Essay

Knowing But Not Doing: Selecting Priority Conservation Areas and the Research–Implementation Gap

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Abstract: *Conservation assessment is a rapidly evolving discipline whose stated goal is the design of networks of protected areas that represent and ensure the persistence of nature (i.e., species, habitats, and environmental processes) by separating priority areas from the activities that degrade or destroy them. Nevertheless, despite a burgeoning scientific literature that ever refines these techniques for allocating conservation resources, it is widely believed that conservation assessments are rarely translated into actions that actually conserve nature. We reviewed the conservation assessment literature in peer-reviewed journals and conducted survey questionnaires of the authors of these studies. Two-thirds of conservation assessments published in the peer-reviewed scientific literature do not deliver conservation action, primarily because most researchers never plan for implementation. This research-implementation gap between conservation science and real-world action is a genuine phenomenon and is a specific example of the "knowing-doing gap" that is widely recognized in management science. Given the woefully inadequate resources allocated for conservation, our findings raise questions over the utility of conservation assessment science, as currently practiced, to provide useful, pragmatic solutions to conservation planning problems. A reevaluation of the conceptual and operational basis of conservation planning research is urgently required. We recommend the following actions for beginning a process for bridging the research-implementation gap in conservation planning: (1) acknowledge the research-implementation gap is real, (2) source research questions from practitioners, (3) situate research within a broader conservation planning model, (4) expand the social dimension of conservation assessments, (5) support conservation plans with transdisciplinary social learning institutions, (6) reward academics for societal engagement and implementation, and (7) train students in skills for "doing" conservation.*

Keywords: area selection, conservation planning, knowing-doing gap, social learning, systematic conservation assessment

Sabiendo pero No Haciendo: Selección de Áreas Prioritarias para la Conservación y la Brecha Investigación-Implementación

Resumen: *La evaluación de la conservación es una disciplina que evoluciona rápidamente y cuya meta es el diseño de redes de áreas protegidas que representen y aseguren la persistencia de la naturaleza (i.e., hábitats de especies y procesos ambientales) mediante la separación de áreas prioritarias de las actividades que las degradan o destruyen. Sin embargo, no obstante una creciente literatura científica que refina estas*

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técnicas para la asignación de recursos para la conservación, es amplia la creencia de que las evaluaciones de la conservación raramente se traducen en acciones que realmente conservan la naturaleza. Revisamos la literatura sobre evaluación de la conservación en revistas con revisión por pares y aplicamos cuestionarios a los autores de estos estudios. Dos tercios de las evaluaciones de conservación publicadas en la literatura científica revisada por pares no consideran acciones de conservación, primariamente porque la mayoría de los investigadores nunca planean la implementación. Esta brecha investigación-implementación entre la ciencia de la conservación y la acción en el mundo real es un fenómeno genuino y es un ejemplo específico de la "brecha conocer-actuar" que es ampliamente reconocida en la ciencia del manejo. Debido a los recursos tristemente inadecuados que se asignan a la conservación, nuestros resultados originan preguntas sobre la utilidad de la evaluación de la conservación, como es practicada actualmente, para proporcionar soluciones pragmáticas a los problemas de planificación de la conservación. Se requiere urgentemente una reevaluación de las bases conceptuales y operativas de la investigación para la planificación de la conservación. Recomendamos las siguientes acciones para iniciar un proceso para reducir la brecha investigación-implementación en la planificación de la conservación (1) reconocer que la brecha investigación-implementación es real, (2) obtener preguntas de investigación con profesionales, (3) situar la investigación en un modelo de planificación de la conservación más amplio, (4) expandir la dimensión social de las evaluaciones de la conservación, (5) apoyar los planes de conservación con instituciones de aprendizaje social transdisciplinarias, (6) recompensar a académicos por compromisos con la sociedad y su implementación y (7) entrenar a estudiantes en habilidades para 'hacer' conservación.

Palabras Clave: aprendizaje social, brecha conocer-hacer, evaluación sistemática de la conservación, planificación de la conservación, selección de área

Introduction

Unnaturally high rates of species extinction and habitat loss through anthropogenic activities have plunged the world into an environmental crisis (Pimm et al. 1995; Vitousek et al. 1997). The resources allocated to stemming this crisis are minute compared with the resources allocated to the activities causing the massive decline (James et al. 1999). A great deal of time, money, and effort has been invested in the development of spatially explicit techniques for identifying candidate areas for conservation action. These techniques, commonly called conservation assessments, provide scientifically defensible information for the efficient deployment of conservation resources. They enhance the effectiveness of implemented conservation actions by better ensuring ecological functioning and resilience of protected areas, minimizing implementation and opportunity costs, reducing conflict between interest groups, and avoiding reactive litigation by developers (Noss et al. 1997; Soulé & Terborgh 1999; Margules & Pressey 2000).

When perceived as a subdiscipline of conservation biology, the science of conservation assessment has evolved from a strong belief in the importance of conservation researchers doing research of societal relevance (Soulé & Wilcox 1980). Undertaking research that is not only innovative but useful is a recently expressed goal of the Society for Conservation Biology (Meffe et al. 2006). There has been an exponential increase in the number of conservation assessments published in the peer-reviewed literature since the late 1980s (Pressey 2002). Despite this growth in productivity, however, a wide spectrum of practitioners and researchers have suggested that few conservation assessments published in the peer-reviewed literature are translated into conservation action (e.g., Noss et al. 1997; Prendergast et al. 1999; Cabeza & Moilanen 2001; Whitten et al. 2001; Balmford 2003). If the science of conservation assessment is not leading to actions that effectively conserve nature then what is the point of it (Whitten at el. 2001)?

This research–implementation gap in conservation planning manifests in a number of ways. Documented cases of conservation assessments successfully being translated into conservation action are relatively rare in the peer-reviewed literature (Ehrenfeld 2000; Maddock & Benn 2000), as are conservation assessments that attempt, but fail, to be translated into effective action (Jepson et al. 2002; Knight 2006). Global-scale conservation assessments are thought to lack effectiveness in informing the delivery of conservation action (Mace et al. 2000; Whitten et al. 2001; Brummitt & Lughadha 2003). Rather than doing conservation, researchers appear preoccupied with describing the lack of representativeness of existing protected-area networks, experimentally testing data, and improving the efficiency of area selection algorithms in theory (Rodrigues et al. 2000; Knight et al. 2006*a*). The activities of conservation organizations rarely appear to be informed by published research (Pullin et al. 2004), and conservation and land management organizations typically develop their own conservation assessment techniques independently of research in published journals (Prendergast et al. 1999; Hopkinson et al. 2000).

This gap between research and implementation is almost certainly the norm for other subdisciplines of conservation biology (Saunders et al. 1991; Pickett et al. 1997;

Ehrenfeld 2000; Stinchcombe et al. 2002; Linklater 2003). For example, Linklater (2003) found that the quantity of scientific literature on endangered rhinoceros increased in response to its decline, but became dominated by ex situ laboratory-based studies despite conservation action plans identifying in situ and ecological studies as priorities. More generally conservation biology has a poor record of translating research into action because most research has been theoretical (Salafsky et al. 2002). Whitten et al. (2001) laments our impotence as a discipline to stem habitat destruction and species extinction in priority areas. Fazey et al. (2005) found that only 20% and 37% of studies had high relevance to policy and management, respectively. Many more examples of this gap between published conservation biology research and priorities for action could be cited.

This "knowing–doing gap" (Pfeffer & Sutton 1999) is also widespread in many other applied sciences, for example management and organizational science (Pfeffer & Sutton 1999; Starbuck 2006), environmental psychology (McKenzie-Mohr 2000; Sommer 2003), ecology (Ehrlich 1997), restoration ecology (Higgs 2005), landscape ecology (Opdam et al. 2001), and ecosystem management (McNie 2007). It is clear that the science of conservation assessment is not alone in facing the challenge of translating research into action.

In the conservation sciences we rarely ask of ourselves how well we are performing (Ehrenfeld 2000), so here we focused on the importance of critiquing the design and application of area selection studies (Cowling et al. 2004). We sought first to establish whether the research–implementation gap in conservation planning is a real phenomenon by assessing the extent to which conservation assessments published in the peer-reviewed literature have been translated into action. Second, we examined whether authors of conservation assessments intended to implement research outcomes. Third, we examined whether or not the objectives of a conservation assessment influenced the perceived effectiveness of implemented actions. Our objective is to highlight current limitations in the way the science of conservation assessment is practiced, with a view toward improving the societal relevance and effectiveness of this research (Cowling et al. 2004). Confirming or denying the research–implementation gap is fundamental to identifying new and more effective approaches to the design and implementation of conservation assessments.

Methods

We investigated the research–implementation gap in conservation planning through a literature review linked to an international questionnaire survey of authors. We identified all articles containing a conservation assessment that appeared in a peer-reviewed journal written in English between 1998 and 2002. We defined a conservation assessment as any spatially explicit, repeatable approach that identified areas as potential priorities for nature conservation activities. We did not include expert-based approaches because these appear to be considered by many conservation researchers as distinctly less defensible approaches and because they form a relatively small proportion of the peer-reviewed literature. Gap analyses and assessments of representativeness were also excluded, unless they specifically took the step beyond the assessment of conservation status to area selection, because conservation status and area selection are related but different activities (Pressey & Cowling 2001). Where a suite of publications was developed from one project, we assessed only the paper detailing the conservation assessment. Grey literature was excluded because of the difficulties of comprehensively collating it. We reviewed the literature from 1998 to 2002 because (1) conservation assessment is a relatively young science, and technique testing early in the life of the discipline was essential for establishing the relative benefits and limitations of different approaches, (2) examination and understanding of recent trends in the discipline is of far greater use for identifying the existence of, and solution for, the research–implementation gap than trends in the mid- to distant past, and (3) our experience with a significant and growing number of pragmatic regional conservation planning initiatives (e.g., Knight et al. 2006*b*) suggests that implementation may take several years to get underway, meaning the 4-year lag between 2005 (when the review was undertaken) and the 2002 cutoff provides sufficient time for implementation to have begun.

The questionnaire included 4 questions and was specifically designed to be simple and rapidly completed by respondents so as to secure a high response rate. It was emailed to lead authors, or the author listed for contact, of identified articles. If the first author could not be located, another author was contacted. Questionnaires were sent to authors of 159 conservation assessments.

Results

We secured a 55.3% response rate (88 responses received). Responding authors were primarily from universities (59.1%) but also were from research groups (22.7%), government departments (11.4%), and nongovernmental organizations (4.5%).

We reviewed the literature for the degree to which questionnaire responses from authors of published conservation assessments reported implementation activities. Only 5.7% (5) documented the implementation of actions that promoted nature conservation on the ground. Almost one-third of conservation assessments (29.5%, 26) discussed implementation in theory (i.e., the actions that could be undertaken). Implementation was not mentioned in 62.5% (55) of the articles reviewed. Questionnaire results revealed that implementation of action occurred more often than the peer-reviewed literature indicates, with 33.0% (29) of conservation assessments leading to implementation of action.

Overall, 26.1% (23) of conservation assessments had the objective of implementing some form of action. The identification of areas for implementation of conservation action was the primary objective in 19.3% of the studies, and an additional 6.8% (6) sought to identify areas for the implementation of action and to improve research techniques for priority area identification. Almost 70% (60) of conservation assessments were formulated primarily to improve research techniques, with little or no intention to implement action.

Actual attempts to translate conservation assessments into action were marginally higher than indicated by their objectives: in 33.0% (29) of the studies, implementation attempts were made. The intention to implement action was strongly linked to the objective of the conservation assessment. More than 94% (16) of conservation assessments whose objective was to implement action and 83.3% (5) whose objectives were to implement action and improve conservation assessment techniques actually were implemented. Only 11.7% (7) of conservation assessments whose primary objective was to advance science through improvement of conservation assessment techniques resulted in action being implemented.

Respondents were also asked to rate the perceived effectiveness of the actions implemented. Of the 108 actions reported from the 29 conservation assessments that attempted implementation, only 13.0% (14) were considered "highly effective." The majority of implemented actions—58.3% (63)—were considered only "fairly effective." "Poorly effective" and "ineffective" actions were reported by almost one-fifth (19.4%, 21) of respondents. These results are researcher's perceptions and are not the result of quantified monitoring of conservation effectiveness.

Discussion

The research–implementation gap in conservation planning is a real phenomenon. It is possible that our results overestimate the extent of this gap because authors may be unaware of implementation activities that use their research. Nevertheless, we regard this as unlikely, because practitioners typically do not access the peer-reviewed literature (Redford & Taber 2000) in search of techniques to implement, and most implementing organizations have developed their own (often unpublished) conservation assessment techniques (Prendergast et al. 1999; Hopkinson et al. 2000). In addition, the research–implementation gap may be narrower in the grey literature, which we did not analyze because it is not systematically accessible.

It is of great concern that the majority of conservation assessments published in the peer-reviewed literature were not designed with the intention to implement conservation action. Unsurprisingly, conservation assessments not designed to be implemented were not translated into action. Of those that were intended for implementation, the majority led to implementation of conservation action, albeit with questionable effectiveness. This raises an important question. Why are conservation researchers, who have chosen a mission-oriented career, failing to do science that contributes meaningfully toward stemming the environmental crisis?

Basic research is doubtless an essential complement to the genesis and continuing effectiveness of all applied sciences, including conservation science (Noss 1999). Nevertheless, our theoretical understanding of the technical dimensions of conservation assessment now far exceeds our ability to apply this knowledge effectively to solving pragmatic conservation planning problems. For example, conservation assessments should include economic costs of implementation if interventions are to be cost-effective (Naidoo et al. 2006); however, we are far from being able to establish institutional structures that ensure the effective spending of conservation funds in priority areas (e.g., Smith et al. 2003).

Conservation assessment is but one relatively small but essential stage of operational models for conservation planning (Pressey et al. 1996; Knight et al. 2006*a*). Unfortunately, the majority of conservation planning research is focused on conservation assessment at the expense of other stages that are arguably more important for implementing effective conservation action. The rich literature on conservation assessment manifests as a preoccupation by researchers with developing ever more elegant techniques to apply to a diminishing pool of increasingly well-known subjects (Kirkpatrick & Brown 1991). The causes of the research–implementation gap are undoubtedly a complex suite of factors, so how does one improve the societal relevance of conservation assessments?

Recommendations for Bridging the Research–Implementation Gap

Ensuring that conservation assessment techniques are of societal relevance requires a move beyond the trickle-down, transfer, and translate models of knowledge dissemination (van Kerkhof & Lebel 2006). Much more is required than merely publishing research in high-impact journals in the hope that the outcomes will trickle down to practitioners. Moreover, providing practitioners access to the literature (Prendergast et al. 1999) or even assisting them through the translation of research outputs and direct transfer of skills (Rodrigues et al. 2000) is likely to have limited success in closing the knowing–doing gap (Pfeffer & Sutton 1999; van Kerkhof & Lebel 2006). Below we present recommendations for both scientific institutions and individual researchers to better ensure conservation assessments are usefully applied to pragmatic conservation problems.

1. Acknowledge the research–implementation gap is real.

First, the research–implementation gap in conservation planning must be acknowledged as a real phenomenon. Management science has been researching the knowing–doing gap for several decades. Earlier refutations of the research–implementation gap in conservation planning (e.g., Pressey 1999; Pressey & Cowling 2001) have successfully clarified lingering misunderstandings and promoted the benefits of adopting conservation assessment techniques but have not denied the existence of this gap. Bridging the research–implementation gap requires that we as a scientific community acknowledge and agree we generally are not conducting research of societal relevance and move beyond simply noting the existence of the research–implementation gap to implementing tangible changes to correct it.

2. Source research questions from practitioners.

Those doing conservation assessment research typically do not have responsibility for processes that implement conservation action. If they wish to translate their research into action, then they must engage practitioners (Knight et al. 2006*b*). In short, conservation planners must facilitate a solution to a specific practitioner's need; it is generally not effective to conduct a conservation assessment and then attempt to promote it post hoc to a practitioner (Knight et al. 2006*b*). Researchers should therefore formulate problems collaboratively with stakeholders so as to comprehensively understand implementation opportunities and constraints and design user-useful, user-friendly assessments (e.g., Theobald et al. 2000; Pierce et al. 2005).

3. Situate research within a broader conservation planning operational model.

Conservation assessment techniques are useful tools for allocating conservation resources; however, alone, these can never manifest conservation action (Cowling et al. 2004; Knight et al. 2006*a*). Conservation assessments that are translated effectively into action are typically situated within a broader conservation planning operational model (e.g., Brunckhorst 2000; Knight et al. 2006*a*). These operational models typically integrate a range of activities as a suite of multiple stages, of which conservation assessment is but one early stage. Conservation assessment is complemented with other stages, including stakeholder visioning, development of planning products and an implementation strategy, mainstreaming of outcomes, enabling (i.e., capacity building) of stakeholders, and finally the implementation of conservation instruments and social learning institutions (Knight et al. 2006*a*). Specifically, conservation assessments should be linked to implementation strategies that detail the actions required to manifest conservation opportunities at areas identified as important for achieving conservation goals. Together these strategies comprise an effective conservation plan (Knight et al. 2006*a*, 2006*b*).

4. Expand the social dimension of conservation assessments.

If a conservation assessment is to be usefully applied, it must be conducted in a context that situates it within the real world. This requires an accurate understanding of how social-ecological systems function (Meffe 2001; Carpenter & Folke 2006). This can be operationalized in 2 ways. First, conduct a social assessment of a planning region prior to, and with equivalent resourcing as, a conservation assessment (Cowling & Wilhelm-Rechmann 2007). This ensures a sound understanding of implementation opportunities and constraints and may serve as an early means of engaging stakeholders. Second, it is more useful to map conservation opportunities than priority areas on the sole basis of biological or environmental data (Knight & Cowling 2007). Mapping conservation opportunities with a range of human, social, and economic data greatly facilitates the translation of maps of important areas into action (Knight et al., unpublished data). Researchers should focus on natural systems and processes compromising valued nature (Margules & Pressey 2000) and on key people, networks, and institutions affecting decision making and conservation instruments appropriate for implementation (Salafsky et al. 2002; Knight et al. 2006*a*). This allows the development of a land management model that can be collaboratively developed with stakeholders to guide implementation (Hulse et al. 2004).

5. Support conservation plans with transdisciplinary social learning institutions.

Many practitioners appear not to realize the benefits of science for decision making (Pressey 1999). There is an urgent need for institutions that translate science into action by fostering relationships between researchers and practitioners (Prendergast et al. 1999). Examples include high-level, multijurisdictional, decision-making committees (e.g., Lee 1993), thematic bioregional initiatives (e.g., Soulé & Terborgh 1999), and local-scale forums for engaging stakeholders in conservation and natural resource management (e.g., Knight & Cowling 2006). These should focus on a transdisciplinary approach to social learning and adaptive management (Salafsky et al. 2002; Carpenter & Folke 2006; Knight et al. 2006*a*) so as to constantly improve decision-making processes through learning. This requires researchers to cease overstating the importance of theoretical research (Prendergast et al. 1999), be humble and interested in practitioners' needs, and refocus their worldview on the effectiveness of actions rather than the efficiency of algorithms (Prendergast et al. 1999; Rodrigues et al. 2000). In doing so, they will need to fit in with broader planning processes, build networks with a diverse range of stakeholders of complementary skills, and advocate the value of nature, the importance of science to establishing effective management, and the benefits of conservation assessments.

6. Reward academics for societal engagement and implementation.

Academics appear generally to regard societal engagement and implementation activities as unprofitable (Diamond 1986). Researchers who (understandably) wish to advance their careers achieve progress by conforming to existing structures and processes (Starbuck 2006). Nevertheless, research institutions typically promote inward-looking, unidisciplinary approaches (Max-Neef 2005) and so place little value on implementation, which is outward-looking and multi- and interdisciplinary in practice. Few institutions offer incentives encouraging researchers to do useful research (Burbidge & Wallace 1995) and perversely discourage useful research by valuing the production of information above doing conservation through institutional structures that reward researchers for publications in high-impact journals that eschew implementation issues (Campbell 2005). It is therefore imperative that organizations such as the Society for Conservation Biology (1) convince administrators of research institutions of the value and importance of applied research; (2) encourage reformation of staff progression criteria, inclusive of incentives for researchers to engage society and conduct pragmatic research (Hobbs 1998; Briggs 2001); (3) convince funding bodies to encourage applied research and demand accountability for implementation; and (4) promote the publication of pragmatic studies in peer-reviewed journals.

Academic conservation planners will find the move beyond conservation assessment into a broader conservation planning process challenging because they will be required to balance their personal values against the values and challenges of working collaboratively with practitioners (Davis et al. 1999; Kiker et al. 2001; Hulse et al. 2004); the extended time periods required for effective implementation, which counters the demand for regular publications (Pressey & Taffs 2001); the prospect of their recommendations being drastically modified by political, social, and economic imperatives (Peters 1991; Soulé & Terborgh 1999; Margules & Pressey 2000); and the reality that even the best-designed and engaged conservation planning process can fail to be implemented for unforeseen reasons.

7. Train students in skills for doing conservation.

Universities produce conservation professionals with excellent skills for describing the current environmental decline, but without the skills to stem it (Soulé 1986; Jacobson & McDuff 1998; Penn 2003). Conservation biology courses must embody consilience—the fusion of knowledge traditions (Wilson 1998)—complementing knowledge and skills from the humanities, social sciences, and natural sciences. Students must be taught the skills required to do effective conservation and about the formulation of scientific thought, the mission of conservation science, the responsibilities of being a conservation professional, how projects operate in the real world (see Salafsky et al. 2002 for an excellent example), and specifically about the research–implementation gap.

A Call to Action

The science of conservation assessment has lost its way and become a displacement behavior for academia (Whitten et al. 2001), one in which research identifies where conservation needs to be done, but is silent on how to actually achieve it (Knight et al. 2006*a*). This impotence can be remedied because conservation assessment techniques have much potential to transform conservation planning (Prendergast et al. 1999; Salafsky et al. 2002). Nevertheless, we are not in the business of "what might be." Our collective fascination with ever-refining computer-based conservation assessment techniques must be tempered by the need to develop techniques that can deliver products that are useful for implementation.

Ultimately, an effective conservation planner is one who links knowing and doing. Inevitably, this requires engaging people and the choices they make. Excellent examples exist in which conservation planners have built productive partnerships with practitioners, collaboratively identified conservation problems so as to understand implementation opportunities and constraints, and designed conservation assessment approaches and conservation planning products tailored to meet practitioners' needs for achieving conservation goals (e.g., Kirkpatrick 1983 from Pressey 2002; Pressey 1998; Cowling et al. 1999; Stoms et al. 2002; Rouget et al. 2006). Although the science of conservation assessment alone will only ever be able to solve a small proportion of conservation problems (Schön 1983; Cowling et al. 2004), it is, however, an important component of broader conservation planning processes that deliver effective conservation action. We have much to learn about how to situate conservation assessments and translate them into effective action, but conservation researchers who engage society and the needs of practitioners (Salafsky et al. 2002; Knight et al. 2006*b*) are well on the way toward bridging the research–implementation gap in conservation planning.

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