Measuring Results of the State Wildlife Action Plans

A synopsis of key findings from the report *Measuring the Results of Wildlife Conservation Activities*

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Citation of this report: The Heinz Center 2008. Measuring Results of the State Wildlife Action Plans. Washington, DC, xx pp.

Major funding for this project was provided by the Doris Duke Charitable Foundation, through the Wildlife Habitat Policy Research Program of the National Council for Science and the Environment.

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Key findings and recommendations

This report has been written to provide state wildlife agencies and their partners in the United States with a suite of tools and approaches that can be used to develop performance measures for the new State Wildlife Action Plans. The recommendations and findings in this report draw from existing bodies of knowledge and practice, including ecosystem monitoring and programmatic evaluation. The tools and approaches contained in this report are broadly applicable to other areas of wildlife management and natural resource conservation.

Key findings and recommendations of this report include:

1.) Evaluating the performance of wildlife conservation activities described in the State Wildlife Action Plans will require evaluation and monitoring activities at multiple levels (field, program, and statewide) and geographic scales. Techniques and approaches for monitoring will likely differ across scales and levels, as will the specific monitoring targets and the types of data that are collected. The approaches that are actually implemented should be driven by the information needs of wildlife managers, key decision-makers, and the interested public.

2.) There is an emerging consensus among experts and in the literature on the steps that should be taken to develop performance measures for wildlife management activities. These steps include, in order:

- Identify conservation targets (species or vegetative communities);
- Develop a conceptual model that relates conservation targets to stressors or threats, as well as conservation activities;
- Use the model to select potential indicators of target status and conservation effectiveness;
- Develop a monitoring program to measure and track indicators;
- Implement conservation activities, measuring indicators to track progress; and

- Use information from the indicator measurements to modify activities and adjust the conceptual models.

3.) Simple conceptual models such as “logic models,” “causal chains,” or “results chains” can be useful tools for wildlife managers. These models enable managers to clearly articulate their understanding of how management actions will lead to desired conservation outcomes, and may also help suggest intermediate or “proxy” indicators for projects where the full environmental benefits might not be detected for years or even decades.

4.) Monitoring and assessment at the state or regional level are probably most tractable using “coarse filter” measures (i.e. landscape-scale habitat metrics), especially if resources for monitoring and evaluation are limited (as is currently the case with many State Wildlife Action Plans).

Each State Wildlife Action Plan describes key “habitats” for wildlife in a particular state or territory. In many cases these “habitats” correspond to vegetative communities, ecoregions, or other ecological features that can be mapped using tools such as Geographic Information Systems (GIS) software and remotely sensed imagery. At a minimum, states should monitor the extent of these areas on a regular basis, and track the amount of key “habitat” that is currently in some form of conservation management. Other landscape-scale metrics such as degree of fragmentation and habitat patch size may also be useful for monitoring wildlife habitats at a state level.

5.) “Fine filter” (i.e. species-level) measures are easily understood by the public and decision-makers. However, outside of certain popular groups such as game species and breeding birds, very few wildlife species in the U. S. are monitored with sufficient frequency or rigor to provide reliable estimates of population status and trends over time. It will require significant new resources to design and implement new monitoring programs, especially for rare or uncommon species. Given these resource limitations, we suggest that states carefully select a small subset of species for in-depth monitoring, and work with existing monitoring programs (e.g. Breeding Bird Survey, federal programs for endangered species) whenever possible.

6.) For reporting purposes, we suggest using a simple pie chart, which we call the "species trend chart," to summarize the direction of population trends for multiple species of conservation interest within a particular state. The pie chart reports the percentage of species in a particular sate that are declining, stable, increasing, extinct/extirpated, or with population trend unknown. Similar charts can be used to present the percentage of key "habitats" that are in different management categories (conservation management, other public lands, developable private land, and lost) and to present trends in the extent of these "habitats" (increasing, stable, declining, or lost).

Conclusions

- Monitoring programs for wildlife and ecosystems can be costly and complex, but need not be. In many cases, monitoring protocols and even data are already available.
- Simple metrics are available that show progress towards addressing the key goals (habitat and species conservation) of the State Wildlife Action Plans.
- Simple modeling exercises can help show what intermediate steps (and metrics) are most important and should be tracked as part of a monitoring and evaluation program for the State Wildlife Action Plans.

Introduction

State and federal wildlife agencies in the United States spend millions of dollars every year on projects that are intended to benefit wildlife species and their habitats. How do we know whether or not these conservation measures are working? This deceptively simple question has been the subject of considerable discussion and debate in recent years. Standard measures of success such as the number of acres protected or restored have been roundly criticized, due to the fact that these measures cannot always be clearly linked to changes in wildlife populations. Yet many wildlife agencies lack the funding and personnel needed to develop sophisticated new monitoring programs that could actually track the effects of specific conservation actions on individual wildlife populations. New approaches for monitoring and evaluation are clearly needed.

Fortunately, many new tools and techniques have been developed in recent years that can be used by wildlife managers and wildlife management agencies to determine whether or not their activities have been effective. A new report from The Heinz Center, "Measuring the Results of Wildlife Conservation Activities," summarizes a suite of techniques and approaches that are relevant to state wildlife managers interested in developing performance measures for the new State Wildlife Action Plans (also known as Comprehensive Wildlife Conservation Strategies). This document presents some of the key findings and conclusions from that report.

The State Wildlife Action Plans represent a significant advance in biodiversity conservation planning for the United States. Each of these plans includes information that will be necessary in order to implement conservation strategies for specific targets -- individual species, suites of species, or vegetation or ecosystem types. In this report, we describe how the information contained in the individual plans can be linked together into detailed evaluation, and monitoring strategies for specific conservation targets.

Steps for Developing Performance Measures

One of the major findings of this study is that there is a straightforward sequence of steps that need to be taken in order to develop performance measures for conservation activities. These steps are described in differing levels of detail by various authors who have written books and articles on the subject of performance measurement (e.g. Holling 1978; Walters 1986; Margoluis and Salafsky 1998; Noon 2003).

Each of the State Wildlife Action Plans already includes information that can be used to develop monitoring strategies for specific targets -- individual species, suites of species, or vegetation or ecosystem types. What is needed, in many cases, is to link the information contained in the state plans into targeted monitoring and evaluation strategies for specific conservation targets. Elements of the state wildlife plans that are relevant to this discussion include: lists of species and habitats, descriptions of threats, and other factors that could influence species or their habitats, descriptions of conservation actions, and descriptions of monitoring and evaluation strategies.

The Steps

The sequence of steps needed to develop a monitoring and evaluation program include:

1. Identify a conservation target (species, vegetative communities, ecoregion, natural area, etc.) and any associated threats, stressors, or potential conservation actions that could affect the target;
2. Develop a model that shows how stressors or threats affect the target, as well as conservation activities;
3. Use the model to select potential indicators of target status and conservation effectiveness;
4. Develop a monitoring program or gather existing monitoring data to measure and track indicators;
5. Implement conservation activities, measuring indicators to track progress; and
6. Use information from the indicator measurements to modify activities and adjust the conceptual models (= Adaptive Management).

We will review these steps in order, with greatest attention to steps 1-3 (the process of target selection, conceptual modeling, and indicator selection). We have found that there are many books, reference manuals, reports, and other sources of information that describe steps 4, 5, and 6. Many of these references are included in a reading list at the end of this document. These steps are also discussed in more detail in our main report.

1) Select a target (species or habitat type)

Given the breadth of the State Wildlife Action Plans and the relatively modest resources available for implementation and monitoring, states may find it helpful at first to focus their monitoring and implementation activities on a few target species or vegetative communities where conservation success can be easily defined and measured.

Some criteria that may be helpful in selecting targets for priority implementation work include:

- The target is well defined (taxonomy of species clearly resolved, vegetative or ecological communities are well defined).
- For individual species, the basic biology, life history, and habitat requirements are reasonably well understood, geographic distribution within the state is fairly well known, and scientifically sound monitoring protocols are available.
- For vegetation cover types or ecological communities, maps are available that show their extent and distributions in the state.
- Limiting factors or factors causing the decline of species or loss of habitat/vegetation type are well understood.
- Actions needed to reverse or stabilize decline of species and ecological communities are well understood.

The following table shows how these criteria might be used to select a broad conservation target from among seven taxonomic groups included in a state wildlife action plan. In this case, birds appear to be the logical choice for an initial target, as there is more information available for birds than for the other taxonomic groups. The process can then be continued (for example, by looking next at major functional or taxonomic groups within birds) until a manageable subset of targets is identified.

Taxonomic Group	Taxonomy Resolved?	Biology Understood?	Geographic Distribution Known?	Monitoring Protocols Available?	Factors Causing Decline Are Known?	Conservation Activities Identified?
Birds	Yes	Yes	Yes	Yes	Yes	Yes
Small Mammals	Mostly	Some Species	Not completely	Yes	No	No
Reptiles	Mostly	Some Species	Not completely	Yes	No	No
Amphibians	Mostly	Some Species	Not completely	For frogs	No	No
Fish	Mostly	Some Species	Yes	Yes	No	No
Freshwater Snails	No	Some Species	No	No	No	No
Caddisflies	No	Some Species	No	No	No	No

Several state wildlife agencies have selected individual species as monitoring targets, whose population trends also serve as management indicators for particular ecosystems of conservation interest. Two of the case studies in our longer report, from Oregon and Nevada, provide more details about how the wildlife agencies in these states have selected individual species that can serve as management indicators.

2) Build a simple conceptual model for each target that includes threats/stressors as well as conservation activities.

For each target, we recommend building a simple conceptual model that describes how major environmental or anthropogenic factors could influence the target, either positively or negatively. Conceptual models take many forms, from sophisticated computerized quantitative models, to simpler spreadsheet models, to the very simple box-and-arrow diagrams (Walters 1986; Margoluis and Salafsky 1998). Because state wildlife managers are dealing with complex and poorly known ecological systems, we recommend starting with very simple models, representations of the world that use boxes and arrows to show expected cause-and-effect relationships.

1.) System Models. Nevada Department of Wildlife developed a series of simple models (see Figure 1 for an example) that show the inter-relationships between a conservation target (either a species or ecosystem), its direct stressors, indirect stressors which affect the target by acting through one or more of the direct stressors, and potential conservation actions that could ameliorate one or more of the stressors. These models can help managers develop an understanding of the relative importance of particular activities and the suite of actions that are needed in order to reduce the effects of all possible stressors. The models can also show the importance of scientific research that is needed in many cases before specific conservation actions can be developed (for example, effective control techniques must be developed for certain aquatic invasive plant species in spring seeps).

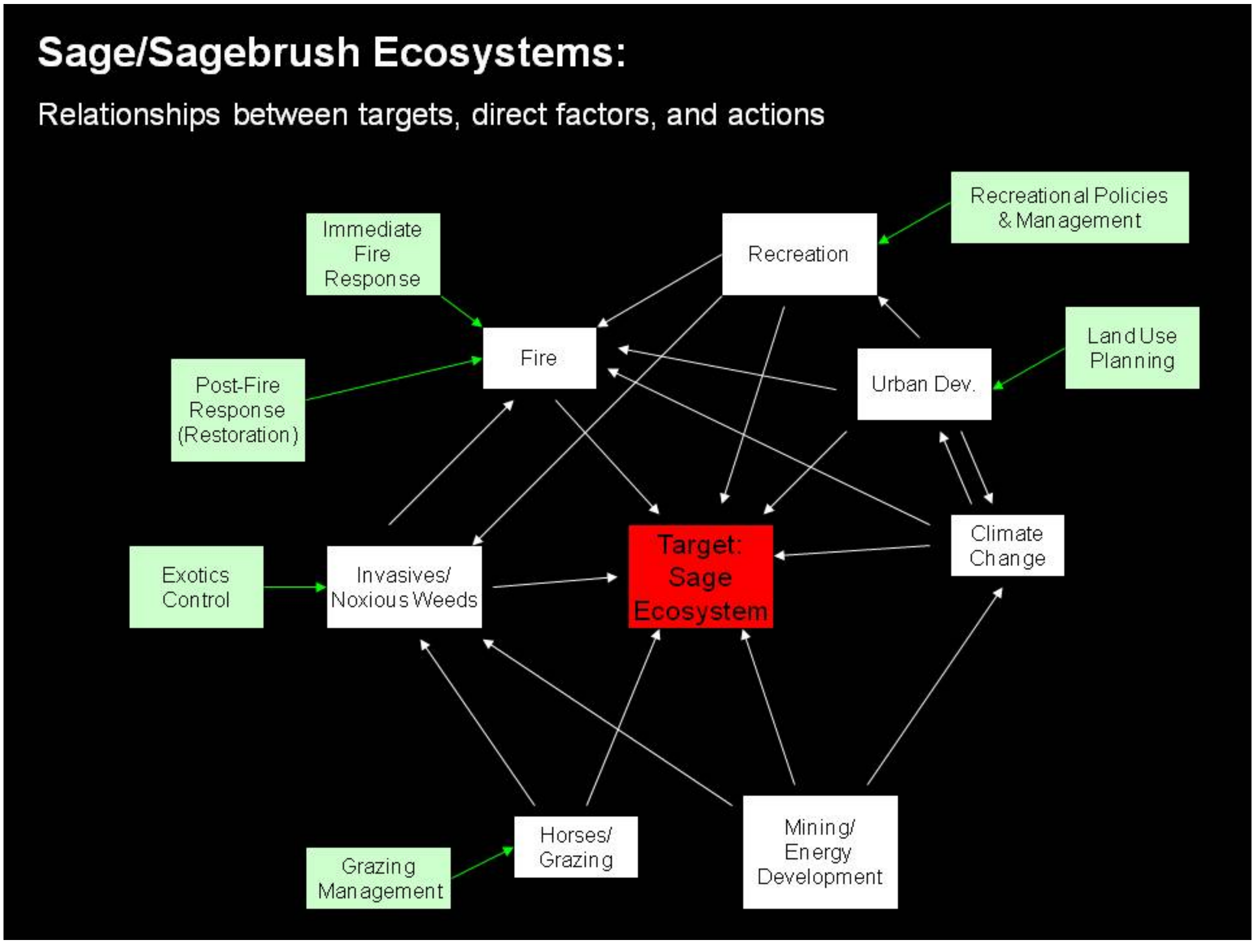

Figure 1: Conceptual model for sage and sagebrush ecosystems in Nevada, showing target (red), factors (white), and potential conservation and management actions (green).

2.) Logic Models. A second type of conceptual model links conservation activities to desired conservation effects through a series of intermediary steps. These models are known as "logic models," although other names include "logic chains," "results chains," and "causal chains." Logic models are commonly used in the public health, philanthropic, and social service sectors as part of performance measurement and evaluation systems. These simple models show the anticipated causal links between activities, short-term outputs, intermediate outcomes, and long-term outcomes.

It is very easy to construct a simple logic model or causal chain for a particular activity, by following a few simple steps:

1. Start by listing the specific action or activity at the top of a piece of paper.
2. At the bottom of the piece of paper, list the project's desired outcome.
3. Between the activity and the desired outcome, list as many intermediate steps as are needed to link the two in an unbroken logical progression. As you move down the chain, keep asking the question "and then what happens" at each step, until the activity and goal are completely linked in a chain of logical steps.

Figure 2 is an example of a logic model for a project that is intended to increase grassland bird populations. This is a very simple model, which only considers a single conservationa activity, a single target, and a single outcome. More complex (and realistic) models are possible, including models which quantify the probabilities of different types of transitions between the intermediary states. We discuss methods for developing these models in our longer report.

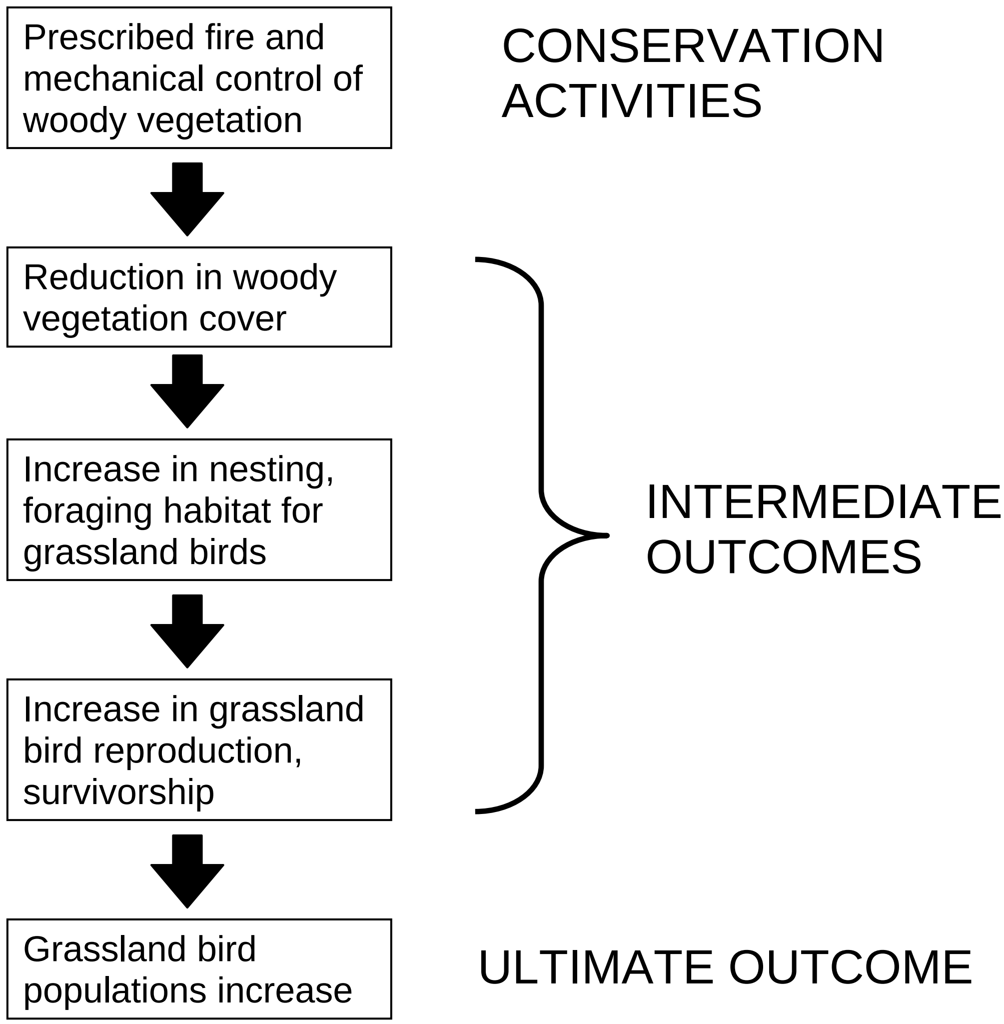

Figure 2: Logic model illustrating how grassland management could lead to improvements in the population of grassland bird species.

3) Use the model to select management indicators

Models are important tools for selecting management indicators. Figure 3 shows the grassland bird causal chain again, but this time with a list of potential indicators (in ovals) or *environmental attributes that could be measured by a project manager to determine whether or not the project had the desired effect*. To the right of these indicators, our project manager has listed the trends that would be expected in each of her indicators if the project was implemented.

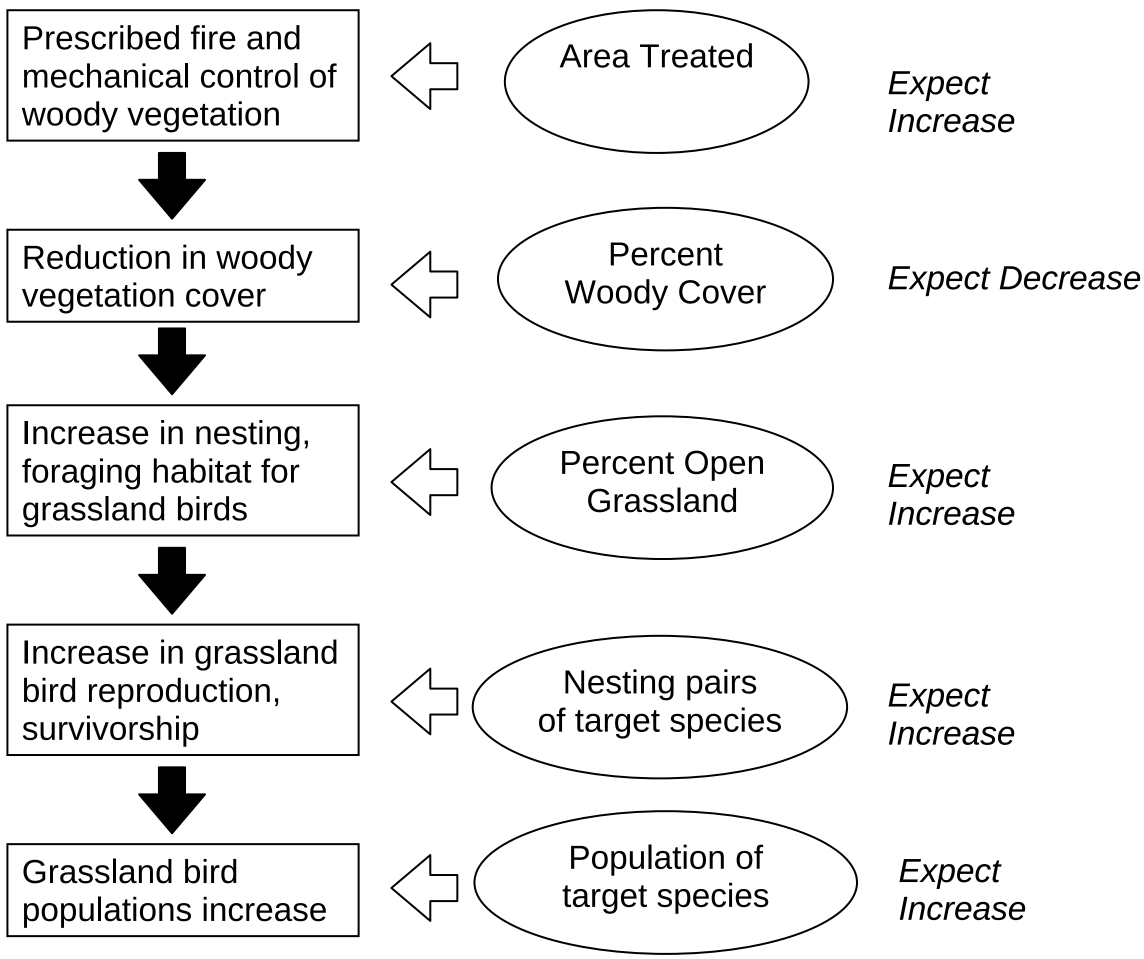

Figure 3: Grassland bird logic model, with potential management indicators in ovals and expected direction of change for each indicator in italics.

4) Develop a monitoring program to track and measure indicators

Once indicators have been selected, the next step is to design a monitoring program that tracks these indicators and provides managers with the information that they need in order to know whether their conservation actions are having the desired effect. Development of a monitoring program does not necessarily mean the collection of new data; as will be seen our larger report, it is often possible to obtain data on species and habitat types of interest from existing state, federal, academic, and private monitoring programs. Examples of some of these programs are listed below. It is worth discussing your monitoring needs with state, federal, and academic partners, to see what data they may already have that could be used in your monitoring program.

In some cases it will be necessary to develop new monitoring programs to track species or ecological communities that are poorly known. Although the development of new monitoring programs is beyond the scope of this report, the appendix provides information that will be useful to state wildlife managers who are interested in developing new programs. We recommend consulting with species or ecosystem experts, as well as persons familiar with the design of monitoring programs, in establishing any new data collection efforts.

Sources of Monitoring Data

- U.S. Geological Survey (including Natural Resources Monitoring Partnership, Cooperative Wildlife Research Units)
- U.S. Fish and Wildlife Service (for U.S. FWS trust species)
- NOAA (for marine and anadromous fish species)
- Other federal land management agencies (for rare, threatened, or endangered species on their lands)
- NatureServe (for species tracked by the Natural Heritage Programs)
- Universities (for species of interest to individual professors)

5.) Implement conservation activities and the monitoring program.

The actual implementation of conservation activities and the collection of monitoring data fall outside the scope of this report. Many other books and manuals (including Margoluis and Salafsky (1998), Groves (2003) and Williams, Szaro, and Shapiro (2007)) are already available which describe how to implement conservation activities and initiate the monitoring of conservation programs.

6.) Use information from the indicator measurements to track progress, adjust conservation activities, and revise the conceptual model

As the monitoring program progresses and data are collected, managers will want to schedule regular reviews of these data and assess whether or not their activities are actually leading towards the desired effect on the conservation target. These reviews allow managers to learn from the effects of previous management decisions: what works well, what works less well, what does not work at all. In many cases, managers will be reviewing information from intermediate or "proxy" indicators that do not measure conservation outcomes directly, but rather measure intermediate steps towards an overall conservation goal.

Information from monitoring programs should also be used to adjust the conceptual model that has been developed for a particular conservation target. This is easiest to see in cases where a project is clearly failing to meet its conservation objectives. Suppose a project is failing, and a careful review by managers indicates that a new stressor has been added to the system which completely overwhelms the positive conservation activities that have already been implemented (think off-road vehicles driving illegally over a newly-planted prairie restoration, or a poorly designed upstream development which dumps new sources of stormwater run-off into a restored stream reach). The conceptual model for this conservation target would need to be adjusted to incorporate the new stressor, and the suite of possible conservation activities would need to be adjusted accordingly to deal with the new stressor more effectively.

Even when a project seems to be on track, revising a conceptual model is a good idea when evidence from the monitoring program or new scientific research suggests that there are significant flaws or gaps in the existing model. Poor models can easily lead to poor decision-making at some point in the future. Reviewing and revising models is an important part of an ongoing monitoring and evaluation program.

This process of learning what works (and what doesn't) from monitoring programs and adjusting conceptual models and management activities accordingly is known as adaptive management. More information about adaptive management is available in standard references such as Holling (1978), Walters (1986), and Williams, Szaro, and Shapiro (2007).

Sample Indicators for Wildlife Management Activities

Certain types of indicators are commonly measured by wildlife and natural resource managers as part of their efforts to determine the effectiveness of fish and wildlife management activities. In this section, we provide descriptions of some of these common indicators. The primary focus here is on indicators that describe aspects of wildlife populations and habitats, because these are the primary conservation targets that have been identified in the State Wildlife Action Plans.

Our findings are based on an extensive review of both peer-reviewed and "grey" literature. Our intent in conducting this literature review was to find as many examples as possible of indicators that have actually been used in real-world settings by wildlife managers or evaluation practitioners. It is easy to describe what aspects of wildlife populations should be measured in an ideal setting with unlimited resources; it is much harder to say what measures will actually work in particular real-world management contexts.

In summarizing these findings, we have found it useful to separate the "things" or attributes that are measured by wildlife managers into two broad categories: simple metrics, which are single measurable aspects of wildlife populations or habitats; and composite metrics, or multi-metric indices that combine two or more different simple metrics into a single rank or index value.

While simple metrics are usually measured at the site or local level, they can often be "bundled" across multiple sites to produce statistics that describe conditions at regional, state, or even higher levels. It should be noted that there may be practical or theoretical limits to bundling or aggregating simple metrics. These limitations are discussed in more detail in our larger report.

Simple metrics

Simple metrics measure a single aspect or attribute of a wildlife species or habitat. Many of these metrics can be measured directly in the field, while others can be estimated using remote sensing data.

Species population metrics: Given that many wildlife management projects are conducted for the purpose of recovering or improving populations of particular wildlife species, it is no surprise that there are a suite of widely-accepted metrics for evaluating the status of populations and species. Probably the simplest (at least conceptually) are the "count" variables (number of individuals, number of occurrences, number of populations or meta-populations, and so on). Counts per area or per transect can provide estimates of population density, while repeated counts over a series of time intervals can provide estimates of population trends (Sauer, Link, and Nichols 2003). Population trends are often available for species of conservation interest through monitoring programs such as the Breeding Bird Survey or the Christmas Bird Count. Population trends can often be estimated by experts when precise quantitative data are lacking.

For many species it is quite difficult to accurately census an entire population, so demographic or population models are used to estimate population size or population trends using data collected through statistically valid sampling schemes (Thompson 2004). The types of data that are actually collected from the wildlife population of interest will depend on the particular management model that is used, but such models often rely on data on occurrence, abundance, reproductive output, age structure, survivorship, migration, and mortality (Cantu and Richardson 1997; Shult and Armstrong 1999; Sauer, Link, and Nichols 2003; Thompson 2004).

Species composition: One of the simplest measures of biodiversity at a given site is the number of species per unit area (also known as species richness). There have been a number of more sophisticated metrics developed to measure biodiversity, but species richness remains popular due to the fact that it is easily calculated or estimated from field data. A manager may also be interested in the percentage of species at a site that share some particular ecological property, such as intolerance to disturbance. For instance, the percentage of ecologically sensitive macroinvertebrates is one of the individual metrics that contributes to the Index of Biotic Integrity for freshwater systems (discussed in more detail under "Composite Metrics" below).

Species distribution: Changes in the distribution or migratory patterns of species can provide powerful indirect evidence of significant changes in the local, regional, or global environment (Sauer, Link, and Nichols 2003; Thompson 2004). At local scales, species distributions in the U. S. are typically quantified as single occurrences using the element occurrence standards developed for various taxa and ecological communities by NatureServe (2002). At larger spatial scales, species distributions are often displayed visually using range or point maps. Depending on the level of accuracy in these maps, changes in the area of species distributions could be quantified using Geographic Information System (GIS) software.

Habitat extent: Most reporting of habitat protection and restoration activities is done using extent variables, which are based on linear or areal measurements of a particular area, vegetation type, or ecological community of conservation interest. Related measures include the number of acres protected, acquired, or restored; number of new miles of riparian forest buffer planted; size of conservation easement; number of miles of river opened to fish passage. Although easy to measure using GIS, satellite imagery, or standard land surveying techniques, some authors (e.g. Ferraro and Pattanyak 2006) have noted that these variables provide little information about habitat quality or the ecosystem processes that are critical for supporting wildlife populations.

Habitat composition: Composition metrics for wildlife habitat typically enumerate or describe aspects of the vegetative community (Ruiz-Jaen and Aide 2005). Such measures may be quantitative (numbers of plant species, numbers of canopy tree species), or qualitative (lists of the dominant species). At larger scales, habitat composition is usually measured by percent of particular land cover types within an area of interest (usually based on a GIS map derived from satellite data or aerial imagery; The Heinz Center 2002).

Habitat structure: These metrics describe physical parameters of the habitat itself – basal area of a forest stand, average height of vegetation in a grassland community, average height of understory shrubs, sinuosity of a creek, frequency of riffles and pools in a stream reach (Ruiz-Jaen and Aide 2005).

Habitat function/process: Many ecologists argue that this is one of the most important categories of variables (e.g. Ruis-Jaen and Aide 2005), yet it is one of the most difficult to define. Part of the definitional complexity stems from the fact that many structural or compositional metrics also provide clues to ecosystem function. For example, seedling composition, height, and density together provide valuable information about forest stand recruitment and long-term stand dynamics. The depth of the soil organic layer is a structural attribute of soil, yet it also provides important insights into nutrient cycling. Another suite of variables commonly used in assessing ecosystem function are the concentrations of various chemicals and ions (including dissolved oxygen, nitrogen or phosphorous inrun-off, soil pH).

Some ecosystem processes have their own specialized measurement vocabulary and sets of associated indicators. For example, fire managers have developed their own sets of indicators and metrics to quantify pre- and post-fire fuel loads, burn extent, and burn frequencies (National Park Service 2003).

Resource variables: These variables describe key resources for wildlife species such as prey, water, host or food plants, and mutualistic partners (e.g. ants that tend the larvae of Karner Blue butterflies). Many resource variables are actually species or habitat measures, which would not otherwise be of management interest if they were not essential to particular wildlife species. For these variables, managers are typically interested in the presence, abundance, and spatial distribution of the resource.

Composite metrics

Composite metrics translate multiple quantitative measurements or qualitative assessments into a single metric that may facilitate comparisons between sites or across geographic levels. Such metrics are particularly helpful in combining measurements with different units (e.g. numbers of fish and average fish length) into a single metric for comparative purposes.

Probably the best known composite metric is the Index of Biotic Integrity for warm-water streams (Karr 1981), which in its original version combined 12 metrics (reflecting fish species richness and composition, number and abundance of indicator species, trophic organization and function, reproductive behavior, fish abundance, and condition of individual fish) into a single quantitative index scaled from 12 (lowest) to 60 (highest). The values of this index can be compared across stream segments, and the methodology can be also applied to different orders of streams, allowing some comparisons across different geographic scales.

The NatureServe (2002) or Natural Heritage ranking system is a series of nested ranked variables that measure the conservation status of rare species or unusual vegetation types at different geographic scales. It differs from the IBI in at least two important respects: the nested variables do not scale up according to a strict mathematical formula; and the system relies to a certain extent on expert judgment in establishing the rankings for each element at each level. Species or habitat occurrences are grouped using quantitative and/or qualitative standards into “Element Occurrences” or EOs. Within each state or territory, the rankings and number of EOs are used to establish a state or “S” rank. Within each country, the “S” ranks collectively help determine the national or “N” rank. And the various “N” ranks within a species’ distribution help determine its global or “G” rank. (For species found in only one country, the “N” rank is usually synonymous with the “G” rank.)

A similar combination of metrics occurs in Red List indices, which measure changes in the global conservation status of groups of species which have been comprehensively assessed at least twice using the International Union for the Conservation of Nature(IUCN) methodology (Butchart et al. 2005). Red List indices are a very coarse assessment tool, but can nonetheless be used to demonstrate global changes in the conservation status of broad taxonomic categories such as birds or amphibians.

Non-Biological Metrics

The next three sections focus on metrics and measurement strategies for different types of activities that are often associated with conservation and wildlife management programs. These activities are important for many reasons: outreach and education efforts build public support for wildlife conservation; research and monitoring activities build the information base that is needed to effectively manage natural areas and wildlife; and regulatory approaches are an integral part of wildlife management in the United States. Measurement strategies for these activities are typically drawn from social science approaches, which may be less familiar to wildlife biologists than species and habitat metrics.

Social Metrics: Outreach, Education, Fundraising, Partnership-Building

Although many wildlife professionals focus their attention on wildlife species and their habitats, it is clear that wildlife conservation occurs within a broader social context. Human activities are often responsible for driving the processes that help or hinder wildlife populations. For example, suburban development displaces forest-interior bird species but provides habitat for other bird species. Recreational boaters may inadvertently transport aquatic invasive species. And chemical treatments aimed at insect pests may adversely impact bird species. These and other human activities are, in turn, driven by economic forces, quality-of-life issues, and major demographic shifts. Different types of activities – outreach, education, partnership-building – are necessary to address these issues.

Understanding and describing the relationships between broader socioeconomic factors and wildlife conservation requires input from social scientists, economists, and evaluation professionals. Such scientists are not always included in discussions about wildlife conservation, because their activities are seen as external to the immediate conservation needs of species and their habitats. However, these scientists may nonetheless be able to offer valuable perspectives on human actions and motives. In particular, they may be able to identify specific indicators that track social processes that have a direct effect on wildlife and habitat. While an in-depth discussion of potential indicators and metrics for social processes is outside the scope of this review, the interested reader is referred to standard textbooks such as Trochim (2006) for an introduction.

Research and monitoring

Basic research is an important ancillary activity to wildlife conservation and is identified as a key activity in many of the state wildlife action plans. Research outputs are typically quantified in the academic sector by counting some combination of 1) number of pages published in peer-reviewed journals, 2) number of articles published in peer-reviewed journals, 3) the impact factor of the journals in which the research is published or 4) number of citations of a published article (Monastersky 2005). Since much of the research activities conducted or sponsored by wildlife managers will not be published in peer-reviewed journals, other appropriate measures may include the relevance of a particular report to management decision-making, or the citation of a particular report in future public discussions and debates over natural resource management.

Monitoring of wildlife populations is another important ancillary activity and there is an extensive literature on how to design monitoring programs to provide information at a level of detail sufficient to answer specific questions about species or populations of interest (Gibbs, Droege, and Eagle 1998; Sauer, Link, and Nichols 2003; Thompson 2004). More information about the design of monitoring programs is provided in the final chapter of our longer report. Some of the key questions in designing monitoring programs such as appropriateness of design, sensitivity, precision, and accuracy (Margoluis and Salafsky 1998), could also be used to evaluate these programs. There has been particular interest in the use of volunteer or “citizen science” monitoring programs in recent years, and citations are provided below to published papers that review select citizen monitoring programs in more detail. In general, these studies are encouraging: with proper training and given simple tasks such as tree identification, citizen monitors achieved levels of accuracy comparable to those of more experienced field naturalists. However, significant questions have been raised in the literature about the design of some “citizen science” efforts, particularly in regards to sampling strategies and the interpretation of results (Sauer, Link, and Nichols 2003).

Regulatory Programs

Regulations that limit or prohibit hunting or collecting are one of the oldest and most widely used tools for managing wildlife, both game species as well as endangered species (Leopold 1933). While these programs make intuitive sense where hunting or collecting is a verifiable threat to the continued survival of wildlife populations, there have been few studies that have rigorously investigated the effects of these regulations. The available data are highly subject to interpretation, as is shown by recent debates between advocates and critics of the federal Endangered Species Act. These debates hinge on whether the number of species recovered (the view of the Act’s critics) or the number of species that have gone extinct (the view of the Act’s advocates) is an appropriate metric for judging the success of this act. In reviewing this debate, the Government Accountability Office (2006) argued that neither of these metrics provides a complete picture, and that more information about the time and costs required for full achievement of recovery goals was needed in order to fairly evaluate the effectiveness of the Endangered Species Act.

Rodrigues (2006) suggests another metric that may be appropriate for regulatory programs: the number of species that would have become extinct if conservation activities had not occurred. Although this metric is intriguing, it could only be populated with actual data for taxa such as birds and some mammals where long-term information about population status, trends, and the results of conservation activities is available. And proving a counterfactual – what would have happened in the absence of conservation activities – is extremely difficult in many real-world cases.

A Reporting Template for State Wildlife Action Plans

Our longer report “Measuring Results of Wildlife Conservation Activities” describes a series of simple outcome measures that can be used to measure the results of wildlife and habitat conservation activities at the state or regional level. These simple measures can be combined into a reporting template. This template can serve as the basis of reports to government agencies and legislatures, funders, and the interested public.

Habitat Measures

For the first measure (Figure 4), we report the percentage of acres of key wildlife habitats (as identified in the State Wildlife Action Plan) according to their current management status. In this example, we use the management categories “Conservation Lands” (which includes lands whose primary management is for conervation, and private lands with similar management goals), “Other Public Lands” (meaning lands which are publicly owned but are being managed for a non-conservation use), “Developable Private Lands,” and “Converted to Other Uses.” Individual states may wish to have their own set of categories that best reflect the land management activities in their state. Including the percentage of acres that have already been lost can be helpful in putting current conservation activities in perspective: either a significant portion of these key habitats have already been lost, in which case the remaining areas are especially important for wildlife; or a significant portion of the key habitat areas are still extant, in which case there are significant opportunities for wildlife conservation and management on these lands.

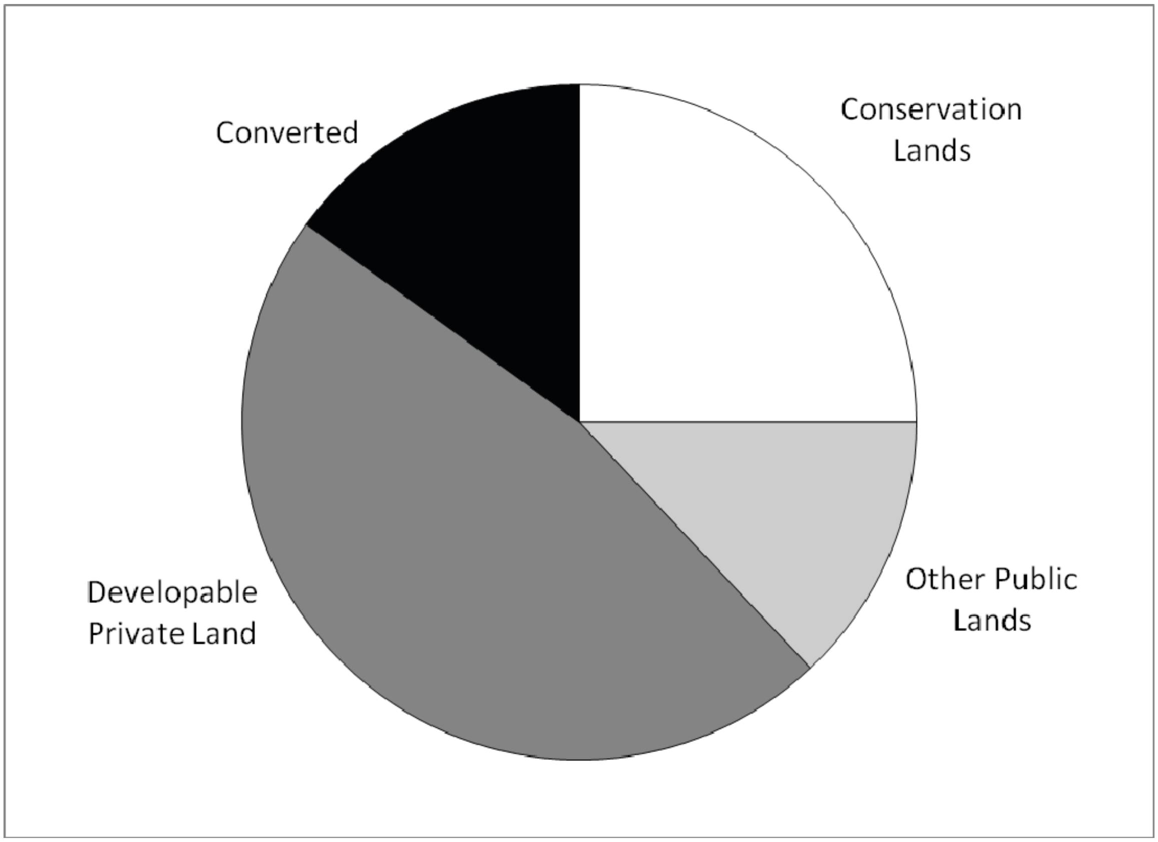

Figure 4: Management Status of Key Wildlife Habitats in Hypothetical State in 2006.

For the second habitat measure (Figure 5), we report the percentage of key wildlife habitats (as defined in the State Wildlife Action Plan) that are increasing in area, decreasing in area, stable in extent, or converted to other uses.

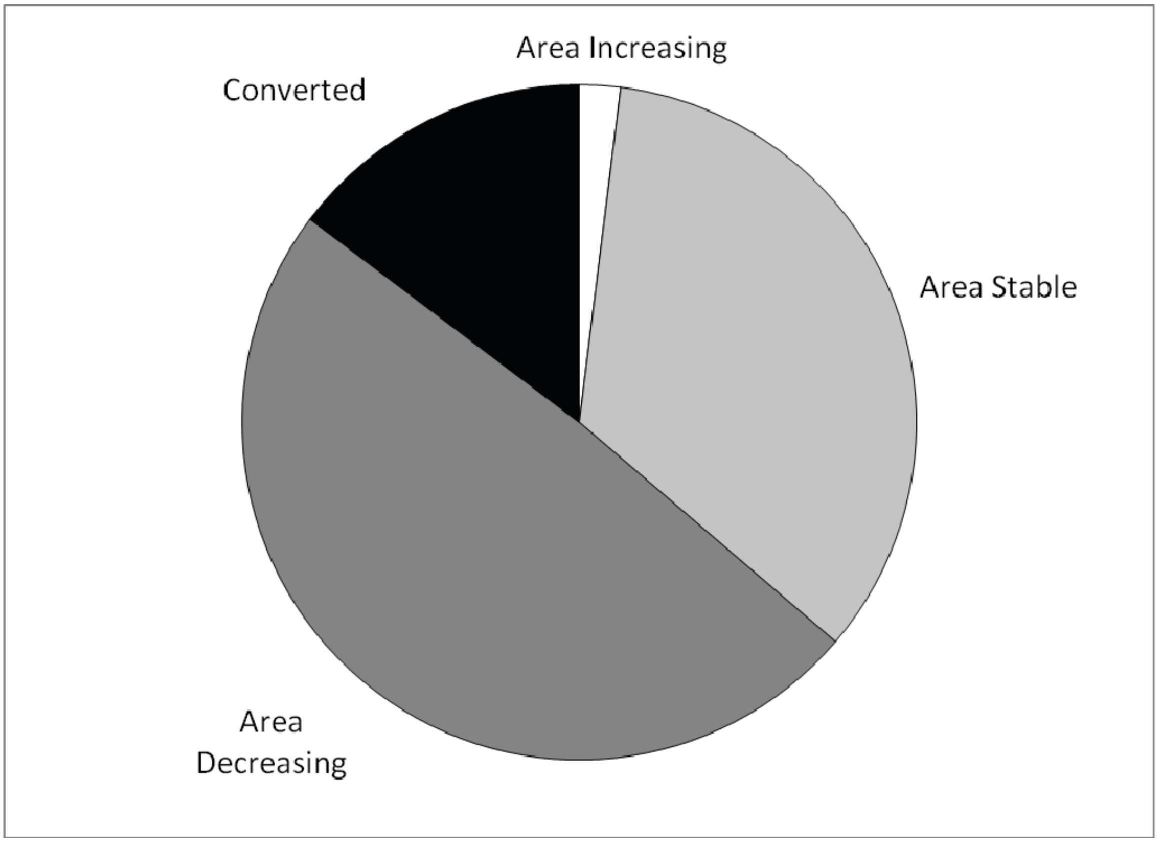

Figure 5: Trends in Extent of Key Wildlife Habitats in Hypothetical State, 1998-2006.

Species Measures

Figure 6 shows a simple pie chart, which we call the the "species trend chart," which summarizes the available information regarding the status and trends of species of greatest conservation need in a particular state. The chart reports the percentage of species that have increasing, decreasing, or stable population trends, or for which a population trend is unknown, or which are already extinct or extirpated within a state.

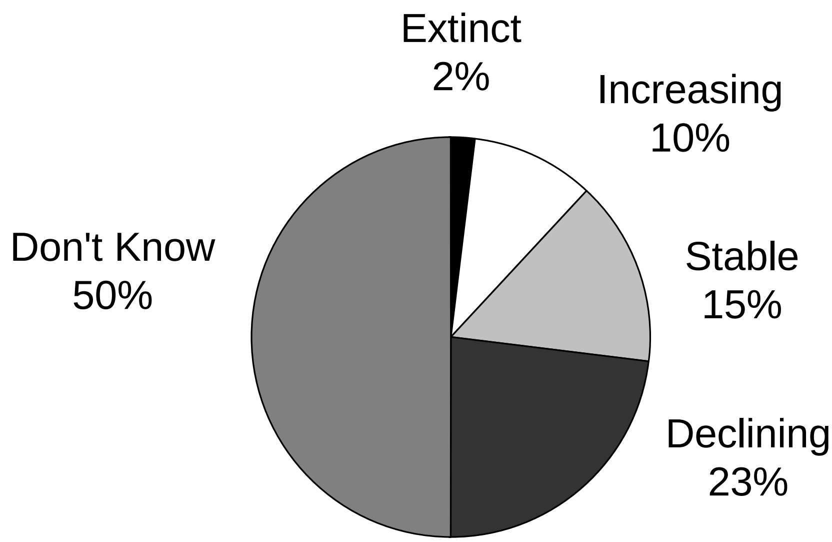

Figure 6: Population Trends in Species of Greatest Conservation Need for Hypothetical State, 2006

Output Measures

It is also useful to track a series of output measures associated with the implementation projects that have actually been completed. Figure 7 shows a very simple bar chart that reports the number of projects in each of the categories of conservation actions described by the International Union for the Conservation of Nature – Conservation Measures Partnership (2006). We have added an extra category for research and monitoring projects, since these activities figure prominently in the State Wildlife Action Plans but were not included in the IUCN-CMP taxonomy of conservation actions.

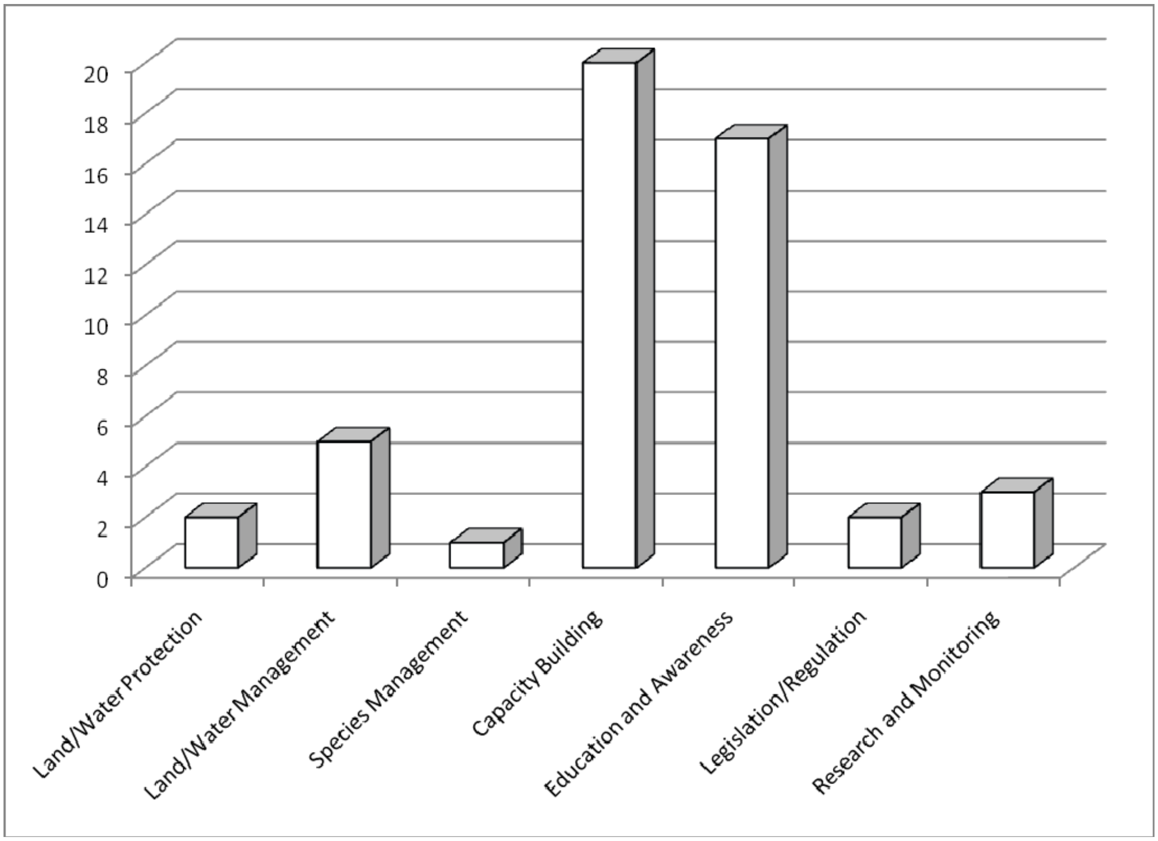

Figure 7: Number of State Wildlife Action Plan Implementation Projects in Hypothetical State, by Major Category, 2006-2008

Of course, other output measures are possible. We recommend that states and organizations develop similar charts that track their progress towards implementing the types of conservation activities that are most relevant for their particular management priorities. Figure 8 shows another simple output chart that shows the number of projects that have been completed for each of six broad focal taxa in a particular state:

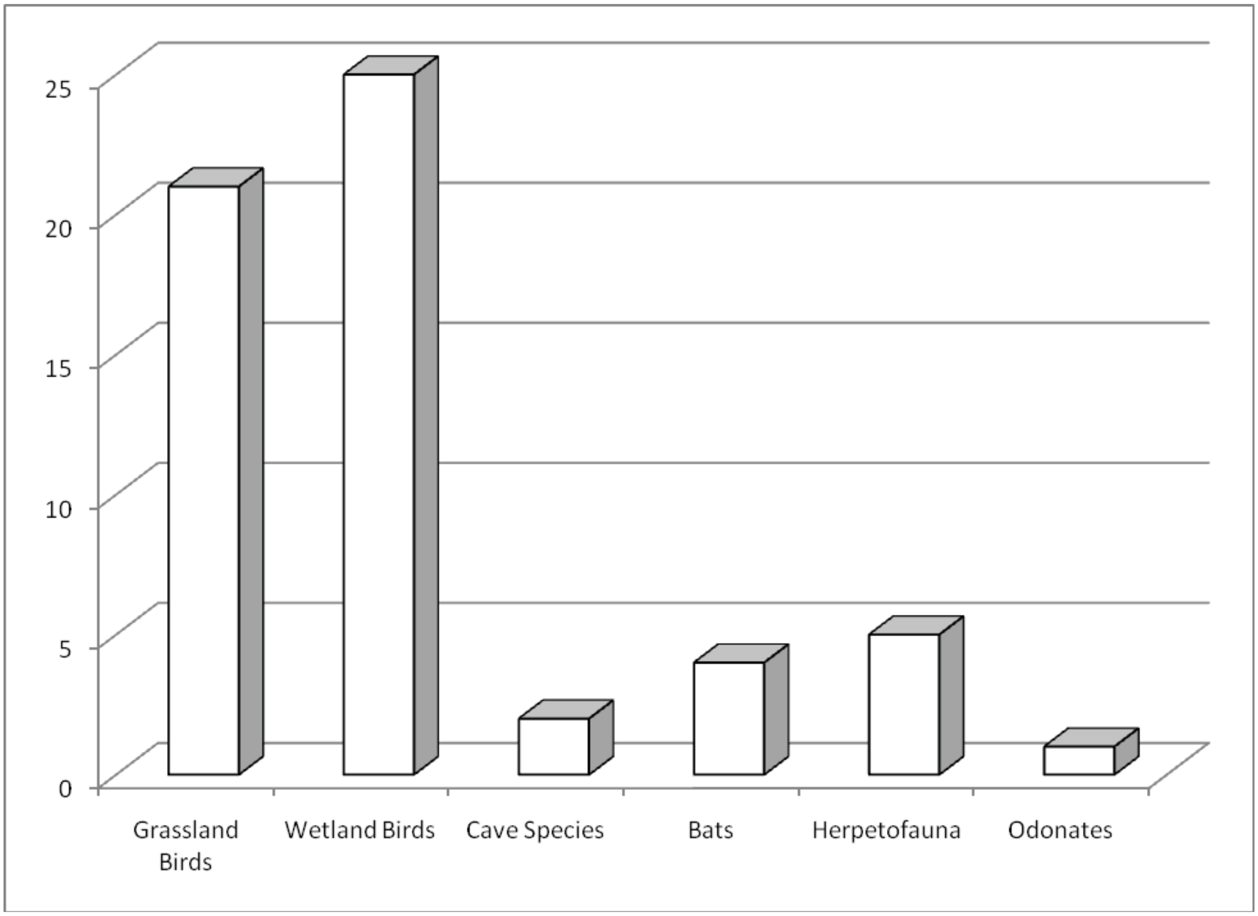

Figure 8: Number of State Wildlife Action Plan Implementation Projects in Hypothetical State, by Focal Taxa, 2006-2008

Points to Remember

- Simple statistics are available for measuring and reporting the results of State Wildlife Action Plan activities.

- It’s better to monitor a few things well than many things poorly.

- It may be more feasible to monitor changes in vegetation or ecosystem extent over time, using remote sensing imagery, than to monitor population trends across numerous species.

- Individual wildlife species often have broad popular appeal but it may be difficult to obtain reliable estimates of population size and other important demographic or population parameters.

- There is nothing wrong with selecting monitoring targets for a State Wildlife Action Plan that are well known or for which monitoring programs already exist.

- Once a conservation target has been selected, simple models (“system models” or “logic models”) can be helpful in selecting appropriate management indicators.

- Simple models can also help to identify priority conservation actions, by showing how these activities would affect a conservation target (species or ecosystem).

- Consult with federal agencies, other state agencies, and academia in designing a new monitoring strategy. Most likely, monitoring protocols and even monitoring data are already available from other sources.

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