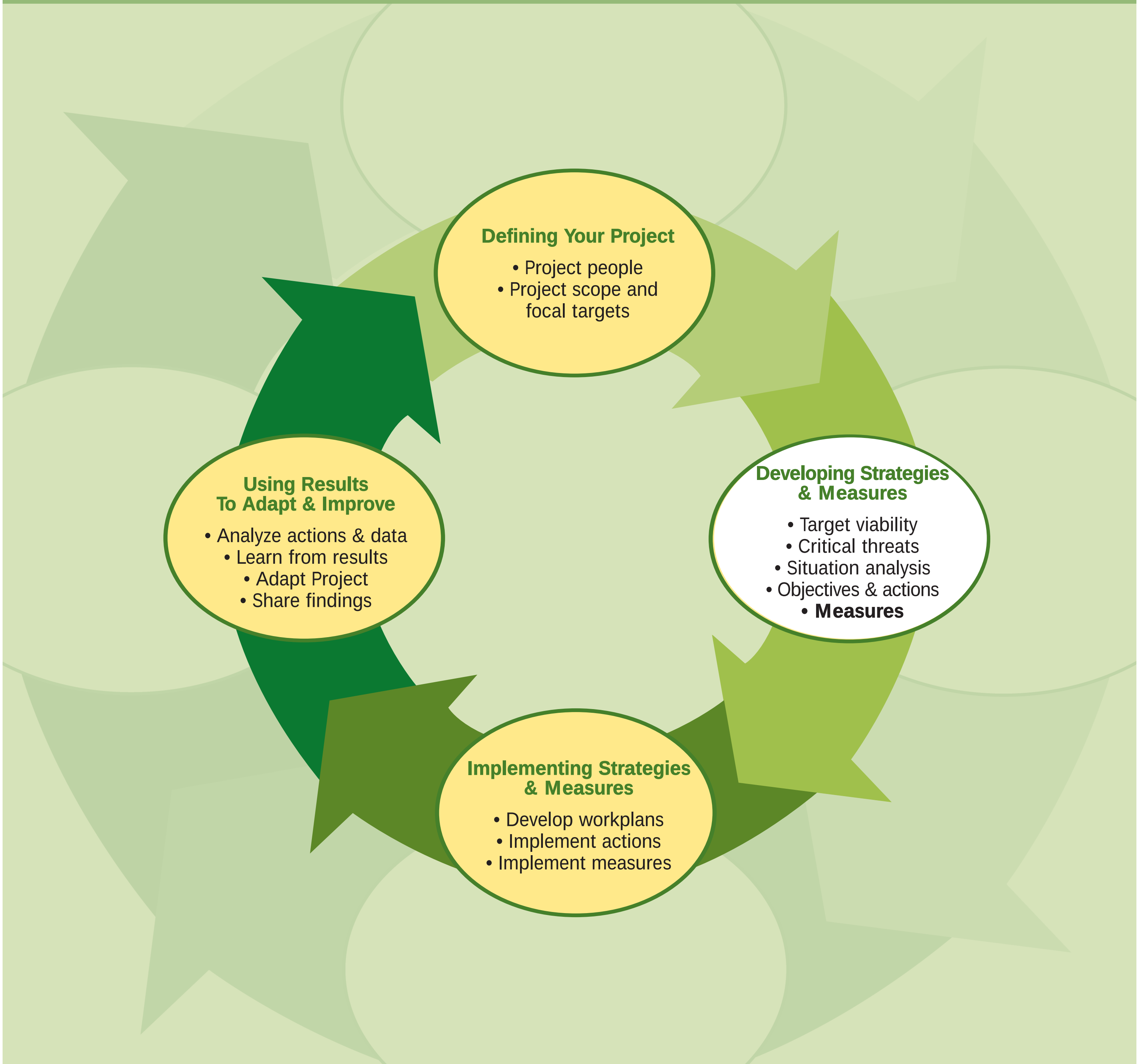
7. Establish measures



Basic Practice Seven

This document is a chapter from the Conservation Action Planning Handbook. The complete Handbook is available online at http://conserveonline.org/workspaces/cbdgateway/cap/practices.

The CAP Handbook is intended as a guidance resource to support the implementation of The Nature Conservancy's Conservation Action Planning (CAP) Process - a powerful instrument for helping practitioners get to effective conservation results. The CAP process is a key analytical method that supports Conservation by Design, the Conservancy's strategic framework for mission success.

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This is a living document that will adapt and change as new information becomes available and as we hear from you about how to improve it. The most recent version will always be available at: http://conserveonline.org/workspaces/cbdgateway/cap/practices

For more information on Conservation Action Planning visit www.conservationgateway.org/cap.

Conservation Action Planning
Step 7: Measuring Results

As summarized in TNC's CAP Overview of Basic Practices:

This step involves deciding how your project team will measure your results. This step is needed to help your team see whether its strategies are working as planned and thus whether adjustments will be needed. It is also needed to keep an eye on those targets and threats that you are not acting on at the moment, but may need to consider in the future. Specific questions that this step answers include:

"What do we need to measure to see if we are making progress towards our objectives and whether our actions are making a difference?"
"Are there other targets or threats that we need to pay attention to?"

Expected Outputs
- A realistic list of the indicators your project will measure to track the effectiveness of each conservation action.
- If necessary, a list of the indicators your project will measure to assess the status of selected targets and threats that you are not currently working on.
- Briefly describe the method(s) for collecting each indicator.

The Importance of Measuring Results

Measuring the results of your conservation work is perhaps most important for the members of your project team. Good measures allow your project team to determine whether you are making progress relative to your desired results, assess the effectiveness of your management actions, and adapt your conservation action plan to get the best results.

Measuring and reporting on results also can enhance your relationships with people outside the project team. Good measures will enhance your team's accountability, credibility and transparency with donors who are increasingly looking for evidence of a return on their investment. They are also the foundation for an improved understanding of what strategies work well under which circumstances that can in turn lead to better decisions on future priorities and strategies both locally and by other project teams.

One of the strengths of the CAP process is the full integration between conservation planning, taking action, and measuring results. This chapter will describe this linkage and how it creates a connected feedback process that is critical for adaptive management.

Defining Measuring Results

To measure results, first and foremost, you must define the questions you want to answer. For most conservation projects, measuring results answers two basic and interrelated questions: (1) Strategy effectiveness - Are the conservation actions we are taking achieving their desired results? and (2) Status assessments - How is the general status of the project changing?

Each of these two questions is discussed in more detail below. The distinction between strategy effectiveness and status assessment questions is not what is being measured (either can focus on biodiversity targets, threats, or conservation management status) but why you are measuring it. Are you spending money and taking action to achieve some kind of specific result? If so, you will want to measure the effectiveness of these actions. If instead you are measuring something that is not the focus of current conservation action but you want to determine whether action is warranted, then you are measuring for status purposes.

> Terms at a Glance
>
> Strategy Effectiveness - Answering the question: "Are the conservation actions we are taking achieving their desired results?"
>
> Status Assessment - Answering the questions: "How is the biodiversity we care about doing?", "How are threats to biodiversity changing?", or "How is the conservation management status changing?" Answers to these questions, even when no actions are occurring, are important to determine if actions are needed.
>
> Indicators - Measurable entities related to a specific information need (for example, the status of a key ecological attribute, change in a threat, or progress towards an objective). A good indicator meets the criteria of being: measurable, precise, consistent, and sensitive.
>
> Methods - Specific techniques used to collect data to measure an indicator. Methods vary in their accuracy and reliability, cost-effectiveness, feasibility, and appropriateness.

The same information can thus address status assessment or strategy effectiveness questions. For example, a project may gather water quality data for status purposes to confirm that upstream industrial sources are not discharging excessive levels of pollutants. If status assessment measures reveal undesirable levels of pollutants, strategies may be implemented to abate the pollution threat and the same water quality indicator will shift from a status role to a strategy effectiveness role (some additional strategy effectiveness measures with closer ties to the actions being implemented may be added as well). Similarly, population size of a particular species may be tracked to see if it is above or below a particular threshold. Declining trends or a drop below the threshold level may serve as a trigger for taking management action and a shift from status to strategy effectiveness measures.

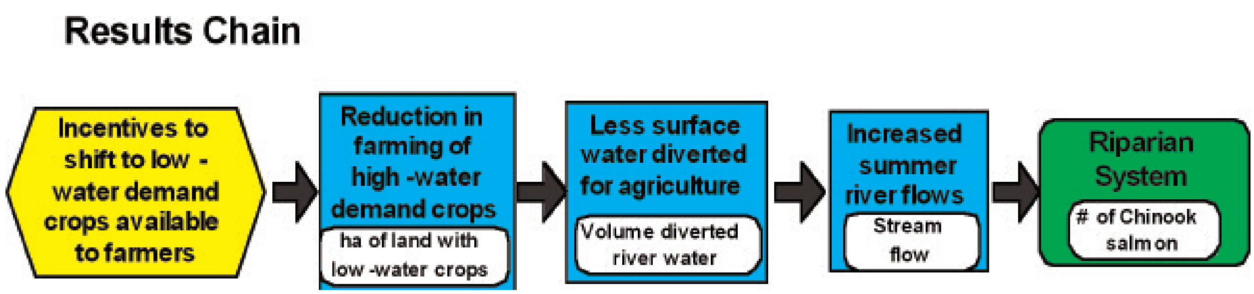
The Two Components of Measuring Results

Strategy Effectiveness

Returning to our two questions above, strategy effectiveness measures are designed to tell us if our actions are leading to their intended results. Strategies in biodiversity conservation projects ultimately aim to affect the biodiversity we care about. Sometimes actions have a direct link to the conservation targets and measuring results is fairly straightforward. For example, if the action is planting trees to restore species composition and abundance, you may use percent survival of planted trees two years after planting as the primary indicator of strategy effectiveness. In other cases, conservation actions affect biodiversity indirectly by focusing on underlying causes behind the sources of stress. In these cases, you should consider measuring indicators at multiple stages of the causal chain(s) that link the actions to the biodiversity to better assess whether the strategies are working. Consider the example shown in Box 1 where the conservation action is passing legislation to motivate farmers to switch from high water demand crops to low water demand crops to benefit salmon, who are suffering from low river flows influenced by agricultural water diversions.

Box 1. Example of Measuring Strategy Effectiveness

Consider the following conservation situation where salmon are part of a riparian system conservation target that is stressed by extremely low river flows. Water is being diverted from the river to grow high water-demand agricultural crops. A strategy is identified to pass legislation providing financial incentives to motivate farmers to switch to low water demand crops. The project team has specified the following threat abatement objective: "By 2010, reduce the amount of water from the Blue River diverted for agricultural purposes from 5000 gallons/day to 1000 gallons/day". The following results chain diagram conveys the underlying assumptions that link the legislative strategy to the source of stress to the conservation target. Potential strategy effectiveness indicators are listed below each desired result.



How could the effectiveness of the incentive strategy in this situation be monitored?
Consider the following candidate strategy effectiveness indicators:

1. **Number of Chinook salmon** - Salmon population size is a key ecological attribute and there is hope that conservation action will ultimately lead to increases in salmon numbers. However, there are many other factors affecting the salmon population and using this as the sole indicator will not provide very sensitive feedback to the effectiveness of the strategy.
2. **Stream flow** - Altered flow regime is an identified stress (or altered key ecological attribute) and determining if this key attribute is improving is important. But once again, it does not provide a very direct measure of the effectiveness of the particular conservation action and is likely influenced by other factors such as annual variation in rainfall.
3. **Volume of water diverted** - Actually tracking the amount of water used for agricultural purposes adds an important measure of the threat itself and specifically measures progress towards the stated threat abatement objective.
4. **Hectares of low-water crops** - An additional indicator that will help inform the effectiveness of the strategy is the hectares of farm land converted from water-intensive crops to low-water need crops.
5. **Actions taken and immediate output** - It is also helpful to track whether actions are being implemented as planned and to record the immediate outputs of these actions (e.g., what specific actions were taken?, did legislation pass?, how many farmers signed up for the incentive program?).

Simply tracking the number of salmon in the river does not provide a sensitive measure of strategy effectiveness given the series of linked changes that must occur for the legislative action to affect the salmon. Likewise, simply tracking whether or not the legislation passed provides an insufficient measure of strategy effectiveness - what if farmers never use the new incentive program?

The series of if-then assumptions that link actions and desired results can be recorded in narrative descriptions but diagrams like the one shown in Box 1 are particularly valuable for capturing and communicating these relationships. These diagrams, known as "Results Chains" (WWF & FOS 2006) are similar to the situation analysis diagrams described in *Step 5: Complete Situation Analysis*. Situation analysis diagrams include boxes and arrows that show the relationship between targets, threats, and underlying causes to assist with strategy identification. Results Chains start with selected strategies and change the boxes to result-oriented descriptions that capture the presumed consequences of taking actions. Situation analysis diagrams show the project situation today whereas the results chain diagram shows the desired future condition of the project.

Status Assessment
Most projects will have some conservation targets, or at least some key ecological attributes for some targets, that are currently within an acceptable state (i.e., target viability goals are being met) and without critical threats bearing down on them and therefore do not require any immediate management attention. With no strategies or stated objectives, there will be no need for strategy effectiveness measures. Does this mean the project team should ignore these targets entirely? No - some type of periodic status assessment is needed to reaffirm that the targets continue in a state that does not require management attention. The status assessment needs of a project can often be addressed with less intensive, and/or less frequent measurements than strategy effectiveness measures. Status assessment needs can sometimes be met with data that is periodically gathered by someone else as part of long-term monitoring efforts. In addition to evaluating whether a conservation target is at an acceptable state (e.g., meeting long term goals set for that target), status assessments often serve an early warning role to trigger action or more intensive measurement when undesirable changes are detected.

Why Bother Distinguishing Between Strategy Effectiveness and Status Measures?

Project teams are typically challenged by the need to take action, measure the effectiveness of actions being taken, and measure the status of biodiversity to determine if new actions are needed. The allocation of limited resources across these three needs is often done without a deliberate consideration of the tradeoffs among these competing priorities.

Many conservation projects do not measure or report on the results of their conservation actions. For example Bernhardt et al. (2005)[9] found that for 37,000 river restoration projects in the United States costing an estimated $14-$15 billion, less than 10% of the restoration projects had any form of assessment or evaluation. The consequence of this low attention to measuring results is significant: "Because most project records were inadequate to extract even the most rudimentary information on project actions and outcomes, it is apparent that many opportunities to learn from successes or failures, and thus to improve future practice, are being lost." Choosing to not measure results can lead to inappropriate allocations of valuable resources if, for example, we continue to unknowingly invest in actions that are not having the desired impacts.

At the other extreme, occasionally we find very large status assessment allocations for projects in relatively intact, unthreatened landscapes with few identified conservation actions. There is practically no limit to what you can spend money on in the name of status assessment - detailed vegetation measures with canopy and under story sampling, population monitoring of large mammals, small mammals, birds, amphibians, reptiles, and insects. But what is the conservation impact of all this status assessment information? In many cases it may be quite limited. Certainly, some studies of intact systems are needed to serve as reference areas or to establish baseline conditions if future impacts are anticipated. However, investment of limited conservation resources in this type of status assessment should be carefully evaluated if there are competing resource needs for implementing strategies and measuring strategy effectiveness.

9. Bernhardt, E.S., et al. 2006. Synthesizing U.S. River Restoration Efforts Science 308 (5722), 636.
http://www.sciencemag.org/cgi/content/full/308/5722/636/DC1

Clearly defining the need for strategy effectiveness and status measurements contributes to making informed decisions that will lead to stronger applied investments in taking action and measuring results. See the Case Study titled "From Status to Effectiveness Measures for a Globally Rare Plant" in the *Resources and Tools* section below for an example where changes in the allocation of resources improved the management relevance of the measured results. For additional information on the challenges and solutions associated with allocating resources between taking action, measuring the effectiveness of actions taken, and doing status assessments, see Salzer and Salafsky (2006) in the *Resources and Tools* section.

Indicators and Methods

Regardless of the question being addressed, developing a plan for measuring results ultimately involves determining the indicators that you will collect and the methods you will use to measure the indicators.

An indicator is a measurable entity related to a specific information need, such as the progress towards achieving an objective, change in a threat, or status of a target. Indicators can be quantitative measures or qualitative observations. Good indicators meet the following criteria:
- **Measurable:** Able to be recorded and analyzed in quantitative or in discreet qualitative terms.
- **Clear:** Presented or described in such a way that its meaning will be the same to all people.
- **Sensitive:** Changing proportionately in response to actual changes in the condition or item being measured.

Methods are specific techniques used to collect data to measure an indicator. Good methods meet the following criteria:
- **Accurate:** Gives minimal or no error.
- **Reliable:** Results obtained using the method are consistently repeatable.
- **Cost-Effective:** Not overly expensive for the data the method yields or for the resources available to the project.
- **Feasible:** Project team has people who can use the method, as well as the material and financial resources to use the method.
- **Appropriate:** Appropriate to the environmental, cultural, and political context of the project.

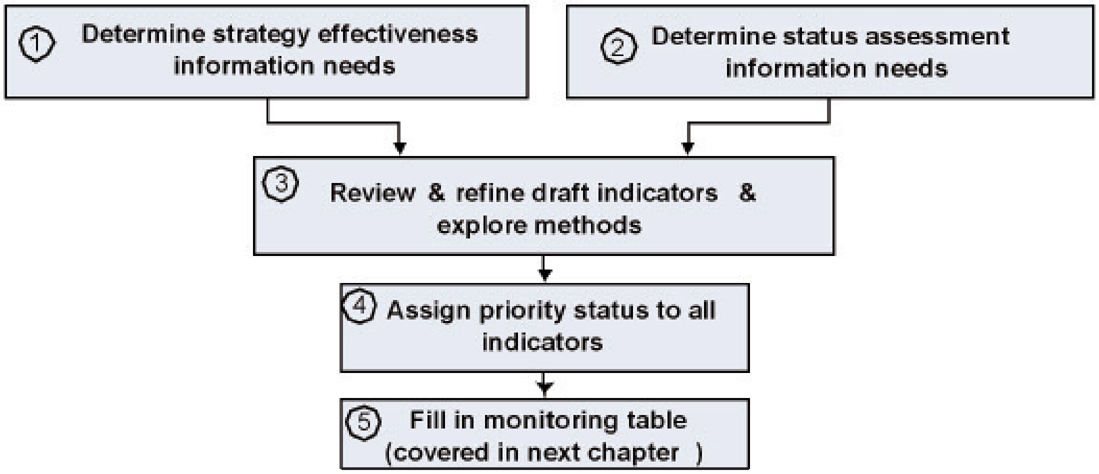
Instructions on providing additional details to complete a monitoring plan - who, where, when, and cost information - is covered in the following chapter - *Step 8: Develop Work Plans.*

Commonly Used Methods

By completing steps 1-6 of the CAP Basic Practices process you and your project team will have done much of the work needed to design an effective program to measure your conservation results. These earlier steps outline the desired outcomes and key assumptions underlying your project that serve as the basis for your measures plan. Well-defined objective statements and strategic actions (*Step 6: Develop Strategies*) identify threat-based and action-based indicators to measure. The threat summaries (*Step 4: Identify Critical Threats*) and diagrams from your situation analyses (*Step 5: Complete Situation Analysis*) will suggest additional candidate indicators. Initial viability analyses identify candidate key ecological attributes and indicators for measuring the impacts of actions on targets or for periodic tracking of their status (*Step 3: Assess Viability*). If your project team invests the up-front time in these design steps, then deciding what to measure and developing your measures plan will be straightforward.

Commonly used methods follow the sequence of numbered steps in Figure 1.

Figure 1. Commonly Used Method for Developing a CAP Measures Plan



1. Determine Strategy Effectiveness Information Needs

You should start by identifying what information is needed to track the effectiveness of strategies being implemented by your project. Resources are being spent to achieve desired results and you need to know whether the current course of action is showing progress and should continue or is not showing progress and should be revised.

Every stated objective should have at least one indicator used to track progress towards achieving the desired results. The number and type of strategy effectiveness indicators needed per objective will vary depending upon the complexity, risk, or uncertainty associated with the strategic actions being implemented. If your project team has developed good viability assessments and written clear and measurable objectives and described the strategic actions needed to achieve them, you will already have the most important information you need to identify priority strategy effectiveness needs and corresponding draft indicators.

In many cases, the selection of strategy effectiveness indicators is very straightforward. Because most strategies focus on abating critical threats or improving degraded key ecological attributes, strategy effectiveness information needs are often associated with the highest ranked threats and the key ecological attributes of targets that are of greatest concern to the project team. Indicators for measuring the effectiveness of strategies should correspond to threats listed in the threat summary table and/or to key ecological attributes of concern listed in the viability assessment. Consider the following examples of strategy effectiveness indicators for objectives from actual Conservation Action Plans:

Project: Cookson Hills

Objective: Secure legal protection on 18,000 acres by 2015

Indicator:

- Acres in legal protection (addresses critical threat)

Project: Bering Sea

Objective: Reduce current (2005) number of albatross caught in longlines & nets by 50% by 2010 in US waters and by 2015 in Russian waters

Indicators:

- Short-tailed albatross incidental take (addresses critical threat)
- Short-tailed albatross breeding population size (from target viability assessment)

Project: Lake Wales Ridge

Objective: By 2013, climbing ferns have been completely eradicated from within 10 miles of all conservation properties

Indicator:

- Number and aerial extent of climbing fern locations (addresses critical threat)

Project: Current River

Objective: Achieve and maintain less than 20% in-stream grazing in target creeks.

Indicator:

- Percent of stream subjected to in-stream grazing (addresses critical threat)

Project: Cookson Hills

Objective: Protect all caves in the Conservation Area from human intrusion by 2008

Indicators:

- Evidence of anthropogenic disturbance (addresses critical threat)
- Bat diversity/ abundance (from target viability assessment)

These five examples illustrate strategy effectiveness approaches that rely on indicators of critical threats and/or target viability. For situations where strategic actions are aimed at underlying causes behind critical threats, consider selecting indicators at key steps along the causal chain that connect the action(s) to the target. For example, consider the following objectives and strategic actions for the Andean Bear target from the Condor Bioreserve in Ecuador where bears are killed due to conflicts with livestock grazing.

Goal: Andean Bear / Population size of at least one adult bear per km^2 of available habitat.

Threat: Illegal hunting of Andean Bears

Objective: By September 30 2007, 50% of Andean bear conflict hunting has been reduced over 2000 hunting levels in three critical sites of the CBR: Oyacachi, Cosanga and Cuyuja.

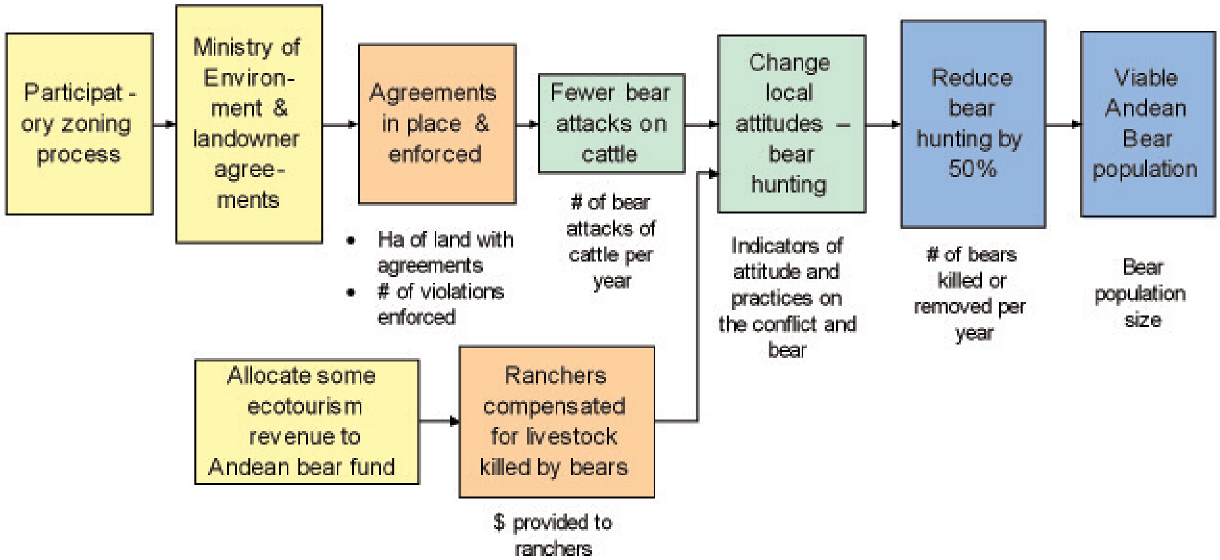
Strategic Actions:

(1) Work with private land owners and communities to create separate land use zones for cattle grazing and bear conservation areas to reduce the hunting of Andean bears due to conflicts with cattle grazing, especially in Oyacachi, Juan Montalvo and Cosanga.

(2) Allocate some ecotourism revenue to an Andean Bear fund to compensate ranchers for cattle killed by bears.

The project team has made the linkage between the actions they are taking and their desired results explicit through the use of a Results Chain diagram (WWF and FOS 2005) as shown in Figure 2.

Figure 2. Results Chain for the Andean Bear focal target at the Condor Bioreserve project in Columbia



The indicators listed below the factors are *potential* indicators for measuring the results of the actions being taken. The project team needs to decide which indicators are most important and/or feasible to monitor with available resources. If the objective is to cut in half the number of bears killed each year and you suspect the primary motivation is conflict with cattle, it seems you would at least want to keep track of # of bears killed, # of bear attacks on cattle, and some periodic estimate of the bear population itself.

The Results Chains tool is very useful for guiding the selection of strategy effectiveness indicators. See *Resources and Tools* for instructions and examples of completed Results Chains (WWF-FOS 2005).

The CAP Workbook includes a data entry wizard - the Strategy Identification Wizard - that makes is easy to associate threat-based, target-based, or any other indicators to your stated objectives. The threat summary table includes a utility that makes it easy to link your indicators to specific threats (double-click on threat-threat ranks to open the utility).

2. Determine Status Assessment Needs

Your draft strategy effectiveness indicators likely address most of your critical threats and a subset of the key ecological attributes of your focal targets. You should review the threats and key ecological attributes that are not the focus of your current action plan to identify additional potential status assessment indicators to monitor.

Start by reviewing your threat summary table. Are there threats that are not the subject of current actions, perhaps with Medium or Low ranks, that raise sufficient concern to warrant measuring? Undesirable changes in these threats may trigger new conservation action. For example, you may currently consider illegal timber harvesting to be a Low-ranked threat but confidence in the threat rating was weak so you may ask rangers and other project staff to keep records of any newly cut stumps they observe on routine visits through the project area.

Add additional threat-based status indicators into the CAP Workbook by double-clicking on target-threat ranks in the Threat Summary Table and using the "Add Indicators" utility.

Next, review the indicators from your target viability assessment. The viability assessment process often generates lists of Key Ecological Attributes and Indicators that exceed the capacity of project teams to assess on a regular basis. Thus, it is important to identify the indicators that are most important to regularly measure. Some of the viability indicators will have already been selected for strategy effectiveness purposes and likely represent the highest priority viability indicators for measuring (the monitoring table in the CAP Workbook lists all viability indicators and shows which ones are linked to the project's objectives).

Identify key ecological attributes and indicators where you have hypothesized a connection to potentially critical threats but where uncertainty in target status is serving as a barrier to taking action. Improving the understanding of the status of these key ecological attributes and indicators will inform pending conservation action decisions. For example, you may know that periodic flooding is necessary to lead to riparian forest recruitment events but you don't yet know whether upstream water uses are sufficiently altering the flow regime to prohibit recruitment. Measuring an indicator of riparian tree recruitment will help you determine if strategies affecting upstream water management are needed.

It will be less important to regularly measure viability indicators associated with key ecological attributes confidently assigned to Good or Very Good status ratings that are not associated with critical threats. Lower priority ranking may lead to the selection of less costly measurement techniques (qualitative vs. quantitative methods) or less frequent assessment intervals.

3. Review and Refine Draft Indicators and Explore Methods

When people think of measuring results, they also often think of complex methods involving quantitative indicators that require specialized skills - for example, mark-recapture population monitoring of an animal population or counts of plants in rectangular quadrats. Methods, however, do not need to be complex or sophisticated and indicators can be quantitative or qualitative. In fact, if you can get the information you need using a simple, inexpensive method, it is far preferable to do this than to choose a complex, expensive method. While the information you gather may be less precise, it may be sufficient for the types of decisions you are making. When planning for measuring results, you need to keep in mind that it should be a relatively small portion of your project budget - a general rule of thumb is about 5-15% of your overall budget (this will vary considerably depending on the project and the actions being taken). If your methods for measuring results are too complex, you will not have enough money to implement actions and measure the results.

For example, consider the following alternative indicators and methods for tracking the abundance of an invasive plant population:

- **Indicator:** Patch location and size. **Method:** Detailed mapping of all patches of the invasive species using a global position system and management of the data within a Geographic Information System.
- **Indicator:** Population size. **Method:** Total census of all plants in the population.
- **Indicator:** Mean density or cover. **Method:** Quantitative assessments of density or cover in randomly positioned quadrats to estimate the average plant density or average cover with confidence intervals around estimates.

- **Indicator:** Relative abundance rank. **Method:** Qualitative estimates of abundance based on wandering transect survey method.
- **Indicator:** Presence/absence. **Method:** Quick site visit to determine whether the invasive species is present or not.

All of these indicators and methods are valid, but each varies in its level of effort, cost, and accuracy. You will need to balance the need for greater accuracy and precision with considerations of the risk and uncertainty of anticipated results and resource availability.

As you review the list of draft strategy effectiveness and status assessment indicators, consider the following tips for refining indicators and selecting potential methods:
- Use existing data sources
- Consider alternative methods
- Pursue locally-based solutions
- Measure surrogate indicators
- Evaluate potential indicators and methods using desired criteria
- Record a brief description of selected methods for each indicator

Use existing data sources
Before you invest time and effort into developing and implementing your methods for measuring results, you should determine if the data you need is available from existing, reliable sources. Assuming these methods meet the criteria for good methods, you should try to use this data rather than spending your project resources on collecting primary data. In some cases, you may not be able to get exactly what you need from secondary sources, but you should evaluate whether what you can get would meet your needs. If so, you should consider modifying your indicator so that you can draw on this existing source. For example, if you have identified the need to measure river flows, you may discover that a government agency has an automated stream flow gauge 10 miles upstream that provides a reliable enough estimate of stream flows within your project area and you may be able to download annual flow data from the internet. You should be careful, however, that your new indicator does truly serve as a good measure of your information need. Good sources of data include ongoing research projects and routine monitoring by scientific institutes, universities or government agencies.

Consider alternative methods
If existing data sources cannot meet your needs, consider alternative methods before selecting a particular approach. There is typically a wide range of potential methods to assess a given indicator. These methods vary in terms of specific measurement techniques, the use of statistical sampling methods, and the degree to which management treatments are spatially replicated and compared to themselves and/or to untreated controls over time.

There are typically many alternative measurement techniques. For example, measures of aerial extent of an ecological system can be measured directly on the ground by pacing or with measuring tapes, tracing polygons on aerial photographs and estimating cover with a grid-overlay, walking the perimeter of patches with a global positioning system, or collecting and analyzing geo-referenced satellite imagery. The size of animal populations can be assessed via a variety of methods including asking local villagers to report the number of animals they have seen or heard recently, conducting a complete census, using relative indices of abundance (e.g., track or scat counts), using mark-recapture techniques, or using distance sampling methods. Plant populations can be assessed via total counts, rank order estimates of abundance (e.g., 1-100, 101-1000, 1000-

10,000, > 10,000 individuals), demographic techniques, simple or nested frequency measurements, biomass estimates, or estimates of plant cover (e.g., ocular estimates, point-intercept, line-intercept, or direct cover measurements). See Elzinga et al. 2001 in the *Resources and Tools* section for an overview of many common measurement techniques for plant and animal populations.

You need to decide whether or not your methods will involve statistical sampling procedures. Sampling is the act or process of selecting a part of something with the intent of showing the quality, style, or nature of the whole (e.g., counts of plants gathered within randomly positioning quadrats used to estimate the overall population size with 95% confidence intervals). Many monitoring methods do not require sampling procedures. Sometimes, you can count or measure all individuals within a population. Other times, you may select qualitative approaches such as subjectively positioned permanent photo-points. If you do elect to use sampling procedures, there are many sampling decisions that must be considered including the selection of specific sampling units (e.g. quadrats, points, line transects), the size and shape of the sampling units, the arrangement of sampling units within the area of interest (e.g., simple random sampling, systematic sampling, stratified random sampling), whether sampling unit locations should be permanently marked or temporary, and the number of sampling units to sample. See the *Resources and Tools* section of this chapter for several good books to guide the selection of efficient sampling designs.

Assessing the results of specific conservation actions with a high level of scientific certainty requires an experimental research design with adequate levels of replication and controls. Although it is desirable to achieve strong scientific inferences regarding the consequences of your actions, competing demands on limited resources typically limit the opportunity for full field experimentation to assess the impacts of most conservation actions. You should pursue more rigorous experimental research designs when the uncertainty or risk associated with your actions warrants this higher level of scientific certainty. Even without a fully replicated experiment design, you can markedly improve the probability of learning whether actions being implemented are leading to the desired results by measuring a combination of indicators located at different positions along a results chain (see WWF-FOS 2006 for more information on Results Chains).

In many cases you or your colleagues will be aware of the range of methods available. If this is not the case you can learn about various methods by talking to experienced people, reviewing documents or manuals on the subject, taking courses, or scanning through examples of monitoring plans available through shared information systems such as TNC's Conservation Project Database (http://conpro.tnc.org).

Explore the use of locally-based monitoring methods

Locally-based monitoring methods embraces a broad range of approaches, from censuses by local rangers, inventories by citizen scientists, or using economic or resource use/extraction data from the very actors that may be creating threats.

There are many examples of manuals that guide the establishment of local volunteer monitoring programs. See *Resources and Tools* for links to the U.S. Environmental Protection Agency (EPA)'s published manuals for volunteer monitoring of lakes, streams, estuaries, and wetlands and the U.S. Forest Service's 2006 guide on Broadening Participation in Biological Monitoring: Handbook for Scientists and Managers.

Locally-based options may be particularly appropriate when local communities are actively using the natural resources within the project area. In some natural resource use cases, you can find an indicator that simultaneously informs threat status and target viability status.

Consider a situation where you are concerned about the potential downward trend in the population of some fished species. You could focus strictly on target viability measures and do underwater surveys where counts of fish by estimated size class are made for a fixed duration of time at numerous monitoring stations. Alternatively, you could take a completely threat-based approach where you track the number of fishing boats working in the area, number of fishing trips, or the number of people employed as fisherman. However, you could simultaneously track the threat and the target if you work with the fisherman to keep and share good catch records. Measuring trends in the total weight or volume of the catch, the size distribution (or simply the average size) of fish caught, and the effort required to obtain their catch (number of hours spent fishing) could yield valuable threat and target status information. For example, if it is taking fisherman more time to catch the same quantity of fish and the average fish size is steadily declining, you have reason to be concerned about the status of the fish population. Alternatively, perhaps a large marine reserve has been established nearby and more and larger fish are being caught with less effort providing an indicator of stable or increasing population size. In either case, as long as you believe your catch records are accurate and complete, you may not need separate underwater fish counts to assess the status of the fish population.

Similarly, if you are concerned about the over-harvesting of non-timber forest products, the most cost-effective assessment approach might be to measure harvest levels rather than directly measuring the population of plants in the forest. For example, if in year one it takes a villager an average of four hours to fill a basket with masuatake mushrooms and in year three it takes an average of 8 hours to collect the same volume of mushrooms, there is reason to be concerned about the status of the masuatake mushroom population, even without separate counts of mushrooms in the field.

See *Resources and Tools* at the end of this chapter for a set of 15 locally-based monitoring case studies (Danielsen et al. 2005).

Consider measuring proxy indicators

In some cases you cannot collect the information you need directly because data are too difficult, too expensive, or culturally inappropriate to acquire. In these cases you should consider measuring proxy or surrogate indicators. For example, you might use the number of orangutan nests as a proxy for the orangutan population size. Or if you are working to control a non-native plant species by having volunteer work crews annually pull out all established plants, you may rely on the number of person-hours it takes each year to control the population as a proxy measure of the abundance of the non-native species. A steady decline in the annual control effort needed to treat the population suggests a reduction in the abundance of the non-native species.

Evaluate potential indicators and methods using desired criteria

As you consider alternative indicators and methods, you should review and apply the criteria introduced in the "Defining Measuring Results" section, repeated here:

Criteria for Indicators:

- **Measurable** - Able to be recorded and analyzed in quantitative or in discreet qualitative terms.
- **Clear** - Presented or described in such a way that its meaning will be the same to all people.
- **Sensitive** - Changing proportionately in response to actual changes in the condition or item being measured.

Criteria for Methods:

- **Accurate** - Gives minimal or no error.
- **Reliable** - Results obtained using the methods are consistently repeatable.
- **Cost-Effective** - Not overly expensive for the data the method yields or for the resources available to the project.
- **Feasible** - Project team has people who can use the method, as well as the material and financial resources to use the method.
- **Appropriate** - Appropriate to the environmental, cultural, and political context of the project.

Record a brief description of the method associated with each indicator

The proposed method should be briefly summarized in the monitoring plan. If the method is not well known to those doing the measurements, it may be necessary to define and describe the method more fully in a separate document (see Slapcinsky & Gordon 2003 and Slapcinsky et al. 2006 in the *Resources and Tools* section for examples of monitoring plans for quantitative and qualitative monitoring from TNC's Florida Program).

> The monitoring table in the CAP workbook includes a field to record a brief description of the method and also includes a separate field to record the citation and location of a more detailed monitoring plan.

4. Set Priority Status for all Indicators

You have now developed the basic elements of a plan for measuring results by selecting strategy effectiveness indicators, status assessment indicators, and providing a brief description of the methods for measuring each indicator in a draft monitoring table. You should have also linked all indicators to objectives, targets, key ecological attributes, and threats.

The previous steps for identifying indicators and methods incorporated many priority-setting criteria. We have emphasized the importance of covering the project's strategy effectiveness needs before exploring the status assessment needs. We have placed higher priority on measuring high-ranked threats and the key ecological attributes of greatest concern. We have suggested ways of reducing the overall cost for measuring results, and thereby allow you to cover more of your measures needs, by using existing monitoring data collection efforts, engaging local participants in the data collection efforts, and considering qualitative approaches. Still, it may not be possible to implement all identified indicators in the early phases of a conservation project. Consider assigning a priority status to each indicator to help ensure that the most critical indicators are measured first. Within the CAP Workbook, each indicator can be assigned a Very High, High, Medium or Low status within the Monitoring worksheet.

5. Complete Monitoring Table

You are now ready to complete more details in the monitoring table to set the stage for implementing the plan for measuring results. The additional detail includes specifying the following categories of information for each priority indicator:

- When (timeframe & frequency of data collection)
- Where (location of data collection)

- Who (people responsible for data collection, data management, and analysis)
- Cost (of monitoring the indicator)
- Funding source
- Current indicator status (measurement value and date)
- Complete monitoring plan (reference and date)
- Summary report (reference and date)
- Implementation status

Guidance associated with completing the monitoring table is covered as part of the next chapter, *Step 8: Develop Work Plans.*

Opportunities for Innovation

- **Share your approaches for measuring results.** Developing and implementing effective and efficient plans for measuring results has lagged behind many of the other steps of the CAP process. Sharing your measures plans via The Nature Conservancy's web-based Conservation Project (ConPro) Database (http://conpro.tnc.org) will facilitate the exchange of ideas and new approaches for measuring the results from conservation projects. Attach Results Chains and any descriptions of tips or innovations you've used as ancillary files to your ConPro project records.
- **Engage local stakeholders in your measures activities**. Explore ways to engage the people who live or work in or near the project area in collecting your measuring results information. Locally-based methods embrace a broad range of approaches, from self-monitoring of harvests by local resource users themselves, to censuses by local rangers, and inventories by amateur naturalists or using economic or resource use/extraction data from the very actors that may be creating threats. See the Danielsen et al. 2005 reference and website in the *Resources and Tools* section for 15 locally-based monitoring case studies.

Resources and Tools

Basic guidance and examples of developing and implementing plans for measuring results can be found in the following sources:

Danielsen F., Burgess N. and A. Balmford. 2005. Monitoring matters: examining the potential of locally-based approaches. Monitoring matters: examining the potential of locally-based approaches. Biodiversity and Conservation 14:2507-2542.
http://www.monitoringmatters.org

Elzinga, C., D. Salzer, J. Willoughby, and J Gibbs. 2001. Measuring and Monitoring Plant and Animal Populations. Blackwell Science. Massachusetts, U.S.A. 360 pp.
Note: This book has a companion website with many links to other plant and animal monitoring websites, online sample size calculators, online statistics tools and more.
http://www.esf.edu/efb/gibbs/monitor/popmonroot.html
Also: This work (except for the animal population monitoring sections and plant community section) is downloadable online at:
http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf

Herrera, B. 2006. Medidas del éxito en la conservación. In: Granizo, Tarsicio et al. 2006. ed. Manual de Planificación para la Conservación de Áreas, PCA. Quito: TNC USAID.
Note: This is the Measures chapter from the Spanish CAP Handbook. The whole document is available for download at:
http://conserveonline.org/workspaces/cbdgateway/cap/resources/2/2/Manual_PCA_Spanish.pdf/download

Herweg, K, K. Steiner, and J. Slaats. 1998. Sustainable land management: Guidelines for impact monitoring. A good, practical resource for conservation practitioners interested in designing monitoring systems and in specific methods, including low cost alternative approaches.
http://srdis.ciesin.org

Margoluis, R., and N. Salafsky. 1998. Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press. Washington D.C. Measures of Success is a practical, hands-on guide to designing, managing, and measuring the impacts of community-oriented conservation and development projects. It presents a simple, clear, logical, and yet comprehensive approach to developing and implementing effective programs, and can help conservation and development practitioners use principles of adaptive management to test assumptions about their projects and learn from the results.
Book is available for free download in Spanish at:
http://fosonline.org/Resources.cfm

Pilz, David; Ballard, Heidi L.; Jones, Eric T. 2006. Broadening participation in biological monitoring: handbook for scientists and managers. Gen. Tech. Rep. PNW-GTR-680. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 131 p.
http://www.treesearch.fs.fed.us/pubs/24897

Salzer, D., and N. Salafsky. 2006. Allocating resources between taking action, assessing status, and measuring the effectiveness of conservation actions. Natural Areas Journal 26(3):310-316.
http://conserveonline.org/workspaces/cbdgateway/cap/practices/supportmaterials/bp7sm/Effectiveness_Measures_Salzer_Salafsky_NAJ_2006.pdf/download

Slapcinsky, J.L. and D.R. Gordon. 2003. MONITORING REPORT for Pine Rocklands for the Terrestris Preserve, Big Pine Key, Florida.
http://conserveonline.org/workspaces/cbdgateway/cap/practices/supportmaterials/bp7sm/PINE_ROCKLAND_2003.pdf/download

Slapcinsky, J.L., Pace-Aldana, B., and D.R. Gordon. 2006. MONITORING REPORT 2006 Paronychia chartacea ssp. chartacea on the Tiger Creek Preserve.
http://conserveonline.org/workspaces/cbdgateway/cap/practices/supportmaterials/bp7sm/Parochar_2006.pdf/download

USEPA 2006. Volunteer Monitoring. US Environmental Protection Agency website with resources for volunteer monitoring of Estuaries, Lakes, Streams, Wetlands, or Quality Assurance Project Plans.
http://www.epa.gov/volunteer/

WWF/FOS. 2005. Sourcebook for the WWF Standards: Results Chains.
http://conserveonline.org/workspaces/cbdgateway/cap/practices/supportmaterials/bp7sm/Tools-Results_Chain_2005-10-21.pdf/download