Chapter 17
A General Model for Site-Based Conservation in Human-Dominated Landscapes: The Landscape Species Approach

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Abstract It is widely recognized that parks and preserves cannot provide adequate habitat for the vast majority of wildlife species, and that alternative strategies are necessary for the long-term protection of biological diversity. Effective conservation planning often requires balancing a variety of competing interests with limited funding and creates inherent conflict if the needs of humans are not considered as part of the process. The Landscape Species Approach (LSA) of the Wildlife Conservation Society is an innovative approach to landscape-scale conservation planning which aims to create wildlife-based strategies for conserving large, wild ecosystems integrated in wider landscapes of human influence. This chapter describes the development and steps involved in the LSA approach, its application to the Adirondack Park in northern New York State, and advantages and disadvantages of the process.

Keywords Biological diversity • Conservation planning • Landscape Species Approach • Monitoring • Priority setting

17.1 Introduction

Effective conservation planning often involves making difficult decisions and balancing competing interests to achieve conservation goals, almost always in the context of limited funding. It is widely recognized that parks and preserves alone cannot effectively conserve all of the elements of biological diversity that should be

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conserved (Fischer et al. 2006). Protected areas are often not large enough, are seldom connected to other protected areas, and may be subject to negative human influences despite their protected status. Similarly, planning for conservation without taking the needs of humans into account creates inherent conflict, and biological diversity often loses in the long run.

In an effort to engage in effective conservation planning in the face of these constraints, The Wildlife Conservation Society (WCS) has developed an innovative approach to landscape-scale conservation planning that recognizes that animals do not acknowledge park boundaries and that aims to create wildlife-based strategies for conserving large, wild ecosystems that are integrated in wider landscapes of human influence. The Landscape Species Approach (LSA) is focused on addressing the ecological needs of and human threats to viable populations of a suite of species dubbed 'Landscape Species.'

The LSA was developed using 12 design and demonstration sites on four continents. Today, it has been applied, at least in a part, at a total of 28 land and seascapes across Africa, Asia, Latin America, and North America. Thus, this approach to landscape-scale conservation has broad geographic relevance. The LSA has no pre-defined scale for the area in which it will or should be applied. It has been applied by WCS in landscapes and seascapes as small as a few thousand (Glover's Reef Atoll, Belize) to more than 2 million (Coastal Patagonia, Argentina) square kilometers. In principle, the LSA could be adapted to even smaller spatial scales and used to enhance conservation efforts in places such as urban greenbelts. The only scalar limitation to applying the LSA is the availability of adequate information across the entire target area. Thus, for the purpose of applying the LSA, we define a 'landscape' as an area sufficient in size, composition, and configuration to support at least one ecologically functional population of all conservation features – species, communities, functions, and services – for the long term.

Our objectives in this chapter are to briefly review the steps involved in completing the LSA, discuss the gaps between the theory and on-the-ground reality as the LSA was applied in the Adirondack Park, and describe the advantages and disadvantages of the process as a whole.

17.2 The 10 Steps of the Landscape Species Approach

Each WCS project that uses the LSA proceeds through a series of 10 steps (Didier et al. 2009a; Table 17.1), similar to 'Systematic Conservation Planning' frameworks used by other authors and organizations (Groves et al. 2002). Several on-line technical manuals (www.wcslivinglandscapes.org) and published papers (Coppolillo et al. 2004; Didier et al. 2009a; Sanderson 2006; Treves et al. 2006) describe these steps and provide tools for completing them in detail.

Table 17.1 The 10 steps of conservation planning using the Landscape Species Approach (Didier et al. 2009a)

Step	References
1. Compile relevant information on the conservation context of the site.	Treves et al. (2006)
2. Use a conceptual model to set a broad goal and to describe threats and barriers to achieving it.	Wilkie and LLP (2004b)
3. Select a set of Landscape Species.	Coppolillo et al. (2004) Strindberg et al. (2006)
4. Set quantitative Population Target Levels for conserving Landscape Species.	Sanderson (2006)
5. Map Biological Landscapes for each Landscape Species.	Sanderson et al. (2002) Didier and the Living Landscapes Program (2006)
6. Map Human Landscapes for each important human activity.	Sanderson et al. (2002) Didier and the Living Landscapes Program (2006)
7. Map Conservation Landscapes for each Landscape Species.	Didier and the Living Landscapes Program (2008)
8. Assess the sufficiency of current and need for additional conservation areas.	In development.
9. Prioritize areas for action.	In development.
10. Develop a monitoring framework.	Wilkie and the Living Landscapes Program (2006)

17.2.1 Step 1: Assessments of Context, Stakeholders, and Threats

The initial step in the LSA or any conservation planning process usually involves a series of activities devoted to understanding the context for conservation in a landscape (Pressey and Bottrill 2008; Chap. 3).

One of the first decisions to be made is what geographic region and what flora and fauna are under consideration. For the LSA, planners should try to make a first approximation of the extent of the landscape, based on relevant social, political, and ecological boundaries. As a part of this decision-making process, planners should also discuss which elements of biological diversity they are interested in conserving. For example, in the planning process described in Section 17.3, we focus on the species and ecosystems that occur within the Adirondack Park of New York. However, as mentioned, a specific aim is of the LSA is to test and refine the relevance of these a priori boundaries for Landscape Species. For example, is the Adirondack Park sufficiently large to conserve the chosen Landscape Species?

After a first approximation of the landscape boundary is made, practitioners should then compile a set of basic contextual information for that landscape, including information on stakeholders, economic and social value of natural resources, governance and land-tenure systems, and biological diversity and threats to it (Pressey and Bottrill 2008).

Early in the process, it is important to identify a set of stakeholders who should be engaged for planning, not only because stakeholder participation is critical for acceptance of any planning products but also because stakeholders are often a critical source of information not otherwise available (e.g., where species or human activities occur) (Didier et al. 2009a; Chaps. 4 and 10). Until now, WCS had not developed its own or used a formal process for assessing stakeholder communities and identifying which ones to invite into the planning process, although recently it has begun pointing practitioners to formal processes developed by other organizations (e.g., Golder and Gawler 2005; Groves 2003; The Nature Conservancy 2000).

Particularly important in contextual analyses for new projects are threats assessments. Within the LSA, WCS has developed a method for identifying, ranking, and mapping threats (Treves et al. 2006; Wilkie and the Living Landscapes Program 2004a). A multi-stakeholder workshop is held for the purpose of generating a comprehensive list of human activities with the potential to negatively impact biological diversity in the region and to rank them in order of their perceived importance to those stakeholders participating.

The results of a successful threats assessment will indicate where within the landscape the most important human activities that threaten biological diversity occur, when they occur, whether they have changed in intensity over time, the relative severity of each threat, how long the system may require to recover if the threat were removed, and how urgent the need for management action may be (Wilkie and the Living Landscapes Program 2004a).

One of the requirements and key components of the threats assessment is its participatory nature. Bringing together a diverse set of stakeholders can help elucidate the relative roles of management capacity, stakeholder awareness, and policies or regulatory mechanisms in mitigating threats to biodiversity, and inviting a diverse set of stakeholders may serve to help reconcile conflicting interests. Likewise, one of the primary purposes for holding the workshop is to bring together the principal actors who may ultimately be required to work cooperatively to reduce threats and conserve biological diversity in the landscape or seascape of interest (Wilkie and the Living Landscapes Program 2004a). The complete steps of a threats assessment are detailed in Wilkie and the Living Landscapes Program (2004a) and include: (1) providing a step-by-step description of the task to be completed, (2) explaining what is meant by direct and indirect threats, (3) asking each participant to identify 3–7 threats to biological diversity in the landscape, (4) organizing human activities from all participants into groups, (5) voting to identify the highest priority threats for conservation to mitigate, (6) characterizing and mapping the highest priority threats, (7) reviewing and presenting threat maps, and (8) discussing results and additional steps that may be needed to complete the threat assessment.

17.2.2 Step 2: Development of a Conceptual Model

A conceptual model is a graphical representation of the goals, conservation features, causal network of threats to biological diversity, and priority conservation activities of any conservation project (Margoluis et al. 2008). Conceptual models are essentially a representation of what conservation managers think they know implicitly and, as such, they (1) explicitly define what needs to be influenced or changed as a result of project activities (i.e., the conservation features), (2) characterize and prioritize the factors that directly or indirectly threaten the species or landscapes that need to be conserved, (3) graphically represent how these threats, individually or in combination, cause the undesirable changes in the species or landscape, (4) demonstrate that the activities that are focused on reduce key threats and attain quantitative conservation targets, (5) provide a strategic framework for determining what to monitor to assess project effectiveness and to adapt project activities, and (6) offer a structure for reviewing and revising project assumptions and activities as conditions change over time (Wilkie and the Living Landscapes Program 2004b).

Conceptual models may be exceedingly simple or fairly complex but all are composed of four basic elements: goals, focal ecological features (with population targets levels), threats, and activities (Fig. 17.1). Table 17.2 provides definitions of these terms.

Wilkie and the Living Landscapes Program (2002) provide a brief overview of the process of creating conceptual models, and a full treatment of the methodology

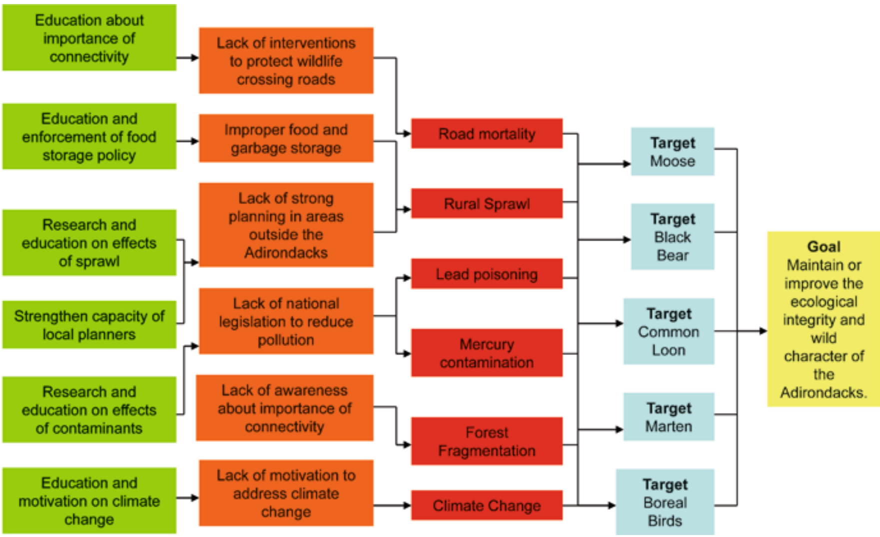

Fig. 17.1 Example of a partial and highly simplified conceptual model for the Adirondacks with goal (*yellow*), targets (*blue*), direct threats (*red*), indirect threats (*orange*), and interventions (*green*)

Table 17.2 Key terms and definitions we use in this paper. The exact words used differ from place to place and author to author, but the basic concepts are common to most conservation planning exercises

Term	Definition
Goal	A broad, visionary statement of what conservation wants to achieve at a particular place. Example: “Conserve the ecological integrity and wild character of the Adirondack Park.”
Threat	A human or human-mediated activity which negatively impacts biodiversity or impedes our ability to reach our conservation goals and targets.
Direct threat	A threat which directly changes the abundance, quality, or extent of a conservation feature. Four major categories of direct threats, especially for species, include direct extraction (e.g., hunting), competition from exotic species, habitat/land-cover conversion, and pollution of habitat (Wilkie and the Living Landscapes Program 2004a).
Indirect threat	A social, economic, legal, or political factor that enables a direct threat to occur. Typical examples include “lack of alternative economic options”, “lack of laws,” “lack of enforcement,” “lack of education/knowledge.”
Landscape	An area sufficient in size, composition, and configuration to support at least one ecologically functional population of all conservation features for the long term.
Biodiversity feature	An element of biodiversity that a project aims to conserve, including species, ecosystems, habitats, subspecies, genes, ecological functions, ecosystem services, etc.
Focal biodiversity feature	A subset of conservation feature that a project will explicitly focus activities on. As it is typically impossible to focus activities on and collect information about all conservation features, projects typically have to select a “representative” and practical subset, the successful conservation of which will hopefully result in the conservation of most if not all conservation features. Landscape Species are focal conservation features.
Population target level	The state or condition of a biodiversity feature that a project wants to maintain or achieve. For Landscape Species, this is generally expressed in terms of a desired number of animals across the landscape (e.g., 4,000 elk), although PTLs can be far more detailed (e.g, a population of 3,000–5,000 elk, containing at least 10% reproductive females, at local densities no greater than 3/km^2).
Conservation area	An area where conservation actions are taken (e.g., hunting enforcement) or actions are aimed to have an impact (e.g., new laws to outlaw hunting in particular places). Protected areas are considered one form of conservation areas.

is provided in Wilkie and the Living Landscapes Program (2004b). Usually, conceptual models are first built in draft form, but are refined and adjusted as other steps (e.g., selection of Landscape Species) are completed. As such, they serve as a repository for much of the planning information produced during the LSA.

When completed, conceptual models, although fluid and expected to change over time, provide a means for planning project priorities. Using a conceptual model, all members of a conservation project should be able to identify how and why any proposed intervention would have an impact (Wilkie and the Living Landscapes Program 2002). Conceptual models also provide a framework for developing a monitoring strategy that tracks changes in the model over time and allows for review and update of project priorities, which are key parts of measuring the effectiveness of conservation actions. (Monitoring frameworks are discussed further in Step 10, Section 17.2.8)

17.2.3 Step 3: Selection of Landscape Species

While most landscape-scale conservation projects have a broad goal or vision to conserve all or most of the biological diversity native to a place, it is impossible to dedicate sufficient resources to plan and act in such a way as to conserve all of it (Groves 2003). A process for selecting focal conservation features is commonly used, and many conservation NGOs have developed specific procedures for doing so, including The Nature Conservancy, World Wildlife Fund, and Conservation International (Bottrill et al. 2006). Within the LSA, WCS has developed a procedure for selecting a suite of focal conservation features called Landscape Species that should ensure that landscapes are large enough, sufficiently connected, and well configured to support functional populations of most other biological elements. In this sense, Landscape Species, as a group, are explicitly selected to serve as an ‘umbrella’ for conservation of all other features in the landscape (Lambeck 1997).

Landscape Species are defined as wildlife that typically require large, ecologically diverse areas to survive and often have significant impacts on the structure and function of natural ecosystems. Because of their habitat requirements and movement behavior, Landscape Species may be particularly threatened by human alteration and use of natural landscapes. Landscape Species are often cultural icons that can help generate a constituency for the conservation of biological diversity (Redford et al. 2000; Sanderson et al. 2002). WCS believes that planning conservation strategies to meet the needs of a suite of Landscape Species identifies the necessary area, condition, and configuration of habitats to meet the long-term ecological requirements for most species occurring in a wild landscape (Coppolillo and the Living Landscapes Program 2002). Thus, as noted above, no predefined rules are set for the extent of the landscape at which the LSA process might be applied. The boundaries of the potential site are determined by the needs of the wildlife species themselves.

The selection process is meant to identify an efficient set of species as focal features. To the degree that a selected set of Landscape Species appears insufficient to represent the broader set of conservation features or particular species are impractical for use (e.g., they are difficult to monitor), we recommend that planners consider adding other species to their set of focal conservation features, including broader and finer levels of biological organization (e.g., ecosystems, species assemblages, subspecies, or genotypes), special elements (e.g., threatened, endangered, or endemic species), and ecological processes (e.g., fire) (Groves 2003).

The process for selecting Landscape Species is described in detail in Coppolillo and the Living Landscapes Program (2002), Coppolillo et al. (2004), and Strindberg et al. (2006), and the process is facilitated by software, available at www.wcslivinglandscapes.org. Briefly, the selection process begins with identification of a set of candidate species. Although, in theory, any species can be considered a candidate, but it is practical to consider only those that will score highly on at least one or more of five selection criteria (Coppolillo and the Living Landscapes Program 2002). It is also important that the candidate pool be comprised of species that occupy the full range of habitat types in the target landscape.

Once the pool of candidate species has been selected, the next step is to score each, using data from local experts, field studies, and published literature, according to five selection criteria: (1) area requirements, (2) heterogeneity of habitat use, (3) vulnerability of the species to threats, (4) socio-economic significance, and (5) ecological functionality (Strindberg et al. 2006). The suite is then compiled by first selecting the candidate species with the highest composite score across the five criteria. Additional species are then added by iteratively selecting the candidate species that (1) is most complementary to the species already selected, in terms of habitats and threats they represent and (2) has a high composite score. As iterative selection proceeds, significant flexibility is given to planners in terms of choosing among candidate species that may have similar composite scores. Species are added to the suite until all threats and habitats have been represented by at least one Landscape Species.

No set number of Landscape Species is required to represent any particular landscape, as long as all of the important habitats and threats are represented by the final selected suite of species. Most of the landscapes on which WCS has applied this methodology have selected between three and eight Landscape Species. Landscape Species can come from any taxa. While in application at WCS landscapes, most selected species have been birds or mammals, other taxa including fish, invertebrates, amphibians, and reptiles have been selected. While to our knowledge, no plant species have been selected, they have been candidates. Species from these other taxa are not selected as often because they tend to score lower in terms of area requirements, heterogeneity of habitat use, or vulnerability to threats criteria (i.e., are not affected by multiple threats) or, commonly, not enough ecological information is available for them to complete the process.

17.2.4 Step 4: Establishing Population Target Levels for Landscape Species

Population target levels generally refer to the number of individuals needed to be saved across a landscape. Although many conservation biologists would prefer to leave it to policy makers to choose specific numbers, increasingly, policy makers look to scientists to objectively determine how many individuals are 'enough' (Sanderson 2006; Soulé et al. 2005; Tear et al. 2005). Although difficult, setting population target levels is often unavoidable so that choices with respect to natural resources can be justified and the success and cost of conservation efforts can be assessed (Groves 2003). Sanderson (2006) gives a detailed description of the many ways of setting population target levels for conservation. No single target level is correct for all times for any particular species, and setting population target levels is complicated by the fact that people's attitudes toward wildlife are highly variable and affect their feelings about what constitutes a 'desired population size.' For a variety of reasons, it may be desirable to conserve as many animals as possible or to maintain populations at current or historical baselines. Many different circumstances and desires can lead to different population target levels.

Sanderson (2006) provides a full discussion of the process and methodology of setting population target levels and highlights a number of potential criteria by which they may be determined, including demographic sustainability, ecological functionality, social dynamics, economic benefits, cultural benefits, and historical baselines. As a general rule, conservation should first ensure that the population is self-sustaining (demographic sustainability), then work to ensure that the population fully interacts with its environment (ecological functionality). Conservation efforts can then attempt to allow for human use above the levels necessary for ecological integrity and, finally, can work toward historical levels when humans had significantly lower impacts on ecological patterns and processes (Sanderson and the Living Landscapes Program 2006).

17.2.5 Steps 5–7: Mapping Biological, Human, and Conservation Landscapes

Once the key threats to wildlife within the focal landscape have been identified, a suite of Landscape Species with which to work chosen, and population targets for those species set, the next step is to undertake the mapping exercises needed to prioritize where conservation actions should be focused. This step consists of the construction of three important maps: (1) Biological Landscapes, (2) Human Landscapes (also referred to as Threat Landscapes), and (3) Conservation Landscapes.

A Biological Landscape is a map that represents the 'attainable' distribution of a Landscape Species, reflecting what habitats are important for the species and what its distribution would look like if conservation actions mitigated negative impacts of human activities (Didier et al. 2009a; Fig. 17.2). Biological Landscapes are typically expressed in abundance units (e.g., number of individuals, biomass) and represent 'habitat capacity' as opposed to actual abundances, or the capacity of the landscape to support a species throughout its life cycle.

Human (or Threat) Landscapes are maps of the distribution of human activities that affect Landscape Species (Fig. 17.3). Measures of vulnerability such as Human Landscapes are critical components of effective conservation planning (Wilson et al. 2005). As Biological Landscapes represent patterns in abundance, Human Landscapes are meant to represent patterns of how anthropogenic threats reduce species abundances. They typically are created first to reflect the distribution and relative intensity of human activities (e.g., relative number of hunters, concentration of pollutants) independent of a particular species, and then converted into maps of impact for particular species (i.e., reductions in abundance). In addition, they are often created in two versions: a 'Past' version that shows the spatial distribution of

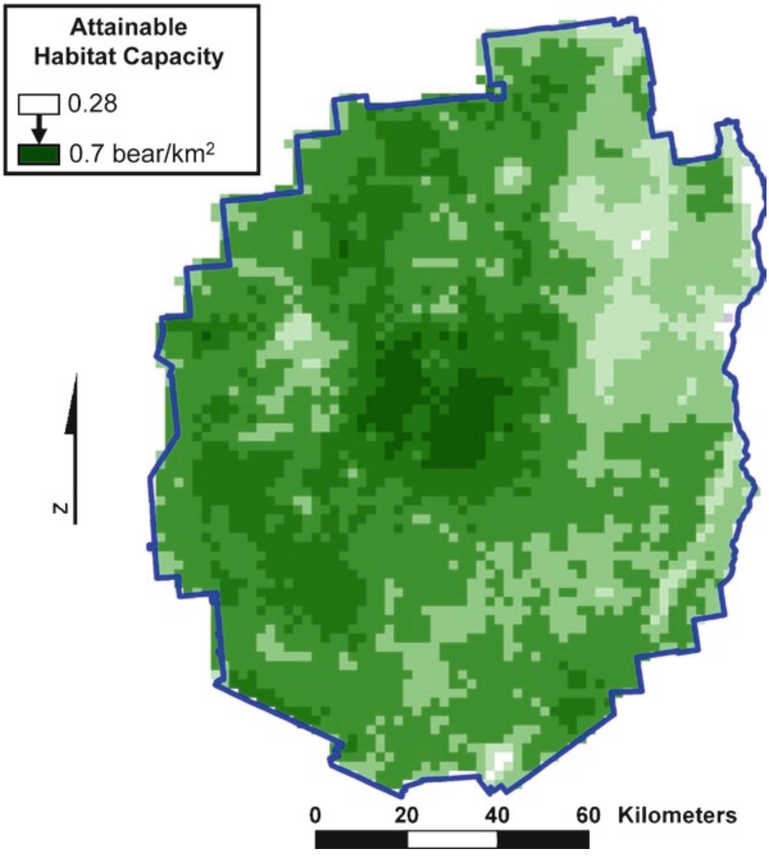

Fig. 17.2 Example of a biological landscape for black bear in the Adirondack Park, NY

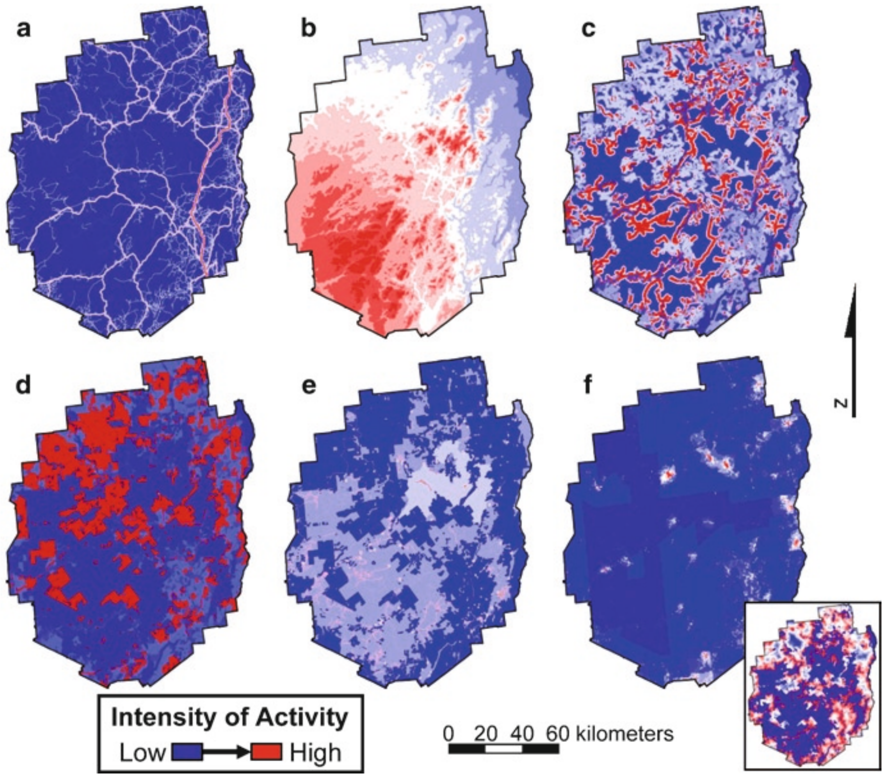

Fig. 17.3 Examples of human (Threats) landscapes for the Adirondack Park, NY, showing relative intensity of effects from (**a**) roads, (**b**) airborne contaminants, (**c**) hunting/poaching, (**d**) forest management, (**e**) recreation, and (**f**) development

human activities and impact up to the present, including recent impacts of ongoing activities, and a 'Future' version that forecasts human activities.

Most Biological and Human Landscapes are typically mechanistic models built from information in the literature or expert knowledge of the landscape. In a few cases, when sufficient field data have been available for the landscape and species in question, empirical and statistical modeling techniques (e.g., generalized additive models, Maximum Entropy models) have been used to generate such landscapes (Guisan and Zimmermann 2000; Phillips et al. 2006). Both empirical and mechanistic models, in fact, often take advantage of many sources of information, including field data, expert-opinions, and literature (Didier and the Living Landscapes Program 2006).

The combination of Biological and Human Landscapes can allow practitioners to produce additional maps, including the species' current (given the impact of human activities through present) and predicted future distributions (given the impacts of future human activities; Fig. 17.4). Conservation Landscapes are created by subtracting the three different distribution maps from one another (Fig. 17.5)

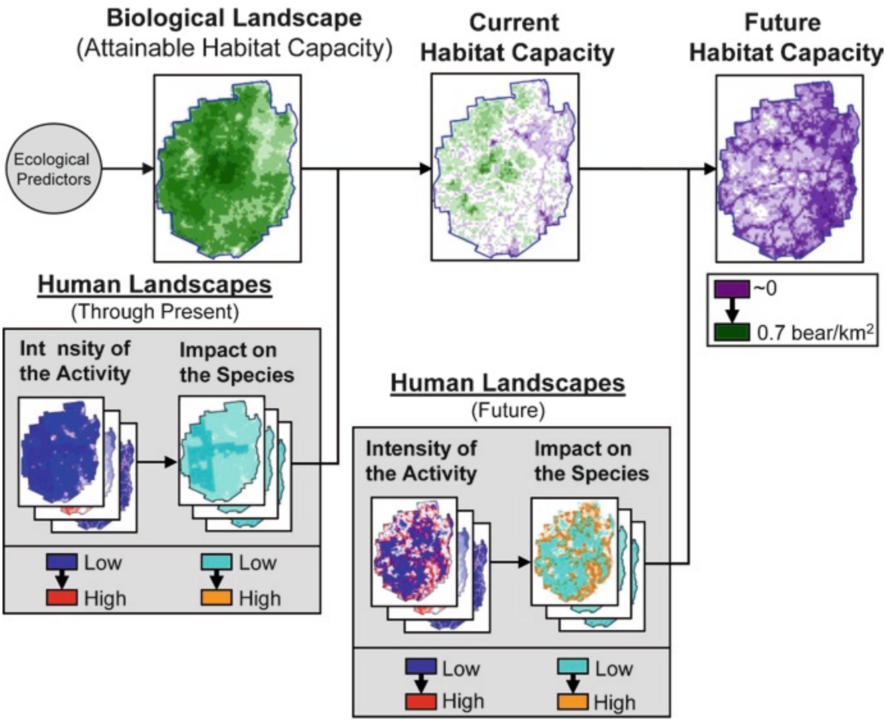

Fig. 17.4 Examples of current and future distributions of black bear constructed from biological and human landscapes in the Adirondack Park, NY

and depict the possible impacts of conservation actions across the study region. One version of the Conservation Landscape is created by subtracting the current distribution from the attainable (i.e., Biological Landscape) and represents the potential to increase populations by mitigating past threats (i.e., population recovery). A second version, created by subtracting the future from the current distribution, reflects the potential for preventing decreases by mitigating future threats (i.e., preventable loss; Didier et al. 2009a). Depending on the target species and the focal region that are the subject of the exercise, one or the other may be particularly useful and relevant.

For some target species, such as black bear (*Ursus americanus*) in the Adirondack Park, for example, the population is already at an ecologically functional level and not in danger of precipitous declines in the near future. In this case, prioritizing locations where actions should occur to prevent the decline of black bear populations in the future may be most useful. Other species, which may be rare and have already declined in the focal region – for example, the guanaco (*Lama guanicoe*) in the San Guillermo landscape of Argentina (Didier et al. 2009a) – may benefit as much or more from conservation actions aimed at areas where significant recovery or even recolonization is possible.

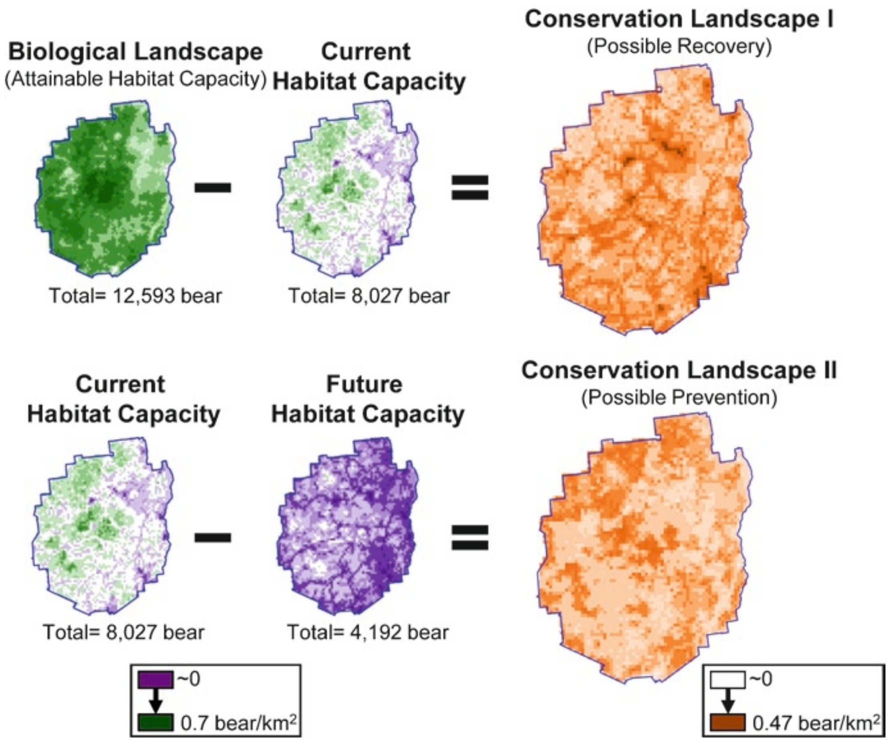

Fig. 17.5 Examples of Conservation Landscapes depicting potential benefits of interventions aimed at recovery (Conservation Landscape I) and prevention (Conservation Landscape II) in the Adirondack Park, NY

Didier et al. (2009b) provide a detailed description of the conceptual framework that underlies Biological, Human, and Conservation Landscapes. Didier and the Living Landscapes Program (2006, 2008) provide hands-on technical guidance in creating these maps, both available from the Living Landscapes Program website (www.wcslivinglandscapes.org).

17.2.6 *Step 8: Estimating the Sufficiency of Existing Conservation Areas and Evaluating the Need for Additional Ones*

When population target levels and species' distribution maps (attainable, current, and future) have been completed, these tools can be used to determine the sufficiency of existing conservation areas (do current abundances within protected areas meet population target levels?) and the need and possible impact of additional areas (what would happen if conservation actions were taken in this new area, and would overall targets be reached?). Maps of potential distributions can be compared with population target levels and used to estimate 'recovery' targets (e.g., how many individuals need to be added to the current population to reach the target?) and 'prevention targets' (e.g., what level of loss, measured in number of individuals, must be prevented to maintain the target?) Four outcomes of this process are possible (Didier et al. 2009a):

1. The current and future distribution maps for the species indicate that it is currently above the population target level, suggesting that additional conservation areas are not needed to reduce threats. In this case, practitioners might wish to review the target level or focus on monitoring and prevention of new threats.
2. The current distribution map indicates that although the species' is currently above the population target level, the future population is below it, suggesting that conservation efforts should focus on preventing future threats. Additional conservation areas may be needed or the effectiveness of activities occurring in existing ones improved.
3. The attainable population is above the population target level, but the current and future are below it, suggesting that new conservation areas may be needed and that conservation actions in existing or new areas need to both prevent future threats and mitigate impacts that have already occurred.
4. The attainable, current, and future populations are all below the population target level, suggesting that actions to mitigate both past and future threats are needed, but also that the current extent of the landscape needs to be expanded to reach target levels.

17.2.7 Step 9: Prioritize Areas for Action

Conservation Landscapes are critical tools for setting conservation priorities because they provide information on the possible impact of conservation activities in terms of adding animals to the current population or preventing future losses and, as such, can help practitioners decide where and when to invest resources. For example, the 'minimum' extent of the landscape needed to reach the target level for a particular Landscape Species can be determined by iteratively selecting those areas with the highest possible recovery or prevention impact (Didier et al. 2009a).

Though valuable, Conservation Landscapes do not incorporate all of the sources of information practitioners are likely to want to use in setting conservation priorities. For example, the costs of implementing conservation actions have not been included (Wilson et al. 2007). Similarly, practical constraints or particular opportunities that may make conservation easier or harder in any given location are not represented. Human judgment and expert opinion are, therefore, critical to setting conservation priorities (Carwardine et al. 2009; Didier et al. 2009a; Chap. 11).

Methods for setting site-specific priorities within the LSA have been drafted but have not yet been satisfactorily tested with field sites. It is likely that population targets and Conservation Landscapes will be used as inputs for decision support software such as Marxan or C-Plan (Ball and Possingham 2000; The University of Queensland n.d.), which can perform benefit-cost analyses to identify networks of conservation areas that efficiently meet quantitative targets for multiple biodiversity features such as Landscape Species. Although the methodology for this step has not yet been fully tested, the approach outlined here may allow for the inclusion of 'costs' in the priority setting process by incorporating them as land area, estimating monetary costs of implementing conservation actions, or estimating opportunity costs. Maps that identify both short- and long-term priority areas and that change as information improves can then be produced (Didier et al. 2009a).

17.2.8 Step 10: Monitoring Frameworks

The last step in the implementation of the LSA involves the critical step of monitoring the effectiveness of conservation actions and areas that are implemented. While difficult, monitoring is necessary because it permits (1) determination of whether or not the project is meeting its objectives and having a positive conservation impact, (2) identification of which actions lead to the success or failure of a particular conservation approach, (3) evaluation and revision of assumptions about why and where conservation efforts are needed, and (4) confidence that all participants in the project, from international NGO's to government staff to local residents, learn from the experience and use this knowledge to improve their implementation of future conservation programs (Ferraro and Pattanayak 2006; Margoluis et al. 2008; Stem et al. 2005; Wilkie and the Living Landscapes Program 2006).

Although costly, in order to demonstrate that LSA activities reduce threats and conserve wildlife and their habitat, monitoring at three key levels is needed: activities, threats, and conservation features (Fig. 17.6). Assessing how well actions are implemented is an example of performance monitoring, documenting changes in threats represents outcome monitoring, and tracking changes in the status of conservation features is an example of impact monitoring (Wilkie and the Living Landscapes Program 2006). Given that time, personnel, and funds are always limited, it is rare that monitoring can be implemented for every intervention, threat, and conservation target. A realistic approach to this challenge is to bring together a knowledgeable group of field staff and use a Delphi process to decide (1) which monitoring information is a priority and should, therefore, have resources allocated to it, (2) what level of precision is needed to feel confident in making a management decision based on the monitoring information, (3) what information would be highly useful but require additional funding to obtain, and (4) what information, while useful, would be unnecessary (Wilkie and the Living Landscapes Program 2006). The people involved in this discussion should address the tradeoffs associated with each choice, as well as the confidence associated with different qualitative

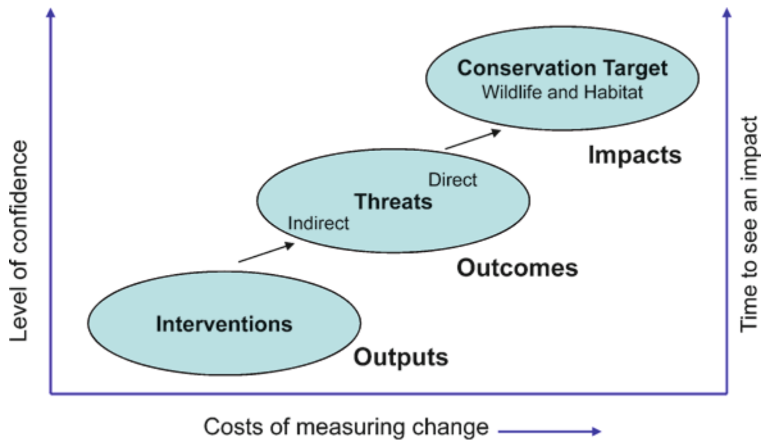

Fig. 17.6 Targets of monitoring efforts and the relative benefits and costs of monitoring at each level (Wilkie and the Living Landscapes Program 2006, used by permission)

and quantitative approaches to monitoring. Wilkie and the Living Landscapes Program (2006) provide additional details for creating monitoring frameworks.

17.3 Theory Versus Reality: an Adirondack Case Study

17.3.1 Challenges and Opportunities

Rarely does the conception of what a conservation planning process should entail match the reality of actually applying that process in a field-based situation, and the LSA is no exception. The LSA has been applied nearly in its entirety in the Adirondack Park, New York, and parts of it have been applied in other landscapes worldwide, including as of January 2009, 12 other terrestrial landscapes scattered across North America, Latin America, Africa, Asia, and two marine seascapes (Didier et al. 2009a). The Adirondack Park was one of the initial 'design and demonstration' landscapes, where the concepts and methods behind the LSA were developed and tested in situ. As such, the procedures used in the Adirondack Park are somewhat different than those more ideal steps described above. As one of the few sites that have completed most of the steps in the approach, the Adirondack experience can provide a valuable perspective on what worked well and what did not.

One of the challenges to conservation planning is that only in applying a method are all the limitations of the theory revealed. The approach, as envisioned in theory, often misses things that are important in practice. An example of this was in the process of selecting Landscape Species in the Adirondack Park, which was completed early in the design phase and prior to the development of the Landscape Species Selection software and associated technical manual (Strindberg et al. 2006).

Although the software is now available and has greatly simplified the process of selecting Landscape Species, its use for other landscapes suggest that human 'input' remains important in interpreting and enhancing computer-based output (Carwardine et al. 2009). Two specific problems arose in the Adirondack Park: habitat heterogeneity and 'monitorability.'

'Heterogeneity of Habitat Use' is one of the five criteria by which Landscape Species are selected. Candidate species that use more habitats receive a higher score for this criterion and are more likely to be selected. In theory, selecting Landscape Species with heterogeneous habitat requirements helps to identify the composition and configuration of habitat types necessary for successful conservation of diverse landscapes (Coppolillo and the Living Landscapes Program 2002). It also helps ensure that the suite of Landscape Species is smaller than it would otherwise be, as the suite as a whole must represent all important habitat stipulated by the planner.

It was found, however, that forcing Landscape Species to have heterogeneous habitat needs can bias selection toward wide-ranging generalists that use many habitats but, through their generalist nature, are not strongly affected by loss or degradation of any particular habitat. For example, in the initial run of the Landscape Species Selection, black bear was the only species needed to complete the suite. Individual black bears in the Adirondack Park to some degree use nearly all of the available habitats (e.g., deciduous forest, high- and low-elevation evergreen forest, wetlands) They are also affected, although not dramatically, by nearly all threats acting in the Park (e.g., hunting, poaching, unsustainable forest management, disturbance associated with recreation). They are, in many respects, what would appear to be a near perfect 'Landscape Species.'

However, in total, black bears are not particularly vulnerable in the Adirondack Park – they are fairly abundant throughout most of the park, their population is probably increasing, and they show no short-term sign of decreasing. They are also not particularly sensitive to changes in the extent or quality of any of the habitats they use – they can simply move elsewhere or rely on other resources.

Although at least technically only the black bear was needed to complete the landscape species suite, it was felt that to focus conservation on a single species would be misleading and ill-advised. Therefore, black bear was chosen as the initial Landscape Species, but the selection process was restarted without it, which eventually resulted in the inclusion of five additional species.

A second problem emerged with selection of Landscape Species. Some species that were selected were known to be difficult or impossible to monitor in the field. For example, the American Three-toed Woodpecker (*Picoides dorsalis*) was initially selected as a representative of low-elevation boreal habitat in the Adirondack Park. However, this species, although a good indicator of low-elevation boreal habitat when present, exhibits behavioral characteristics, such as periodic population irruptions in response to food sources created by recent fires, that make it particularly hard to find in some years. American Three-toed Woodpeckers will follow insect outbreaks and take advantage of recent fires and other disturbances that create newly dead trees and, as such, even under natural conditions are not always reliably present in the habitat with which they are typically associated. As such, it would be very hard to interpret the results of monitoring activities or to assess whether conservation activities were effective. Furthermore, such behavioral characteristics call into question whether the species is representative of others that have the same habitat requirements. The American Three-toed Woodpecker was kept as a Landscape Species, but several other low-elevation boreal birds were added, thus creating an assemblage of species to represent the habitat type.

These kinds of ad hoc modifications worked well for most steps in the LSA, and lessons learned have often been incorporated into the LSA for the benefit of other landscapes and planners, For example, subsequent to the application of the LSA in the Adirondack Park, the Landscape Species selection process and software was revised such that the 'heterogeneity of habitat use' criterion now favors species that *require* multiple habitats, rather than those that simply *use* multiple habitats as generalists do (Strindberg et al. 2006).

Monitorability, however, has not been incorporated as an explicit criterion in the software's algorithm, although guidance materials (Strindberg et al. 2006) now recommend that planners consider it. The software also now incorporates substantial flexibility and interactive processing so that planners can incorporate other criteria and opinions of stakeholders and experts into the selection process. As mentioned before, it has become clear that strict reliance on software and algorithms for selection of Landscape Species or any of the other steps in planning is ill-advised and that input of scientists and others is needed to ensure that acceptable and practical planning products emerge.

A second major challenge of applying the LSA, and certainly with other conservation planning methods, is that the theory envisions the use of better data than usually exists or is realistic to collect. This is exemplified by the procedures for setting population target levels and those for creating monitoring frameworks. Sanderson (2006) gives a thorough treatment of the possible methods for setting population target levels and the necessity of doing so in a transparent manner. Sanderson (2006) describes how although minimum viable population (MVP) estimates are a commonly used target, they are in many cases far below what should be considered desirable for many species, and other more ambitious targets, such as ecologically functional or historically representative levels should be articulated. Unfortunately, if estimates are available in the literature at all, they are usually MVP's. Although the notion of an ecologically functional or historically representative population level is appealing, finding actual numbers to support an estimate of those population levels can often be exceedingly difficult (Chap. 9). When practitioners are faced with an ambitious conservation planning methodology for which they cannot provide all of the necessary information, the result can be frustration, significant expenditure of time, and analytical results that are either incomplete or comprised of too much guesswork to be useful for real decision-making.

The last step in the LSA process, the construction and implementation of a monitoring framework, is also an example of where the data needed to complete conservation planning are unavailable or too expensive to collect. Although it is agreed that monitoring is a critical component of any conservation program, and although Wilkie and the Living Landscapes Program (2006) clearly articulate the reasons why monitoring at all three levels – target, threat, and intervention – is critical, funding for monitoring is often the most difficult to secure for the long time periods that are necessary to make monitoring data useful. Tracking populations of target species over the long term, in particular, does not have the 'sex appeal' of conservation projects that have immediate and demonstrable results such as purchasing land. Monitoring target species may be appealing if they are large 'charismatic megafauna.' These species, however, are often some of the most difficult to monitor in the field. Monitoring of threats and activities themselves is slightly more financially feasible in many cases but, in general, the reality of implementing a full monitoring program for targets, threats, and activities is probably only rarely met for all Landscape Species at a given site.

A third challenge of applying the LSA and conservation planning in general is that it simultaneously strives to incorporate all the complexity of real-world decision-making while making the process easily understandable (Hajkowicz et al. 2009). The mapping of Biological, Human, and Conservation Landscapes associated with the LSA in many ways exemplifies this challenge. Didier and the Living Landscapes Program (2006, 2008) provide details on how to map these landscapes, using GIS, expert knowledge, and spatial modeling techniques. However, as with population target levels, planners often balk at the apparent lack of data to create and validate the products (e.g., data on moose (*Alces alces*) sightings in the Adirondack Park are insufficient) and are often uncomfortable using 'educated guesswork' to complete the maps (e.g., moose are probably abundant in forests that have been disturbed because they contain abundant forage). In this sense, the theory of the mapping procedures can be too ambitious with respect to the available data. It is also often too complex to explain easily to stakeholders and, for this reason, risks stakeholders rejecting its results (Didier et al. 2009b; Hajkowicz et al. 2009). In many places, however, the theory is also too simple. For example, information on distribution of biological diversity (Biological Landscapes) and threats (Human Landscapes) are often less important for making decisions about where to work than is information about costs to implement conservation actions in different areas, opportunities for action, or political will (Naidoo and Ricketts 2006; Newburn et al. 2005). In total, the challenge for conservation planning and the LSA is that it is never possible to know exactly which criteria are truly the most important, relevant, or feasible to use in particular places, and a generalized framework that incorporates them all is complex and hard to communicate.

The process of developing the LSA in the Adirondack Park and elsewhere has resulted in important lessons for practitioners who seek to apply this or other conservation planning methodologies to achieving landscape-scale conservation planning. Based on the lessons learned applying the LSA in the Adirondack Park, it is clear that one goal should be to make the conservation planning framework of the LSA flexible: to have the complex, fully developed methodologies ready for those who want them, and simplified, resource-light tools for those who need them. It is also important to collect and make available information on the costs of doing conservation planning itself: how much time, money, and what kind of expertise are needed to complete various steps and tools (Didier et al. 2009a; Morrison et al. 2009). That way, those who seek to implement similar projects can better judge the costs versus the benefits and make decisions about which tools are most appropriate to use.

17.3.2 Implications and Conclusions

As noted in Didier et al. (2009b), the LSA has had several positive impacts, both in the Adirondack Park and elsewhere. One of the greatest strengths of the approach in the Adirondack Park has been the focus on Landscape Species themselves as a result of their selection. Because it was done before the selection software was developed, Landscape Species were selected in the Adirondack Park through a series of stakeholder meetings over a period of several years. Directly involving members of the scientific community as well as interested members of the general public resulted in a strong appreciation for WCS as an organization that involves local community members in conservation and is genuinely appreciative of their input. One of the most important outcomes of the participatory nature of the species selection process in the Adirondack Park is that the WCS Adirondack program became an integral player in all conservation issues involving these focal species and wildlife in general in the park. It has greatly served to distinguish the niche of WCS in the Adirondack Park from other environmental organizations as a distinctly science-based organization whose primary goal is to protect wildlife.

The participatory nature of the species selection process in the Adirondack Park has also spawned a number of important programs and efforts in which WCS is essentially participating in the co-management of wildlife species in the park. The early focus on black bears as a target species for the park has led to a suite of research and education activities that have resulted in policy changes for backcountry food storage and dramatic declines in the number of negative human-bear conflicts reported in the High Peaks region of the park.

Similarly, a focus on the Common Loon (*Gavia immer*) as an important target in the park has led to long-term collaboration with the New York State Department of Environmental Conservation (NYSDEC) on research and education efforts and has ultimately resulted in increased protection for Common Loons from local and airborne contaminants, such as lead and mercury. Moose populations have been slowly increasing in the Adirondack Park since 1980 and their population trajectory has now reached the point of attracting the attention of NYSDEC as well as Adirondack residents. The early selection and focus on moose as Landscape Species has led to collaboration with NYSDEC on moose research to try to determine the current status of the population in the Adirondack Mountains, as well as its distribution and habitat affinities. Last, a focus on boreal birds as Landscape Species has also led to long-term research and monitoring efforts in collaboration with NYSDEC. Several boreal bird species are considered to be Species of Greatest Conservation Need (SGCN) under New York State's Comprehensive Wildlife Conservation Strategy through the State Wildlife Grants program of the U.S. Fish and Wildlife Service. Because of their selection as SGCN for the state and Landscape Species for the Adirondack Park, the WCS Adirondack program has been able to leverage funding to conduct long-term monitoring on a suite of species to inform and contribute toward the establishment of a long-term boreal wildlife conservation plan for the Adirondack region.

In addition to these three projects, several of the selected Landscape Species are also the focus of efforts to model and protect connectivity in the Black River Valley, which separates the Adirondack Park from the Tug Hill Plateau to the west. Black bear, American marten (*Martes americana*), and moose are part of a suite of species on which The Nature Conservancy, in collaboration with WCS, is focusing to inform long-term conservation of connectivity between these two biologically important regions of Northern New York State, thus exemplifying how the LSA can have cascading impacts at increasing spatial scales. As much the result of the species selected through this process as of any particular outcome, the direct focus on Landscape Species has raised the profile of this set of species in the Adirondack Park and provided a base from which to form long-term collaborations to work cooperatively to conserve them.

The specific outcomes of the LSA have also been used to inform other conservation initiatives in the Adirondack Park. The outcomes of early stage Conservation Landscapes were shared with the Adirondack Nature Conservancy for their potential use in ecoregional planning for the greater Northern Appalachian/Acadian ecoregion. Outcomes of Conservation Landscapes have also been used in several instances to provide information to the Adirondack Park Agency, the regional private land-use authority, for their use in project review. Common Loon, moose, and black bear, in particular, have been highlighted with respect to proposed residential developments and potential impacts to these species and their habitats in particular regions of the Park.

The LSA has also been used indirectly to support conservation in the Adirondack Park through presentations of the work for various audiences, including local college students, outdoor writers, and local government representatives. The above examples illustrate the important role that the LSA has played in applied conservation in the Adirondack Park. Through not only the explicit goal of the LSA – to provide a framework for setting conservation priorities – but also through serving as a springboard for collaborative management and protection efforts, the LSA has undoubtedly contributed significantly to long-term conservation of Adirondack wildlife and habitats. Although its application requires an investment of time and significant information, the LSA provides an extensive toolkit and methodology for applying site-based, spatially explicit conservation planning based directly on the needs of wildlife species. As such, it is useful for any conservation project that involves spatial planning and prioritization of goals and objectives.

17.4 Lessons Learned

Several lessons emerge from the development and application of the Landscape Species Approach. First, it is important to plan the planning (referred to as 'scoping' in Pressey and Bottrill 2008). It is best to start with a basic framework of conservation planning similar to the 10 steps outlined here or elsewhere (Groves 2003; Pressey and Bottrill 2008), and then decisions about what is most important to do first can be made in light of the time and money available for the project.

Second, when embarking on a conservation planning effort, it is critical to consider carefully the balance between complexity/realism of the models used and the need to communicate and explain those models with stakeholders (Hajkowicz et al. 2009). A good approach to any step in conservation planning is to first identify all the complex factors that may affect the decision or model (e.g., conservation value, threat, opportunities, costs), and then first to focus explicitly on the few that are most important, saving the others to address through longer-term efforts.

Third, it is clear that engaging in conservation planning has many benefits. One of the unheralded ones is that by simply facilitating a logical, participatory process of conservation and development planning, an organization can raise its profile and become an integral player not just in planning, but decision-making and implementation for conservation within a region.

Fourth, the value of expert opinion should not be discounted. Conservation planning tools by themselves cannot answer the ultimate conservation questions. Every tool is incomplete and is not a perfect fit for all situations, and thus, experts and stakeholders should be allowed to modify and manipulate outputs from the tools, fixing errors, and incorporating missing or additional decision-making criteria.

Fifth, participation of stakeholders is absolutely critical for successful conservation planning and especially for implementation of its results. With that said, decisions about who should participate and, more importantly, when in the process their participation should occur, need to be made strategically (McCulloch 2006). It is important to recognize that internal planning for an organization versus external planning for a set of stakeholders may need different levels of participation.

Finally, conservation planning always needs to be approached as a long-term, adaptive process that requires a significant investment of time and resources. Costs – both in terms of time and money – should be recorded both to better understand the current planning effort and design other efforts in the future. Outcomes – both in terms of successes and failures – should be noted. No planning effort will ever be complete or perfect the first time around, but with careful attention to learning how each individual effort could have been made better, the record of success for landscape-scale conservation planning efforts will steadily improve over time.

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