



An evaluation of environmental, institutional and socio-economic factors explaining successful conservation plan implementation in the north-central United States



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ABSTRACT

Conservation plans are commonly used tools for prioritizing areas for protection, but plan implementation is often limited and rarely formally evaluated. Without evaluations of planning outcomes, it is difficult to justify expending resources to develop new plans and to adapt future plans so they are more likely to achieve desired conservation outcomes. We evaluated implementation of four conservation plans in Wisconsin, USA, by quantifying land protection within plan boundaries over time. We found that 44% of lands inside plans are currently protected, compared to 5% outside plans. We then asked which environmental, institutional, and socio-economic factors explained implementation of the most recent (2008) plan by the state natural resources agency. Institutional and environmental metrics related to agency policy and past actions explained 61% of implementation variability among individual priority areas within the plan: the agency having secured acquisition authority (a policy requirement) and subsequently successfully protected land in the priority area prior to the conservation plan being completed, and acquiring land near open water (a policy priority). Our findings suggest that implementation is possible under a wide variety of socio-economic settings and indicate that development of new conservation plans may not necessarily lead to action in new locations in the near term, but rather may facilitate action in locations where the institutional groundwork for action has already been laid. Considering institutional policies of active conservation partners in the development of future conservation plans can facilitate identification of priority areas that are more likely to correspond with on-the-ground implementation opportunities.

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1. Introduction

Conservation plans (hereafter, plans) are commonly used tools by governmental agencies and non-governmental conservation organizations worldwide. Plans are intended to guide conservation actions, and to provide a framework for evaluating conservation achievements (Bottrill and Pressey, 2012). Unfortunately, relatively few plans are implemented, and in few cases are implemented actions considered highly effective, leading to what has been termed the planning–implementation gap (Knight et al., 2008). Formal evaluation of plan implementation is still rare (Bottrill and Pressey, 2012), making it difficult to justify continued resource expenditures for developing new plans (Groves et al., 2002) and impeding the adaptive management process (Grantham et al., 2010).

Biodiversity conservation can be achieved through a variety of actions, including species and habitat management, policy and legislation,

education, training/capacity building, and research (Kapos et al., 2009). Land protection through acquisition or conservation easements continues to be the backbone of many conservation strategies (Bengston et al., 2004), and is one of the primary outcomes expected by staff and stakeholders developing conservation plans (Bottrill et al., 2012). Thus evaluating land protection within plan boundaries is one approach for quantifying implementation success (Bottrill and Pressey, 2012).

While conservation plans are often based primarily or solely on biological data (e.g., Lerner et al., 2006), social, economic, and political conditions at national, regional and local scales often shape opportunities for implementing plans (Knight et al., 2011a; Radeloff et al., 2013) and affect the ability and willingness of organizations to act on those opportunities (Cowling and Wilhelm-Rechmann, 2007; Ban et al., 2013). At national levels, social and political conditions can greatly influence when major conservation actions are likely to occur (Radeloff et al., 2013). Political affiliation, income, and education have all been shown to influence support for local conservation actions, including land protection (Bultena and Hoiberg, 1983; Kroetz et al., 2014; Moon et al., 2012). Social factors specific to the planning process, such as ineffective

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stakeholder involvement, can lead to low acceptance of plans and limited support for their implementation (Martin et al., 2012). Land ownership and tenure patterns may shape opportunities for land protection within a region (Knight et al., 2011b), and land value may determine where land protection is most likely (Scott et al., 2001).

Institutional factors may also play an important role in conservation plan implementation. A lack of human and financial resources within agencies and other participating organizations may limit implementation opportunities, particularly when proposed actions include land protection, which is staff- and funding-intensive (Knight et al., 2011a). Agency missions as well as broader societal concerns may stipulate that lands protected for biodiversity also serve additional purposes, such as supporting local economies, which can restrict viable implementation options (Sunderlin et al., 2005). Agency policies may also define priorities (e.g., US Fish and Wildlife Service, 2014) or impose limitations (e.g., Wis. Admin. Code NR §1.41) on where land can be protected at broad and local scales. Being aware of and explicitly accounting for these socio-economic and institutional factors in planning processes is critical for the success of conservation plans and programs (Ban et al., 2013; Faleiro and Loyola, 2013).

Our overarching goal was to understand the circumstances under which implementation of conservation plans may be most likely. Our objectives were to 1) evaluate to what extent past plans have been implemented, and 2) identify which environmental, institutional and socio-economic factors best explain where recent plan implementation efforts have been successful. We assessed implementation by quantifying land protection within plan boundaries for four plans established for the state of Wisconsin, USA, using more than a century of land protection records. We developed a conceptual model of the implementation process to facilitate identification of specific environmental, institutional and socio-economic metrics that may influence implementation of conservation plans. We then evaluated which metrics explained implementation success of the most recent (2008) plan, as this is the most relevant time period for informing future implementation efforts. Our analysis used existing spatial datasets that are available across most regions of the world to facilitate application of our approach in other locations.

2. Methods

2.1. Study area

Wisconsin is a biologically diverse state in the north-central United States covering approximately 145,000 km². Tallgrass prairies and oak savannas historically dominated southern Wisconsin; northern hardwood forests dominate northern Wisconsin. Current major threats to biodiversity include habitat loss, invasive species, and pollution (WDNR, 2005), and housing development is the major cause of habitat loss and fragmentation (Radeloff et al., 2005). Wisconsin's state natural resources management agency, the Wisconsin Department of Natural Resources (WDNR), has a long history of conservation planning and land protection, and continues to actively protect land (Carter et al., 2014a).

2.2. Evaluating implementation of conservation plans

Statewide, spatially-explicit conservation plans were completed for Wisconsin in 1939, 1964, 2004, and 2008 (Wisconsin State Planning Board and Conservation Commission, 1939; National Park Service, 1964; Pohlman et al., 2006; WDNR, 2008). All four plans were expert-based and developed by or in close collaboration with WDNR (Appendix S1). Plan goals were either conservation only (2008 plan) or a combination of conservation and recreation (1939, 1964, and 2004 plans, Appendix S1). Criteria used to identify priority areas within all four plans were similar and primarily biological (e.g., high quality natural areas, important populations of rare species); additional criteria considered

in some plans included recreation, water quality, scenic, scientific, geologic, and historic value (Appendix S1). Plan boundaries were digitized from hard copy (1939 and 1964 plans), available as GIS data (2008 plan), or estimated based on the location, size, and detailed description of each priority area in the plan (2004 plan, see Appendix S1).

Implementation of conservation plans for which land protection is a major goal can be quantified in a number of ways, including institutional capital outcomes such as the area of land protected or the amount of funds expended for land protection, and natural capital outcomes such as the change in biodiversity representation within the protected areas network resulting from the protection of specific habitats (Bottrill and Pressey, 2012). We quantified plan implementation using the area of land protected because data on habitat composition across the state over the century long time period examined here were not available. We quantified plan implementation using land protection data (both acquired lands and lands with conservation easements) from three sources: 1) lands protected by WDNR between 1876 and 2013 (WDNR, 2013d), 2) additional lands protected by other agencies and conservation organizations (Conservation Biology Institute, 2012), and 3) conservation easements held by other agencies and conservation organizations (National Conservation Easement Database, 2012). We defined protected lands as the cumulative total area of land protected according to these three data sources, which includes lands that are publicly owned, lands with conservation easements, and lands within tribal reservations. We calculated the cumulative area of land protected annually by WDNR within each plan boundary. We also calculated the total area of land protected as of 2013 within and outside of each plan boundary by WDNR and by all agencies and conservation organizations combined (i.e., total protected lands documented in the three data sources listed above).

2.3. Identifying factors explaining plan implementation

Drawing on the most recent (2008) conservation plan for Wisconsin and the authors' more than four decades of collective experience in planning, land protection, and natural resources management, we first conceptualized steps in the decision-making process that lead to plan implementation via land protection. Our overarching question was, 'What conditions likely need to be met for implementation (via land protection) to occur within an individual priority area in an existing conservation plan?' We identified five main considerations that influence whether an agency (here, WDNR) is likely to be able to successfully protect land within a specific priority area in an existing conservation plan (Fig. 1). Our model builds upon prior work conceptualizing the overall conservation planning and implementation process in an agency context (Carter et al., 2014a) by focusing specifically on key considerations in the agency land protection process.

We present the five major considerations for protecting land within the boundary of an existing conservation plan as a set of questions. A negative response to any question decreases the likelihood (sometimes to zero) that the transaction will be successful (Fig. 1). First, is there land available to protect within the priority area? If all lands within an individual priority area are already protected or if no private (unprotected) land is available for sale or easement, no land protection can occur. Conservation plans may include priority areas that are already largely or completely protected because they are priorities for other reasons (e.g., land management, Carter et al., 2014b). Second, is the available land in the priority area a priority according to laws, administrative code, or formal policies governing agency land protection actions? While such laws and policies are subject to change, substantive changes are infrequent, leading to a much longer effective lifespan for acquisition policies (decades) compared to individual conservation plans (usually 10 years or less). Individual land parcels that do not rank highly according to the specific criteria listed in agency acquisition policies are unlikely to be protected (e.g., US Fish and Wildlife Service, 2014). Third, is the priority area included in a formal agency implementation plan? Conservation plans are often developed by multiple stakeholders

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