird Synopsis, the first outlining the effectiveness of ten interventions relating to bird reintroductions and a second that summarises 33 papers relating to bird conservation management. This year we will publish a special issue relating to the evidence for human behaviour change in conservation. We have also changed the format of the journal articles to what we consider a modern, more professional style.

The utility of adding small case studies to a growing body of open access literature is demonstrated particularly when the outcome is a negative result – showing circumstances in which the intervention does not work. The compilation of the Bird Synopsis shows the ineffectiveness of aversive conditioning of mammal predators as a conservation tool to reduce predation of threatened or important bird species (Williams et al. 2013). A recent study in *Conservation Evidence* demonstrated an endangered grassland bird in Paraguay did not show the anticipated use of burnt habitat (Pople & Esquivel 2012), which is critical information to assist with this species' recovery. As another example, Smith & Lockwood (2012) found that a species translocation prior to sand dune disturbance did not result in a new population, although the original population was not actually affected in the long term by the sand removal as previously thought. The publication bias towards positive results and disregard for negative results in scientific journals (Lortie *et al.* 2013) compounds the issue, providing little assistance to conservation practitioners deciding on an optimal management strategy. *Conservation Evidence* encourages the publication of negative results, to reduce the chance that conservation resources are not spent on ineffective management.

OVERCOMING THE BARRIERS TO CONDUCTING EXPERIMENTS

We acknowledge that designing and conducting scientifically sound ecological experiments and measuring meaningful conservation outcomes are difficult tasks (Kapos *et al.* 2009, Underwood 2009, Jones 2012). Randomised, controlled trials, which are the gold standard experimental protocol in medicine (Sackett *et al.* 1996), may be challenging for social, economic and political problems (Mark 2009), but can be achieved (e.g. Joshi 2012).

We note that the evidence required could be obtained at little extra cost of the overall management, by tweaking interventions rather than carrying out parallel scientific activities. These possible overlaps between science and management are important because conservation donors may be reluctant to fund projects which outline the experimental aspects of the project if they believe their money will be spent on research instead of direct conservation efforts.

We also acknowledge that many conservation practitioners do not have access to journals and do not have their time paid to write beyond the requirements of the donors of the grants they use and the proposals they write. This is a major concern because they hold a huge amount of experience and knowledge which would benefit the practice of conservation generally. It would be beneficial for conservation management, if funding bodies would recognize the need and importance of testing and publishing the outcomes of conservation work. This could also involve providing additional funding to conservation organizations to extract existing information from internal reports and the grey literature to write scientific papers, and disseminate the information more widely than their own current staff members.

Aside from these situations, with careful planning and a small amount of time, practitioners and land managers could contribute substantial amounts of useful, relevant and credible information, which would hopefully be used to improve conservation practice. If practitioners were able to regularly test interventions using sound scientific methods and make the results publically available, conservation practice would gain enormously from the shared pool of knowledge and would move towards an inquisitive culture of experimentation, critical evaluation and evidence-based practice.

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