“Devil Tools & Tech”: A Synergy of Conservation Research and Management Practice

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Abstract
Biodiversity conservation continually presents new challenges, yet conservation resources are limited, and funding for applied conservation research projects more so. Recently, many have reported on the “research–implementation gap,” whereby conservation research findings are infrequently translated into conservation actions. In this perspective, we describe our experiences working in a large multi-institutional, multi-disciplinary team as we attempt to bridge the research–implementation gap by developing conservation tools needed to address the conservation challenges faced by Tasmanian devils (Sarcophilus harrisii). We discuss our project’s history, lessons learnt, outcomes, and future plans to provide insights that may help others develop multi-institutional projects, designed to target rapid and direct implementation of conservation research into management action. Key to our success is the needs-based prioritization of research measured against the management team’s questions, recognition of the different needs of academia, industry and government, a collegiate approach, and willingness to embrace adaptive management. Challenges include developing a project which meets all strategic targets of different institutions, in addition to sourcing funds. Overall, our goal has been to establish an enduring research-management framework, to facilitate improved integration of scientific research into the management needs of Tasmanian devil conservation, and serve as a template for other species management projects.

Introduction: the conservation research–implementation gap
Preserving our planet’s biodiversity has been described as a “wicked” problem characterized by a myriad of complexities and challenges (Game et al. 2014). To address this we need to have evidence-based approaches to conservation, where realistic solutions are provided by scientists who understand management (Braunisch et al. 2012). The disconnect between those that produce science and those that use this science to make management decisions is referred to as the research–implementation gap (Knight et al. 2008). Some reviewers have attributed this gap to a lack of implementation planning from researchers (Cook et al. 2013), while others highlight the challenges of translating technical and fundamental findings into direct management actions (Shafer et al. 2015). Cash et al. (2003) assessed those who have successfully bridged this gap and found there to be four key elements across successful programs: collaboration, communication, translation, and mediation. More recently it has been argued that conservation researchers and management practitioners need to work together better from the outset (e.g., Susskind et al. 2012; Hoban et al. 2013; Wood et al. 2015). The literature contains pleas from both parties for improved integration of conservation science and practice, highlighting the need for workers in both industries to come together. While Legge (2015)
provides a practitioner’s perspective, others provide recommendations to assist conservation scientists in translating their findings (e.g., Gordon et al. 2014; Wood et al. 2015; Keller et al. 2015), dissemination of successful case studies (Shafer et al. 2015), and recommendations on how to integrate scientists into management organizations (Cook et al. 2013).

In theory, management practitioners and conservation scientists working together enables researchers to benefit from developing research questions targeting real-world problems, and conservation management teams to benefit by obtaining the data they require to address those problems (Cook et al. 2013). In practice however, while recent work has discussed the benefits of collaboration and open communication between scientists and policy-makers, this is not always straightforward (Karl et al. 2007; Susskind et al. 2012). Management practitioners and conservation scientists often have different perspectives on problems and different measures of “success.” However, because consultation between researchers and managers can expedite both the collection of data and its use, integrating communication from the early stages of a project’s development allows the identification of synergies that can support the goals of all parties (Susskind et al. 2012). In this perspective, we draw on our own experiences working in a large multi-institutional, multi-disciplinary team to develop conservation tools needed to address the problems faced by the Tasmanian devil (Sarcophilus harrisii) to highlight how the four key elements described above can bridge the research–implementation gap (Cash et al. 2003). We do not claim to have all the solutions to the challenge of research implementation, but by providing a discussion of our project’s history, lessons learnt along the way, outcomes, and our plans for the future, we hope that this project will provide insights that help others to develop positive collaborations for their projects.

A framework for fruitful collaboration: the “devil tools & tech project”

In Figure 1, we summarize some of the stages at which, in our experience, communication between management practitioners and research can lead to positive outcomes for both. In the following paragraphs, we describe how the development of our “tools & tech” project led to these observations.

Origins of the “tools & tech” project

The Save the Tasmanian Devil Program (STDP) is the official government response to the decline in Tasmanian devil populations due to the contagious and lethal devil facial tumor disease (DFTD), which was first observed in 1996 (Hawkins et al. 2006). The aim of the STDP is to ensure “an enduring and ecologically functional population of devils living wild in Tasmania” (STDP, 2014). There are a number of management actions surrounding this aim including development and maintenance of an insurance population, release of animals onto islands/fenced sites, annual monitoring of wild populations and recovery of wild devil populations (DPIPWE, 2010).

The insurance population (IP) commenced in 2006 (Hogg et al. 2015) and was designed to be a source population for releases onto islands and fenced sites. The STDP contracted the Zoo and Aquarium Association Australasia (ZAA) to manage the insurance population on their behalf. In order for the ZAA to successfully manage the IP, an understanding of genetic relationships between founders was needed, as many founding animals were sourced from the Tasmanian north-west and west coast, ahead of the disease front at the time (Hogg et al. 2015). The intent of the IP was to release devils back into Tasmania within 30 years, or 5 to 6 generations (CBSG, 2008), as it was believed that DFTD would cause the extinction of the devil in 25 years (McCallum et al. 2007). Species management modeling indicated that inbreeding would be a concern in the short-term if founder individuals were closely related (Rudnick & Lacy 2008). ZAA and the University of Sydney formed a collaboration to determine founder relatedness, as the university specialized in devil genetics and were undertaking parentage analyses for IP devils. At the same time, the first island release site was being established and parentage analyses on a broader scale would be needed to facilitate ongoing genetic management. Due to already low genetic diversity of the species, previously developed microsatellite markers (Jones et al. 2003; Cheng & Belov 2012) were unsuitable for founder analysis (Hogg et al. 2015), and so an assay for genotyping single nucleotide polymorphisms (SNPs) was proposed and developed (Wright et al. 2015). From these initial discussions the concept of the “devil tools & tech project” was conceived, with the underlying concept of bridging the gap between the lab bench and forest floor through a collaborative approach for applied management of the devil in the Tasmanian landscape. That is, an integrated approach of conservation research and management, with scientists and managers contributing equally.

On reflection, we believe the success of the “tools & tech” project lies in the fact that we started with one small, targeted project to determine whether the integrated approach would meet the needs of all parties. Once the process and “ground rules” were established we were able to build the overall project. For example, a quarterly meeting schedule was established for both face-to-face and on-line meetings where each party was tasked with
Our larger project grew via the incorporation of quality scientific data into management practice in real-time. As the release of devils onto Maria Island by the STDP was initiated, San Diego Zoo Global was seeking to fund a post-doctoral research position on a conservation-based Australian species and so “tools & tech” was born. We brought together people from each of the three disciplines: academia, government, and industry. It is important to consider the combination of three areas: research, practice, and policy (e.g., Hoban et al. 2013) and so in our opinion all three perspectives should be addressed and incorporated to make an integrated project truly successful.

**Implementation**

Excellent communication has been crucial to the success of our program. The lead personnel from each of the partner organizations communicate regularly to ensure that changes within research/practice/policy can be addressed and implemented. As an important outcome of this approach is applied management, strong communication ensures that the implementation of adaptive management processes does not compromise the integrity of the conservation research being undertaken. That is, when changes are to be made to management practices, we think about how these changes may impact any current long-term research projects and endeavor to minimize any impact. For example, when a cohort of devils involved in a long-term behavioral research project were needed for breeding, communication with researchers ensured that the project was completed prior to the transfer date.

Dialogue between the research and management teams was undertaken, and continues, at each stage of

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**Figure 1** Differences between the traditional conservation research approach and the Devil Tools & Tech approach, where there is full integration between research/practice/policy, with the final conclusion being a beneficial conservation outcome for the species. Darker heavier lines are indicative of a higher probability of success/occurrence, with thin gray lines indicative of lower probability.
project development from the initial questions, sourcing of funds, conducting research, and analyzing preliminary data. By creating a feedback loop between the research and management teams, scientific discoveries and development of new tools and technologies can be directly implemented in the field in a shorter timeframe (Figure 1). As a result alternative avenues for applied conservation funding have been sourced as we are using new, innovative science to develop the conservation tools. Further, management teams can utilize the raw data prior to publication to ensure the rapid implementation of new discoveries.

The use of raw data requires a level of trust between the research and management teams, particularly when the data being utilized are produced by students, or other individuals, who are developing their skills. Working with conservation practitioners provides research students with industry exposure and an opportunity to receive training in the mechanisms of conservation implementation (e.g., meeting deadlines, permits, timely communication), providing them with additional transferrable skills that can help them in future careers in the conservation sector (Knight et al. 2008). A person with research experience, who is a member of the management team, is also part of the doctoral student advisory team. In addition, the STDP has developed a governance structure to share both samples and data acquired during daily management actions. These data and samples are managed through a data sharing agreement with the STDP under an oversight committee.

Outcomes

There are a number of direct management outcomes which have already been implemented as a result of the “tools & tech” project. These include identification of parentage of individuals held in group enclosures; determination of founder relationships to better inform breeding recommendations (Hogg et al. 2015); development of a new SNP-assay to assist with genomic analyses (Wright et al. 2015); and development of contraceptive tools to ensure even genetic representation across founding animals in fenced/island populations. A recent STDP initiative designed to augment and recover wild devil populations in the presence of DFTD (STDP, 2014) is also benefiting from the “tools & tech” approach. New research projects have been developed to assist in the implementation of this initiative, such as augmenting wild sites with devils selected for release based on their different genetic variants, and assessing the benefits of olfactory cues to dampen the potential dispersal of released individuals. A number of these management outcomes would not have been possible if it were not for the interaction with researchers and the support of the academic sector, further highlighting the benefits of bridging the research–implementation gap.

Even though some conservation research outcomes have been already implemented into management (Figure 1), academic success indicators take longer to measure. Although the project is still in its early days, some academic success indicators include 20 research students and post-doctoral fellows, and publications which are just starting to emerge (e.g., Morris et al. 2015; Wright et al. 2015; Grueber et al. 2015). Other additional outcomes include raising the public profile of the “tools & tech” project and the broader plight of the Tasmanian devil, via the STDP newsletter, social media, print media, visitors/members to participating zoos and fauna parks and on-line presence (e.g., a documentary video about the project, produced by San Diego Zoo Global; http://bcove.me/t61imr6t [accessed 15 July 2015]).

Lessons learned

In order to better assist those who are embarking on the development of an integrated approach between management practitioners and conservation scientists we thought it useful to highlight some of the lessons we have learned. This is by no means an exhaustive list, but rather areas where we think our partnership is succeeding and how we were able to reach this goal.

From the start, we recognized that this project would be a significant investment for all parties, both intellectually and financially. This has underpinned the collegiate manner in which this project functions as we are all equal partners (Susskind et al. 2012). We did not commence the project with, and still do not have, a chief investigator/partner investigator mentality but rather each party from the outset raised what they needed from the project and what was important to the strategic goals of their institution. This way we were able to assess everything that was required of the partnership from the beginning and develop it in order to meet all partner needs. This is not a static process but an evolutionary one in recognition that institutional needs, particularly government and industry, change over time. Together, we have been successful as our organizations have had the capacity and resources to support the personnel involved in the project, as well as helping us to build capacity, e.g., San Diego Zoo Global post-doctoral fellowship.

We do have a species coordinator who, due to the management of the insurance meta-population and the purpose of the IP, works closely with all partners on different aspects of the project and so by default has become the project coordinator. This role ensures both regular communication between partners and timely communication of any changes and assists with mediation if required.
We developed an umbrella framework—“devil tools & tech”—with an overarching aim: to take the latest tools and technologies from the lab bench and make them directly applicable to the forest floor; to develop novel techniques and concepts for conservation work; and to trial their implementation in real world situations. The difference between our umbrella project and many other conservation research/management projects is that the questions were sourced from the management practitioners, allowing researchers to facilitate answers to specific management needs, which led to further management questions (Figure 1). In this way we are not answering one question, but multiple, sometimes overlapping questions, at the same time. Each research question we answer contributes to the larger management machine of the Save the Tasmanian Devil Program.

We promote a strong culture of collaboration and collegiality. This philosophy is strengthened by everyone’s willingness to communicate and collaborate, across all the different sectors, and prioritize our time accordingly. We have regular on-line “face-to-face” meetings between lab and field teams, as we are located in different Australian states. Staff and students from each partner organization are encouraged to join these meetings, to work with and learn about the other partners and how their work fits into the bigger picture (see also Jenkins et al. 2012). A two-yearly meeting of all stakeholders, which includes staff/students from the lab, field, and zoos, is held to encourage better communication and give all partners an overview of how their efforts are working together to approach the goal of saving the devil.

The issue of devil management in the presence of DFTD lends itself well to working at the science–practice–policy interface; that is Tasmanian devils are an iconic species that the public and government are committed to saving. We also initiated further collaborations with other members of our institutions to participate in the larger project. What commenced as a multi-institutional project, with a genomic focus, has now expanded into a multi-institutional, multi-disciplinary approach to provide management solutions for integrating Tasmanian devils back into the wild. To date, there have been no local extinctions of devils in the wild; therefore, waiting to reintroduce devils post extinction of both the devil and DFTD, as was originally suggested in 2006, is not possible (STDP pers. comm.). As all parties recognize the value of an adaptive management approach, we have been able to expand and evolve the “tools & tech” project to encompass changes in management focus. Another core characteristic of the “tools & tech” approach is that we did not rely on passive dissemination as is generally the case in the “conventional approach” (Figure 1). The transition from one small targeted project to a multi-faceted conservation research program directly servicing management actions and questions is the result of the approach taken here, rather than the conventional approach of disparate scientists working on different aspects of the conservation challenges that face the Tasmanian devil, irrespective of the tools needed for management.

Looking ahead

The issue of managing devils in the presence of DFTD lends itself well to working at the science–practice–policy interface; that is Tasmanian devils are an iconic species that the public and government are committed to saving.

This has contributed significantly to the success of the “devil tools & tech” project and our ability to source funding. Further, our approach contains the key elements known to bridge the research implementation gap, communication, collaboration, translation of results and mediation (Cash et al. 2003). In light of our successes and lessons learnt, we are commencing discussions with other research and management teams in regard to establishing similar projects with other Australian native fauna. The development and implementation of the “devil tools & tech” project has been underway since 2011 and will continue in its present form until 2018. Even now, the current project partners are broadening the umbrella framework to expand beyond the initial scope and timeframes of the project, whilst at the same time embodying the philosophy of the project. This further work will continue into the future and endure beyond the original “tools & tech” lifespan. It is hoped that the framework we have built will persist for as long as government/academia/industry participate in the central aim of having an ecologically functional and persisting population of Tasmanian devils in the wild.
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