Practical considerations for monitoring invasive mammal eradication outcomes

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Abstract Monitoring provides important evidence to evaluate if invasive mammal eradications on islands achieved conservation goals and to inform future allocation of conservation funds. However, monitoring can be costly, and compete with management actions for resources, so it is important that efforts are targeted. It can be difficult to obtain results of monitoring from previous projects, which puts future projects at a disadvantage when projecting possible conservation outcomes. In this short paper we discuss practical considerations for designing monitoring associated with an eradication programme. We focus on the ecological outcomes of invasive species eradication, as opposed to specifically monitoring if an eradication was successful or not. We identify major motivations for undertaking monitoring and present a decision tree intended to improve the efficiency of monitoring by supporting project managers determining when and what to monitor, and how to incorporate monitoring into project planning.

Keywords: decision tree, monitoring, post-eradication, project planning

INTRODUCTION

There is a substantial shortfall between the investment in conservation worldwide and the amount required to tackle the current biodiversity crisis (McCarthy, et al., 2012). It is well established that this necessitates prioritised, efficient allocation of resources, with evidence-based management (Sutherland, et al., 2004; Wilson, et al., 2006; Kapos, et al., 2008; Underwood, et al., 2008). Monitoring, defined as the collection and analysis of repeated field-based empirical measurements (Lindenmayer & Likens, 2010), provides this evidence. Over the past fifty years the eradication of invasive mammals from islands has developed into a reliable and effective conservation tool, resulting in substantial conservation gains (Veitch, et al., 2011; Jones, et al., 2016). There has been noteworthy progress in determining why, what, when and where to eradicate mammals from islands. Prioritisation of management is more robust and evidence-based than ever. When and how much to invest, how to balance different outcomes, and dealing with uncertainty of outcomes have all been addressed in recent literature (Donlan & Wilcox, 2007; Dawson, et al., 2015; Donlan, et al., 2015; Helmstedt, et al., 2016). Yet why, what, when and where to *monitor* following eradication is not always apparent. Recent assessments have highlighted that data on native species' responses to eradication are rare, often not quantitative, and not readily available through published sources, suggesting that monitoring, or reporting on monitoring, following eradication is uncommon (Jones, et al., 2016; Brooke, et al., 2017; Towns, 2018). Both eradication, and monitoring the outcomes that result, can be costly (e.g. Helmstedt, et al., 2016; Springer, 2016). Assuming both activities are being funded from the same combined budget, there is a potential trade-off between spending on eradication versus spending on monitoring (Possingham, et al., 2012). This paper discusses what to consider when designing monitoring of eradication projects. We focus on monitoring the wider ecological impacts of invasive species eradication, rather than short-term post-eradication monitoring for signs of invasive species that determines whether an eradication project has succeeded or failed. The paper incorporates inputs from the Island Invasives 2017 workshop: "Effective monitoring of response to eradications" attended by 60 conference participants. We aim to outline the main considerations for practitioners assessing the monitoring needs for projects they are involved in.

WHY, WHEN AND WHAT SHOULD WE MONITOR?

Possingham, et al. (2012) identified five separate benefits of long-term monitoring. Three of them—auditing the outcomes of a project (Case study 1), detecting unanticipated outcomes and researching mechanisms for those outcomes—have ecological benefits. The other two

CASE STUDY 1: AUDITING THE OUTCOMES OF RAT ERADICATION AT ANACAPA, CALIFORNIA, USA

Black rats (*Rattus rattus*) were successfully eradicated from the three islands of Anacapa in the Channel Islands, California USA, in 2001–2002. The goal of the eradication project was to improve seabird nesting habitat, and aid recovery of Scripps's murrelet (*Synthliboramphus scrippsi*, formerly Xantus's murrelet) and ashy storm-petrel (*Oceanodroma homochroa*) (NPS, 2000). The project was funded via oil-spill restoration resources, and an additional goal was to offset impacts that had occurred to these two species during the 1990 American Trader spill (ATTC, 2001). Monitoring included tracking artificial eggs (mimicking Scripps's murrelet eggs) before the eradication to quantify rat predation on this life history stage, and after the eradication to confirm the expected outcome of removing that impact (Jones, et al., 2005). Long-term monitoring of focal seabird species ensued for a decade including the hatching success, distribution and abundance of Scripps's murrelet on the island, which saw a three-fold increase in hatching success and expansion of nesting (Whitworth, et al., 2013). The ashy storm-petrel was discovered breeding on the island 10 years post-eradication, highlighting the contribution of the project towards stated goals (Whitworth, et al., 2013; Newton, et al., 2016). The operation was also the first aerial broadcast of rodenticide in the USA, and short-term non-target monitoring was undertaken to follow expected impacts (Howald, et al., 2010), and improve knowledge for further planning of this activity in the USA. Surveillance monitoring of other taxa also occurred, including endemic deer mice, herpetofauna and inter-tidal communities, to understand the broader impacts that occurred as a consequence of the eradication.

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– informing stakeholders of outcomes and engaging the public – have social benefits. Whether ecological or social, several of these benefits involve measuring or reporting against targets, so clearly defining the target outcomes of eradications is often a prerequisite for designing monitoring.

Monitoring may yield diminishing returns in terms of advancing our ecological knowledge, when the same outcome is monitored repeatedly. It can, therefore, detract from investment in future management action. This is an important consideration for repeated monitoring of the same island or site (Possingham, et al., 2012), but also for monitoring across projects where islands share similar habitat types, and invasive mammal-native species interactions. The target outcome of an eradication of a particular invasive species e.g. population recovery of a threatened species, may be confidently predicted if it is driven by a simple mechanistic relationship or there is sufficient evidence from previous eradications that benefited the same or ecologically similar species. The decision whether to monitor should, therefore, be informed by the current state of evidence: what prior knowledge exists and is it sufficient to confidently predict outcomes? For invasive mammal eradications, the evidence-base for predicting different outcomes is mixed. Individual outcomes have been reported for several projects but not consistently or comprehensively.

A key recommendation made during the Island Invasives 2017 monitoring workshop was to compile a synthesis of monitoring efforts to date, to identify taxonomic or geographic gaps in coverage that will help target future monitoring efforts. Although no comprehensive synthesis exists currently, some studies have collated and synthesised monitoring, either at a regional level (e.g. Russell, et al., 2016; Towns, et al., 2016), or globally for a taxonomic group. Schweizer, et al., (2016) reviewed available evidence of vegetation responses to goat (*Capra hircus*) and European rabbit (*Oryctolagus cuniculus*) eradications. Although there was evidence that vegetation responded following herbivore removal, variation in monitoring methods, timeframe and accounting for native versus non-native vegetation response hindered the drawing of conclusions. Thus, the authors recommended further monitoring to develop a general model of expected vegetation responses. Brooke, et al., (2017) collated seabird demographic responses following invasive mammalian predator eradication, highlighting that, in general, seabird populations increase following invasive mammal eradications. However, not all populations grew, insufficient data were available to distinguish between threatened and non-threatened species, and variation in response among major seabird taxa was evident. Thus, while generally seabirds can be predicted to respond positively following invasive mammal eradication, we lack sufficient knowledge to predict how and why this circumstance occurs, hence the recommendation for systematic long-term monitoring to improve understanding of the mechanisms of seabird population recovery (Brooke, et al., 2018).

The social benefits that accrue from monitoring–stakeholder feedback and public engagement–are more linear because, while ecological knowledge grows cumulatively from all projects that monitor, the social returns are primarily project specific. Foreseeably, the ecological need for monitoring may be low but, if the operation had high public or stakeholder interest, monitoring will be necessary.

Beyond a theoretical framework for monitoring, The Nature Conservancy is one organisation looking at their motivations for monitoring at an institutional level (Montambault & Groves, 2009). They found monitoring was a tool for managing risk and securing future investment–the greater a project's risk or higher the likelihood it could lead to follow-on funding, the higher the investment that should be made in monitoring (Case study 2). Eradication operations with considerable ecological uncertainty, or reputational risk, and those whose success could leverage additional public, political or financial support for future operations therefore all warrant a significant investment in monitoring (Table 1).

Having identified the motivations for monitoring, and decided on that basis whether monitoring is needed, it becomes easier for a project team to decide what to monitor and how. When the aim is to confirm that an eradication achieved target outcomes, monitoring focusses on those target beneficiaries. When the risk of unexpected outcomes is high, broader surveillance monitoring is appropriate. Both rely on assessing *the state* of target or non-target species or habitats, whereas understanding broader ecosystem responses is likely to require more detailed research into ecological mechanisms.

The goal and audience for reporting ecological outcomes of an eradication can influence the type of monitoring undertaken. When there is a need to report outcomes in a peer-reviewed publication to a technical or scientific audience, a different approach such as a quantified before-after comparison, may be required than for projects reporting to non-technical audiences such as donors or local communities (Case study 3), for which qualitative approaches like photo-monitoring vegetation changes may be sufficient. Further, the stakeholders using Traditional Ecological Knowledge will require a different approach

CASE STUDY 2: LEVERAGING CONSERVATION GAINS THROUGH GOAT ERADICATIONS IN THE GALÁPAGOS, ECUADOR

The ultimate goal of Project Isabela, initiated in 1997 and completed in 2006, was to facilitate the restoration of Pinta (5,940 ha) and Santiago (58,465 ha) Islands and the larger, northern portion of Isabela Island (approximately 250,000 ha; the whole island encompasses 458,812 ha). The project began in response to the massive destruction by introduced goats of both native vegetation and terrain (Galápagos Conservancy, 2017). Long-term vegetation monitoring was established on six of the 12 islands in the Galápagos where goats had been introduced (Tye, 2006). Permanent plots and transects showed that eradication or reduction of goat populations led to regeneration of native vegetation (Hamann, 1993; 1979), with a return to a near natural state in most cases after 20 years (Tye, 2006). The monitoring programme successfully fulfilled a number of roles. It confirmed, overall, the success of goat eradication in facilitating recovery of native vegetation and it provided lessons for subsequent eradication operations. In doing this, monitoring helped to manage the risk associated with the operation. The programme highlighted cases where individual species did not recover following goat eradication or exclusion so additional conservation management was required, including the tree fern (*Cyathea weatherbyana*) on Alcedo, whose last two remnant populations were protected by fences in 1997 (Tye, 2006). Perhaps most importantly monitoring demonstrated to public, state and donor audiences the benefits of invasive species management helping to leverage future investment. This led to the Charles Darwin Foundation (CDF) and the Galápagos National Park Service (GNPS) convening a workshop in 2007, on the completion of Project Isabela, to develop an action plan for managing rodents within the Galápagos (Galápagos Conservancy, 2017).

Table 1 Motivations and conditions for monitoring biodiversity outcomes of invasive species eradications.

Why?	When?	What?
Confirm target outcomes[1]	Outcomes are complex and difficult to predict, or poorly studied	Target beneficiaries – quantitative studies
Detect non-target outcomes[1]	Large or complex systems where outcomes are unpredictable	Non-target surveillance – quantitative studies
Learn about whole ecosystem responses[1]	Ecosystem responses remain poorly studied.	Ecological mechanisms of change – quantitative question-driven research. Community ecology
Inform stakeholders[1]	If required, especially for larger operations	Target beneficiaries – qualitative studies (see Case Study 1)
Engage the public[1]	Inhabited islands, regularly visited islands, large operations, publicly funded operations. Projects involving beneficiary species with a high public profile	Target beneficiaries – qualitative participatory monitoring
Ecological risk and uncertainty[2]	Threatened species involved and outcomes uncertain e.g. complex systems	Target beneficiaries – empirical studies
Reputational risk[2]	Large operations funded by key donors, or receiving political and public backing	Target beneficiaries – qualitative studies?
Leverage[2]	Exemplars and trial operations in new geographies paving the way for subsequent repetition/scaling-up	Target beneficiaries – empirical studies

Sources: [1]Possingham, et al., 2012 and [2]Montambault & Groves, 2009.

than non-Western science frameworks. Thus, identifying early the key audiences and their needs is recommended as this will influence the cost and approach of monitoring.

Finally, there are a number of practical considerations which may predispose projects to monitor, namely: when existing baseline data are particularly good; when there are existing established monitoring programmes e.g. run by rangers, universities or participatory groups; and/or when funding for monitoring does not compete with management.

Integrating monitoring into project planning

Fundamentally, monitoring should be considered in the earliest stages of project planning. This allows for additional baseline data to be collected if existing data are insufficient for a robust before-after comparison, and for monitoring to be costed and potentially included in the project budget.

There is a wide spectrum of possible monitoring investment for invasive mammal eradication projects, ranging from not monitoring at all, through to comprehensive whole ecosystem monitoring. The few whole ecosystem studies that exist (e.g. Towns, et al., 2016; Griffiths, et al., 2019) provide detailed learning into how systems respond to the eradication of particular species and provide a model for planning equivalent exercises elsewhere. Although these excellent studies represent the optimum approach for eradication monitoring, they are not achievable for all projects, nor may they be necessary to achieve project goals. Here, we aim to provide general guidelines for deciding what level of monitoring is required.

Fig. 1 presents a decision tree outlining the key considerations which determine whether monitoring is necessary, what needs to be monitored and the type of monitoring needed. Although it is presented as a workflow, several steps are inter-related and feed into one another.

1. Defining the desired outcomes of eradication

The most common motivation for monitoring is to confirm the expected outcomes for native taxa after removing a pest species from an island. It is therefore essential that projects clearly define their objectives (Prior, et al., 2018): why is eradication proposed?; what is it expected to achieve? Outcomes should be explicitly split into proximal outcomes, which will typically include the removal of an invasive species and the undesirable interactions with native species (e.g. predation), and ultimate outcomes such as the recovery of a native species. These ultimate outcomes are sometimes referred to as impacts (Nam, et al., 2013). Conceptually, post-eradication outcomes like improved survival and recruitment can lead to impacts like population growth. Where possible, outcomes should be specific, measurable, agreed-upon by those involved in the project, realistic (i.e. ecologically viable), and time-bound (Doran, 1981).

CASE STUDY 3: MONITORING ON ST AGNES AND GUGH, ISLES OF SCILLY, UK

Brown rats (*Rattus norvegicus*) were successfully eradicated from the islands of St Agnes and Gugh in 2013 (Thomas, et al., 2017). The islands have a combined area of 142 ha and a population of 82 people, making it the largest community-led rat eradication project in the world to date. Engaging the community in all aspects of the project including monitoring – and keeping them engaged throughout the life span of the project – was key to the project's success. Community members, especially schoolchildren, were involved in the work, with many people volunteering to take part in monitoring of native shrews, invertebrates, plants and birdlife. The islands' seabirds are of particular value to the community, and islanders are involved in ongoing 'chick check' walks which monitor the breeding success of Manx shearwaters (*Puffinus puffinus*) and European storm-petrels (*Hydrobates pelagicus*) two species which have bred on the islands for the first time in living memory following the eradication of rats. The monitoring activities associated with the eradication project have therefore fulfilled several roles – they have provided ongoing scientific data on the wider ecological impacts of rat eradication and have provided powerful publicity and advocacy information regarding the immediate benefits of eradication on species preyed upon by rodents, such as shearwaters and storm-petrels. The monitoring has also galvanised and helped maintain ongoing community support for the project and ownership of its long-term outcomes.

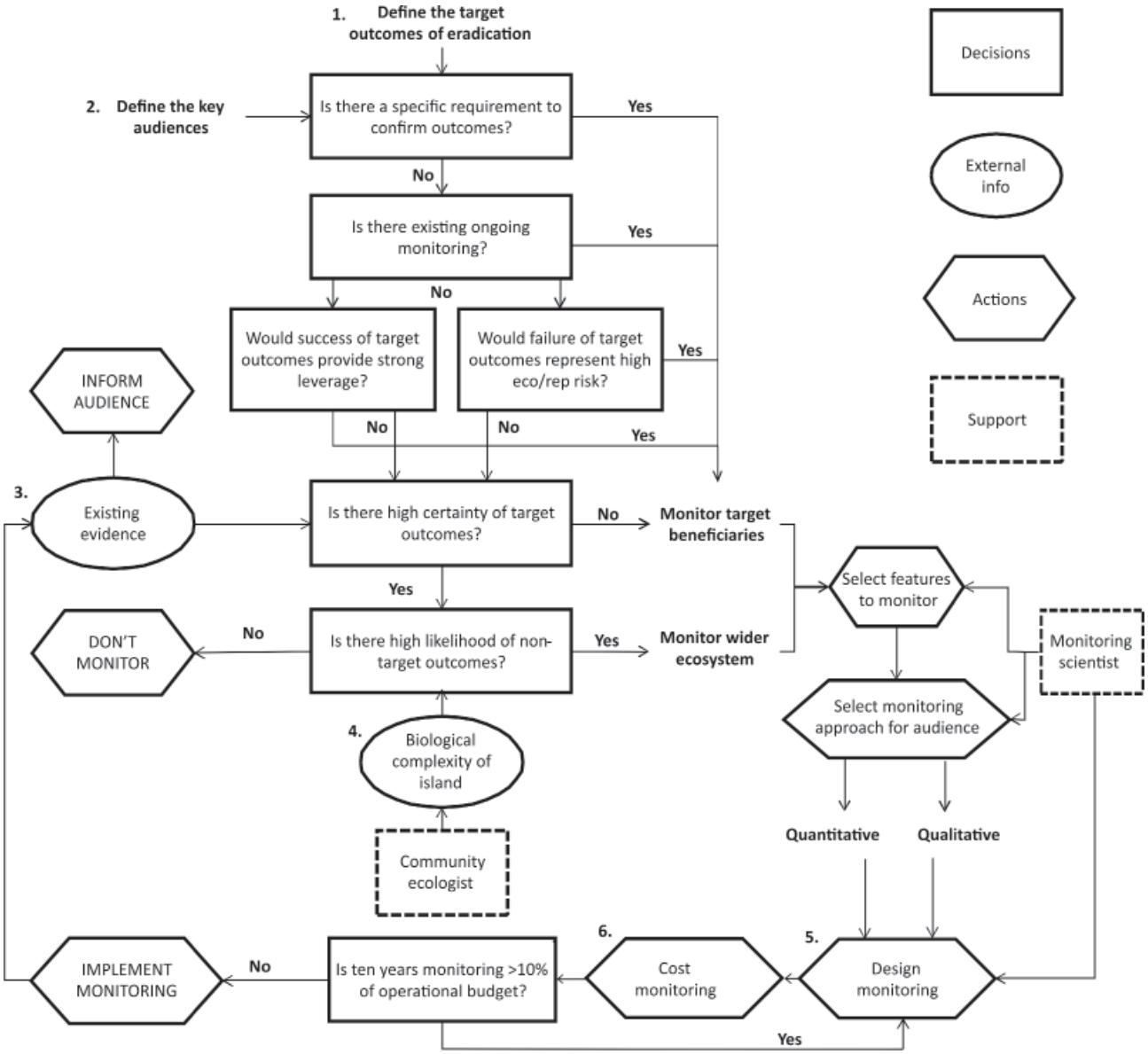

Fig. 1 A decision tree to assist with planning biodiversity monitoring in relation to eradication programmes. After the target outcomes of the eradication and the key audiences are defined, gathering existing evidence and answering a number of questions will inform the scope that monitoring needs to encompass, as well as guide selection of monitoring targets and the required approach to monitoring. Numbered points are discussed in the text.

2. Defining the key audiences

Just as *what* is monitored is driven by project goals (e.g. seabird protection), to *whom* monitoring results should be communicated should also be defined as a part of project planning. For each project, target audiences should be identified: a relevant group for whom the results of ecological monitoring will be of interest, some of whom may actively request the information, while others may be informed more for advocacy and education purposes. By defining these audiences, managers can prioritise and determine what messages and products (e.g. peer-reviewed publications, images, webpages, reports or public lectures) monitoring needs to inform and, in a feedback loop, can identify what to monitor. Key audiences may include the local community, especially island residents or communities close to the island; permit providers such as statutory bodies and island managers wanting to understand the wider ramifications of eradication; conservation scientists and technical communities wishing to use monitoring data to highlight ecological benefits of projects to advocate for similar work; donors vetting project outcomes and return on investment; and decision makers at local and regional levels. At a higher level, the data may also be used to lobby policy makers to enact or amend legislation relating to invasive species and their management. Finally, project managers may wish to engage the wider public with the results of their monitoring work, seeking to develop more broadly society's understanding of the issues posed by invasive species on islands.

3. Identifying existing resources

Determining the presence and suitability of existing baseline data for the target island is an important activity. Existing baseline information may satisfy pre-eradication information needs and can inform future monitoring to replicate the baseline methodology. This exercise may identify stakeholders already engaged in monitoring on the target island, or nearby control islands, whose ongoing work may be tailored to inform eradication outcomes.

It is also valuable to assess the outcomes of other eradication projects that benefited similar species or ecosystems, for example ground-nesting seabirds like terns (*Sterna* spp.) perform well after the removal of all invasive mammalian predators (Brooke, et al., 2017). The

consistency with which previous eradications delivered particular outcomes will establish the level of confidence in achieving desired management goals. Syntheses have been undertaken for some taxa that outline broad-scale responses (e.g. Jones, et al., 2016; Schweizer, et al., 2016; Brooke, et al., 2017). Williams, et al., (2017) synthesised information from 16 before-and-after studies documenting seabird responses to predator removal and provide practitioners with effectiveness and certainty ratings for invasive mammal control as a conservation intervention. If the results among projects vary considerably, or there is a specific requirement for reporting to an audience on localised information, then monitoring is warranted.

4. Adopting a whole-ecosystem approach

When planning and designing monitoring, ecosystem processes and community structure should be considered (Zavaleta, et al., 2001; Prior, et al., 2018). By modelling the trophic interactions in a system, flow-on effects can be anticipated, reducing the likelihood of unexpected outcomes (e.g. Baker, et al., 2017). There is a gradient of approaches available to achieve this process, ranging from simple food web diagrams through to models with input from community/ecosystem ecologists. Generating sophisticated models is challenging for many sites owing to a lack of baseline information. However, even simple exercises capturing current and projected interactions within an ecosystem could aid planning. By considering the trophic interactions on an island, those component taxa of interest which are most likely to be impacted can be identified and elevated to monitoring targets. This will also clarify the complexity of the system which highlights the potential need for wider surveillance monitoring beyond anticipated outcomes.

5. Designing monitoring

There is a whole suite of taxa- and site-specific monitoring methods that projects can utilise—it is not our aim to discuss them here. Rather, we focus on three key elements of monitoring design: i) choosing between quantitative and qualitative monitoring methods; ii) determining what to monitor; and iii) allowing for pre- and post-eradication comparison.

The need for quantitative or qualitative monitoring is influenced by the audience to whom monitoring results will be communicated. As described above, a spectrum exists. At one end, are projects for which quantitative monitoring is required: for example, those with quantitative targets such as percentage population changes or reductions in negative trends; or those aiming to quantify outcomes to inform other eradication operations (e.g. by providing evidence for syntheses like Williams, et al., 2017). Further along the spectrum are projects that may need only to provide qualitative evidence of outcomes to laypersons' audiences: perhaps photo-plots illustrating the growth in vegetation following an eradication; or "traffic-light" assessments of ecological integrity (e.g. Tierney, et al., 2009) of an island system following eradication.

To serve most purposes, monitoring can likely focus on taxa or habitats identified when the target outcomes of the eradication were defined. But, when potential secondary outcomes have been identified, such as increases in invasive invertebrates or prey-switching by meso-predators, taxa or habitats predicted to be affected can also be selected as monitoring targets. When outcomes are highly uncertain, we recommend wider surveillance monitoring is undertaken to detect hard-to-predict secondary outcomes. In that case, taxa can be selected for monitoring based first upon need (they are predicted to be affected, but with unknown consequences), and then opportunity, e.g. continued monitoring is worthwhile because baseline data exist and monitoring can be continued easily; there are people involved in the project with particular expertise; there are taxa present for which monitoring is likely to be particularly cost-effective.

Sampling design should ideally occur before eradication. In some instances a Before-After-Control-Impact (BACI) approach may be possible (Quinn & Keough, 2002), whereby control islands (either those with invasive species but where no eradication is carried out, or those with no comparable invasive species at all) can be compared to experimental islands (those with the eradication e.g. Samaniego-Herrera, et al., 2017).

6. Monitoring cost

A major determinant of monitoring design is the economic cost, relative to available budget. For monitoring planned shortly after an eradication, an opportunity for cost saving is to combine efforts with activities to confirm the success or failure of the operation itself.

The amount invested should increase relative to risk and leverage potential (Montambault & Groves, 2009), but there are no clear guidelines on what proportion of a budget to allocate for monitoring and evaluation. There has been no review of proportional expenditures by conservation projects on monitoring and evaluation, but within the development sector and across major foundations typical expenditure is 3–5% of programme costs (Austrian Development Agency, 2009; Twersky & Arbreton, 2014), rising to an upper ceiling of 10% (Zondag, 2009). Establishing a fixed limit for monitoring budgets helps to guide monitoring design, and may result in iterative design to keep monitoring within budget. Including monitoring costs in the overall eradication budget is perhaps the most straightforward way of funding monitoring, when it is a relatively small component of the overall fund-raising target. However, funds secured in this way are often time-bound and not goal dependent—they often expire before monitoring has been conducted for enough years to demonstrate that a target outcome has been reached. Addressing this issue by exploring financial mechanisms such as endowment funds to separate and safeguard monitoring budgets and ongoing biosecurity, or integrate ecosystem monitoring with biosecurity monitoring, could help future projects and improve upon the current approach that relies on post-eradication fund-raising specifically for monitoring.

Making the most of monitoring results

With so many eradication projects now being carried out worldwide and many of them generating data through associated monitoring, it is increasingly difficult for scientists, managers and field officers to keep up to date with new findings, and they can be hampered by language barriers. Furthermore, the data generated are not always disseminated widely. Understandably, positive changes to target beneficiaries and to flagship species, are the most widely reported. Changes in the abundance of other taxa, especially plants and invertebrates, are less often reported, or likely monitored (Jones, et al., 2016; Towns, 2018).

Understanding the outcome of previous eradication projects' pre- and post-eradication monitoring may help new projects gain support for their work, may help to identify and thus allow minimisation of negative secondary impacts, and may help to optimise the allocation of resources to conservation actions where monitoring can be reduced. It is very important, therefore, that first the results from any monitoring that has occurred are disseminated, and second that the information is curated in a readily accessible and searchable manner accessible to technicians, land managers, scientists, conservation bodies, educators and other interested parties. Ideally, they would all be available via a single repository but nothing

exists currently (although there is a searchable database of island eradications; Holmes, et al., 2019). Although the outcomes of individual eradications may not be considered sufficiently novel for higher profile journals (Brooke, et al., 2018), a number of journals specifically promote the dissemination of evidence by promoting publication of the outcomes of conservation interventions (Sutherland, et al., 2017). There are opportunities for open access publishing with no limit on the number of papers publishable or the geographies covered, and a streamlined submission and review process. There is a range of ways in which results can then be disseminated more widely (Table 2).

Monitoring informs future conservation practice; it enables us to increase our likelihood of success and reduces uncertainty. We believe that there is a need to broaden information availability and shared resources through diverse platforms, in order to facilitate knowledge exchange. To date, the findings of post-eradication monitoring have not been consistently disseminated, so a behavioural change must be supported and requires incentivising. Including these costs in eradication budgets and encouraging donors to support the collection of evidence that confirms return on investment are first steps in tackling the problem.

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Table 2 Summary of dissemination routes for pre- and post-eradication monitoring data, particularly to the invasive species-specific technical community.

Media	Dissemination route	Target audience
Raw data	Inter-agency scientific collaborations	Invasive species practitioners and scientists
	Small organisations collaborating with larger ones who can support with data analysis and interpretation	Any
Analysed results	Journals reporting outcomes of conservation intervention in a searchable database	Invasive species-specific scientific and technical community
	Aliens-l listserver	Invasive species-specific scientific and technical community
	Held in central database (e.g. Database of Island Invasive Species Eradications—subject to copyright issues)	Invasive species-specific scientific and technical community
	Eradication project/ organisation websites	Invasive species-specific technical community
Technical reports	Briefing documents, e.g. POST (Parliamentary Office of Science and Technology) notes	Local, regional and national government
	Aliens-l listserver	Invasive species-specific technical community
	Regional websites, e.g. Pacific Invasives Learning Network, PestSmart Connect	
	Annual compendium	Invasive species-specific technical community
	Island Invasives Conference proceedings	Scientific and academic community, invasive species-specific scientific and technical community
	Community forums (newsletters, magazines, websites)	Community in which eradication project was conducted, communities in which similar projects are planned
Layperson reports	Through Aliens-l listserver	Invasive species-specific technical community
	Held in central database?	Invasive species-specific technical community
	Schools	Primary and secondary school children, and teachers
Educational materials	Universities (use examples in lectures on island restoration and species recovery)	Students
	Talks/presentations	Community in which eradication project was conducted, communities in which similar projects are planned, special interest groups (e.g. local bird or mammal groups)
	Web sites	
Social media	Projects own Facebook pages, and links to reports via twitter and instagram	Scientific and academic community, invasive species-specific scientific and technical community. Community in which eradication project was conducted, communities in which similar projects are planned, special interest groups (e.g. local bird or mammal groups)

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