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Funding and delivering the routine testing of management interventions to improve conservation effectiveness

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ABSTRACT

Evidence-based approaches are key for underpinning effective conservation practice, but major gaps in the evidence of the effectiveness of interventions limit their use. Conservation practitioners could make major contributions to filling these gaps but often lack the time, funding, or capacity to do so properly. Many funders target the delivery of conservation and can be reluctant to fund primary research. We analysed the literature testing the

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Funding
Testing interventions

effectiveness of interventions. Of a sample of 1,265 publications published in 2019 that tested conservation interventions, 96% included academics. Only 21% included conservation practitioners, of which just under half were first or last author. A community of conservation funders and practitioners undertook a series of workshops to explore means of improving the quality and quantity of intervention testing. A survey of the suggested proportion of conservation grants that should be allocated to testing intervention effectiveness showed practitioners tended to prefer larger percentages (median 3–6%) than funders (median 1–3%), but the overlap was considerable. Funders can facilitate the testing of interventions through a range of measures, including welcoming applications that incorporate testing, allocating funds to testing, and providing training and support to deliver testing. The funders represented by the authors of this paper have committed to these actions. Practitioners can contribute by committing to routine testing, benefiting from funding allocated specifically to testing, and establishing processes for testing interventions. The organisations of the practitioner authors have committed to test at least one intervention per year and share findings, regardless of outcome. Currently, practitioners rarely lead the testing of conservation actions. We suggest processes by which both funders and practitioners can make this routine. This will not only improve the effectiveness and cost-efficiency of practice, but also make conservation more attractive to funders.

1. Introduction

Evidence-based practice is essential for effective conservation (Sutherland & Wordley, 2018). It is the process of assessing systematically collected scientific literature for reliability and relevance and combining it with knowledge and experience to make decisions (Sutherland et al., 2004), including within project cycle development (Battisti, 2018). A challenge to broad application is that the underlying literature is sparse and uneven: Christie et al. (2020) analysed the literature on tests of commonly used conservation interventions, finding that of 2,399 interventions collated by www.conservationevidence.com, 35.3% had not been tested, and 20.2% had just one test. In addition, 13.5% of the interventions assessed were ineffective or even harmful; these include routinely implemented interventions.

Knowledge gaps can lead to conservation interventions being implemented with little or no evidence of effectiveness. Junker et al. (2020) showed that despite considerable research on primates, there were few tests of commonly used conservation interventions. Studies have found that widely used interventions may be ineffective, such as bat gantries in the UK (Berthinussen & Altringham, 2012), while some may even be harmful, such as translocation of large carnivores to reduce human-wildlife conflict (Athreya et al., 2010). Indeed, one of the barriers to enabling evidence use in practice is that the information needed by practitioners is not available, both in terms of its existence or accessibility (Walsh et al., 2019). Despite the increasing availability of open access articles, there remain significant gaps in the existence of evidence for the effectiveness of many interventions. There is an urgent need to fill knowledge gaps and increase the reliability of evidence by testing interventions in different contexts.

1.1. The relative roles of practitioners and academics in contributing to the evidence base

There is an expectation that conservation interventions undertaken by practitioners are based on sound evidence, complemented by ongoing testing of commonly used or novel interventions. Universities and research institutes have played a major role in providing underlying research, but little addresses practical solutions (Arlettaz et al., 2010; Williams et al., 2020). This disconnect between research and practice reflects the finding that most papers in conservation journals do not make management recommendations (Simonetti, 2011) and do not reach the audiences most in need (Shanley and López, 2009). It is less well known how much practitioners contribute to the literature on testing the effectiveness of interventions.

1.2. Funding and capacity to generate evidence

Whilst testing and documenting interventions benefits the community and helps improve global practice, it typically takes a share of the total resource available for immediate conservation benefit. For example, it may be more challenging to incorporate tests in small projects with small budgets, while larger projects can more readily use a small proportion of total funds to carry out tests. It may be easier to get funds for testing larger scale projects because the proportion of the budget is less, but then the complexity of disentangling impacts is more complicated. The type of work is also likely to influence funding distribution, with conservation policy interventions more challenging to test than direct conservation interventions.

To examine the challenges of generating and funding evidence in conservation practice, and to seek solutions, a group of funders and practitioners met in a series of workshops. These were instigated by The Environmental Funders Network and catalysed by a collective desire to improve practice through better use of evidence. These began in person in October 2019 and continued throughout 2020 and 2021 online. The main objective was to share ways to improve the effectiveness of funded projects by ensuring they have considered the lessons learned from others, thereby reducing the risk of project failure. This paper provides conclusions resulting from these workshop discussions.

2. Methods

2.1. The role of practitioners in documenting tests of actions

To assess the proportional contribution of conservation practitioners to the evidence-base we reviewed the authorship of 1,265 articles that tested conservation actions published in 2019 in English language journals (Fig. 1). These were extracted from the Conservation Evidence database (a catalogue of journals reviewed is listed at https://www.conservationevidence.com/journalsearcher/english) in which all papers in a journal volume are searched to determine whether they include a test a conservation action. This comprised 30 major conservation journals and 40 subject specific journals.

2.2. Allocation of funding

Each workshop participant was asked to vote via an online survey for the percentage of funding awarded to conservation projects they felt should be allocated to testing. Choices were presented in categories from 0.5 to 1%, 1–33%, 3–6%, and greater than 6%. This data was independent of others and presented anonymously and separated for funders and practitioners.

3. Results

3.1. The role of practitioners in documenting tests of actions

The majority of articles reviewed (96%) included at least one academic author, while 10% involved organisations linked to zoos and

botanical gardens. Twenty-one percent involved conservation organisations, but in only 125 papers (10%), were the authors affiliated to conservation organisations the first or last author. This is likely to be an overestimate, given many of these practitioners also had affiliation with academic institutions or were in research roles (i.e. not necessarily practitioners). This suggests that practitioners infrequently lead research.

3.2. Allocation of funding

While practitioners tended to prefer larger percentages (median 3–6%) than funders (median 1–3%), the key finding is that there is considerably overlap and close agreement (Fig. 2). The difference in responses partly reflects differences between organisations.

4. Discussion

Scaling-up the testing of interventions is required to establish best practice and to ensure best use of the limited resources available in conservation. Conservation practitioners who routinely carry out interventions can fill these knowledge gaps. This is especially true when adopting active adaptive management approaches. These seek answers through testing and can lead to a virtuous circle in which conservation interventions inform their improvement (Gibbons et al., 2011). Such an ambition needs integration into conservation organisations' priorities to allow evidence generation to become more significant and routine. There are, however, challenges to achieving this. Organisations may lack sufficient time, funding, scientific capacity, or other resources to test the effectiveness of interventions routinely. Furthermore, organisations may not always perceive knowledge gaps, or practitioners may not realise that their interventions could make a significant contribution to the evidence base that warrant being shared.

4.1. The routine testing of actions

While some practitioner organisations already carry out and publish tests of interventions (indeed a small number are prolific publishers), a culture of testing and publishing is not widely embedded, as suggested by our analysis of practitioner authorship. We suggest the initial stage in embedding this culture is to review practices and then ask: Of the actions whose effectiveness is unknown, which is the most important action and how can it be tested easily? This review – ideally at an organisational level - is important because many practitioners will act in good faith (perhaps continuing established practices) without knowing the extent to which their activities are supported by recent evidence, or whether what they are doing is contentious or novel. Examples of how two practitioner organisations, Kent Wildlife Trust and Ingleby Farms, have done this are provided by Sutherland et al. (2021).

We recognise a need to scale-up testing to fill evidence gaps and aim to encourage this routinely. There is a huge range of possible actions (Sutherland et al., 2021 lists 2526) many of which have not been tested (Christie et al., 2021). There are three main approaches: (1) Understanding how effective one-off interventions are, such as reintroducing a species or creating a hibernaculum; (2) Comparing the effectiveness of alternative interventions with the same aim, such as treating an invasive plant with herbicide, cutting, or ploughing; (3) Testing modifications to interventions such as cutting the invasive plant in different months, or painting a subset of nest boxes, which may be more informative than comparing against a control (Smith et al., 2014).

Several conservation organisations and government agencies have committed to routinely test and publish the results of at least one intervention each year in peer reviewed journals that welcome the publication of unexpected results (examples are provided under "Learning from 'failure' and sharing results" below). They include Amphibian and Reptile Conservation Trust, Bat Conservation International, Butterfly Conservation, Cairngorms Connect, Durrell Wildlife Conservation Trust, Forestry and Land Scotland, Froglife, Gloucestershire Wildlife Trust, Ingleby Farms, Kent Wildlife Trust, Kingfishers Bridge Nature Reserve, Natural England, NatureScot, Royal Society for the Protection of Birds, Save the Frogs! Ghana, Saving Nature, Vincent Wildlife Trust, The Wildlife Trust for Bedfordshire, Cambridgeshire & Northamptonshire, and The Woodland Trust.

Our expectation is that by leading the way these pioneering practical conservation organisations will set an example that will become the

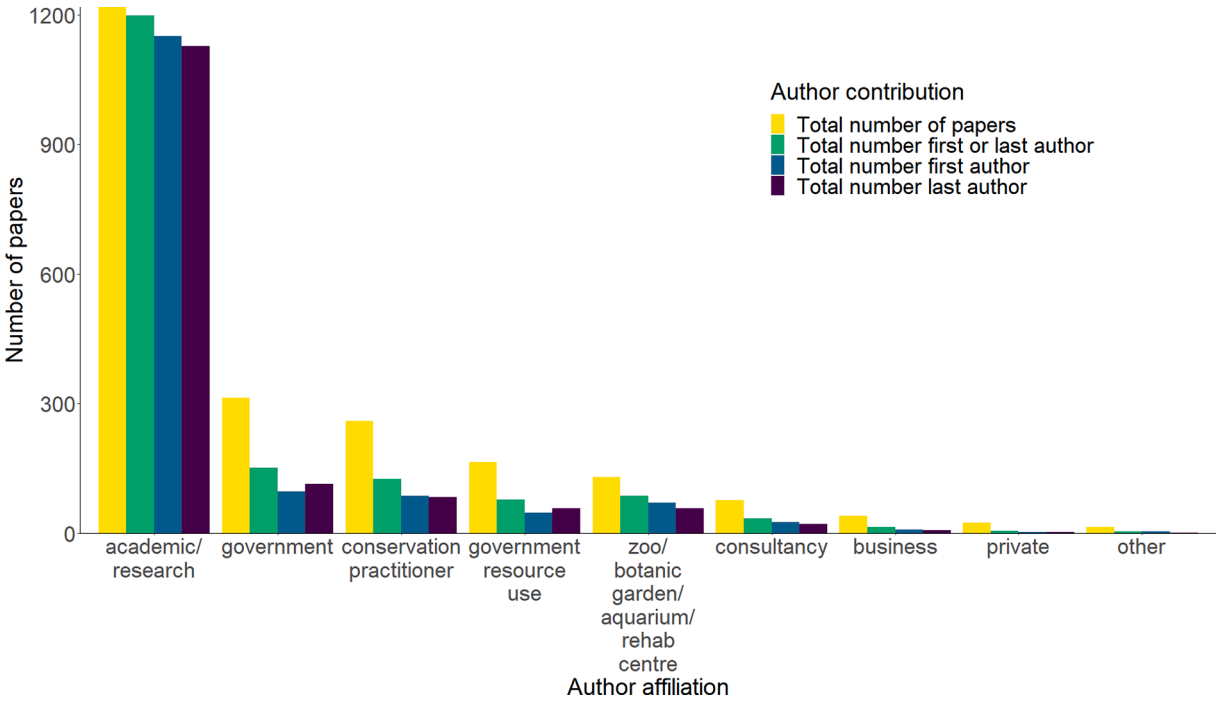

Fig. 1. Analysis of 1,265 papers published in 2019 that test conservation actions, showing the distribution of authorship across organisational affiliations. Each bar is not mutually exclusive; many first and last authors have more than one affiliation and authors often reflect a range of institutions.

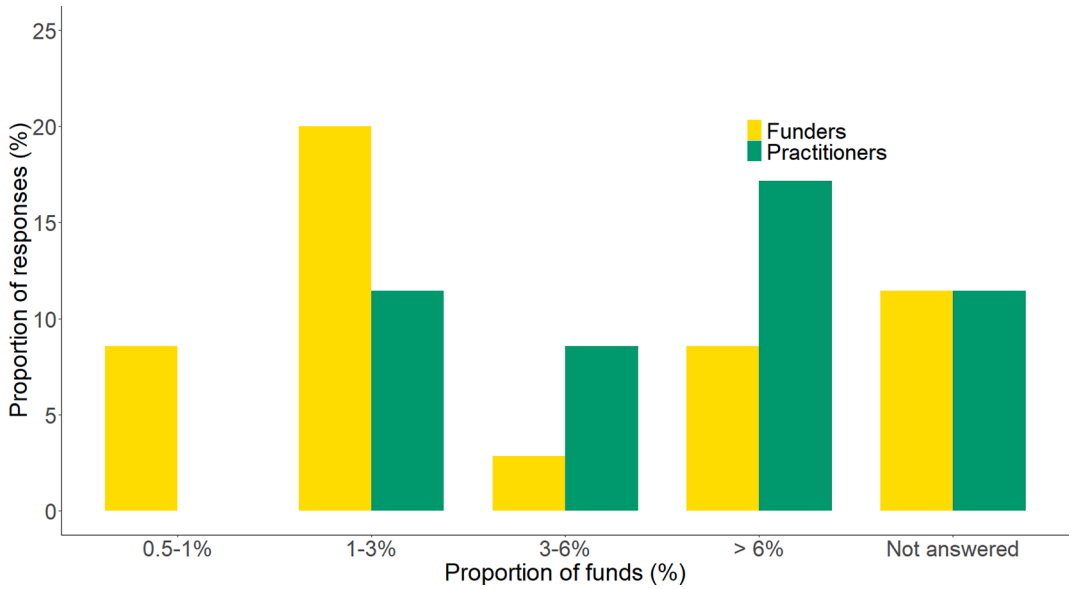

Fig. 2. The percentage of funding for conservation projects that respondents suggested should be allocated to testing effectiveness. For funders n = 18, and practitioners n = 17.

norm, thereby delivering more effective conservation.

4.2. What to test

One key issue is in deciding which issues do not need further research. Keeney (2004) suggests that most decisions have small consequences. There is a need to prioritise testing of those actions whose consequences are highly uncertain, and where greater certainty could lead to more effective conservation. Sutherland et al. (2021) provide a structure for considering whether to examine evidence and a similar approach applies for testing. Testing is not worthwhile if the answer is obvious, or the implications are trivial. Medawar (1969) described science as" the art of the soluble" and stated "Good scientists study the most important problems they think they can solve". We suggest this approach requires identifying answerable questions that are scientifically worthwhile and realistic to embed within conservation practice. Ockendon et al. (2021) followed this logic of considering usefulness and feasibility by generating a ten-point plan for identifying suitable actions to test: What do you care about? What are your main problems? What do you most need to know? What are your broad options? What are the different modifications? What are sensible experimental design options? What are you capable of measuring? What are the options for analysing results? Is it worth carrying out the chosen experimental design? How will the results be documented and shared? Where will this be reported? This a useful framework in the identification of priorities and in establishing if there is capacity to answer key questions. Our objective here is to identify the opportunities for testing rather than options or designs. Ockendon et al. (2021) and many others provide suggestions for approaches to designing experiments, and Sutherlandet al. (2022) provide a process for identifying research questions and collectively generate a list of 100 questions.

4.3. Allocation of funding

The cost of experimenting is a major barrier to the generation of evidence, so funders are essential partners in supporting evidence generation. For example, The Endangered Landscape Programme https://www.endangeredlandscapes.org funds large-scale restoration projects across Europe. It requires that each project designs an experimental test of a planned intervention with results reported to the programme and shared, with open access, to inform adaptive management. Under this programme, Cairngorms Connect is carrying out a series of experiments, including comparing the effectiveness of different types of communication campaigns and the effect of different methods of deadwood creation on saproxylic invertebrate communities.

Funders can facilitate testing of interventions in a range of ways. The following funders have pledged to encourage the testing of actions within their grants: Bat Conservation International, Conservation Leadership Programme, Endangered Landscape Programme, Forestry and Land Scotland, NatureScot, People's Trust for Endangered Species, The Rufford Foundation, Vincent Wildlife Trust, Wildlife Conservation Society, The Whitley Fund for Nature and The Woodland Trust. By encouraging a culture shift among individual funders, it is hoped that this approach will be adopted by many more funders, thereby scaling-up the funding and capacity available for testing interventions.

Three organisations (Endangered Landscape Programme, People's Trust for Endangered Species, The Rufford Foundation) have further committed to allocating funding to testing. If not allocating specific funds, funders could regularly reflect on the extent of testing undertaken in their projects and whether this is appropriate. Funders could also encourage support for the training and collaboration between practitioners and researchers necessary to test interventions.

Our expectation is that by leading the way these pioneering funders will set an example that will become the norm, thereby delivering more effective conservation.

4.4. Costs of testing interventions

Testing single interventions or, better still, comparing variants of interventions, such as treating an invasive species in different seasons, can be relatively cheap (Ockendon et al., 2021). It may even be possible to test interventions with minimal additional cost. For example, if 50 nest boxes are to be erected and monitored, yet there is genuine uncertainty over the best design, then half could be of each design, and use compared. The cost is then focussed in planning the experiment and documenting and sharing results. This work can be facilitated if the funder clearly states their willingness to support generation of new evidence.

The Endangered Landscape Programme provides large grants of up to $5 million per five-year project. Across eight projects initially funded, 0.02%-4% of the total budget was for testing interventions, with an average total cost of $20,000. Some projects choose to test two or more

interventions. Another example, planning and conducting a meadow recreation experiment in Romania by Ingleby Farms, took 39 h of staff time with negligible additional costs (four hours to undertake the action itself).

For some funders, many grants awarded will be for work other than conservation interventions, such as determining status or diagnosing threats. Our advocacy for the allocation of funds to testing only applies to the funding allocated to on-the-ground conservation interventions, rather than for diagnostic components.

With smaller projects and funding sources, it is unrealistic that each grant will include a specific budget line for testing interventions as this would either allocate trivial sums or considerably increase the average cost. A possible solution is that applicants could apply for an optional testing element for which an additional sum is available. Alternatively, successful applicants could be invited to apply for a subsequent testing grant, or the grant provider may recognise and identify which projects are likely to be suitable for tests. Importantly, when key outcomes will not occur within funding timeframes, funders and practitioners should consider longer-term plans that allow the appropriate monitoring of outcomes or breaking down the delivery of interventions into timescales over which testing is most effective. We also recognise a need for funders to consider longer-term funding timescales to permit effective testing.

4.5. Skills required

The routine testing of interventions by practitioners requires considerable skill in design, analysis, and publication. Walsh et al. (2019) identified a lack of scientific training and skills (due to a lack of formal education or professional development courses) as barriers to practitioners. Ensuring that practitioners have access to the skills required to carry out testing is essential. Work towards providing such training resources has already commenced by several authors of this paper. This training includes processes for identifying experimental opportunities, guidance on implementation (Ockendon et al., 2021) and multilingual teaching material (stored on Applied Ecological Resources in multiple languages), which includes experimental design and delivery (Downey et al., 2021). We recognise that the standardisation of methods is a future challenge to address.

Of course, there are costs associated with moving towards conservation practice that shares learning to improve practice. The benefit to an organisation includes improved efficiency and outcomes from adaptive management, enhanced reputation as a result of contributing to the evidence base, and hopefully an increase in funding given to evidence-based organisations than can demonstrate being more effective. The support of funders demonstrated in this paper suggests this transformation is realistic.

4.6. Learning from 'failure' and sharing results

Conservation interventions are not always successful. Indeed, unexpected results illustrate our ignorance of many processes in nature. Recognising that failure is inevitable in every human endeavour is key to enabling lessons to be learned (Catalano et al., 2017). Testing and comparing interventions allow us to document and learn from unexpected results. Failure, if openly shared, provides powerful lessons and can encourage learning and better approaches. Unexpected outcomes can guide subsequent approaches and are vital to improving the evidence base (Knight, 2006). Researchers and practitioners rarely report failed experiments and non-significant results (Zedler, 2007). This omission is often due to a perception that funders may cease funding if they deem projects to have failed, leading to calls for funders to embrace and recognise failure and unexpected results as part of the learning and adaptive management process (Redford and Taber, 2000). The routine regular testing and documenting of results is likely to result in reduced selection of studies to promote.

Creating a fundamental change in the way failure is managed requires a shift in organizational culture and individual mindsets, coupled with the creation of systemic processes to detect and respond to failure, such that we can undertake the interpersonal work of confronting failure as well as the conceptual work of figuring out what went wrong (Schulz, 2010). Catalano et al. (2017) discuss a variety of approaches to learning from failure. In conservation practice, managers can create a team culture in which individuals and groups can learn from failure, including the critical steps of acknowledging that failure is inevitable in complex systems; identifying, discussing, and analysing failures to explore underlying causes; seeking and accepting feedback; proactively and productively managing conflict and disagreement; and widely disseminating lessons learned. A further consideration discussed in detail by Christieet al. (2019) is the importance of psychological safety (the degree to which people feel comfortable taking interpersonal risks in a group setting) in providing the foundations of a culture that fosters learning from failure.

Here we emphasise the importance of sharing of results in the testing process. Whether a project ends in success, failure, or was not completed due to complications, sharing this information can aid the conservation community. Publication bias is an important topic in other areas, although the scale of this problem in conservation is unknown. To overcome this, a commitment to sharing results, whatever the outcome, is required. Many platforms welcome publication of unexpected results, such as the *Conservation Evidence Journal*, *Ecological Solutions and Evidence*, *Conservation Science and Practice*, and *Restoration Ecology's* 'Setbacks and surprises'. The first three specifically welcome contributions from conservation practitioners. The funders involved in this paper have all stated that they welcome transparent reporting of null, counter-intuitive or unpredicted results from conservation interventions.

5. Conclusion

Our intention is to foster the expectation that testing should be routine in conservation practice. With many species and habitats under threat, we must ensure that interventions applied to conserve them are effective. We view a minimum commitment of establishing one test annually as an intermediary step. Testing of conservation actions will improve conservation delivery. Such testing often carries additional costs, and organisations funding conservation work must understand and support these efforts. In time, such investment is likely to be repaid many times over as understanding of how to implement effective conservation improves.

The authors reported no declarations of interest.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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