Measuring the difference made by conservation initiatives: protected areas and their environmental and social impacts

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Success in conservation depends on our ability to reduce human pressures in areas that harbour biological diversity and ecosystem services. Legally protecting some of these areas through the creation of protected areas is a key component of conservation efforts globally. To develop effective protected area networks, practitioners need credible, scientific evidence about the degree to which protected areas affect environmental and social outcomes, and how these effects vary with context. Such evidence has been lacking, but the situation is changing as conservation scientists adopt more sophisticated research designs for evaluating protected areas’ past impacts and for predicting their future impacts. Complementing these scientific advances, conservation funders and practitioners are paying increasing attention to evaluating their investments with more scientifically rigorous evaluation designs. This theme issue highlights recent advances in the science of protected area evaluations and explores the challenges to developing a more credible evidence base that can help societies achieve their goals of protecting nature while enhancing human welfare.

1. Introduction

Protected areas, such as national parks and nature reserves, aim to ensure that some corners of the earth remain sheltered from human disturbance. By measure of their global coverage, these areas are transforming landscapes and seascapes: an estimated 14.4% of the land and 2.8% of the oceans were under some form of legal protection in 2014 [1]. However, by measure of their impacts—the difference that these protected areas have made to conservation outcomes—we have far less evidence of any grand transformation.

How much are protected areas contributing to the conservation of biological diversity and ecosystem services? How are these areas affecting the welfare of people who live near them, as well as other people who may enjoy the services (e.g. tourism) provided by the protected areas? Under what conditions do protected areas deliver their desired environmental and social impacts, and when do they deliver undesirable impacts? Given the evidence about how protected areas have worked in the past, how do we allocate future protected areas and budgets to maximize their desired impacts? The answers to these questions are both contentious (e.g. [2]) and important for ecosystem conservation in the twenty-first century.

Impact evaluation of protected areas is emerging as an exciting and rigorous field of scientific inquiry with the potential to add a new frontier to conservation science and to change the direction of policy [3,4]. This field draws from scientific advances in our ability to infer causality from non-experimental data and in our understanding of the ways in which protected areas are designed, located and managed. Building on these advances, impact evaluation studies apply robust empirical designs and rich datasets to estimate the effects that protected areas
have on environmental and social outcomes, relative to unobservable, counterfactual conditions in which protected areas are absent or appear in alternative forms.

This difference—between what we can observe and what we would have observed had we done conservation differently—is the impact that protected areas aim to cost-effectively maximize. Given our conservation budgets, we may seek, for example, to avoid as much loss of biodiversity and ecosystem services as possible. The concept of ‘avoided loss’ implies a difference between what we have achieved with specific forms of protected areas and what we would have achieved had we invested our conservation resources differently. This difference, however, cannot be inferred from the mainstream scientific studies that focus on measuring conditions in and around protected areas or on characteristics of protected area networks and management (e.g. dollars invested, protected area extent, representation of ecosystems; see [5,6]). A change in focus is needed.

Impact evaluation addresses the end, not the means, of nature conservation. To refocus science on this end, this theme issue brings together scientist and practitioner perspectives on ecological and human welfare outcomes, with examples from terrestrial and marine ecosystems. Together, the articles assembled in this issue point to a research agenda for the study of protected areas in the years to come. This agenda will necessarily be multidisciplinary, like the set of authors in this issue. Much of the agenda seeks to apply improved empirical designs, data and methods to provide better answers to old questions about protected area impacts and how those impacts vary across time and space.

The frontier of this research agenda, for which the beginning steps are outlined in this theme issue, emphasizes science that informs practice. It will include (i) more frequent collaborations among scholars and practitioners, (ii) research that elucidates the mechanisms through which protected areas affect environmental and social outcomes, and (iii) research that draws on evidence from retrospective studies to inform prospective studies that aim to predict impacts in new places and times, with new forms of protection. To be successful, this research agenda needs to be mainstreamed into the activities of the government and nongovernmental donors that support the establishment and management of protected areas [7]. To help implement this agenda, the articles in this theme issue tackle four key challenges.

2. Challenges addressed by articles in this issue

(a) Counterfactual thinking and a focus on selection

In their scene-setting article, Pressey et al. [5] in this issue describe the extent to which efforts to collect and analyse data on protected areas yield results that fail to inform decision-makers about the environmental and social impacts of protected areas and associated management activities (see also [6]). These authors further argue that influential and commonly applied policy targets and objectives for planning and managing protected areas could be detrimental to impact by misdirecting conservation resources.

To measure impacts, scholars must do more than simply document the conditions in and around protected areas and how they change over time (e.g. [8,9]). A focus on conditions in and around protected areas can yield misleading conclusions about impacts [10,11]. Consider, for example, the images from Malaysia on the cover of this theme issue. On the left is an image from a strictly protected area with no signs of human disturbance, and on the right is a forest concession with signs of logging and road construction. Conservation scientists and practitioners typically label protected areas like the one on the left as the "more effective" protected areas. Yet the forest on the left may have appeared exactly the same in the absence of the strictly protected area, whereas the forest on the right may have been completely deforested in the absence of the concession.

To determine which protected areas are most effective, scholars must attempt to estimate more rigorously what conditions would have been like in the absence of protected areas or in the presence of different forms of protected areas or other conservation actions; in other words, the relevant counterfactual conditions. The differences between the observed conditions and the counterfactual conditions are, by definition, the impacts that we seek to understand. Without a strong understanding of impacts based on rigorous methods, scientists cannot offer much guidance to practitioners aiming to conserve biological diversity.

As pointed out by Brockington and Wilkie [2] in their scene-setting article, failure to clearly define the relevant counterfactual conditions also leads to persistent, unproductive debates about the human welfare impacts of protected areas on poor, rural communities. The key question for this debate is not ‘Have communities lost access to natural resources after protected areas were established?’ or ‘Are communities near protected areas poorer, post-protection, than other rural communities?’ Rather, the key question is ‘Are communities better off than they would have been in the absence of protected areas, or with alternative forms of protected areas?’ For example, after a protected area was established, a community may have lost access to forest products and may have experienced a poverty rate of 60%, which was 20 percentage points higher than the average rural community in the same region. Yet if the counterfactual poverty rate in the absence of the protected area would have been 80%, a claim that the protected area made the community poorer would be misleading. An emphasis on estimating counterfactual conditions is an important first step in protected area evaluations and debates (and so is appropriate measurement of the outcomes; see [12]).

Estimating these counterfactual conditions from non-experimental data, however, is challenging and fraught with pitfalls. As documented elsewhere [10,13,14], much of the literature on protected area effectiveness is characterized by comparison of outcomes ‘before protection and after protection’ or ‘with protection and without protection’. Before—after comparisons, however, are confounded by factors unrelated to protection that change over time, such as changes in policy or demand for natural resources (i.e. the ‘before’ is a poor estimate of counterfactual conditions). With—without comparisons are confounded by factors that are systematically associated with the measured outcomes and where and when protection is assigned (i.e. the ‘without’ is a poor estimate of counterfactual conditions). If, for example, protected areas tend to be located on land with low suitability for agriculture, the relevant counterfactual conditions are not represented by conditions on nearby areas with high agricultural suitability. In general, these two popular designs used to estimate counterfactual conditions are unable to eliminate the likely rival explanations—those
unrelated to the type of protection applied—for the empirical patterns we observe.

To better estimate counterfactual conditions, scientists have made important advances in clarifying the research designs, data and assumptions that can be brought to bear [4], both for retrospective and prospective studies (see [15–22]). This theme issue highlights both the advances that have been made and the challenges that remain in applying them more broadly to protected areas.

A key component of these advances is greater attention to understanding selection: why are some habitats or species selected to be exposed to a given form of protection while others are not? Attention to this question is largely absent in the empirical scientific literature on protected areas, both marine and terrestrial. Yet the answers to the question are critical for impact evaluations; in retrospective studies, these answers identify the confounders (rival explanations) whose role must be eliminated to isolate the impacts of protected areas. (The answers also point to appropriate research designs, like those that condition on observable confounders or use instrumental variables [4]). For example, some areas are selected for protection because they are unproductive for other economic uses (see [5]). When we attempt to isolate the effects of protected areas on ecological indicators, we must disentangle the effects caused by protected areas from the effects caused by the productivity of the landscapes or seascapes that are typically protected. In both retrospective and prospective studies, the answers to the question about selection identify moderators and mechanisms of protected area impacts (see [17,19–21,23]). The ways in which these factors shape impacts must be elucidated if we are to have a sound evidence base for guiding protected area management.

(b) Understanding heterogeneity: treatments, moderators and mechanisms

As noted by several articles in this theme issue [5,15,23], protected areas are not homogeneous in their rules or management inputs. Like medical treatments, they represent a range of interventions. For example, some protected areas restrict most human uses, while others permit extraction under regulated conditions. Some employ unarmed guards from local communities while others use armed guards from other regions and issue shoot-on-sight rules for poachers. Capturing this rich complexity of protected area design and implementation is a challenge for researchers seeking to estimate protected area impacts. It is a challenge both because we lack good theory and data on protected area management decisions and because the empirical designs required to evaluate multidimensional interventions like protected areas are demanding in terms of sample size and assumptions.

Even if protected areas were homogeneously applied across time and space, heterogeneous impacts could still arise because the moderators and mechanisms of impacts vary across time and space. For example, protected areas may reduce poverty when they are accompanied by tourism, but not otherwise [24]. Although the science of protected area mechanisms is in its infancy [23], progress is being made on elucidating the factors that moderate protected area impacts.¹ Several of the studies in this issue show how one can go beyond simply estimating the magnitude of protected area impacts towards characterizing how impacts vary conditional on observable, contextual characteristics such as the habitat’s slope and distance to cities or the local communities’ gender and religion composition [15,17,19].

With a better understanding of the important moderating contextual characteristics, practitioners can better site and design protected areas to maximize the desirable impacts. Moreover, with a better understanding of how heterogeneous impacts have arisen in the past, scholars can do better in their attempts to predict future impacts from creating or expanding protected areas in currently unprotected landscapes and seascapes, or from applying new management innovations in existing protected areas.

(c) Predicting impacts in novel contexts

Understanding how protected areas have affected environmental and social outcomes in the past is an important step towards evidence-based protected area management. Another important step is to take the concepts and results from retrospective studies and use them to improve prospective studies, which aim to guide decision-makers in their efforts to establish new protected areas and improve existing ones. Protected area managers are often less interested in the impacts of what they have already done, and more interested in the likely impacts of what they are planning to do.

Prospective studies from the field of conservation planning, when infused with the evidence from retrospective studies and explicit emphases on counterfactual future scenarios, can help decision-makers predict impacts in novel contexts in space, time or protected area configuration. Such predictions will be absolutely critical to enhancing the impacts of protected areas over time. However, achieving an integration of retrospective and prospective impact studies in a unified scientific architecture will take substantial communication and collaboration among evaluators, planners and modellers. Initial steps towards this integration are outlined in three articles in this issue [20–22].

(d) Mainstreaming impact evaluation

The field of medicine has a long-standing tradition of encouraging scholar–practitioner collaborations to generate empirical evidence about the impacts of potential treatments and the conditions under which the treatments work best. Practitioners pose relevant questions to be solved, craft policy targets to be achieved, provide funds to support the development of solutions, and provide the contexts and data through which scholars can test the potential solutions. Scholars help shape the practitioner questions in ways that make them testable and their answers more likely to be generalizable, help formulate policy targets so that they are articulated in a scientifically sound manner and well connected to practitioner goals, provide advice on implementation designs that facilitate inferences about impacts, and help collect and analyse data to draw credible inferences about treatment effects, and the moderators and mechanisms of these effects.

Several articles in this issue highlight how similar scholar–practitioner collaborations will be needed in conservation if protected area impact evaluations, both retrospective and prospective, hope to have an effect on how conservation is actually done in the field [6,25,26]. They characterize both the promise of such collaborations and the serious obstacles to making them a mainstream feature of conservation science and practice. They also highlight how these same obstacles have been addressed in other areas of public policy.
Even in nature conservation, however, there are indications that obstacles are being surmounted. Pressey et al. [5] show the feasibility of policy targets and operational objectives for planning and managing protected areas that are directed towards increasing impact. McKinley et al. [25] draw lessons from experiences at a global NGO that is committed to improving their impact evaluations. Ahmadia et al. [18] provide an example of mainstreaming of impact evaluation in the marine environment. The models described by Fulton et al. [20] are used by marine managers to provide safe, virtual environments for testing alternative settings for regulation and management before they are used in the real world.

3. Conclusion
The articles in this theme issue highlight both where the science of protected areas is headed, and how far we still have to go to create a scientific evidence base that can guide protected area design and management decisions. The articles also highlight that, fundamentally, good impact evaluation is simply good science. Like good science, good impact evaluation demands the development of coherent, mechanism-based causal theories and, in empirical studies, attention to context and to rival explanations for empirical patterns. To be meaningful to conservation practice, good impact evaluation also demands multidisciplinary efforts embedded within scholar–practitioner collaborations.

In the future, better impact evaluations will lead to better evidence about how protected areas affect environmental and social change relative to alternative conservation and development interventions. Better evidence will lead to more relevant policy targets and better designed programs to achieve these targets. The community of conservation science and practice still has a way to go to achieve this future, but as the articles in this theme issue demonstrate, it is within reach.

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Endnote
¹Mechanisms are factors affected by protected areas, which mediate protection’s effects on outcomes. Moderators are unaffected by protected areas, but moderate the magnitude of protection’s impacts (for more details, see [24]).

Guest editor profiles

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References


