Module 6

Monitoring for Management of Protected Areas - An Overview

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1. Why monitor?

The term 'monitoring' has been used to describe many types of activities. It can be defined as the process of gathering information about **variables** such as rate of loss of forest cover or quantity of wildlife poached per month within a **system of interest**, such as a protected area[1]. Monitoring information is used to characterize the status of the protected area at different points in time for the purpose of assessing the state and drawing inferences about changes in state over time (Yoccoz et al. 2001). A simple example of monitoring is the gauge on the dash of your vehicle that shows how much fuel is remaining in the fuel tank. In this case, the fuel is the variable that you are interested in monitoring to assess the status of your vehicle as you travel.

Likewise, in natural resource management monitoring is a critical component of an informed process for making decisions.

i) First, monitoring is important for **decision-making,** as when managers need to know the state of the protected area before deciding on the appropriate course of action during the management cycle. For example, managers need to know if the protected area is intact or degraded. They also need to know the level of illegal hunting in the protected area.
ii) Second, monitoring is critical for evaluating the effectiveness of management actions in the protected area relative to **objectives (see below for definition of objectives)**.
iii) Third, in an **adaptive management** setting, monitoring provides the feedback loop for learning about the protected area (Nichols and Williams 2006). Given the limited resources for conservation and the urgency of many conservation problems, donors, managers and scientists are increasingly keen to ensure that conservation funds are spent on management actions that are most effective in reducing threats to biodiversity. Monitoring is critical to determine trends in biological diversity over

[1] Although monitoring information can be used to characterize the status of any system of interest, for the application of this module for training protected area staff in Lao PDR, we will primarily refer to a protected area as the system of interest.

space and time with an emphasis on evaluating the effectiveness of management actions and policies.

Scientific and Management Objectives for Monitoring

The rationale underlying many monitoring programs is that additional information about any system will be useful. This general approach typically does not result in effective management decisions for conservation and has been strongly criticized (Yoccoz et al. 2001, Legg & Nagy 2006). A more useful and cost-effective approach is to clearly specify the **objectives** of a monitoring program. Such objectives can be usefully categorized into two general classes – scientific and management objectives (Yoccoz et al. 2001).

Scientific objectives:

Scientific objectives focus entirely on learning and developing an understanding of the behavior and dynamics of the monitored system. There are a number of approaches that are used to address scientific objectives from monitoring data-

1. Monitoring in conjunction with manipulation of the studied system for the specific purpose of testing or evaluating hypotheses of interest. A simple example of this is monitoring the regeneration of a palm in response to three different levels (low, medium, high) of harvest by local people to determine the level of sustainable harvest
2. A more common approach to the use of monitoring data to serve scientific objectives is based on retrospective analyses; for example, statistical analyses of time series of population abundance or community-level state variables. An example of this is to use monitoring data obtained from a yearly census of an endangered primate species over a 6 year period in a protected area to determine the status of the primate population over time. For more information on this approach, refer to the module 7 on monitoring wildlife populations for management.

Management objectives:

On the other hand, monitoring programs designed to aid *management objectives* provide information that is useful in making informed decisions about the management of protected

areas. The content of this module will focus on this category of monitoring. Monitoring programs developed in conjunction with management typically serve two specific functions:

1. Identifying the system state. For example, if the size of a population that is harvested for subsistence food by local people (e.g., muntjac) is believed to be too small, then management actions should be directed at increasing numbers, and
2. Providing information on the system response to management actions. *[The use of data from monitoring programs to learn about system response to management actions is similar to the use of monitoring data to distinguish between two competing scientific objectives (see above). Management actions are viewed as manipulations of interest, and system responses identified by monitoring are compared with* ***a priori predictions*** *of alternative* ***hypotheses*** *about system response.] For example, monitoring the number of poaching incidents in response to two different management actions: (i) Guards conduct 25 days of foot patrols per month covering 40% of the protected area and (ii) Establishment of 6 guard posts at trailheads along the border of the core zone.*

Scientists and managers of natural areas need to work together to design and implement effective monitoring programs. Managers need to ask scientists to provide:

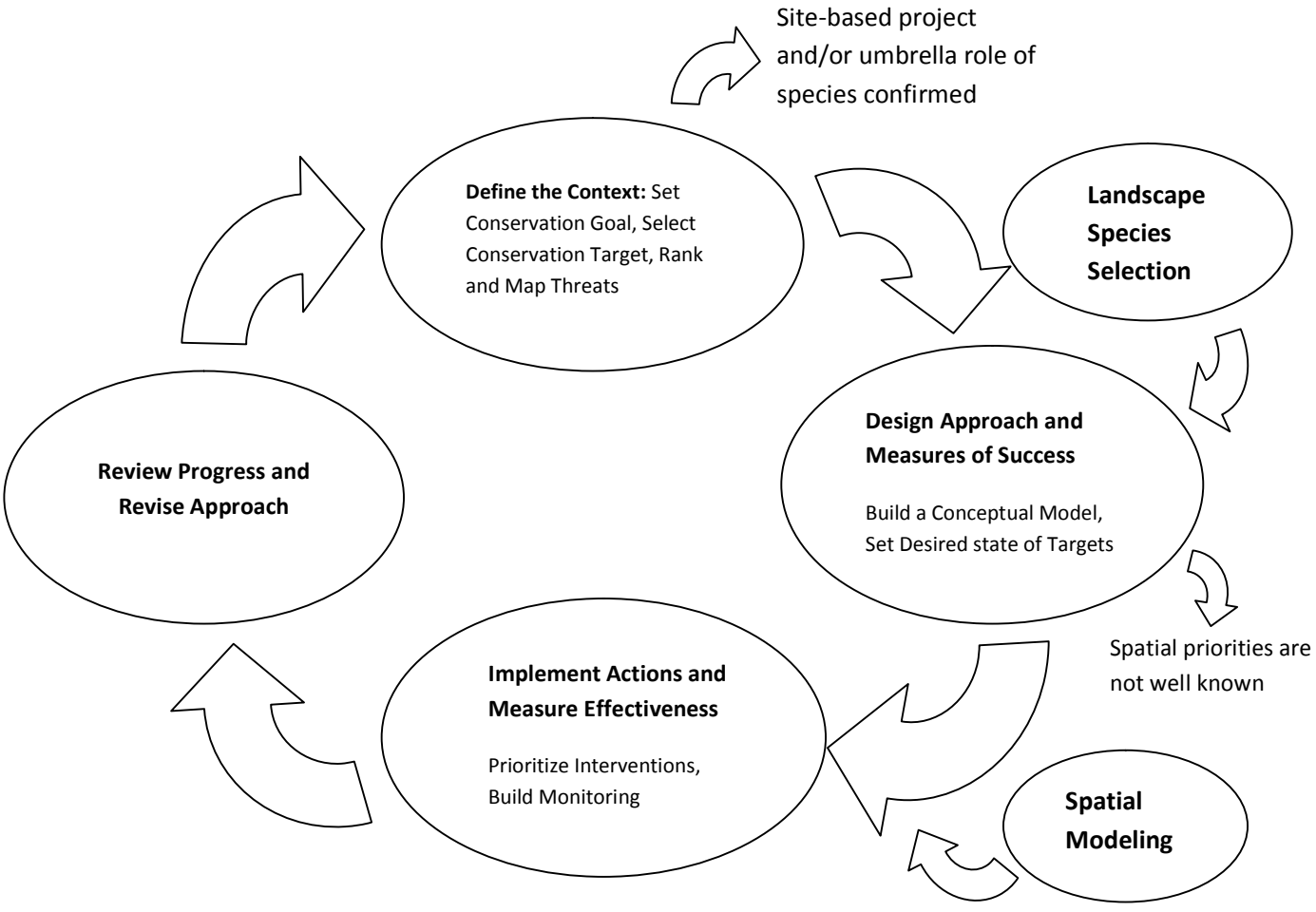
i) clear directions as to what they want measured and how, which is also defined as **monitoring metrics**),
ii) the level of change expected in a given period of time to define the management objectives, and
iii) how to prioritize management tasks in order to have the largest positive impact on the viability of the **conservation targets** they are managing (Barrows and Allen 2007).

For example, managers need to know how to measure changes in the populations of tigers in a protected area; do they monitor tigers or prey or both and how? In the Nam Et-Phou Louey National Protected Area, with advice from scientists, the NPA is regularly conducting camera trap surveys to monitor change in tiger abundance to assess if the NPA has reached it's stated objective of increasing tigers by 50% over a period of ten years. Overall, monitoring must be guided by scientific principles in order to provide information that is statistically defensible and useful for managers responsible for managing biodiversity.

(a) The role of monitoring in the project management cycle

In relation to the project management cycle, monitoring is defined as the periodic collection and evaluation of data relative to stated project goals, objectives and activities. Many refer to this process as Monitoring and Evaluation, which can be abbreviated as "M&E". It is an essential part of good conservation management and a key component of the Project Management Cycle (Refer to Module 2, see Figure 1 below).

Figure 1: The Wildlife Conservation Society's interpretation of the conservation management cycle as developed by the Living Landscapes Program (CITE).



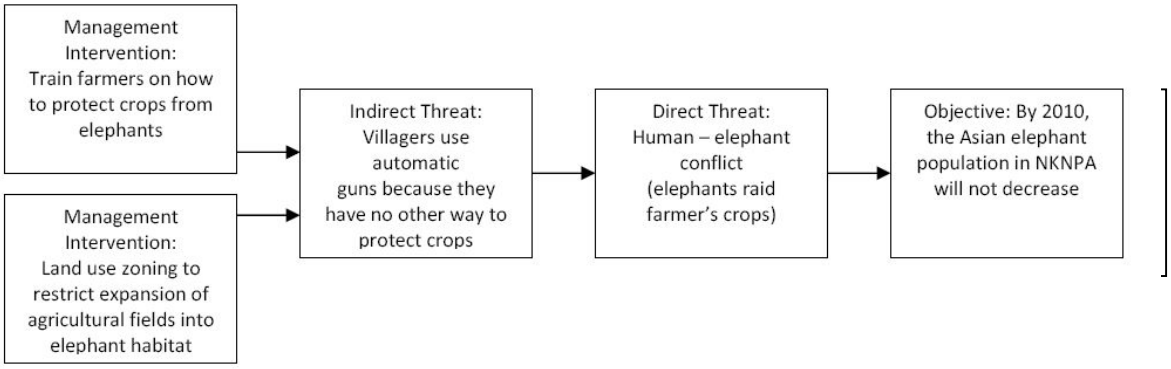
Using a hypothesis-driven scientific approach, monitoring designs need to embrace the **scientific method**, provide insights into the ecological processes at work within natural

systems, and importantly, point directly to if, when, and how active management may need to be employed in order to prevent the loss of biodiversity. A **conceptual model** provides the scientific basis for developing monitoring plans and is viewed as the foundation of all project design, management, and monitoring activities (See Module 2). These models define hypotheses about linkages between changes in the state of biodiversity components, threats and management actions or interventions.

A conceptual model explicitly identifies the components of biodiversity that need to be conserved (**Conservation targets**), what human and natural factors threaten these targets (**direct threats**), the roles that resource users, managers and policy makers play that lead to or facilitate the direct threats (**indirect threats**) and the **interventions** that will be implemented in order to reduce threats.

Monitoring plays a key role in helping us review our assumptions of how, where and why we intervene – by evaluating the **causal linkages** between the interventions, threats and the conservation targets in a conceptual model for a project. Monitoring allows hypotheses related to the causal linkages to be evaluated, accepted or rejected. For example, killing of elephants with automatic guns is a direct threat to the viability of the Asian elephant population, a conservation target in the Nam Kading NPA. One indirect threat that can lead to the killing is when farmers and their crops are repeatedly threatened by the elephants. Two interventions that NPA management is doing to reduce these threats are to, i) train crop protection methods to farmers to use in their existing agricultural fields and to, ii) enforce land use zoning to prevent further expansion of agricultural fields into existing elephant habitat (See Figure 2)

Figure 2: Schematic of a causal linkage



In example above, we need to monitor to assess if the establishment of crop protection systems and land use zoning actually reduces the threat of human-elephant conflict and killing of elephants and thus helps maintain the elephant population within and around Nam Kading NPA.

Overall, there are at least three reasons why monitoring is important:

i. *Monitoring allows us to assess the status of threats and conservation targets.*

In particular, we need to understand whether threats are decreasing or increasing and whether wildlife populations are increasing, remaining stable or declining. [Managers need to know the **system state** before deciding on the appropriate course of action during the ensuing project management cycle.] For example, in the Nam Kading NPA in Lao PDR, a project with the conservation target of maintaining the elephant population in and around the NPA needs to monitor the status of threats to elephant populations (hunting and human-elephant conflict) as well as the status of the elephant populations (See Appendix 1).

ii. *Evaluating the effectiveness of management interventions.*

Monitoring helps us identify which actions lead to the success or failure of a particular conservation approach and evaluate and revise assumptions as to why and where conservation efforts are needed. For example, referring back to the conceptual model for

the Nam Kading NPA, we want to know whether the two interventions designed to reduce the threat of elephant-human conflict i.e. training crop protection methods to farmers in existing agricultural fields and enforcing land use zoning to prevent expansion of agricultural fields into elephant habitat are (i) effective in reducing human-elephant conflict (measured as crop loss, injury to humans or elephants), and (ii) Is one approach more effective than the other in reducing human elephant conflict?

iii. Informing and improving management practice through an adaptive management process.

Monitoring helps us learn from the experience of implementing the chosen management interventions and to modify management interventions accordingly. Thus, monitoring plays a key role in the process known as adaptive management- which is a dynamic process that involves the integration of monitoring results back into project design and implementation. For example, in the conceptual model for the Nam Kading NPA, monitoring may show a further decline in the population density of elephants in the PA due to increased levels of hunting where elephant crop raiding is occurring. This monitoring result indicates the need to review the threat of hunting more carefully and the interventions meant to reduce human-elephant conflict.

(b) Monitoring provides information for decision-making

Monitoring is only relevant when it provides information for decision-making. Monitoring that does not provide relevant information for decision-making is not useful for management and is inefficient because it uses human and fiscal resources that could be directed elsewhere. (Gibbs et al. 1999). Thus monitoring is useful only if it leads to improved management decisions and therefore, a key component of any monitoring plan is a mechanism to use the new information to guide management decisions. Specific questions to ask are:

i) Do the data indicate that the conservation interventions are being implemented well?
ii) Are threats being reduced?
iii) Is the status of conservation targets improving?

Monitoring needs to focus on precisely the information needed to make conservation decisions.

2. What to monitor?

Decisions about which variables to monitor are determined largely by the objectives of the monitoring programs: Monitoring programmers designed to inform management should focus on the state and other variables that are included in the management objectives as well as on variables that are needed to model the managed state variables adequately. *For example, in managing the harvest of red muntjac (a Category 2 Managed Species under the Lao Wildlife Law 2007), the management objective may be to maintain a minimum population size of 10 muntjac/km^2, the state variable of interest. But the monitoring program may also need to take into account a 10% annual harvest of muntjac (which is not a system state variable but which must be considered when determining if you are able to attain the management objective)*

a. Levels of Monitoring

To show that interventions are reducing threats to conservation targets, we need to monitor at all three levels across the causal chain: conservation targets, threats and interventions.

i. Measuring conservation targets (impact monitoring)

This involves tracking changes in the status of conservation targets. For example, measuring changes in the status of elephant populations within and around the Nam Kading NPA

ii. Measuring changes in the levels of threats (outcome monitoring)

This involves measuring changes in the status of threats to conservation targets. In the context of the Nam Kading NPA example, it would involve measuring the rate of occurrence of human-elephant conflict, for example the extent of crop loss, injury to humans or elephants over time.

iii. Measuring the implementation of interventions (performance monitoring)

This involves monitoring a planned intervention. For example, if an intervention is to set up a crop protection system with farmers, then determining the establishment of the crop

protection system (warning systems and deterrents in agricultural fields) is equivalent to monitoring the intervention.

It is important to measure all three components along a causal chain in order to be able to conclusively determine that a positive change in the status of a conservation target resulted from a reduction in a particular threat due to a specific intervention. By monitoring elephant population densities (conservation target), rate of occurrence of human-elephant conflict (threat) and the implementation of a crop protection system (intervention), we maybe able to associate an increase in elephant population densities with a reduction in human-elephant conflict due to the presence of crop protection systems. Although it is often difficult to conclusively establish the causal links between interventions, threats and conservation targets especially in large landscapes with multiple stakeholders, monitoring at these three levels is necessary for us to test the effectiveness of our interventions. (Refer to Figure 2: Schematic of a causal linkage)

(b) Setting priorities and allocating resources for monitoring

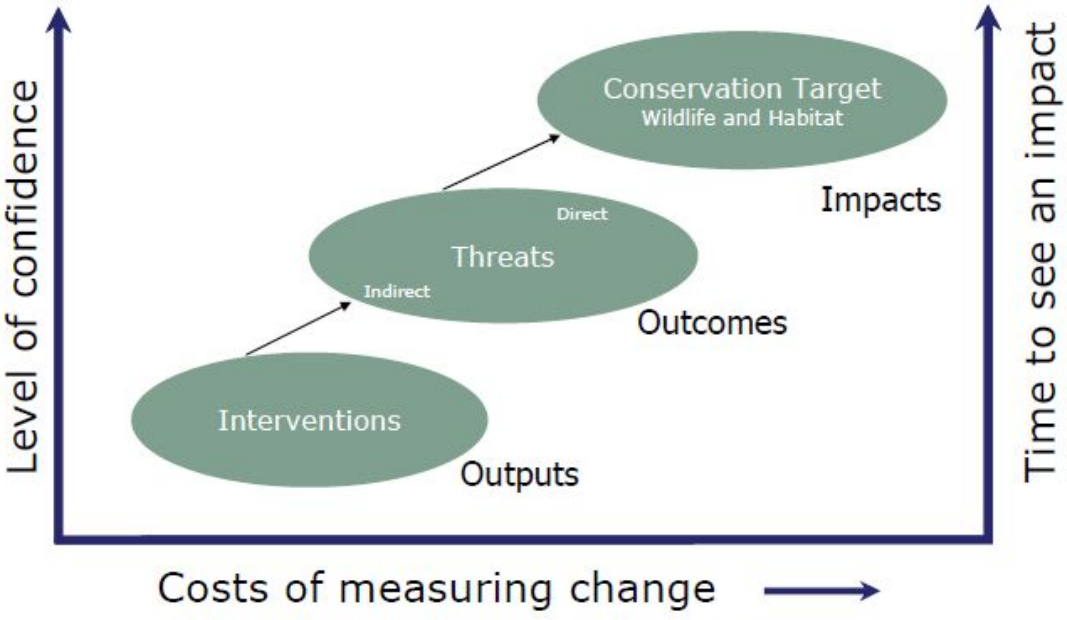
Given that time, financial resources and personnel/staff are limited for almost all conservation projects, managers must achieve a balance between taking conservation action (implementing interventions), evaluating the effectiveness of interventions and monitoring the status of conservation targets and threats. It is often a struggle to make decisions regarding the allocation of limited resources among these competing needs.

Time-scale issues and Tradeoffs

As conservation of wildlife and their habitats is our objective, then we need to monitor their changing status over time. Even in the absence of human pressures, there is natural variation in wildlife populations and habitat quality over time that makes it very difficult to detect changes solely attributable to the interventions that have been implemented in the project.

Thus, the ways in which biological conservation targets (wildlife and their habitats) change over time will determine the monitoring effort necessary to detect changes in conservation targets attributable to human threats. Measuring change in biological conservation targets is often a **long-term** effort. However, given the assumed causal connection between the conservation targets, specific threats and the interventions designed to abate the threats, monitoring threats (outcome monitoring) and interventions (performance monitoring) allows us to measure conservation progress over the **short to medium term**. However, there are trade-offs that we must be aware of when we decide to use outcome and performance measures as estimates of progress towards achieving our objective of conserving our conservation targets. The **timeframe** needed to see results and the **costs** of monitoring decline as we move from monitoring changes in conservation targets to monitoring reduction in threats to monitoring the implementation of interventions (See Figure 3 below). However, short and medium-term measures are compromised in their ability to inform us on the true extent to which our conservation objective is being achieved. Thus the level of confidence with which we can say that we are achieving success declines as we use short to medium-term measures. (LLP Bulletin No. 6).

Figure 3: Tradeoffs in costs, time and level of confidence when monitoring project interventions, threats to wildlife and habitats, and the project conservation objective.



Given that it is impossible to monitor every intervention, threat and conservation target at the same intensity or level of precision, it becomes important to set **priorities** while allocating resources for monitoring. Decisions can be taken based on the following questions

(i) Which monitoring information does the project require to fulfill either donor or institutional requirements? This should be top priority for allocation of monitoring resources

(ii) What level of precision is needed to ensure that the monitoring results can be effectively used to influence management decisions?

(iii)What information would be useful to have but would need additional funding?

There will be trade-offs in cost, precision and confidence associated with different monitoring methods.

There are two key decisions that conservation practitioners need to take in project implementation.

(1) How should managers allocate resources between implementing interventions and monitoring the impact of the interventions and,

(2) How should managers subdivide monitoring resources across different levels of monitoring and types of monitoring indicators.

Salafsky and Salzer 2006 offer a framework to help guide conservation practitioners towards a logical allocation of resources between implementing interventions (taking action) and different types of monitoring depending on the situation they are facing. The framework consists of a decision tree that includes an explicit evaluation of three questions:

1. Are there substantial threats facing the conservation targets? For example, are there substantial threats facing tigers in Nam Kading NPA?
2. Are there clear and feasible interventions (such as enforcement, outreach) known to be effective at reducing the identified threats?
3. Does the project team have high confidence in their understanding of the overall conservation situation? For example, does the protected area staff understand the overall situation related to declining tigers, threats to tigers and potential interventions that could be used to address the threats and increase tiger populations?

The optimal allocation of resources across implementing interventions and different types of monitoring indicators at any given natural area will be determined by diverse factors such as the types of conservation targets, the threats they are facing, level of available resources, project goal and timeline. The careful allocation of scarce conservation funds towards interventions and monitoring is critically important for conservation success (Sheil 2001).
In general the following guidelines are provided to help determine investment in monitoring

- Monitoring results should explicitly guide management decisions about a project.
- To be sustainable, monitoring methods need to be kept as simple and low-cost as possible
- A higher investment in monitoring is needed if (a) the cost of the intervention is high (b) the threat to the biological target is extremely severe and could result in irreversible change (for example extinction).
- There are large gaps in our knowledge

If monitoring a target or threat is very expensive or difficult, it is useful to 'triangulate' using easy to monitor proxy variables.

3. Developing a monitoring framework (Referred to in Module 2)

A monitoring framework is an outline of steps that will be taken to monitor the effectiveness of interventions in reducing threats to conservation targets. The monitoring framework is tightly linked to the conceptual model of your PA or project.

(a) Defining clear goals and monitoring objectives for targets, threats and interventions

For every element of the conceptual model (conservation target, threats and interventions), you need to identify the following:

1. A **quantitative objective** that will be achieved within a given time-frame
2. For **conservation targets**, a *monitoring objective* will describe the status (increase, decrease or maintain at same level) of the wildlife species or habitat that will be attained over a fixed time-period (for example: increase the population of tigers by 50% over the next 10 years).
3. For **threats**, a monitoring objective will specify by how much the threat will be reduced over a certain time-period (for example: to reduce by 90 percent incidents of illegal hunting inside the park over the next 5 years).
4. For **conservation interventions**, a monitoring objective will relate to whether a planned intervention was implemented over a certain time period (for example: to establish 10 guard posts along the boundary of the park over the next 5 years).

In general, a monitoring objective needs to be:

Impact oriented, representing a change in desired condition or state

Measurable, against a baseline or along a standard scale

Time-bound, achievable within a specific period of time.

Below are three examples of monitoring objectives in Nam Kading NPA, Lao PDR.

- ***Monitoring Objective 1*** (Conservation Target): By 2010, increase the Great Hornbill population by 35% inside the Nam Kading NPA.
- ***Monitoring Objective 2*** (Direct Threat): By 2010, stop all habitat loss due to shifting cultivation inside the Nam Kading NPA.

- ***Monitoring Objective 3*** (Intervention): By 2010, complete land allocation zoning in all villages bordering the Nam Kading NPA.

(b) Establishing indicators and appropriate monitoring methods

An **indicator** is a variable or parameter that will be measured over time in order to determine if the project is making progress towards the quantitative objective. There could be one or more indicators for every monitoring objective. Indicators should have the following characteristics. They should be:

(a) *Measurable in either **qualitative** or **quantitative*** terms. Qualitative data is descriptive such as narratives from interviews with villages and quantitative is numerical measures (i.e., abundance or density). (See Appendix 2 for examples)

(b) *Precisely defined.* For example, number of white-handed gibbon groups per hectare of primary forest or Densities (nesting pairs/ km^2 of hornbills in the core area).

(c) *Consistent over time*. If an indicator is expected to provide a reliable measurement of change in a factor, then it is important that observed effects be due to changes in the actual condition, not to changes in the indicator. (This criterion generally applies to proxy indicators as opposed to indicators that measure something directly). Proxy indicators are used as a substitute for an indicator that cannot be directly measured or assessed. For example, in families that invest their wealth in livestock such as cows and goats, the number of cows and goats that a household owns can serve as a proxy indicator for household wealth. Some other examples of proxy indicators are:

- For local livelihoods – it is difficult to measure actual household income, so we can measure the types of items that money is spent on and that represent increasing wealth, for example construction type of house.

- For hunting - it is almost impossible to measure the number of animals hunted each year, so we typically use a proxy or indirect measure of the prevalence of people hunting or the weapons used to hunt animals with (for example number of poachers arrested or guns or snares confiscated).

- For tigers – it is almost impossible to measure the number of animals at very low densities in some sites. So, in order to see if management interventions are working to recover tigers we can use a proxy measure of the availability of tiger prey (e.g., muntjac and wild pig) to assess if attempts to recover tigers are on the right track.

(d) *Sensitive*. A sensitive indicator will change proportionately and in the same direction as changes in the condition or item being measured. (As above, this too applies only to proxy indicators).

Examples of indicators might include:

For Conservation Targets: Density of bamboo species (plants/ha) or Density of Tigers per 100 km^2 of the NPA.

For Threats: Number of illegal poaching incidents recorded per km^2 of patrolling per person per day) or area of forest cleared for shifting cultivation over a 6 month period

For Interventions: Number of guard posts established over a 6 month period or km^2 of patrols conducted within the NPA.

How will information be gathered for an indicator? There is usually a wide range of monitoring methods that can be used to collect data to assess a given indicator. For every indicator, we need to identify at least one monitoring method. The following criteria should be considered while selecting a method to measure a given indicator:

Will the method provide accurate and reliable results?

Is the method cost-effective in terms of resource investment? Are there cheaper ways of getting the same data?

Is the method feasible? i.e. Does the project team have people who can use the method?

Following are examples of **indicators** and **monitoring methods**-

Conservation Target: Area of primary forest in a National Protected Area (NPA)

Indicator 1: Area in hectares of forest in the core zone of the NPA

Potential Monitoring Method 1: Work with community members to develop sketch maps of the forest habitat in the reserve

Potential Monitoring Method 2: Use a Global Positioning System and aerial photography to collect coordinates of forest areas which will be entered into a computer-based GIS.

For the Conceptual Model for Nam Kading NPA, the following could be two indicators that the project team will measure to assess the status of the conservation target:

Conservation Target: Great Hornbill population in the Nam Kading NPA

Indicator 1: # of Great Hornbill/km^2 in the NPA core zone

Indicator 2: Proportion (%) of the NPA core zone where Great Hornbill occurs

Box 1: Example of Monitoring Framework

Conceptual Model Component	**Monitoring Objective**	**Indicator**	**Monitoring Method**
Conservation Target:			
Threats:			
Conservation Intervention:			

Monitoring Approaches

By definition, monitoring efforts involve making comparisons between a protected areas impacts and some defined benchmark. There are two main types of comparisons that can be made:

1. Comparison of a group affected by your PA to itself over time.

This comparison involves measuring how a given factor changes as a result of project activities (tiger densities, level of hunting). The a priori assumption is that the intervention is influencing the response variable and we monitor progress accordingly towards some desired state. There are two main ways in which you can make this comparison:

(a) ***Pre-test/post-test monitoring design****:*

This involves measuring a group before intervention to establish a baseline, and then re-measuring the group after intervention.

Example

Management Objective: By the end of 2012, all households will use one-third less wildmeat (measured in kg per month) than they did in 2010

Management Intervention: Provide alternative sources of protein to households in the form of small loans to purchase livestock.

Monitoring Strategy: Compare the amount of wildmeat in the diet of households at the start of the management intervention to the amount of wildlife used at the end of the stated time period.

Monitoring Method: NPA staff to conduct household surveys to determine wildmeat in diets during the first month of the management intervention and a similar survey with the same group of households in the final year of the intervention.

(b) ***Time-series monitoring design****:*

This involves collecting data multiple times before and after management intervention to compare a group of units to itself over time.

Example

Management Objective: By the end of the third year, there are no incidences of poaching of legally protected species within the core zone of the park.

Management Intervention: The NPA team will conduct meetings, awareness campaigns to educate people on protected species and consequences of illegally hunting protected species and conduct routine patrols to record illegal poaching.

Monitoring Strategy: Compare the number of recorded cases of illegal poaching of protected species over time.

Monitoring Method: The NPA team records the number of illegally poached wildlife during weekly patrol surveys

Comparison of a group affected by your protected area to a group not affected by your protected area over time. This comparison involves measuring how a given factor changes in a group affected by the project relative to a similar group that is not influenced by the project. This type of comparison can help establish causal relationships. This is the counterfactual approach of measuring effectiveness which basically asks the question 'what would happen if we hadn't intervened'. This requires an experimental approach to monitoring (or quasi-experimental) where you essentially have a control or non-treatment group that fits the same general socio-ecological parameters as your intervention site. This is often not feasible with many types of biologically monitoring due to the cost and time-period involved to see change, but is occasionally (albeit rarely) used to evaluate development programs on social parameters which can be evaluated more quickly (Ferraro and Pattanayak 2006). It can help to establish causal relationships but also helps to review assumptions of what interventions work.

For example, in the Nam Kading NPA the staff measured and compared changes in villager knowledge and attitudes towards Great Hornbill conservation over time in villages that received conservation outreach programs (non-control group) and in villages that had not received the outreach programs (control group).

(c) Planning a schedule, and identifying the actors and funding sources

Once the monitoring method for every indicator has been identified and agreed upon, it is important to determine **who** (individual or institution) will be responsible for gathering the

information and the funding source for each method. For example, the NPA biological monitoring staff could be responsible for conducting camera trap surveys of tigers and a university student responsible for collecting data on the density of rattans per sq. km of forest in the core zone. It is useful to list the **funding source** for every monitoring method even if the source is external to the project budget. For example, the monitoring done by the NPA biological monitoring staff could be funded through the project but the student could potentially have his/her own source of funding. The district agriculture office could be responsible for collecting data on a particular intervention such as implementation of land use allocation zoning in villages around the NPA.

Once the step of identifying **who** will collect the information has been completed, a **schedule** for data collection for each method or the periodicity of monitoring activities needs to be planned (the frequency and timing of data collection) How frequently will camera traps be laid out in the forest and for how many days at a time?

When considering the timing of data collection, it is especially important to consider seasonality. For example, hunting could be an activity pursued by farmers during the non-agricultural season rather than the agricultural season when they are busy planting their crops. Any data collection that relates to hunting needs to occur during both these seasons in order to collect data which accurately represents hunting patterns. Similarly, timing of activities is important to ensure that monitoring effort is not wasted. For example, planning to conduct interview surveys with villagers during the crop-growing season may not be productive if most of the villagers are away working long hours in their fields. It is important to measure indicators of fruit availability during the season in which fruit is available.

Conceptual Model Component	**Monitoring Objective**	**Indicator**	**Monitoring Method**	**Who**

A monitoring framework could be developed for each **causal chain** in the project conceptual model. This framework could be envisioned as a 6-column table

Column 1: Component of the conceptual model (type i.e. Threat, conservation target, intervention)

Column 2: Component Description (Tiger populations)

Column 3: Monitoring Objective

Column 4: Indicator

Column 5: Monitoring Method

Column 6: Who will conduct the monitoring?

Component Type	**Component Description**	**Monitoring Objective**	**Indicator**	**Monitoring Method**	**Who**
Conservation target	Elephant populations	Maintain the current population of elephants	Elephant density per km^2	Dung surveys	Nam Kading Park Staff

(See Appendix 3 & 4 for two examples – Nam Kading for conservation targets and NEPL NPA for all components)

(d) Putting in place appropriate data management and processing systems

Given that a key 'output' of the monitoring process is the generation of qualitative and quantitative information, it is crucially important to ensure that this information is appropriately collated and processed. Thus, a significant step in the monitoring process involves the establishment of appropriate data management and processing systems. Appendix 5 outlines MIST which is an example of a tool for managing and evaluating law enforcement monitoring data. The use of standardized systems such as MIST is beneficial as it can help promote best practices and also facilitate communication of results to managers, stakeholders and donors (see next section – Closing the loop).

4. Closing the loop - communicating the results

The data obtained from implementing the monitoring framework needs to be analyzed and the results communicated internally as part of the project management cycle and externally to promote best practices.

(a) Data Analysis: There are two general kinds of analysis for using quantitative and qualitative data:

i. *Describing the data*. Every analysis starts by taking the raw data and summarizing the raw data into a manageable/more meaningful form. This process involves organizing and characterizing observations. This is where information management tools such as MIST are particularly useful.

ii. *Testing Hypothesis about data*. Following the description of the data, the next step is to use the data to examine the success of your project's interventions. This process involves examining how two or more variables differ or how they are related to one another. Sometimes, we need to measure and predict how changes in one or more variables are associated with or lead to changes in another.

[For more information on data analysis methods, see Margoluis and Salafsky chapter 7-Measures of Success]

(b) Communicating results to an internal and external audience

The results from data analysis need to be presented to the project staff, project partners, other stakeholders in and around the project site, and to external audiences

The first step is to pick a format that is most appropriate for the information that you want to communicate and the specific audience that you are trying to reach. There are many different potential audiences who will be interested in the information being generated by your project. Each of these audiences may require that information be packaged in a different way. Specific types of communication tools include:

Oral presentations, discussion session, informal meetings, reports, press and media releases, brochures and pamphlets, formal academic papers and books, visual presentations.

Monitoring should be designed in a way that produces data and information that can be used to (i) test assumptions, (ii) adapt the project according to the monitoring results and (iii) share with an external audience lessons learned from implementing the project. *It is particularly important to get monitoring results and analysis back to managers in a timely fashion in order to effect changes in management approaches as quickly as possible.*

(i) Testing Assumptions: Assumptions are represented by the boxes and arrows that show causal relationships between different factors affecting the target condition. For example, in the elephant conceptual model for the Nam Kading NPA managers are assuming that by training farmers to protect their crops from elephants, the farmers will not use automatic weapons to kill crop-raiding elephants. This also assumes that farmers will adopt the crop protection methods and that the methods are successful in keeping elephants from damaging crops and injuring farmers.

Monitoring data allows you to test whether the intervention you have planned is actually reducing the threat to the conservation target by the desired amount.

(ii) Adapt the project based on the monitoring results.

Once you have formally considered your assumptions, the second step is to use that information to adapt and improve the project. This is done be revisiting the steps in the project cycle repeatedly. For example, if your monitoring results show that elephant abundance continues to decline due to killing of elephants in crop-raiding areas then we may need to adapt our management intervention. In this case, we should assess the crop protection methods to determine if the number of crop raiding incidents has decreased or increased with crop protection in place. If crop raiding has declined but killing of elephants is continuing then we may need to increase enforcement as a management intervention to make sure that elephant killing for illegal ivory trade is not occurring.

(iii) Document and share lessons learned from the project

It is important to share results, findings, successes and failures with project staff and to document these for future reference. In documenting project outcomes, a common mistake is to focus only on success and to ignore or hide failures. There is more to be learned from failures than from successes and hence important to acknowledge failures. The key to a successful project lies in learning from what you are doing whether it works or not

In addition to helping you improve a specific project, the learning that you have experienced can be of utility to others who are implementing similar projects, dealing with similar threats or working in similar contexts.

While the importance of monitoring for achieving effective conservation outcomes is widely acknowledged, the design of monitoring programs and their impacts on conservation have been the focus of much criticism. The following is a summary of the key issues for consideration in designing and implementing a monitoring program for a site.

Conflicts between scientific ideals and practical realities of monitoring (Refer to Brashares and Sam 2005)

There are conflicts between the scientific ideals and practical realities of monitoring that influence the design, implementation and effectiveness of monitoring systems. Most practitioners agree that in an ideal world, monitoring programs would always be spatially and temporally comprehensive, rigorous in their treatment of sampling error, and sustainable over the time scales necessary to examine population and community-level processes (Yoccoz et al. 2001). However, monitoring of biodiversity and resource use in the real word is often costly, hard to sustain, especially in developing countries where financial and technical resources are limited. Moreover, monitoring can be logistically and technically difficult and is often perceived to be irrelevant by resource managers and local communities (Sheil 2001). Hence, in situations with limited funding, project managers will find it challenging to invest in monitoring efforts and thus divert funds away from other

interventions such as enforcement or community development activities that are perceived more important than monitoring. Given that monitoring is an essential step in any conservation project, it is critical to carefully select who, what and how to monitor using the criteria described in the following section.

Criteria for good design, implementation and management of a monitoring program

I. **Why monitor**?

(1) Identify flexible goals and clear objectives for monitoring

(a) Ensure objectives are responsive to management needs

(b) Ensure objectives are developed in a participatory manner with the relevant stakeholders

(c) Clearly state the time frame for the monitoring program and the time expected to see results

II. What should be monitored?

(1) Identify the variable(s) to be measured and ensure they meet the following criteria:

(a) Relevant to management

(b) **Scientifically defensible** and **biologically representative**

(c) **Statistically powerful** and i**nterpretable**

(d) Measurable and feasible

(e) Easily understood

(2) Identify your target population

(a) Define the scale at which you need to monitor and the scale at which you will infer your results

III. How to monitor?

(1) Develop formal collaborations with statisticians and scientists in developing monitoring protocols

(2) Develop monitoring methods and **data collection protocols**

  (a) Address **sampling bias** in selection of sites to be monitored

  (b) Address **detection error** in sampling design

  (c) Ensure minimum sample sizes and sampling effort required to achieve objectives

  (d) Ensure adequate precision of estimates to permit detection of change over time

(3) Solicit feedback and review of monitoring protocols from experts

(4) Assess and evaluate if the methods are the most cost-effective to address your monitoring objectives

IV. Other important considerations for management and implementation

(1) Identify the person/persons responsible for implementation

  (a) Ensure adequate personnel, skills and training are available for implementation and data analysis

(2) Secure adequate funding for the duration of the monitoring program, including design, implementation, analysis and communication of information

(3) Ensure an information management system is in place for managing and communicating monitoring data

(4) Ensure that monitoring objectives, methods, key assumptions and data recording protocols are carefully documented and accessible by all stakeholders

Literature Cited

Barrows, C.W. and M.F. Allen. 2007. Biological monitoring and bridging the gap between land management and science. Natural Areas Journal 27:194–197.

Brashares JS, Sam MK (2005) How much is enough? Estimating the minimum sampling required for effective monitoring of African reserves. Biodiversity and Conservation 14: 2709-2722.

Conservation Measures Partnership. 2007. Open standards for the practice of conservation. www.conservationmeasures.org

Ferraro PJ, Pattanayak SK (2006) Money for Nothing? A Call for Empirical Evaluation of Biodiversity Conservation Investments. PLoS Biology 4: 482-488.

Legg C, Nagy L (2006) Why most conservation monitoring is, but need not be, a waste of time. Journal of Environmental Management 78: 194-199.

Lyons JE, Runge MC, Laskowski HP, Kendall WL (2008) Monitoring in the Context of Structured Decision-Making and Adaptive Management. The Journal of Wildlife Management 72: 1683-1692.

Margolius, R. and Salafsky, N. (1998). Measures of success: designing, managing and monitoring conservation and development projects. Washington, D.C: Island Press

Nichols JD, Williams BK (2006) Monitoring for conservation. TRENDS in Ecology and Evolution 21: 668-673.

Salzer D, Salfasky N (2006) Allocating resources between taking action, assessing status and measuring effectiveness. Nat Areas J 26: 310-316.

Sheil, D. 2001. Conservation and biodiversity monitoring in the tropics: realities, priorities and distractions. Conservation Biology 15:1179-1182.

Wilkie, D. and the Living Landscapes Program. (2002b). Monitoring conservation project effectiveness. Bulletin 6, Wildlife Conservation Society, Living Landscapes Program, Bronx, NY.

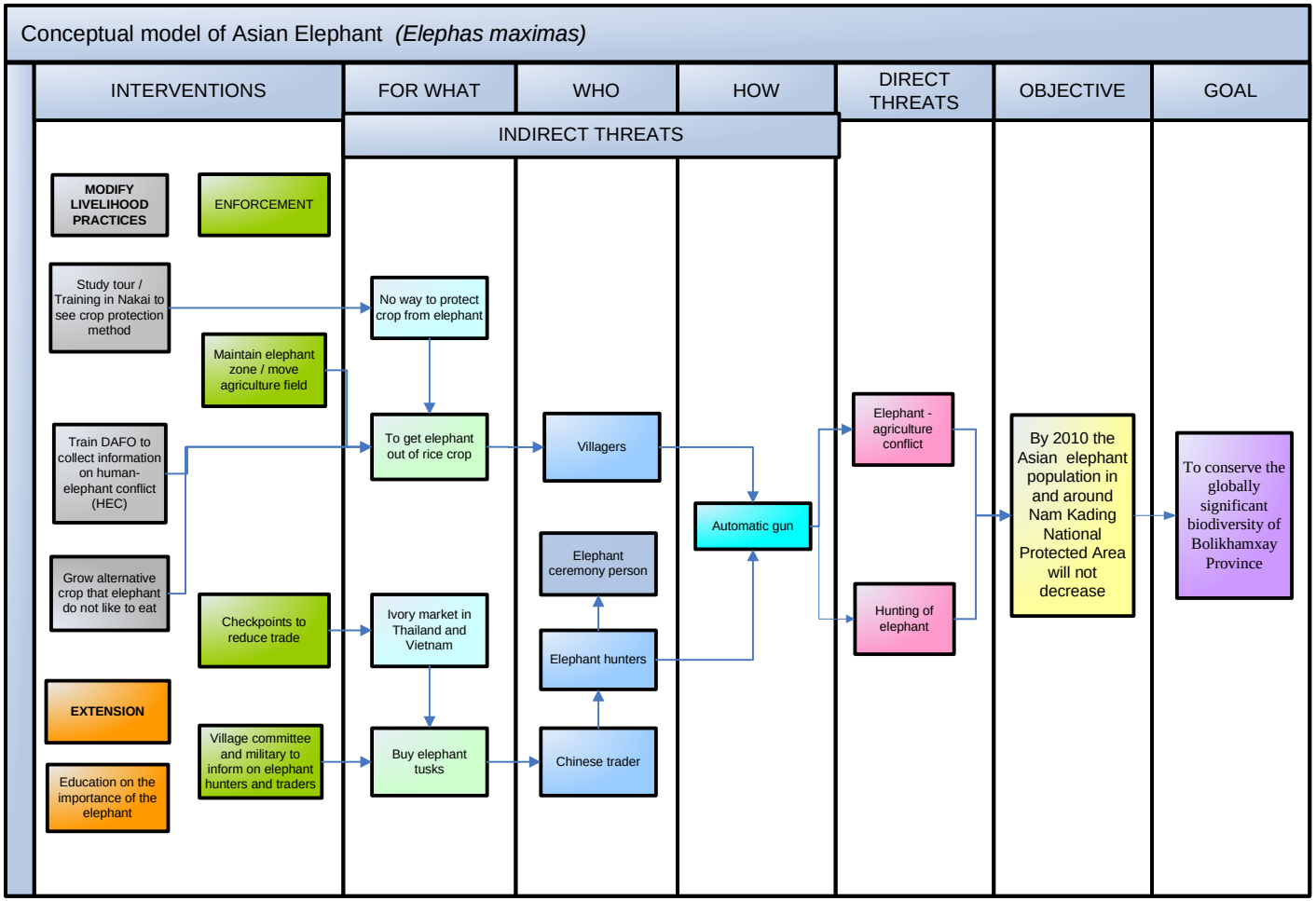
http://wcslivinglandscapes.com/media/file/LLP_Bulletin6_Monitoring_EN.pdf

Wilkie, D. and the Living Landscapes Program. (2002a). Using conceptual models to set conservation priorities. Bulletin 5, Wildlife Conservation Society, Living Landscapes Program, Bronx, NY.

http://wcslivinglandscapes.com/media/file/LLP_Bulletin5_ConceptualModels_EN.pdf

Yoccoz NG, Boulinier JDNaT (2001) Monitoring of biological diversity in space and time. TRENDS in Ecology & Evolution 16: 446-453.

Appendix 1. Conceptual model for Asian Elephant in the Nam Kading NPA (Johnson, Vannalath et al. 2006)



Appendix 2: Quantitative and Qualitative methods (Margoluis and Salafsky, 1998)

Quantitative Methods: produce data that are easily represented as numbers, such as answers to formal surveys. Qualitative data generally describe formal measurements of variables like income, crop production, or animal population densities.

E.g.

Qualitative Methods: These methods produce data that is not easily summarized in numerical form, such as minutes from community meetings and general notes and observations. Qualitative data normally describe people's knowledge, attitudes or behaviors.

E.g.

Table 1: Quantitative and Qualitative approaches to gathering monitoring information on conservation targets, threats and interventions- what sort of modifications?

	Quantitative	Qualitative
Wildlife	Transects Scent and fur trap stations Camera trapping DNA capture-recapture Radio-telemetry	Ranger or tour operator sighting records Hunter assessment of prey density Opinions of park guards
Habitat Loss	Vegetation transects Satellite image analysis Sample plots Km to gather fuel wood	Forester estimate of logged area Farmer estimate of field area Villager elders' judgment
Species depletion	Consumption surveys Catch per unit effort Age and body size Market surveys	Hunter card sort of species biomass Hunter or fisher catch diaries Species ranking of fish catch by fishers Market trader estimate of scarcity Customs confiscations
Pollution	Transects Satellite image analysis Aerial photography Sample plots	Oilwatch web reports Complaints to the Environment Ministry
Invasive exotic species	Transects Aerial Photography Sample Plots Necropsies	Park Staff ranking Ranger log book records
Awareness raising	Attitude surveys Behavior observations Nielsen ratings	Local teachers' perceptions Media reports Focus groups
Economic Alternatives	Household income surveys Consumption surveys Behavioral observation	Community meetings Family interviews Health worker diary
Law enforcement	Court records Police reports Camera trapping	Park Staff ranking Community meetings
Training	Skills tests	Needs assessment
Capacity Building	Financial audits Staff evaluations	Peer audits Work-plan reviews Institutional ranking
Policy reform	Regulatory code reviews Budget for enforcement Court cases held	Lunch with policymaker
Constituency Building	NGO contributor lists Donations	Constituent interviews

Component of Conceptual Model	Landscape Species	Objective	Method	Indicator	Who	Comments
Conservation Target	Tiger	To raise the population of Tiger by 20% over five years	Camera trapping	Patch occupancy - area used	2 Camera trap teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Southern Serow	To raise the population of Southern Serow by 50% over five years	Camera trapping	Patch occupancy - area occupied	2 Camera trap teams	
Conservation Target	Eurasian Wild Pig	To raise the population of Eurasian Wild Pig by 100% over five years	Camera trapping	Patch occupancy - area used	2 Camera trap teams	
Conservation Target	White-cheeked Crested Gibbon	To raise the population of White-Cheeked Crested Gibbon by 10% over five years	Dry season forest transects	Patch occupancy - area occupied	4 Forest transect teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Great Hornbill	To raise the population of Great Hornbill by 35% over five years	Dry season forest transects	Patch occupancy - area used	4 Forest transect teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Asian Elephant	To have no decline in the population of Asian Elephant over five years	Fecal DNA capture-recapture	Density; # of individuals/km2	To be determined	To be initiated in 2009

Appendix 3. Monitoring Framework for Conservation Targets in the Nam Kading National Protected Area (Strindberg, Johnson, et al., 2007)

Tiger Monitoring Framework (NEPL NPA 2007)					
Component of Conceptual Model	**Description of Component of Conceptual Model**	**Objective**	**Method**	**Indicator**	**Who**
Conservation Target	Tiger	To raise the population of Tigers by 50% by 2015.	Camera trap monitoring	Number of tigers/100 sq km	NPA biological monitoring team
Direct Threat	Explosive traps and snares to catch tigers	Eliminate the use of bombs and snares in the NPA core zone	Foot patrols record detection of traps and snares in core zone	Number of bombs and snares encountered per unit effort	Substation patrol team
Indirect Threat	The understanding of the village about rules and regulations is low.	80% of the population of the villages around the core zone (36 villages) will obtain a 70% understanding of the rules and regulations	Pre and post testing, anecdotal observation,	The percentage of people that understand the information presented in various methods.	Outreach team and students.
Intervention	Increase the effectiveness of the patrol substations	Every officer in the substation will patrol 24 days/month	Record and follow up the daily work in MIST monitoring forms	Number of days patrolled per officer	Patrol team leader
Intervention	Demarcate the core zone and NPA	By end of 2008 the Phou Louey Core Zone will be entirely demarcated with signs every 2km	Record and map location of signs	Number of signs placed around the core zone	Patrolling team, and local people

Appendix 4. Monitoring Framework for Conservation Target, Direct and Indirect Threats and Interventions in the Nam Et-Phou Louey National Protected Area (NEPL NPA, 2007)

Appendix 5: Example MIST enforcement data collection form

Road Block, Restaurant, and Market Form

Date 20 Nov 2007 **Location** B. Donkoun **Patrol Types** Road block **UTM-E** 222222222

Team ID. VKMB **Team Leader** Vongxay **Reporter** Vongxay **UTM-N** 55555555

Run No	Time	Observation	Obs Type	Total	Random/ suspect check	Vehicles No/ Village names	Comments
1	7:30	Position	Start				
2	8:30	Check	Motorbike	1	Random	ຫົວພັ ກຄ 2233	
3	8:30	Trade	Wildlife	1	Random	ຫຼວງພະບາງ ກຂ 0001	See Obs form
4	10:15	Trade	NTFP	1	Random	ຫົວພັ ກກ 4400	See Obs form
5	11:45	Position	Rest				
6	12:15	Position	Re-start				
7	15:00	Check	Truck	1	Random	ກຳແພງ ຄຄ 8877	
8	15:38	Trade	Logging	1	Random	ຫົວພັ ຂຄ 0123	See Obs form
9	16:09	Check	People			B. Sakok	
10	17:00	Position	End				

OBSERVATIONS:

Human activity: Trade

Position: (1). Position and **(2).** Check

OBSERVATION TYPES:

TYPE found: Wildlife, Wood, and NTFP

Position Types: (1). Start, Rest, Re-start, End and (**2**). People, Motorbike, Car, Truck

Module 6

Monitoring for Management

Exercises

Kelly Spence
Arlyne Johnson
Madhu Rao

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Introduction:

Monitoring is one method used by managers to determine whether they have achieved the goals and objectives that have been set for a project. In terms of Protected Areas, PA managers want to assess if they are being effective in managing these areas. The following exercises have been devised to help managers think about how best to monitor activities that are implemented in their protected area.

Exercise 1: Monitoring

Part A

Learning objectives:

- To understand an artificial system and what needs to be monitored
- To develop a method for recording the monitoring activity
- Overall, to understand the importance of management and effective monitoring within a protected area

Equipment:

- Clear cylinder with 5mm measured marks on it.
- 2mm holes with plugs to fit (use toothpicks).
- Soup spoon and bowl of water
- Paper to record results
- Stopwatch
- A4 paper for developing data collection sheet

NB: This exercise has to completed outdoors

Time: (30 mins)

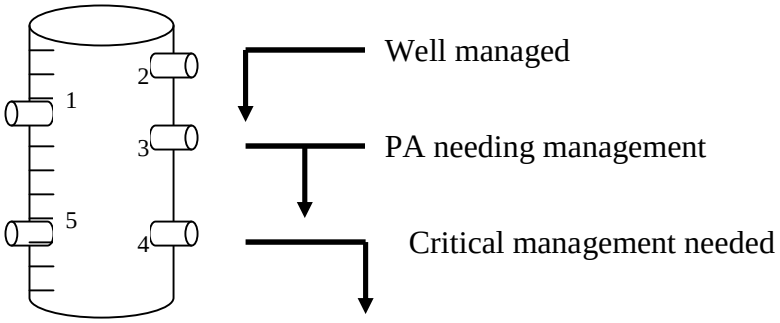
Set up a cylinder with 20 pre-drilled holes in it (holes should be small approx 2 mm round). The cylinder should be clear and with pre-measured marks on it. Each of the 20 holes should be given a number. The holes can be plugged with toothpicks

Fill cylinder with water. See photo/diagram below. The activity should continue for 5 minutes

The cylinder represents the Protected Area. The water represents the muntjacs in the PA. As a manager you need to manage and monitor the water/resources in the cylinder.

People needed:

1. Manager + Assistant Manger – Monitor
2. Hunters (2pple) – remove plugs
3. Enforcement – plug holes
4. Muntjac – replace water (i.e. natural Muntjac population growth)



Instructions to Manager and Assistant:
You must record the water reading every 10 seconds and where there is Muntjacs being harvested. Record these results.

Instructions to Enforcement officer:
Do not do anything – you are on holiday!
After 2 minutes you may return to work and plug up the holes.

Instructions to Hunters:
First time each hunter removes half the plugs. Plugs will be replaced by Enforcement officer. After the plugs are replaced you may remove 1 plug every 15 seconds. After 3 minutes an informant leads to 1 hunter's arrest.

Instructions to Muntjac:
You will replenish the resources by using a spoon to transfer water into the cylinder. 1 spoonful every 30 seconds

1. First the team is to develop a monitoring sheet that displays the following information
    - Water/Muntjac level measured over time
    - Where is the leakage/hunting taking place
    - Who is responsible for the Muntjac depletion
    - Other information

2. Manager is to monitor the following:
    - Record details on the monitoring sheet developed
    - What is the lowest the resources were recorded at?
    - What is the highest that the resources were recorded at?

Part B – Adaptive Management (15 mins)

In an **adaptive management** setting, monitoring provides the feedback loop for learning about the protected area

Learning objectives:
Understanding the role of monitoring to help PA managers learn from the experience of implementing the chosen project interventions and to modify project interventions accordingly – Adaptive management

Equipment: Use of experiment above

In the activity above we observed and recorded information about what was happening in an artificial system. As managers, recording information is the basis of a monitoring plan. In the following exercise managers need to think about what are some management methods that could be made to the above system which could result in change?

E.G. [After 3 minutes an informant leads to your arrest.] Building up an informant network that helps to reduce the hunting threats

1._____

2._____

3._____

4._____

Exercise 2: Starting to develop a monitoring plan

Learning objectives: To ensure that PA managers understand the process of conservation planning for protected areas, in particular, conservation targets, conservation target, etc.
Equipment: Conceptual models

(a) List the conservation targets of your protected area (2mins)

1. _____
2. _____
3. _____

(b) List all the direct threats to the conservation target of your protected area (add more spaces if needed) (5mins)

1. _____
2. _____
3. _____
4. _____
5. _____

(c) List all common indirect threats to the conservation target of your protected area (add more spaces if needed) (10mins)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

(d) List all common interventions identified for your 3 conservation target (5mins)

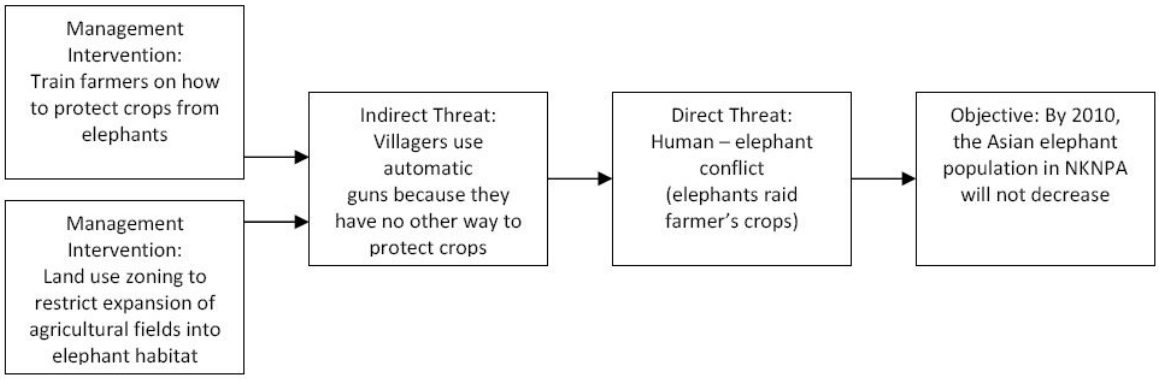
1. _____ ☐
2. _____ ☐
3. _____ ☐
4. _____ ☐
5. _____ ☐
6. _____ ☐
7. _____ ☐
8. _____ ☐
9. _____ ☐
10. _____ ☐

(e) List specific interventions related to each conservation target (5mins)

Conservation target 1	Conservation target 2	Conservation target 3
1._____	1._____	1._____
2._____	2._____	2._____
3._____	3._____	3._____
4._____	4._____	4._____
5._____	5._____	5._____

(f) With a limited budget prioritize the interventions giving a score in the box provided. For example, give the number 1 for the highest priority, the number 2 for the second highest priority and so on. (10mins)

(g) Select one of your conservation target from your conceptual models and develop a casual linkage as in the example below (20mins). If you finish, continue to develop a casual linkage for the other two conservation targets



Exercise 3: Developing a Monitoring Plan

Learning objectives:
To develop skills and understanding of the importance of planning in the design of a monitoring system

Part A: What to monitor (10mins)

Scientists and managers of natural areas need to work together to design and implement effective monitoring programs. Managers need to ask scientists to provide:

i) clear directions as to what they want measured and how, which is also defined as **monitoring metrics**.
ii) the level of change expected in a given period of time to define the management objectives, and
iii) how to prioritize management tasks in order to have the largest positive impact on the viability of the **conservation targets** they are managing (Barrows and Allen 2007).

In general, we can determine what monitoring information we need based on the goal and objectives of each project. Here are some examples from our projects in Laos:

As conservation of tigers and their prey is the goal for the NEPL NPA and the reduction of threats are the objectives to reach this goal, our donors and WCS want know the following (see attached Tigers Forever report on our monitoring results as an example):

- What is the change in abundance of tigers over time?
- What is the change in abundance of prey over time?
- What is the change in abundance and distribution of threats (e.g. claw traps, explosive traps, wire snares, gun shots, illegal access into the TPZ, shifting cultivation, etc) relative to enforcement effort over time (i.e. variable = catch per unit effort)?

Using examples from the Nakai-Nam Theun NPA:

- The wildlife monitoring program there is looking at change in abundance and distribution of selected felids, ungulates, primates and hornbills as a result of enforcement using camera trapping and line transects.
- The principle threat to these species in NNT is illegal hunting and trade. Enforcement monitoring using MIST is now being put into place in the NPA to monitor similar variables as those in NEPL (see above).
- For the Elephant Project, we monitor change in abundance and distribution of human-elephant conflict in response to training and providing equipment for farmers to protect crops from elephants.

(For more details see reports from our wildlife monitoring project in NNT, and our Nakai Elephant Project reports).

1. What is currently monitored in your protected area? Draw a table with information describing what is monitored, why and how. Add more spaces if needed.

What is being monitored	Why	How

Part B:

Using the casual linkages in Exercise 2 developed for the three conservation targets in your protected area above fill in the following tables.

2. Measuring conservation targets (impact monitoring) (5 mins)**. Conservation Target**
Write an example that involves the tracking of changes in the status of all 3 of your conservation target species

e.g. Elephant	Measure the change in status of elephant populations in Nam Kading NPA
1.	
2.	
3.	

3. Measuring changes in the levels of threats (outcome monitoring) (5mins). **Threat**
Write down one example for each of the conservation target species that measures the change in the status of the threat

e.g. Elephant	Measure the rate of Human/Elephant conflict e.g. crop loss, injury to humans/elephants over time
1.	
2.	
3.	

4. Measuring the implementation of interventions (performance monitoring) (5 mins)**.**
Intervention
Write down one intervention for each conservation target that could be monitored

e.g. Elephant	Set up crop protection system with farmers
1.	
2.	
3.	

Exercise 4 – Interventions and Monitoring-Case Example

Learning objectives:
This is a case example for the Irrawaddy Dolphin (*Orcaella brevirostris*). This exercise is structured to help look at monitoring based on the described interventions developed for this species. Please read the information carefully and then proceed to question 1 about monitoring. Table 1 outlines some approaches that may help decide on appropriate monitoring methods for the interventions.

Summary and Background (Smith et. al, 2007)
Irrawaddy dolphins inhabiting the Mekong River were Red Listed as 'critically endangered' by the World Conservation Union (IUCN) in 2004. Preliminary mark-recapture estimates indicate that the population numbers a minimum of 127 individuals (CV = 0.07; 95% CI = 108 – 146). The range of the population has declined substantially and is now primarily restricted to nine deep water areas in a 190-linear km river segment between Kratie and Khone Falls just upstream of the Lao PDR/Cambodia border.

Khone Falls physically obstructs further upstream movement. Based on interview surveys conducted by Baird and Mounsouphom (1994) dolphins are believed to have been once fairly common in the Sekong River and its tributaries as far upstream as the Kalaum District (approximately 950 km upstream of the river mouth in Vietnam).

Between January 2001 and June 2005, 48 dead dolphins were documented, 50% adults/juveniles and 50% calves. Anthropogenic factors were implicated in the deaths of 15 adult dolphins (62.5%). Of these, 13 were due to entanglement in fishing gears described as "large mesh gillnets" (6-14 cm mesh size recorded in four cases), one was reported to have been shot, and one was deliberately killed with explosives over concerns about access to fishing rights. Between July 2005 and March 2006 an additional 18 dolphin carcasses were recovered, including two adults, one juvenile and 16 calves. The large number of recent calf mortalities is worrisome and may indicate a problem with environmental contaminants. Analyses of mercury as a possible threat indicated that levels were not high. Other potential threats that warrant further investigation are illegal dynamite and electric fishing, water pollution, and noise, collisions and harassment from dolphin watching and high-speed transport vessels.

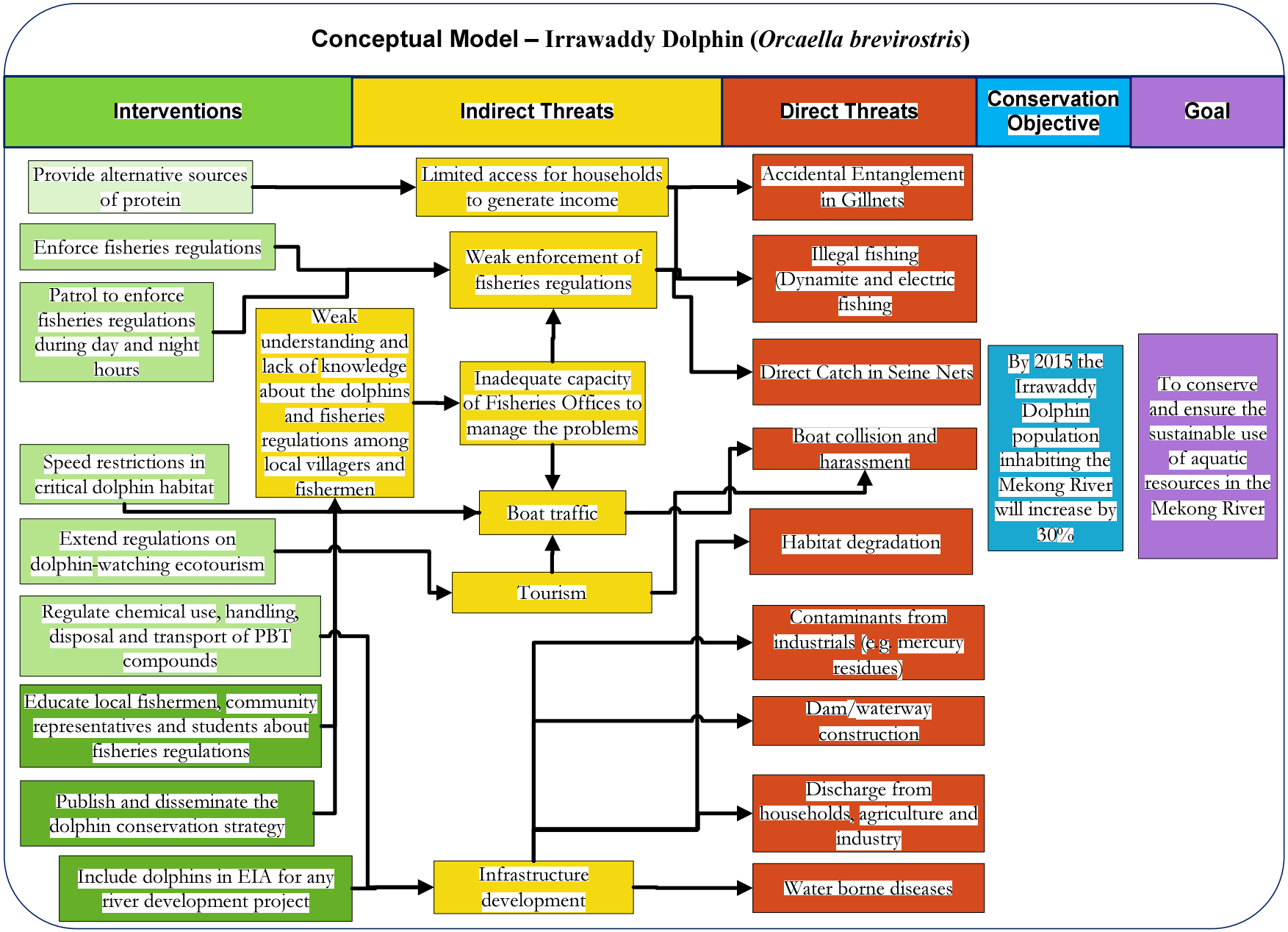
Gold mining operations along Mekong tributaries are a potential source of mercury (Hg), which could have toxic effects on dolphins. Ten liver samples from three adults and seven calves that died between September 2002 and November 2004 were analyzed by Environment Canada (Burlington, Ontario) for mercury concentrations. With the exception of one dolphin, all samples were found to contain mercury concentrations in the range 0.9-3.7 µg/g (wet weight). One adult female was found to have a considerably higher concentration of liver mercury (67 µg/g). As expected liver mercury residues were consistently higher in adults compared to calves due to the bio-accumulative properties of the trace metal. Blubber mercury concentrations were obtained for seven adult dolphins including the three animals for which liver mercury concentrations were available.

At present, given the low concentrations and absence of associated pathology, there is no evidence to suggest that Irrawaddy dolphins in the Mekong River are suffering from the toxic effects of mercury. Further analyses of blubber samples for polychlorinated biphenyls (PCBs) and fluorinated organic compounds will be

conducted by Environment Canada and the Canadian National Laboratory for Environmental Testing.

Additional human activities that could currently be threatening Irrawaddy dolphins in the Mekong River include illegal fisheries (e.g. electric or dynamite fishing) and collisions with motorized boats. However, at present there is no evidence to implicate any of these activities in dolphin deaths. Threats that have the potential to cause problems in the future include (1) resumption of the use of dolphin body parts for traditional medicine that was previously common in Cambodia; (2) habitat degradation from factors such as deforestation, which leads to increased sedimentation; (3) over-fishing which could affect the availability of dolphin prey; and (4) dam construction which could detrimentally affect ecosystem functioning and fragment populations.

Conceptual Model – Irrawaddy Dolphin (*Orcaella brevirostris*)



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Awareness raising	Attitude surveys Behavior observations Nielsen ratings	Local teachers' perceptions Media reports Focus groups
Economic Alternatives	Household income surveys Consumption surveys Behavioral observation	Community meetings Family interviews Health worker diary
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Training	Skills tests	Needs assessment
Capacity Building	Financial audits Staff evaluations	Peer audits Work-plan reviews Institutional ranking
Policy reform	Regulatory code reviews Budget for enforcement Court cases held	Lunch with policymaker
Constituency Building	NGO contributor lists Donations	Constituent interviews

Part A: Monitoring Framework (30mins)

We need to measure the impact of the interventions and whether the interventions are meeting our objectives, and ultimately our goal. Table2 is an incomplete management framework. Using the information given about the dolphin, the conceptual model, and table 1, please complete this monitoring framework.

Table 2: Management Framework for Irrawaddy Dolphin (*Orcaella brevirostris*). (30mins)

Component Type	Component Description	Objective	Method	Indicator	Who
Conservation target	Irrawaddy Dolphin	By 2015 Irrawaddy Dolphin population inhabiting Mekong River will increase by 30%	Boat-based surveys Photo-ID Telemetry Reports of sightings (interviews) Reports of sightings (public) GIS mapping of habitats Biological surveys	Area occupancy Area occurrence Number of individuals found in the area Number of surveys conducted	Fisheries staff Villagers
Direct threat	Accidental entanglement in gillnets	Stop all fishing activities in dolphin critical habitats by 2012			
Direct threat	Illegal fishing	Reduce illegal fishing and prohibit the use of explosive and electric fishing by 80% by 2010			
Indirect threat	Tourism	Restrict all tourists to access in certain areas allocated by 2010			
Indirect threat	Inadequate capacity of Fisheries offices to manage the problems	Increase aquatic resource conservation management and implementation			

		capacity of all fisheries staff by 100% by 2012			
Intervention	Include dolphins in EIA for any river development project	By 2012 reduce potential impacts on dolphin population and its habitat caused by river development projects by 100%			
Intervention	Speed restrictions in critical dolphin habitats	Reduce noise pollution and eradicate boat collisions in all dolphin significant habitats by 2015			

Smith, B.D., Shore, R.G, Lopez A. (2007). Status and Conservation of Freshwater Populations of Irrawaddy Dolphins. WCS Working Papers No. 31.

Exercise 5: Developing a Monitoring framework

Learning objectives: Defining clear goals and monitoring objectives for targets, threats and interventions.

For every element of the conceptual model (conservation target, threats and interventions), you need to identify the following:

1. A quantitative objective that will be achieved within a given time-frame
2. For conservation targets, a monitoring objective will describe the status (increase, decrease or maintain at same level) of the wildlife species or habitat that will be attained over a fixed time-period.
3. For threats, a monitoring objective will specify by how much the threat will be reduced over a certain time-period.
4. For conservation interventions, a monitoring objective will relate to whether a planned intervention was implemented over a certain time period.

See examples from Lao PDR.

- # of tigers per 100 sq km (NEPL)
- # of prey per sq km (NEPL; this is an index of abundance not actual abundance).
- # of gun shots heard per km patrolled per month (NEPL, NK)
- # of crop raiding incidents per month per village (NNT)
- # of crop raiding incidents successfully repeled by farmers per month relative to the number of crop guarding days per village (NNT)
- # farmers trained in crop protection methods (NNT)
- Proportion of the protected area where large hornbills are present (NK).
- Proportion of the protected area where gibbons are present (NK)
- # of tiger prey species confiscated per days of patrol effort per month by Vientiane Capital City enforcement teams (VTE wildlife trade project).

Part A: Monitoring Objective

Here is an example of a Monitoring framework

Conceptual Model Component	**Monitoring Objective**	**Indicator**	**Monitoring Method**
Conservation Target:			
Threats:			
Conservation Intervention:			

We will start to fill this box in one section at a time. Each box will be preceded with an example. Please fill in the blank box below. (10mins)

Conceptual Model Component	**Monitoring Objective**
Conservation Target:	Muntjac population
Threats:	To reduce hunting by 20% in PA
Conservation Intervention:	Outreach on gun regulations will all villages in and outside (5km radius) PA

Conceptual Model Component	Monitoring Objective
Conservation Target:	
Threats:	
Conservation Intervention:	

Part B: Indicator

Measurable – qualitative or quantitative
Precisely defined – with multiple individuals collecting information precision is important
Consistent over time – If an indicator is expected to provide a reliable measurement of change in a factor, then it is important that observed effects be due to changes in the actual condition, not to changes in the indicator.
Sensitive - A sensitive indicator will change proportionately and in the same direction as changes in the condition or item being measured.

Example: Indicator (10mins)

Conceptual Model Component	Monitoring Objective	Indicator
Conservation Target:	Muntjac population	Number of Muntjac per km^2
Threats:	To reduce hunting by 20% in PA	Number of people caught hunting in PA, % of snares collected
Conservation Intervention:	Outreach on gun regulations will all villages in and outside (5km radius) PA	% of increased awareness of huniting regulations from Pre and Post testing questionnaire

PA manager to fill in:

Conceptual Model Component	Monitoring Objective	Indicator
Conservation Target:		
Threats:		
Conservation Intervention:		

Part C: Monitoring Method

Example: Monitoring Method (10mins)

Conceptual Model Component	**Monitoring Objective**	**Indicator**	**Monitoring Method**
Conservation Target:	Muntjac population	Number of Muntjac per km^2	Camera trap (?)
Threats:	To reduce hunting by 20% in PA	Number of people caught hunting in PA, % of snares collected	Foot patrol and detection of snares in PA
Conservation Intervention:	Outreach on gun regulations will all villages in and outside (5km radius) PA	% of increased awareness of hunting regulations from Pre and Post testing questionnaire	Pre/Post testing

PA manager to fill in:

Conceptual Model Component	**Monitoring Objective**	**Indicator**	**Monitoring Method**
Conservation Target:			
Threats:			
Conservation Intervention:			

Exercise 6: Developing a monitoring framework for your Protected Area

Using one of the conceptual model species from your PA, start to develop a monitoring framework for the conservation target (30mins)

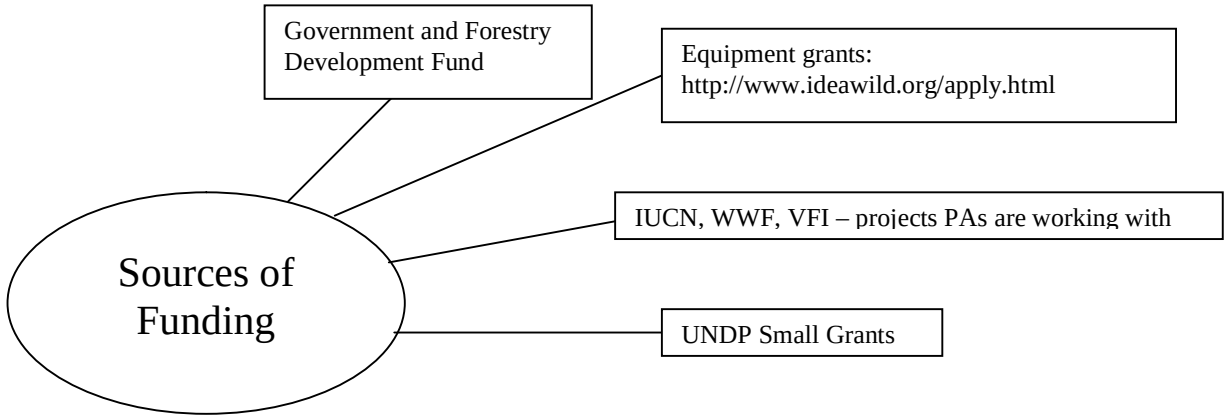
Component Type	**Component Description**	**Monitoring Objective**	**Indicator**	**Monitoring Method**	**Who**
Conservation target	Elephant populations	Maintain the current population of elephants	Elephant density per km^2	Dung surveys	Nam Kading Park Staff

Tiger Monitoring Framework (NEPL NPA 2007)					
Component of Conceptual Model	**Description of Component of Conceptual Model**	**Objective**	**Method**	**Indicator**	**Who**
Conservation Target	Tiger	To raise the population of Tigers by 50% by 2015.	Camera trap monitoring	Number of tigers/100 sq km	NPA biological monitoring team
Direct Threat	Explosive traps and snares to catch tigers	Eliminate the use of bombs and snares in the NPA core zone	Foot patrols record detection of traps and snares in core zone	Number of bombs and snares encountered per unit effort	Substation patrol team
Indirect Threat	The understanding of the village about rules and regulations is low.	80% of the population of the villages around the core zone (36 villages) will obtain a 70% understanding of the rules and regulations	Pre and post testing, anecdotal observation,	The percentage of people that understand the information presented in various methods.	Outreach team and students.
Intervention	Increase the effectiveness of the patrol substations	Every officer in the substation will patrol 24 days/month	Record and follow up the daily work in MIST monitoring forms	Number of days patrolled per officer	Patrol team leader
Intervention	Demarcate the core zone and NPA	By end of 2008 the Phou Louey Core Zone will be entirely demarcated with signs every 2km	Record and map location of signs	Number of signs placed around the core zone	Patrolling team, and local people

Exercise 7: Identifying sources of funding

Time: 20mins

This is a brainstorming exercise. Protected Area Managers are not only faced with the many direct and indirect threats to protected areas, but also how they will finance the interventions that will reduce these threats. Below managers should brainstorm known sources of funding. Some examples are given for you

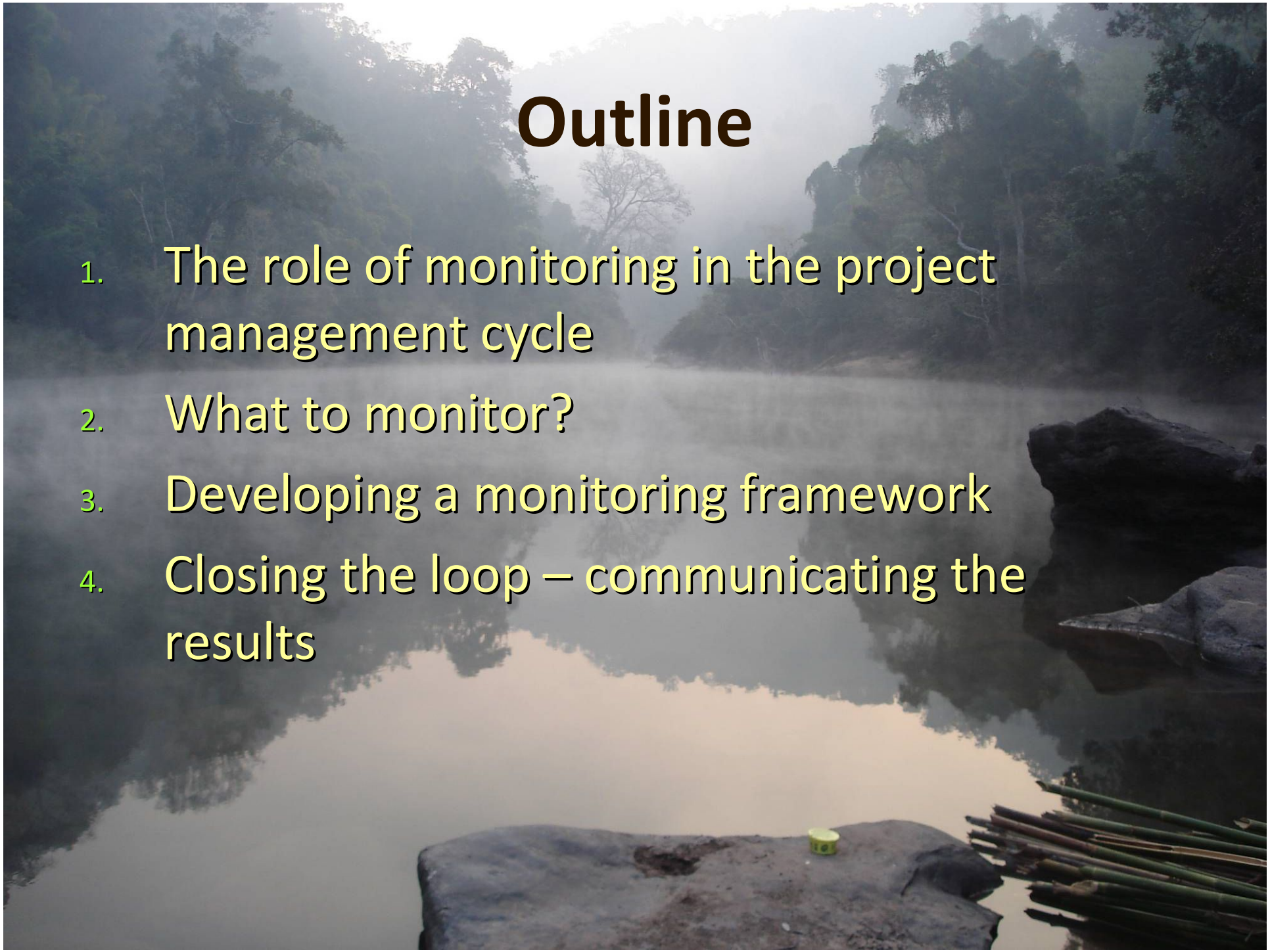


Component Type	Component Description	Objective	Method	Indicator	Who
Conservation target	Irrawaddy Dolphin	By 2015 Irrawaddy Dolphin population inhabiting Mekong River will increase by 30%	Boat-based surveys Photo-ID Telemetry Reports of sightings (interviews) Reports of sightings (public) GIS mapping of habitats Biological surveys	Area occupancy Area occurrence Number of individuals found in the area Number of surveys conducted	Fisheries staff Villagers
Direct threat	Accidental entanglement in gillnets	Stop all fishing activities in dolphin critical habitats by 2012	Patrol Visual observation Reports of sightings (interview, public)	Number of gillnets found in the sites Number of patrols conducted Number of dolphins found in gillnets per year compared to baseline numbers	Fisheries staff Patrolling teams Villagers
Direct threat	Illegal fishing	Reduce illegal fishing and prohibit the use of explosive and electric fishing by 80% by 2010	Boat-based surveys Patrols	Number of patrols conducted Number of illegal fishing activities	Patrolling teams Diary records from patrolling staff
Indirect threat	Tourism	Restrict all tourists to access in certain areas allocated by 2010	Construct “restricted area” signposts at all critical dolphin habitat sites Erect dolphin conservation signs and/or allocate posters near the sites Provide brochures about Irrawaddy dolphin for all tourists Reports from patrolling teams and villagers Tourist interview Attitude surveys	Number of tourists found in restricted areas	Dolphin conservation teams Patrolling teams Villagers

Indirect threat	Inadequate capacity of Fisheries offices to manage the problems	Increase aquatic resource conservation management and implementation capacity of all fisheries staff by 100% by 2012	Conduct trainings for Fisheries staff Providing tasks and exercises to test their progress	Number of trainings conducted Annual staff performance evaluation Results from the exercises	Fisheries Staff and management
Intervention	Include dolphins in EIA for any river development project	By 2012 reduce potential impacts on dolphin population and its habitat caused by river development projects by 100%	Enforcement Inform development organizations of EIA requirements	Number of river development proposals and/or projects that include dolphins in their EIA Quality of the information	Fisheries offices Relevant government agencies
Intervention	Speed restrictions in critical dolphin habitats	Reduce noise pollution and eradicate boat collisions in all dolphin significant habitats by 2015	“Slow down speed” signposts erected on the sites 100 meters away from the main dolphin habitats up and down stream On site boat traffic surveillance	Number of boats running over speed Engine quality checks	Patrolling teams Fisheries staff Villagers

Monitoring for Management: An overview

Madhu Rao, Emma Stokes, Arlyne Johnson, Kelly Spence



Outline

1. The role of monitoring in the project management cycle
2. What to monitor?
3. Developing a monitoring framework
4. Closing the loop – communicating the results

Definition of Monitoring

The process of gathering **information** about **variables** (*e.g. rate of loss of forest cover*) within a **system** of interest (*e.g. a Protected Area*).

The information is used to characterize the **status** of the system (*i.e. the protected area*) at different points in time.

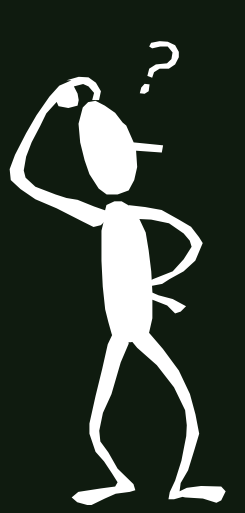
Example of Monitoring

Variable: Level of the fuel

System: Car or motorcycle

Why Monitor?

State of the system
(What is the level of illegal hunting in a protected area?)

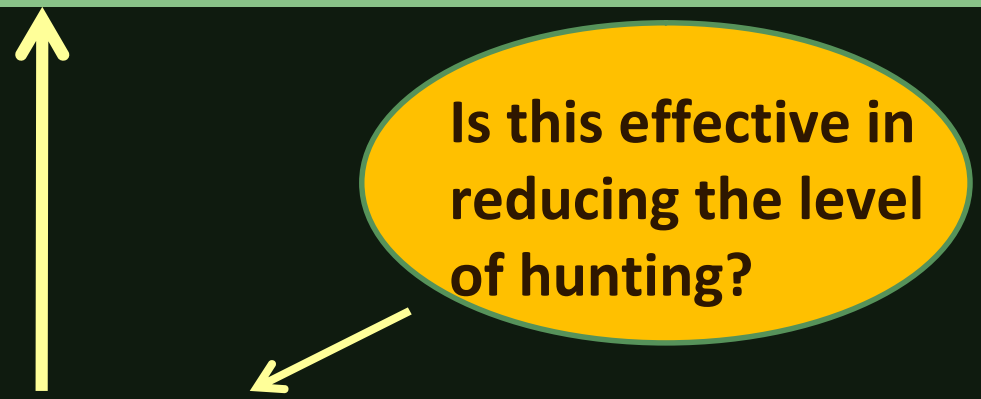


ACTION: Increase patrolling along the border of the PA

1. Monitoring helps managers in decision-making

Why Monitor?

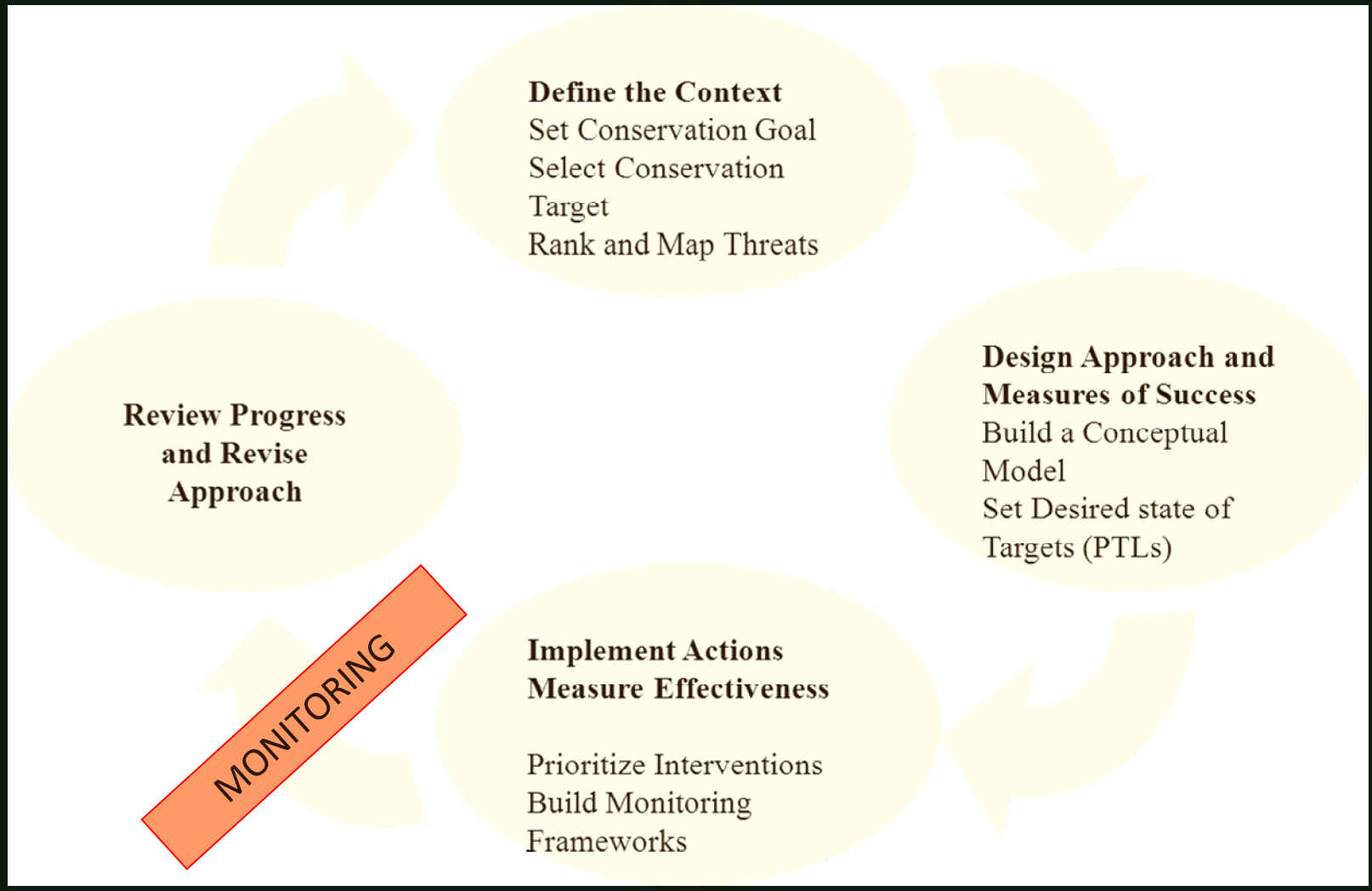
Objective of NPA: To decrease the level of illegal hunting by 90% over a 2-year period



ACTION: Increase patrolling along the border of the PA

2. Monitoring helps evaluate the effectiveness of management actions

Why Monitor?



3. Monitoring provides the feedback loop for learning about the system (For Adaptive Management)

Monitoring Objectives

Any type of additional information about the PA will be useful for monitoring

- Scientific Objectives
- Management Objectives

Monitoring : Scientific Objectives

(1) Monitoring with manipulation of the system

Example

Monitoring the regeneration of a Palm in response to 3 different (low, medium, high) levels of harvest

(To determine the level of sustainable harvest i.e. how much can be harvested to ensure that regeneration replaces harvest?)

Monitoring: Scientific Objectives

(2) Use Monitoring data in retrospective analyses

E.g: Monitoring data from a yearly census of an endangered primate species over a 6-year period

(To determine the status of the primate population over time- is it decreasing, increasing or remaining stable?)

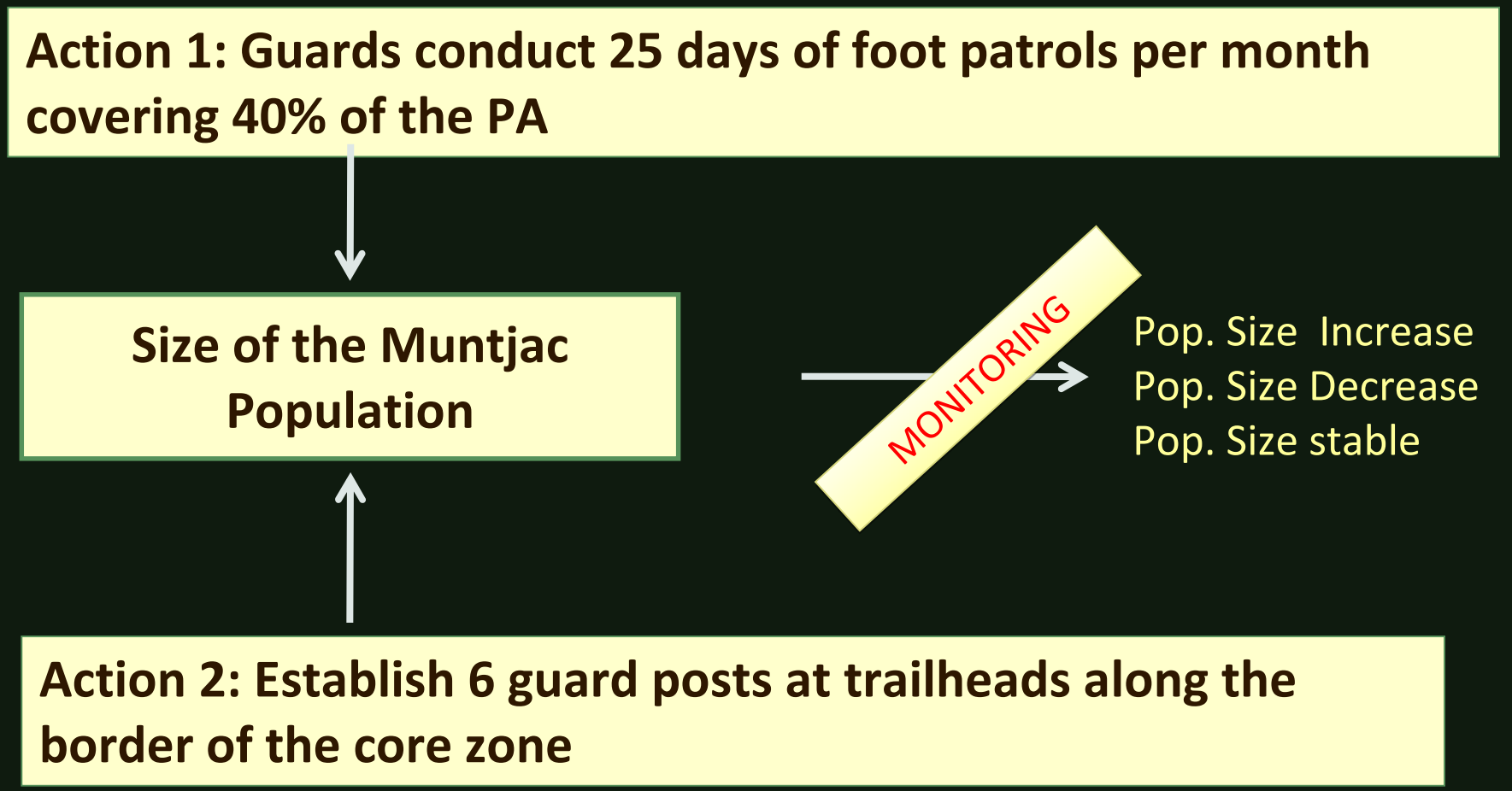
Monitoring : Management Objectives

State of the system
(What is the size of the muntjac population harvested for subsistence food by local people?)

ACTION: Reduce illegal hunting of muntjacs for trade through patrolling

1. Monitoring helps managers in decision-making

Monitoring : Management Objectives



Managers ⇄ Scientists

What to measure and how?
To monitor tigers or prey or both?

Management objectives

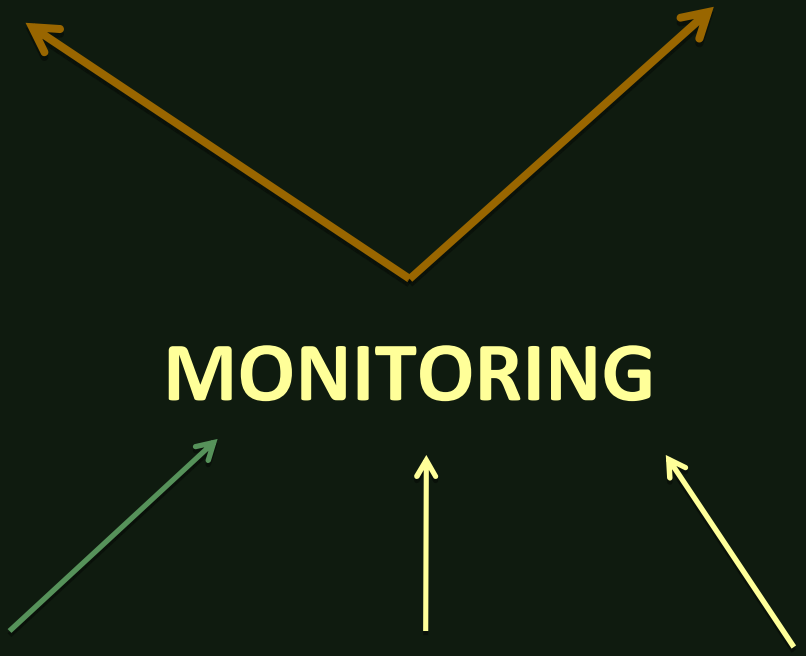
Is it reasonable to expect a 50% increase in the population of tigers over a 10-year period?

How to prioritize management tasks for largest positive impact?

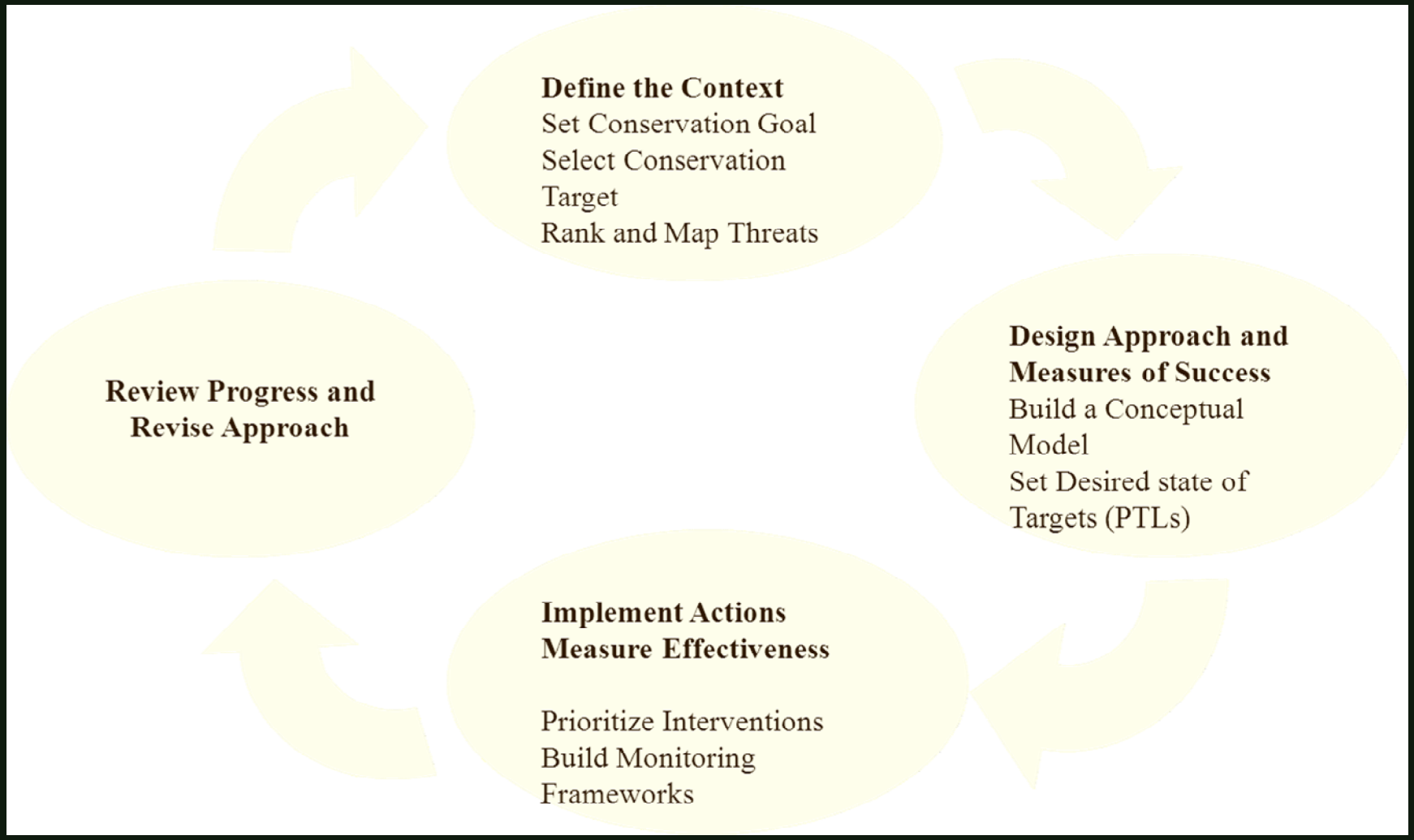
Science---Monitoring---Management

Statistically defensible for managers

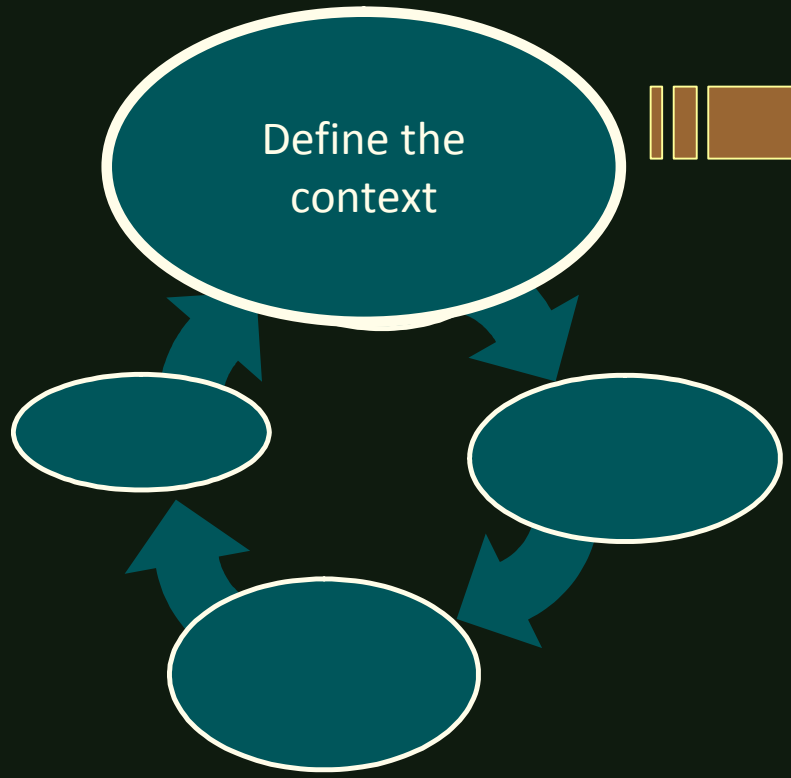
Useful



Monitoring in the Project Management Cycle

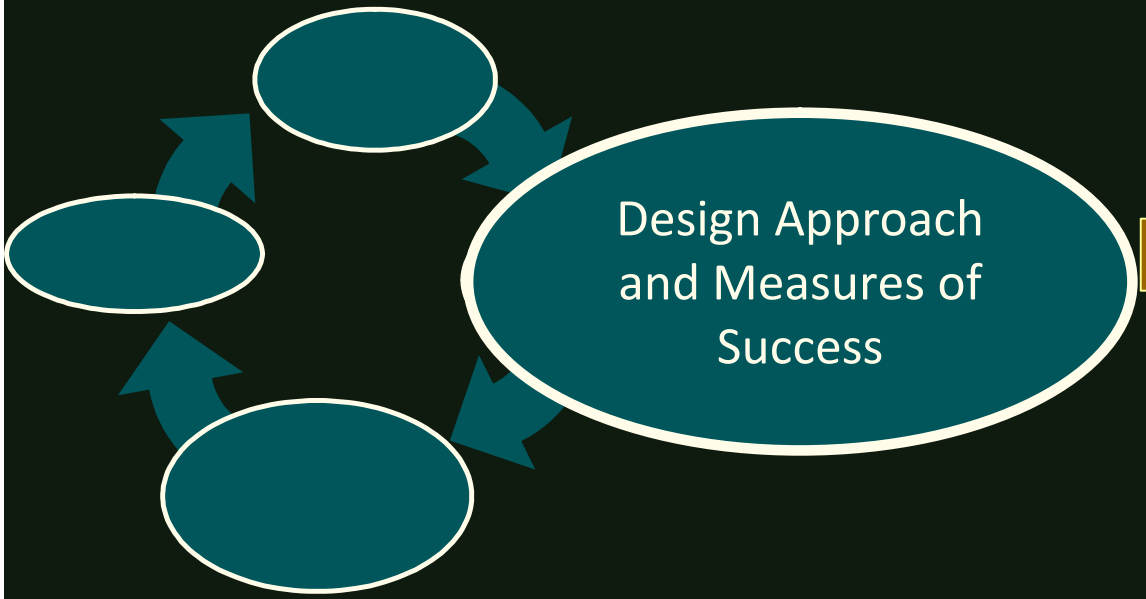


Stage 1 - Define the project site and set the goal.



What do we want to achieve, where…

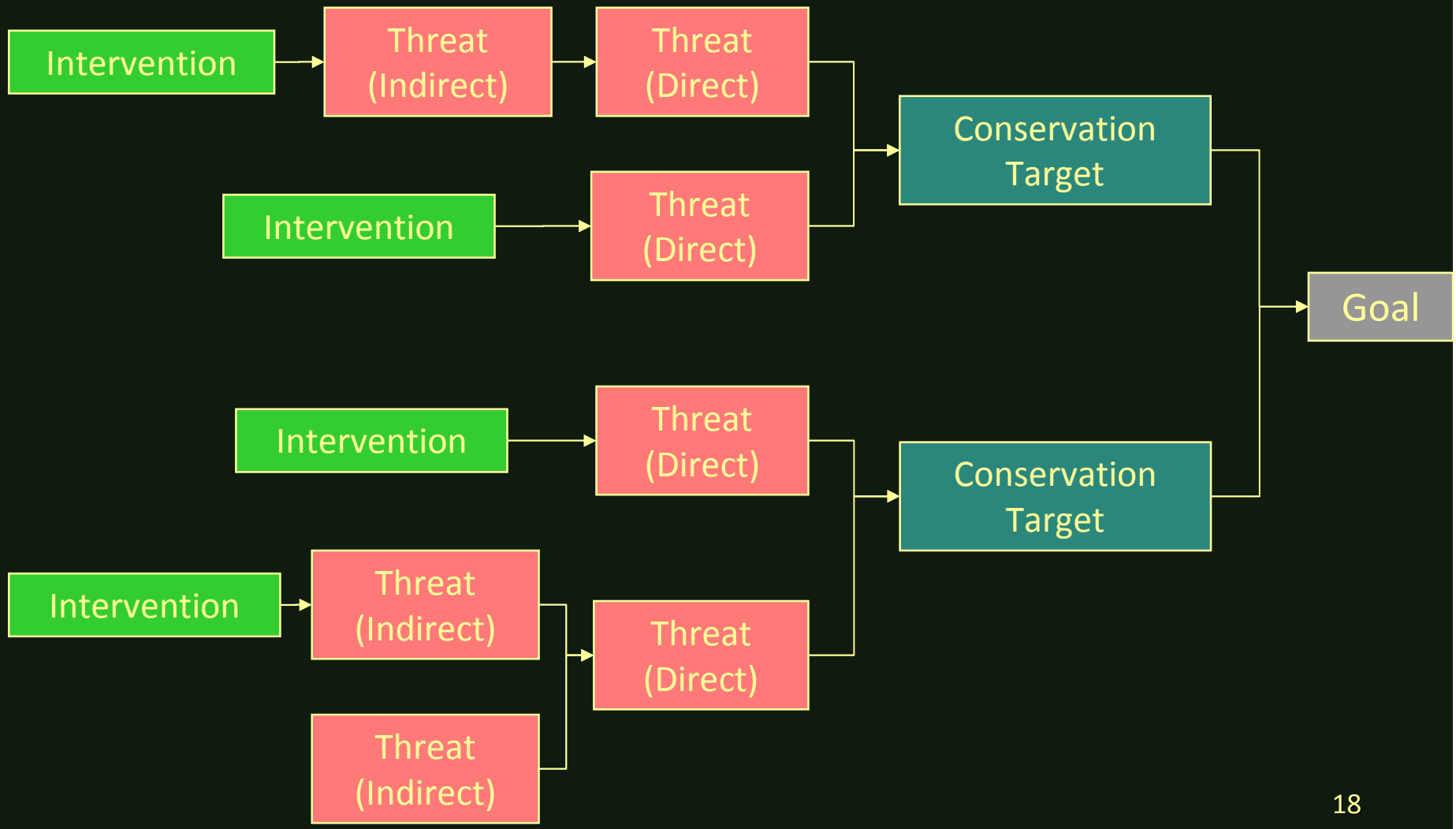
Stage 2 - Design Approach and Rank Threats



i) Conceptual modeling

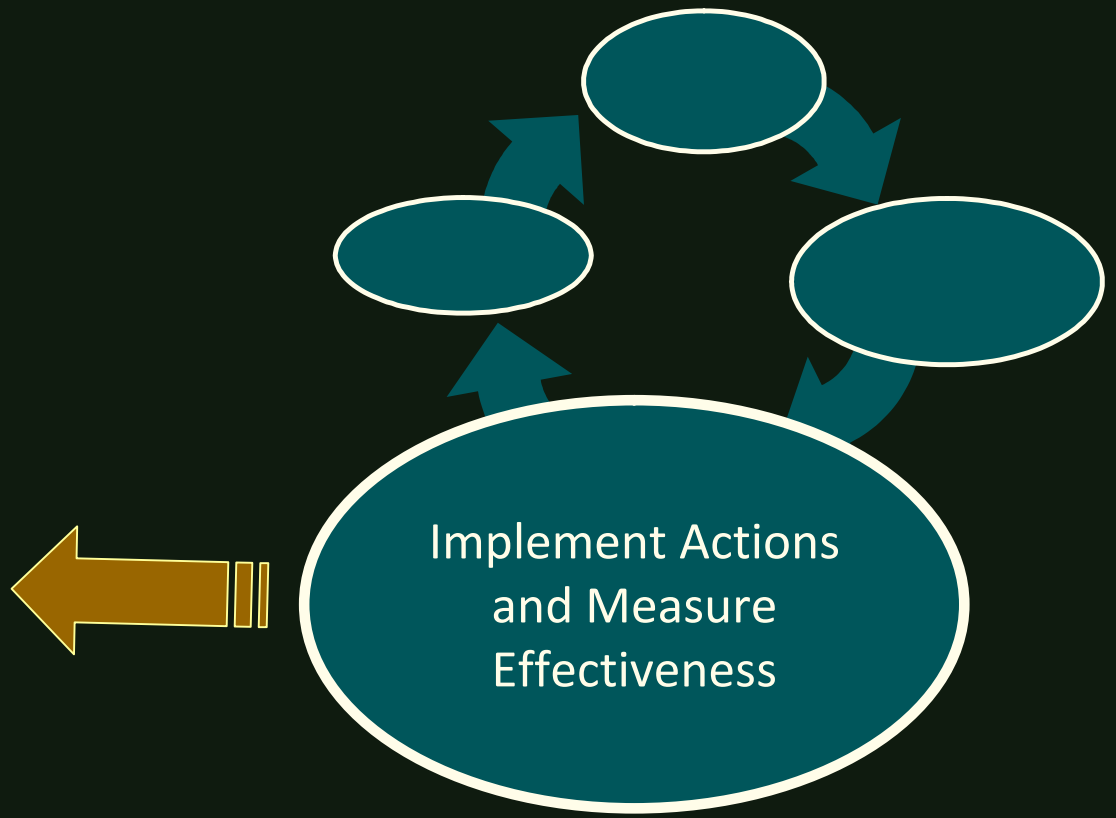
ii) Ranking Threats

Stage 2: Develop a Conceptual Model



Stage 3 - Implement actions and measure effectiveness

-Prioritizing implementation actions



- Monitor

Stage 3 - Implement actions and measure effectiveness

This next stage is divided into 2 parts:

1. Prioritize Conservation activities / Interventions
2. Developing monitoring frameworks to determine if actions are successful

Stage 4 - Review Progress and Revise Approach

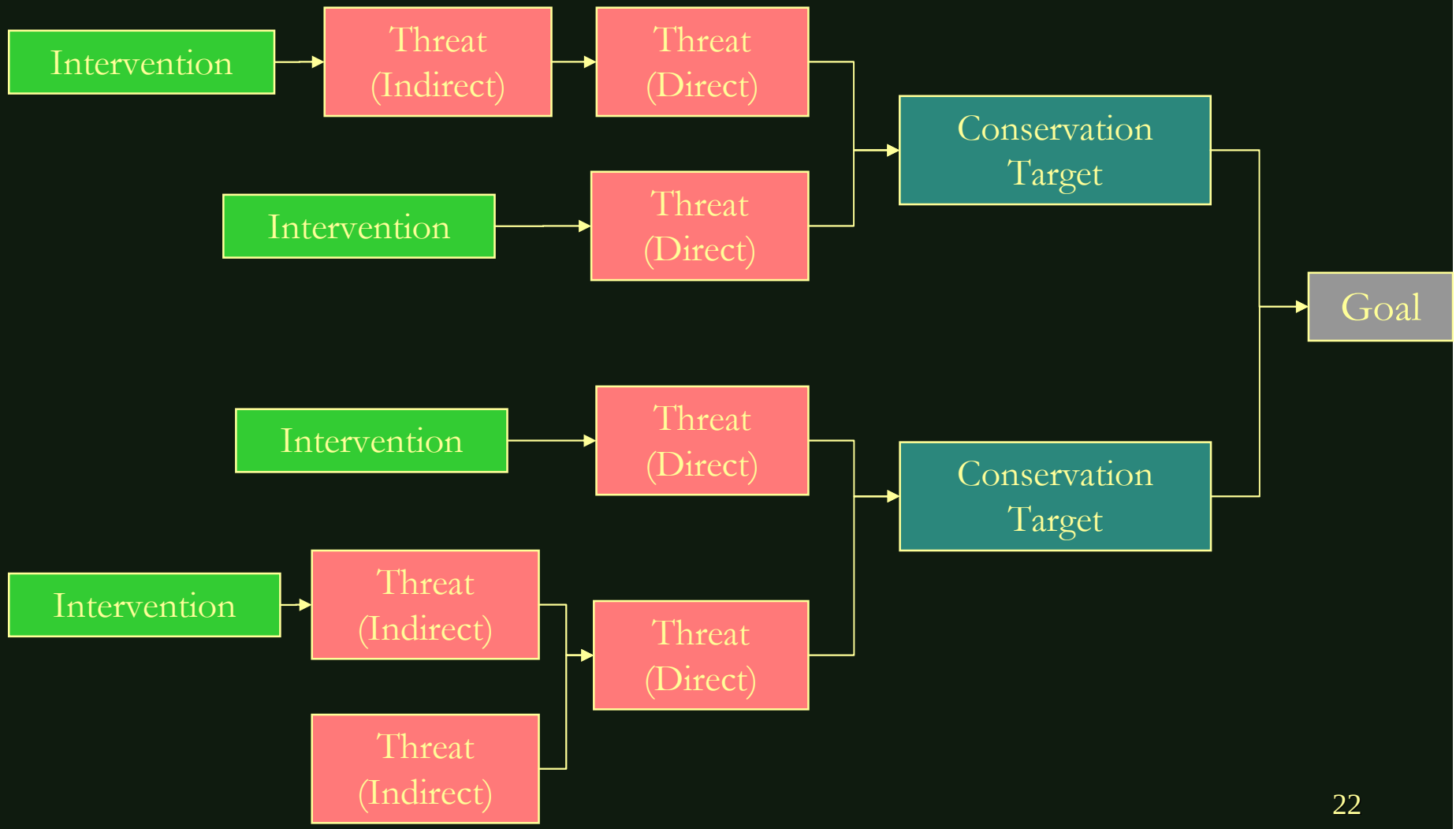
Reports

Discuss results with your project team

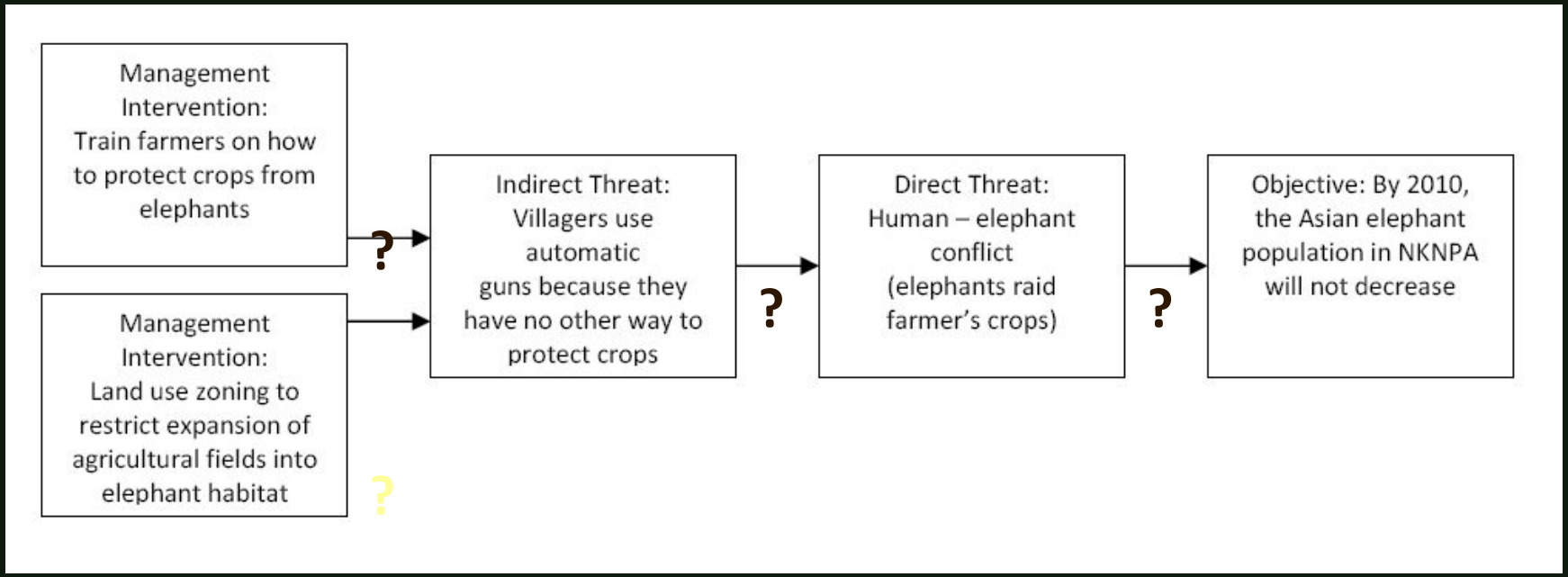
Conservation Audits

Review assumptions

Stage 2: Develop a Conceptual Model



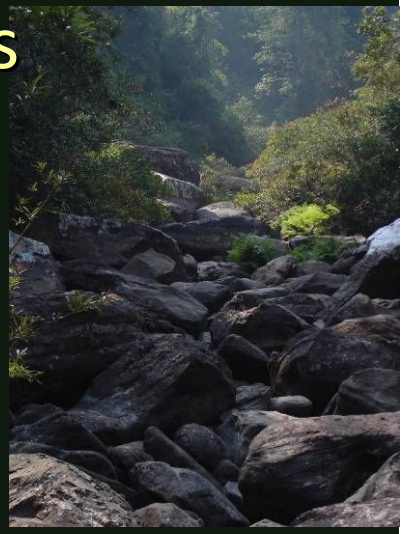
Monitoring: Evaluates the causal linkages between interventions, threats and conservation targets



Does the establishment of crop protection systems and land use zoning reduce the threat of human-elephant conflict and killing of elephants and thus help maintain the elephant population within and around Nam Kading NPA?

Monitoring is Important

1. It allows us to assess the status of threats and conservation targets



In the Nam Kading NPA

Conservation Target = Maintaining elephant population

Monitor: Status of hunting (as a threat to elephant population); elephant population size

Monitoring is Important

2. It helps us evaluate the effectiveness of management interventions

In Nam Kading:

Threat: Human-elephant conflict

Intervention 1: Training crop protection methods to farmers

Intervention 2: Enforcing land use zoning to prevent expansion of agricultural fields into elephant habitat

Are interventions effective in reducing human-elephant conflict? Is one intervention more effective than the other?

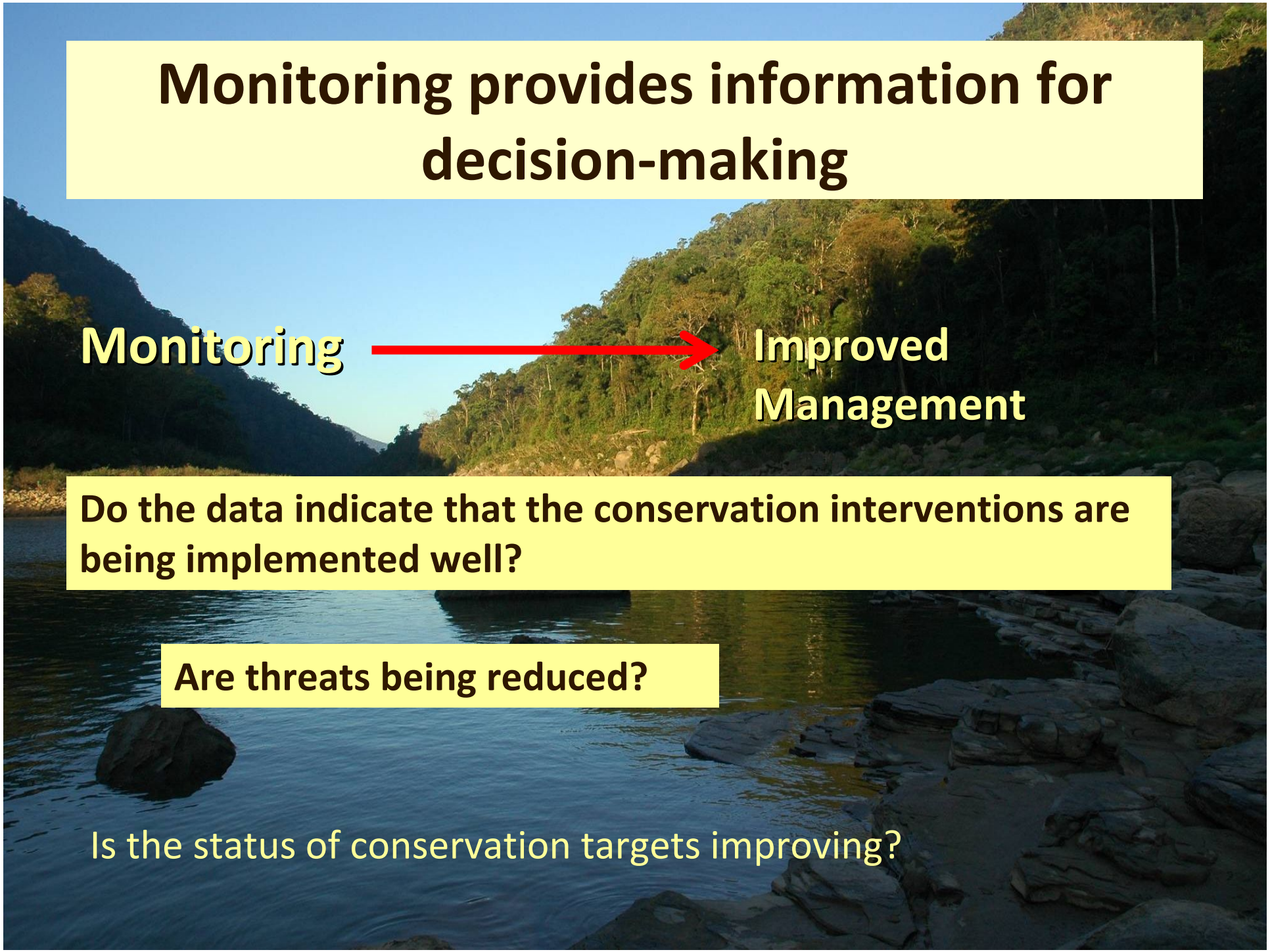
Monitoring is Important

3. It informs and improves management practice through an adaptive management process

For Example:

Nam Kading NPA- [Monitoring] - further decline in the population density of elephants due to increased levels of hunting where elephant crop-raiding is occurring.

Need to review the threat of hunting and the interventions


Monitoring provides information for decision-making
Monitoring
Improved Management
Do the data indicate that the conservation interventions are being implemented well?
Are threats being reduced?
Is the status of conservation targets improving?

What to Monitor?

Monitor at all 3 levels across the causal chain:
Conservation targets, threats and interventions

- Measuring conservation targets

(Impact monitoring)

Example: Measuring changes in the status of elephant populations within and around the Nam Kading NPA

What to monitor?
Outcome monitoring

Measuring changes in the levels of threats (Outcome monitoring)

For example: Measuring the rate of occurrence of human-elephant conflict, extent of crop loss, injury to humans or elephants over time

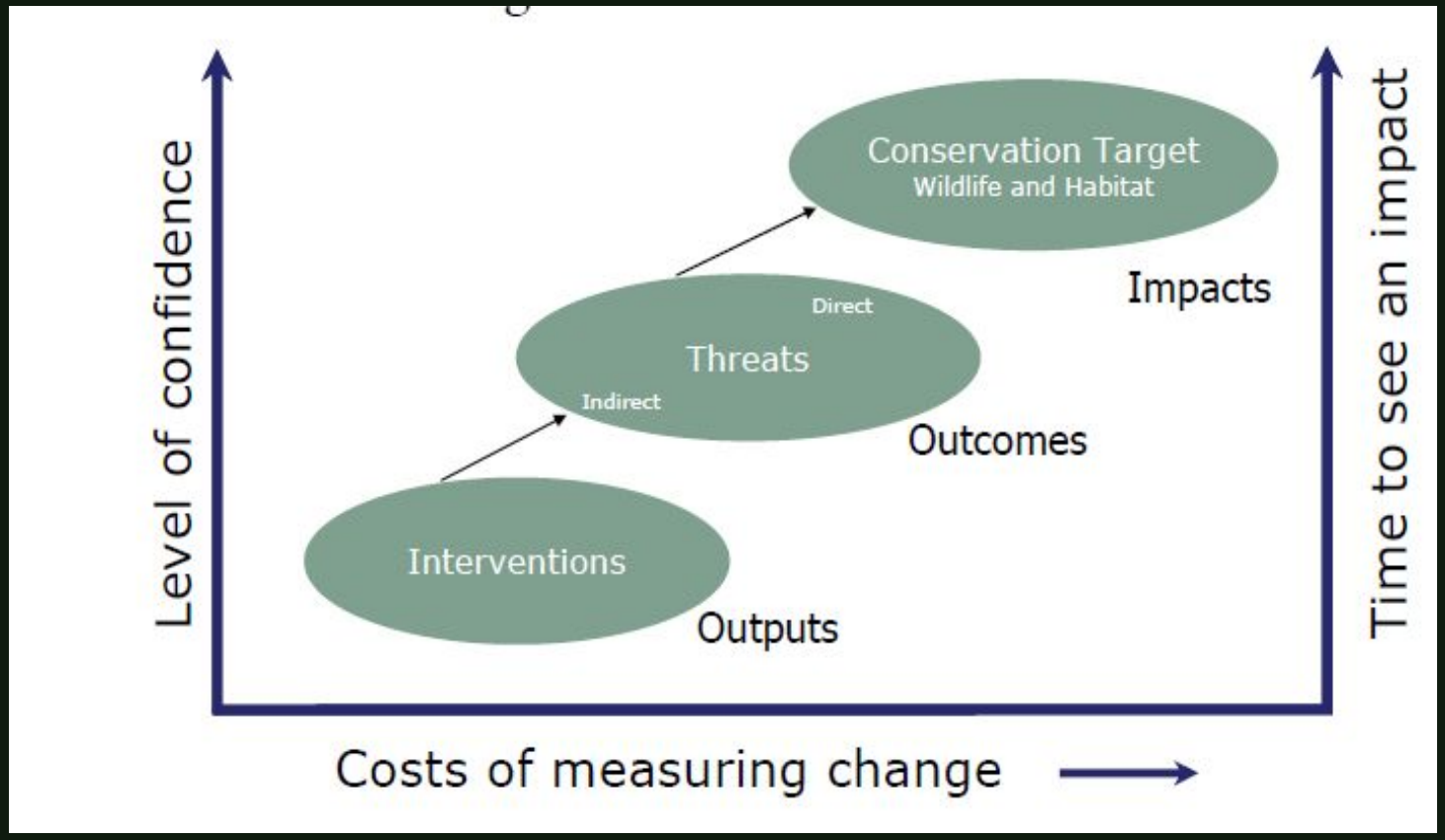
What to monitor?
Performance Monitoring

Measuring the implementation of interventions

Intervention: set up a crop protection system with farmers,

Monitoring: have the crop protection systems (warning systems and deterrents in agricultural field) been established?

Time-scale issues and trade-offs



Setting priorities, allocating resources

- Which monitoring information does the project require to fulfill either donor or institutional requirements? **[TOP PRIORITY]**
- What level of precision is needed to ensure that the monitoring results can be effectively used to influence management decisions?
- What information would be useful to have but would need additional funding?

There will be trade-offs in cost, precision and confidence associated with different monitoring methods.

Decisions for project implementation

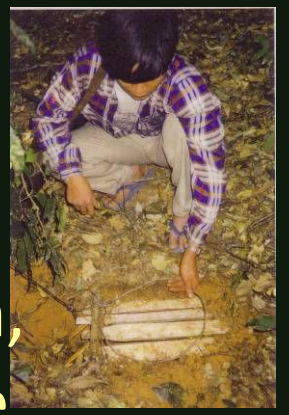
(1) How should managers allocate resources between implementing interventions and monitoring the impact of the interventions?

(2) How should managers subdivide monitoring resources across different levels of monitoring and types of monitoring indicators.

Framework for logical allocation of resources between implementation and monitoring

Are there substantial threats facing the conservation targets?

Substantial threats facing tigers in NK NPA?



Are there clear and feasible interventions (outreach, enforcement) known to be effective at reducing the identified threats?

Does the project team have high confidence in their understanding of the overall conservation situation?

E.g. Do PA staff understand the overall situation related to declining tigers, threats to tigers and potential interventions that could be used to address the threats and increase tiger populations?

DEVELOPING A MONITORING FRAMEWORK

For every element of the conceptual model (conservation target, threats and interventions), you need to identify the following:

A **quantitative objective** achieved within a given time-frame

For **conservation targets**, a *monitoring objective* will describe the status (increase, decrease or maintain at same level) of the wildlife species or habitat that will be attained over a fixed time-period (for example: increase the population of tigers by 50% over the next 10 years).

DEVELOPING A MONITORING FRAMEWORK: Monitoring Objectives

Threats: how much will the threat be reduced over a certain time-period

(*E.g. to reduce by 90 percent incidents of illegal hunting inside the park over the next 5 years).*

Conservation interventions: Was a planned intervention implemented over a certain time period (for example: to establish 10 guard posts along the boundary of the park over the next 5 years).

Monitoring Framework

Component of Conceptual Model	Landscape Species	Objective	Method	Indicator	Who	Comments
Conservation Target	Tiger	To raise the population of Tiger by 20% over 5 years	Camera trapping	Patch occupancy – area used	2 Camera trap teams	Density; # of individual/km2; in the future after populations increase
Conservation Target	Southern Serow	To raise the population of the Southern Serow by 50% over five years	Camera trapping	Patch occupancy – area used	2 Camera trap teams	
Conservation Target	Eurasian Wild Pig	To raise the population of the Eurasian Wild Pig by 100% over five years	Camera trapping	Patch occupancy – area used	2 Camera trap teams	
Conservation Target	White-cheeked Crested Gibbon	To raise the population of the White-cheeked Crested Gibbon by 10% over five years	Dry Season forest transects	Patch occupancy – area used	4 Forest transect teams	Density; # of individual/km2; in the future after populations increase
Conservation Target	Great Hornbill	To raise the population of the Great Hornbill by 35% over five years	Dry Season forest transects	Patch occupancy – area used	4 Forest transect teams	Density; # of individual/km2; in the future after populations increase
Conservation Target	Asian Elephant	To have no decline in the population of Asian Elephant over five years	Fecal DNA capture-recapture	Density: # of individuals/km2	To be determined	To be initiated in 2009

Monitoring Objectives

IMPACT ORIENTED: representing a change in desired condition or state

MEASURABLE: against a baseline or along a standard scale

TIME-BOUND: achievable within a specific period of time

Monitoring Objectives: Nam Kading NPA, Lao PDR

Monitoring Objective 1 (Conservation Target)

By 2010, increase the Great Hornbill population by 35% inside the Nam Kading NPA.

Monitoring Objective 2 (Direct Threat)

By 2010, stop all habitat loss due to shifting cultivation inside the Nam Kading NPA.

Monitoring Objective 3 (Intervention)

By 2010, complete land allocation zoning in all villages bordering the Nam Kading NPA.

INDICATORS

An **indicator** is a variable or parameter that will be measured over time in order to determine if the project is making progress towards the quantitative objective.

One or more indicators for every monitoring objective.

INDICATORS

Measurable: (either qualitative or quantitative)

Precisely defined: E.g. No. of white-handed gibbon groups per hectare of primary forest or Densities (nesting pairs/km^2 of hornbills in the TPZ).

Consistent over time: Observed effects should be due to changes in the actual condition, not to changes in the indicator. (Proxy indicators)

Sensitive: A sensitive indicator will change proportionately and in the same direction as changes in the condition or item being measured. (Proxy indicators)

PROXY INDICATORS

Proxy indicators are used as a substitute for an indicator that cannot be directly measured or assessed.

E.g. in families that invest their wealth in livestock such as cows and goats, the number of cows and goats can serve as a proxy indicator for household wealth.

For local livelihoods – it is difficult to measure actual household income, so we can measure the types of items that money is spent on and that represent increasing wealth, [e.g. construction type of house]

For hunting - it is almost impossible to measure the number of animals hunted each year, so we typically use a proxy or indirect measure of the prevalence of weapons or people used to hunt animals with (for example number of guns or snares confiscated or number of poachers arrested).

Examples of indicators

For Conservation Targets:

Density of bamboo species (clumps/ha) or Density of Tigers per 100 km^2 of park

For Threats:

Number of illegal poaching incidents recorded per sq.km of patrolling per person per day) or area of forest cleared for shifting cultivation over a 6 month period

For Interventions:

Number of guard posts established over a 6 month period or km^2 of patrols conducted within the NPA.

Monitoring methods

For every indicator, we need to identify at least one **monitoring method**.

Criteria for selection of monitoring methods

Will the method provide accurate and reliable results?

Is the method cost-effective in terms of resource investment? Are there cheaper ways of getting the same data?

Is the method feasible? i.e Does the project team have people who can use the method?

Examples of Indicators and Methods

***Conservation Target*:** Area of primary forest in a National Protected Area (NPA)

***Indicator 1*:** Area in hectares of forest in the core zone of the NPA

***Potential Monitoring Method 1*:** Work with community members to develop sketch maps of the forest habitat in the reserve

***Potential Monitoring Method 2*:** Use a Global Positioning System and aerial photography to collect coordinates of forest areas which will be entered into a computer-based GIS.

Monitoring Framework

Conceptual Model Component	Monitoring Objective	Indicator	Monitoring Method
Conservation Target:			
Threats:			
Conservation Intervention:			

Monitoring Approaches

Comparison of a group affected by project to itself over time

A. pre-test/post-test monitoring design*: This* involves measuring a group before intervention to establish a baseline, and then re-measuring the group after intervention.

Example
Objective: By the end of 3 years, all households will use one-third less wildmeat (measured in kg per month) than they did at the start of the project

Intervention: Providing alternative sources of protein to households in the form of small loans to purchase livestock.

Monitoring Strategy: Compare the amount of wildmeat in the diet of households at the start of the project to the amount of wildlife used at the end of the project.

Monitoring Method: Project staff to conduct households surveys to determine wildmeat in diets during the first month of the project and a similar survey with the same group of households in the final year of the 3-year project.

Monitoring Approaches

B. ***Time-series Monitoring Design:*** Involves collecting data multiple times before and after project intervention to compare a group of units to itself over time

Example

Objective: By the end of the third year, there are no incidences of poaching of legally protected species within the core zone of the park.

Intervention: The project team will conduct meetings, awareness campaigns to educate people on protected species and consequences of illegally hunting protected species and conduct routine patrols to record illegal poaching.

Monitoring Strategy: Compare the number of recorded cases of illegal poaching of protected species over time.
Monitoring Method: The project team to record the number of illegally poached wildlife during weekly patrol surveys

The Counterfactual Approach

Comparison of a group affected by your project to a group not affected by your project over time.

This comparison involves measuring how a given factor changes in a group affected by the project relative to a similar group that is not influenced by the project. This type of comparison -

-Can help establish causal relationships

-What would happen if we had not intervened?

For example, in the Nam Kading NPA the staff measured and compared changes in villager knowledge and attitudes towards Great Hornbill conservation over time in villages that received conservation outreach programs (non-control group) and in villages that had not received the outreach programs (control group).

Identifying the actors and funding sources

Who (individual or institution) will be responsible for gathering the information?

Example:
NPA biological monitoring staff -- camera trap surveys of tigers
University student -- data on the density of rattans per sq. km of forest in the core zone.

What is the funding source for each method?

For example:
The monitoring done by the NPA biological monitoring staff could be funded through the project.

Planning a Schedule

How frequently will camera traps be laid out in the forest?

For how many days at a time?

Seasonality is important!

[Hunting could be an activity pursued by farmers during the non-agricultural season rather than the agricultural season when they are busy planting their crops]

Monitoring Framework

Component Type	Component Description	Monitoring Objective	Indicator	Monitoring Method	Who
Conservation target	Elephant populations	Maintain the current population of elephants	Elephant density per km^2	Dung surveys	Nam Kading Park Staff

Putting in place appropriate data management and processing systems

Road Block, Restaurant, and Market Form

Date 20 Nov 2007 **Location** B. Donkoun **Patrol Types** Road block **UTM-E** 222222222

Team ID. VKMB **Team Leader** Vongxay **Reporter** Vongxay **UTM-N** 55555555

Run No	Time	Observation	Obs Type	Total	Random/ suspect check	Vehicles No/ Village names	Comments
1	7:30	Position	Start				
2	8:30	Check	Motorbike	1	Random	ທ້າວ ກຄ 2233	
3	8:30	Trade	Wildlife	1	Random	ຫ້ອງແຍກ ກຂ 0001	See Obs form
4	10:15	Trade	NTFP	1	Random	ທ້າວ ກກ 4400	See Obs form
5	11:45	Position	Rest				
6	12:15	Position	Re-start				
7	15:00	Check	Truck	1	Random	ກ້ານໝາ ຄຄ 8877	
8	15:38	Trade	Logging	1	Random	ທ້າວ ຂຄ 0123	See Obs form
9	16:09	Check	People			B. Sakok	
10	17:00	Position	End				

OBSERVATIONS:

Human activity: Trade

Position: **(1).** Position and **(2).** Check

OBSERVATION TYPES:

TYPE found: Wildlife, Wood, and NTFP

Position Types: **(1).** Start, Rest, Re-start, End and **(2).** People, Motorbike, Car, Truck

Closing the loop - communicating the results

Data Analysis:

***Describing the data*.**

Testing Hypothesis about data

Communicating Results

Types of communication tools:

Oral presentations, discussion sessions, informal meetings,

Important to get monitoring results and analysis back to managers in a timely fashion in order to effect changes in management approaches as quickly as possible.

Conflicts between scientific ideals and practical realities of monitoring

Monitoring : Spatially and temporally comprehensive
Rigorous in treatment of sampling error
Sustainable over the time-scales necessary

Monitoring is:

- Costly
- Logistically and technically difficult
- Perceived as irrelevant by managers and local communities

Hence, invest in Monitoring or in Interventions?

Criteria for good design, implementation and management of a monitoring program

I. Why monitor?

Identify flexible goals and clear objectives for monitoring

- Ensure objectives are responsive to management needs

- Ensure objectives are developed in a participatory manner with the relevant stakeholders

- Clearly state the time-frame for the monitoring program and the time expected to see results

Criteria for good design, implementation and management of a monitoring program

II. What should be monitored?

Identify the variable(s) to be measured and ensure they meet the following criteria:

- **Relevant to management**
- **Scientifically defensible and biologically representative**
- **Statistically powerful and interpretable**
- **Measurable and feasible**
- **Easily understood**

Identify your target population

- **Define the scale at which you need to monitor and the scale at which you will infer your results**

Criteria for good design, implementation and management of a monitoring program

III. How to monitor?

1. Develop formal collaborations with statisticians and scientists in developing monitoring protocols
2. Develop monitoring methods and data collection protocols
    - Address sampling bias in selection of sites to be monitored
    - Address detection error in sampling design
    - Ensure minimum sample sizes and sampling effort required to achieve objectives
    - Ensure adequate precision of estimates to permit detection of change over time
3. Solicit feedback and review of monitoring protocols from experts
4. Assess and evaluate if the methods are the most cost-effective to address your monitoring objectives

Criteria for good design, implementation and management of a monitoring program

IV. Other important considerations for management and implementation

1. Identify the person/persons responsible for implementation
   Ensure adequate personnel, skills and training are available for implementation and data analysis
2. Secure adequate funding for the duration of the monitoring program, including design, implementation, analysis and communication of information
3. Ensure an information management system is in place for managing and communicating monitoring data
4. Ensure that monitoring objectives, methods, key assumptions and data recording protocols are carefully documented and accessible by all stakeholders

Monitoring Framework

Component of Conceptual Model	Landscape Species	Objective	Method	Indicator	Who	Comments
Conservation Target	Tiger	To raise the population of Tiger by 20% over five years	Camera trapping	Patch occupancy - area used	2 Camera trap teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Southern Serow	To raise the population of Southern Serow by 50% over five years	Camera trapping	Patch occupancy - area occupied	2 Camera trap teams	
Conservation Target	Eurasian Wild Pig	To raise the population of Eurasian Wild Pig by 100% over five years	Camera trapping	Patch occupancy - area used	2 Camera trap teams	
Conservation Target	White-cheeked Crested Gibbon	To raise the population of White-Cheeked Crested Gibbon by 10% over five years	Dry season forest transects	Patch occupancy - area occupied	4 Forest transect teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Great Hornbill	To raise the population of Great Hornbill by 35% over five years	Dry season forest transects	Patch occupancy - area used	4 Forest transect teams	Density; # of individuals/km2 ; in the future after populations increase
Conservation Target	Asian Elephant	To have no decline in the population of Asian Elephant over five years	Fecal DNA capture-recapture	Density; # of individuals/km2	To be determined	To be initiated in 2009