

STEPS IN THE PROCESS OF ADAPTIVE MANAGEMENT

ADAPTIVE MANAGEMENT INCORPORATES research into conservation action. At its core, adaptive management involves the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

In a conservation project context, adaptive management is about systematically trying different actions to achieve a desired outcome. It is not, however, a random trial-and-error process. Instead, it involves several specific steps described below and in the adaptive management cycle diagram in Figure 2:

- START: Establish a Clear and Common Purpose
- STEP A: Design an Explicit Model of Your System
- STEP B: Develop a Management Plan that Maximizes Results and Learning
- STEP C: Develop a Monitoring Plan to Test Your Assumptions
- STEP D: Implement Your Management and Monitoring Plans
- STEP E: Analyze Data and Communicate Results
- ITERATE: Use Results to Adapt and Learn

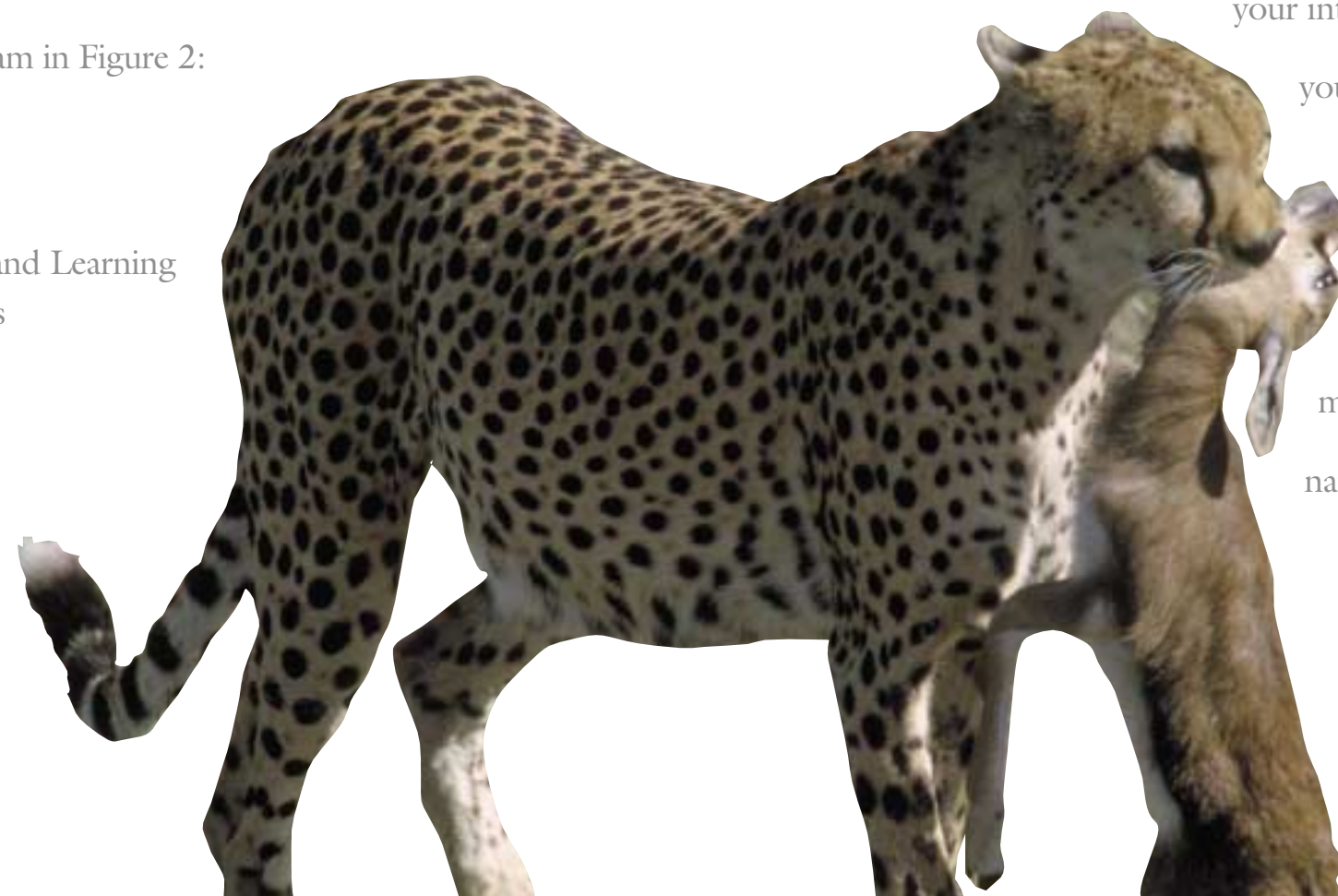
In this section, we go through the various steps in this cycle. For each step, we first define what it means in the

context of conservation projects. We then turn to our theoretical and practical sources to illustrate why this step is important.

As we will see later, a key premise of this cycle is that adaptive management must be carried out by the same people who are responsible for project design and implementation. In other words, adaptive management must be done by your project team. It cannot be left solely to either outside experts that are not involved in project management or to a special research team that is solely charged with looking impassively at the potential project outcomes while the rest of the team sits around waiting for their results. You and your colleagues are the researchers — you are responsible for testing your own assumptions.

Trained scientists can help you answer some questions about the effectiveness of

your interventions, but the questions you ask and the answers you get must be relevant to your ability to ultimately adapt and learn. It is up to you to make adaptive management a natural part of the project process.

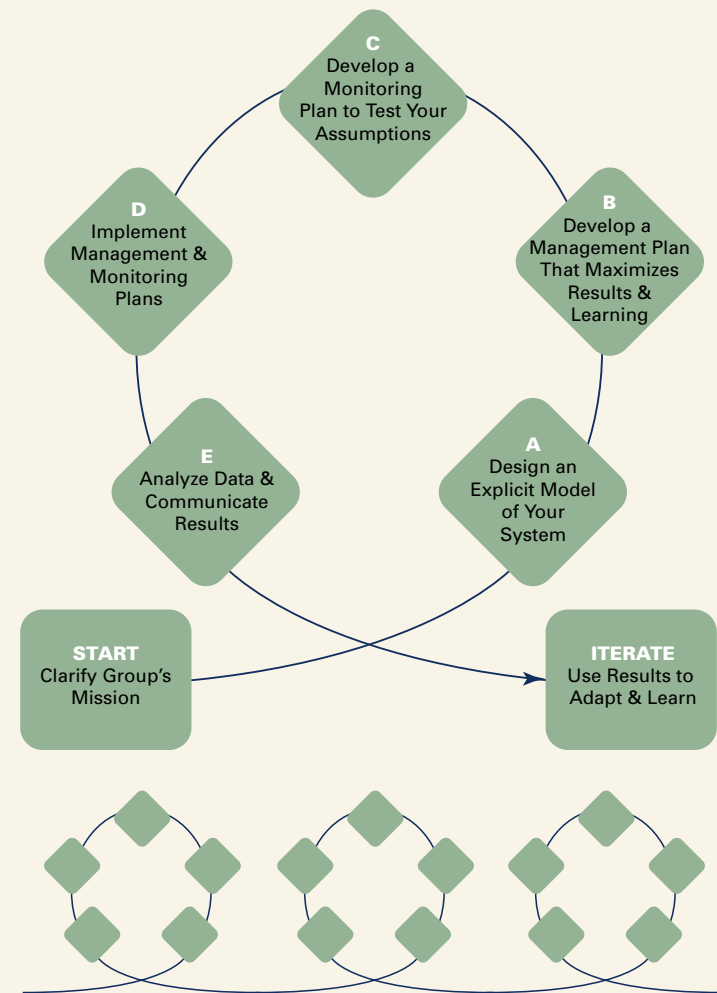


START: Establish a Clear and Common Purpose

The starting point for adaptive management involves clearly defining what it is you are trying to achieve with your project. If you don't know where you want to go, chances are you won't get there. Once you are clear about what the purpose of your project is, you can then determine how you are going to get there — what intermediate steps along the way you must take. Establishing a clear purpose enables you to develop a benchmark for measuring success. Establishing a common purpose enables you to develop effective collaboration among the different members of your project team.

As outlined in *Measures of Success*, to establish a purpose or vision for your project, you need to first determine, broadly speaking, what the mission of your project or organization is.³⁶ Are you primarily interested in forest conservation? In developing the economic welfare of the local community? In improving the health standards in the region? To be effective, you and the members of your project team must agree on a common mission. Furthermore, you must also negotiate a common vision with the other groups

FIGURE 2. The Adaptive Management Cycle



The starting point of the cycle involves determining who will participate in your project and what your overall mission is. Once this is clear, Step A involves assessing the conditions and determining the major threats to biodiversity at your project site. Using a **conceptual model**, your project team defines the conditions and relationships between key factors at your project site. Step B involves using this model to develop a project **management plan** that outlines the results that your team would like to accomplish and the specific actions that your team will undertake to reach them. Step C involves developing a **monitoring plan** for assessing your progress in implementing the project. Step D involves implementing your actions and monitoring plan. Step E involves analyzing the data collected during your monitoring efforts and communicating the information that you obtain to the appropriate audiences. Finally, you use the results of this analysis to change the project and learn how to do projects better in the future. Based on feedback information, you may want to modify your conceptual model, management plan, or monitoring plan.

Source: Adapted from Margoluis & Salafsky 1998.

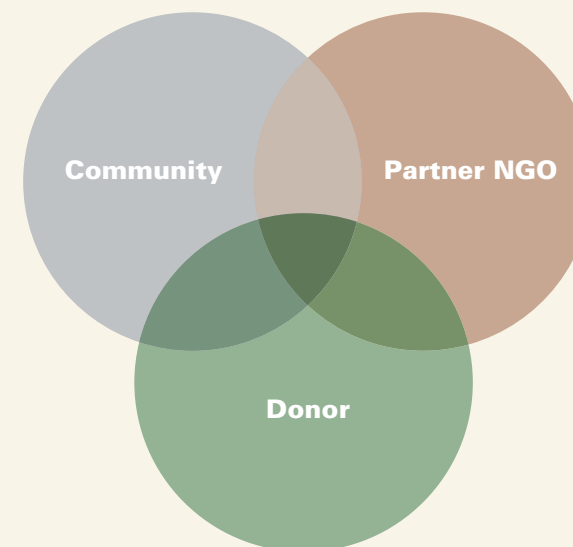
that you will be working with. As shown in Figure 3, it's okay if you and the other groups working together have different missions, as long as you can agree on a common vision for the project.

Once you have established your broad mission, you then need to determine the *target condition* for your project. A target condition is the specific state of the world that you want to focus on. For a conservation project, this target condition might be, for example, “the forest in a certain area” or it might be “the marine resources used by residents of a village.” Next, you transform your target condition into a clear operational *goal* for your project. To do so, you need to think about what changes to this target condition you would like to either see happen or prevent. In the examples above, these changes might be “to conserve the forest” or to “promote sustainable use of the marine resources.” Finally, you need to make sure that your project partners have a similar goal.

Create a Benchmark for Measuring Success

Establishing a clear vision gives your project meaning by defining a clear destination that you are trying to reach. Establishing a clear goal provides your project with a marker that you can use to measure your success in reaching this vision. Ultimately, effective adaptive management requires knowing both where you are today, and where you want to be tomorrow. As you work toward your goal, you can gauge the extent to which you are achieving it and can then adjust your actions to optimize your realization of this goal. Without a goal, you have no standard against which you can compare progress and no device for measuring progress. Without a clearly defined goal, anyone managing a project can claim success at any time by merely saying at the end that whatever was achieved was the desired outcome. By being clear about your goal at the beginning of a project you are placing a stake in the sand, making your intentions clear, and defining in advance what constitutes success. You are providing yourself the means to measure your own progress.

FIGURE 3. Groups With Different Missions Can Implement a Joint Project



Source: Adapted from Margoluis & Salafsky 1998.

The theoretical sources that we reviewed emphasize the need to be clear about what you want to achieve. Pirsig states that the first step in the scientific process is to “state what condition you would like to change or affect.”³⁷ Similarly, Schön states that problem solving starts with “problem setting, the process by which we define the decision to be made, the ends to be achieved, the means which may be chosen.”³⁸ And Senge states that developing a successful learning organization depends on integrating two visions: 1) An idealistic vision of the future that clarifies what is important to us and helps us know what we really want to achieve, and 2) An honest and accurate vision of current reality that tells us where we really are relative to what we want to achieve.³⁹

Many of the project teams that we spoke with also agreed that establishing clear goals is important to provide a framework for measuring success. Dale Lewis of the ZAMBIA ADMADE PROJECT described how ADMADE is very good at measuring the effects of its program. “For us, data collection is very much focused on the dependent variable such as species diversity and population numbers of key species.” In a similar fashion, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how they use the numbers of key animals as the measure of their success. In this case, since it can be hard to count animals directly, they can “monitor behavior of animals as a proxy for animal ‘health.’”

Promote Informed Collaboration

Establishing a clear goal also helps ensure that the different members of your project team understand and agree on a common end. This step is particularly important to projects that have multiple partners and that seek to address both conservation and development issues. If one group is primarily interested in conservation and the other is primarily interested in development, then unless this difference is clearly understood at the start, it will likely lead to conflict later on. These conflicts will lead to decreased efficiency in project implementation and a higher likelihood that nothing lasting will be achieved. However, groups that have different missions can work together — as long as they are clear about what their specific goal is in working together and how they might complement one another in the context of the project.

The theoretical sources we reviewed agree that clarity about what you want to achieve is also essential to team cohesion. If all team members know what it is they are working towards, then there is a higher likelihood that they will all work together. As Senge writes regarding his discipline of Shared Vision, “One is hard pressed to think of any organization that has sustained some measure of greatness in the absence of goals, values, and missions that become deeply shared throughout the organization.”⁴⁰

In our discussions with the project teams, we learned that adaptive management is not a tool for deciding what the broad goal of your project should be. Instead, it can only be effectively used once you and your partners have determined what your goal should be. As Brian Nyberg of the BC FORESTRY INITIATIVE said:

It is vital that before you begin, everyone understands what is on the table and what is not. Before you can start working on an adaptive management design for a project on a given piece of land, you must decide what the values are to which the land is going to be dedicated. Anyone who came to the meeting had to decide, for example, that forestry would be pursued on part of the land base. The decision to allocate the land to forestry had already been made and those who wished it could all be a park were not involved. You have to have limited the option space.

Brian went on to say, “You need to spend time before workshops making sure that the common purpose is agreed upon. Adaptive management is much more effective if you know what you’re trying to achieve.” In a similar fashion, Dale Lewis of the ZAMBIA ADMADE PROJECT said, “It is very important for everyone to have a very good understanding of ‘why’ we do things and how we learn. We do this as a team, we discuss everything, to ensure we are all working for a common goal.”

The project teams also discussed at great length the problems they faced because of conflicting goals among different stakeholders. Dale Lewis of the ZAMBIA ADMADE PROJECT described how many of the challenges that they encountered occurred because “if you were to ask everyone what ADMADE is about, not everyone has the same understanding of the goals of ADMADE...at the institutional level, ADMADE is about conservation. At the community level, however, ADMADE is about development to meet the needs of local people.” John Ericho and Robert Bino of the PNG PROJECT agreed, saying that although the project was set up to achieve conservation goals, the local community is more interested in development. As a result, there has been a great deal of confusion that has hindered the project. It even led to a situation where, as John said, “the villagers in Crater got together and some hot heads said ‘these guys have been here for five years and they haven’t done anything so let’s kick them out.’” To deal with this problem, they had to develop “Two sets of objectives — one set of objectives for conservation and one set for development. We need to work together because they have the forest and we want the forest. So we had to sit down with them and help provide the services that they want.”

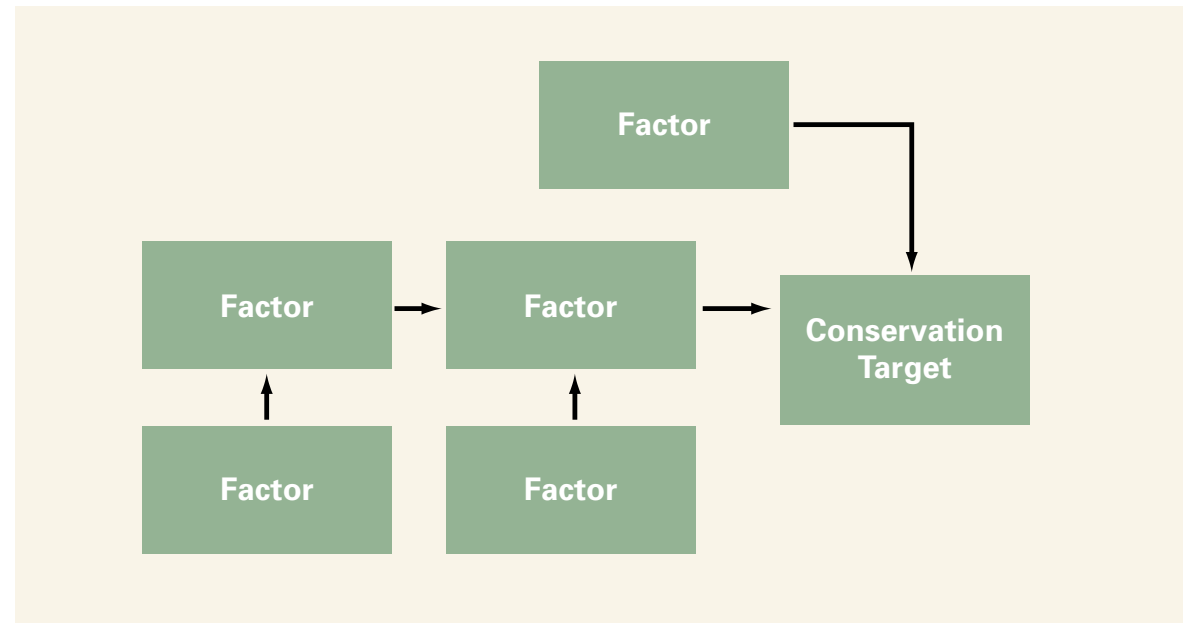
STEP A: Design an Explicit Model of Your System

Once you have set your broad goal, the next step in adaptive management involves developing a shared understanding of the conditions at the site where you are working. Most conservation projects take place in incredibly complex situations. Project managers have to understand the complicated ecosystems that they are working in. If this were not enough, they also have to understand the cultural, social, economic, and political systems that influence the behavior of the many stakeholders at the project site. And all of these different ecological and human factors interact with one another in dynamic and unpredictable ways.

Getting an understanding of the system is typically done through the development of a *model*. Models are simplified versions of reality. They are important for a number of reasons. They help you to organize information. They provide you with a framework for comparing alternative courses of action. They provide an intellectual paper trail that lets you see what the chain of logic was behind a given action. And finally, they provide a vehicle for members of your team to work out a shared view of what is being managed and how the management should be done.

There are many ways of representing key factors, conditions, and relationships that influence biodiversity conservation at a given project site. In our book *Measures of Success*, we outline one process for constructing a conceptual model of your project site. A conceptual model is a diagram of a set of relationships between certain factors that are believed to impact or lead to your target conservation.⁴¹ A good conceptual model presents a

picture of the situation at your project site, showing the assumed linkages between the various direct and indirect threats that affect your conservation target. In abstract form, an initial conceptual model for a conservation and development project looks like:



Collect Relevant Information and Compare Alternative Courses of Action

A good model enables your team to lay out what you think is happening at the project site — it provides a place to collect your team’s current knowledge of the existing conditions. Your model should be based on all available information including secondary sources, government records, and most importantly, a thorough needs assessment conducted with the stakeholders at your project site. Once you have collected this information, the model can then help you determine appropriate interventions.

The theoretical sources that we reviewed all talk about the need to develop a formal model of the system that you are working in. For example, a key discipline of Senge’s involves using “mental models” that determine not only “how we make sense of the world, but how we take action.”⁴² He even goes as far as to propose computer-based ‘microworlds’ that business managers can use as “settings for both crafting visions and experimenting with a broad range of strategies and policies for achieving those visions.”⁴³ Schön talks about how ‘problem solving’ begins with using models to do ‘problem setting,’ saying that:

*In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense.*⁴⁴

Lee states that models help to organize information, saying “the usual experience with ecosystem data is that there is not enough to define the biology with any confidence, but far too much for a single human mind to assimilate. Models are indispensable simply to do routine bookkeeping on large quantities of data.”⁴⁵ Lee also states that once a model has been constructed, it can be used by a manager to compare the potential impact of different policies by testing simulated “what-if” scenarios to test the structure of assumptions built into the model.⁴⁶ And finally, Argyris and Schön start their discussion of learning organizations by asserting that “all deliberate action has a cognitive basis that reflects the norms, strategies, and assumptions or models of the world” of the individual or group undertaking the action. This basis is the group or individual’s *theory of action*. They go on to use mathematical language to describe how this theory functions saying that this theory of action is basically a guide for the problem: “In situation S, if you want to achieve consequence C, under assumptions *a...n*, then take action A.”⁴⁷

The practitioners that we spoke with described finding extensive information about their project site and using models to help them sort it out. For example, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how when his project started, they invested in reviewing the secondary data and literature available on Kafue to learn about the area and ended up with a great deal of information. They then started using a problem tree methodology to sort out the information that had been collected. Likewise, Norm Bilodeau of the BC FORESTRY INITIATIVE said:

It is important to recognize that a model is only a representation of reality and as such is only useful as a guide. All models are to some degree wrong, otherwise they would not be models. However, models when created and used in a realistic fashion, actually act like an “organizer.” They gather complex and wide ranging information and process so that it is more tangible. More specifically they allow us to consider the interrelationships that are impossible for us to fully grasp at a discrete moment of time.

Likewise, Brian Nyberg of the BC FORESTRY INITIATIVE described why it was critical to use a model to develop a management plan for 40,000 hectares of forest, saying that, “The need for a model becomes much greater to simply explore all the complications associated with that large an area over a long time frame. Nobody can wrap their mind around it, so we are trying to spend much more time on the modeling aspects of the ecosystem management.”

Create a Framework for Learning

A good model also enables your team to predict the positive and negative impacts of your activities. These predictions will provide the foundation for learning later on. Once your activities are implemented, you can then go back to your model and see if your assumptions were correct. You can thus use your model as a foundation for learning as you move through the project cycle.

All of the theoretical sources that we reviewed highlight the importance of using a model to make predictions that can be checked over time. For example, Pirsig states that a key step in the scientific method is to use your understanding of the system to predict what will happen once you undertake an experiment.⁴⁸ Lee states that a model provides “an intellectual paper trail” that provides “a way of understanding the chain of reasoning that

leads from database to output.” He goes on to say that constructing a model is “crucial if learning is to be possible: without an understanding of how one’s model of reality works, it is impossible to go back and improve that understanding when reality fails to agree with prediction.”⁴⁹

Some of the practitioners that we spoke with had developed explicit models of their projects. These projects found their models to be very helpful in creating a record of their own thinking. For example, John Ericho of the PNG PROJECT said, “I think for me and Robert, it has been very helpful to go through this process of writing a conceptual model and then coming back and having a look at it as the project goes on.” Brian Nyberg of the BC FORESTRY INITIATIVE also mentioned that models are important to help new personnel understand what is occurring and to create a “legacy of knowledge.” He said:

If we’re talking about some sort of experimental program that requires tending over a period of decades or more, you can count on there being many changes of the personnel involved in the program. So how do you make sure each successive manager is able to understand what has gone on beforehand? A simple model makes it easy for someone to pick it up and say, “This is what they were thinking.”

The operative word here seems to be “simple.” Several of the practitioners that we spoke with described that if models were too complex, they became useless or even counter-productive. For example, Brian Nyberg of the BC FORESTRY INITIATIVE said that on occasions, he became very frustrated with complex computer models. He described being involved in creating an elaborate simulation model that looked at the relationship between deer and elk and their habitats in coastal forests. He said, “It looked very neat and tidy,” on the screen, but “these simulation programs never worked in the real world. We poured in all this money and time and effort, and people stayed up all night and my conclusion at the end was that it told us essentially what we already knew before we started. The model gave very precise and unreliable predictions based on very imprecise knowledge of the modeled system.” He goes on to conclude that the key for us is to “simplify the mathematically focused adaptive management stuff that’s in the literature — you have to ensure that whatever is produced gets used.”

Synthesize Different Perspectives

Another important reason for creating a model of your site is that it enables people to make their different perspectives explicit and to then work out a shared understanding. People often seem to believe that other people see the world in more or less the same way that they do. If you ask a diverse group of stakeholders to develop a model of a given site, they will often act offended and claim that it will be easy to do. Many hours later, however, they are still there at the table, arguing about what causes what and what factors are most important.

The theoretical sources that we reviewed support the importance of using a model to create a common understanding of the situation in the system where you are working. As Lee says:

*The process of building a model is a way of working out a shared view of what is being managed and how the managing should be done. Often that process is conducted by a diverse group of people drawn from different organizations, some of them organizations with conflicting interests...when this happens, model building becomes a way of negotiating.*⁵⁰

In a similar fashion, Senge proposes using models to “make your reasoning explicit and encourage others to explore your views...and provide different views.” He goes on to say:

*Our mental models determine not only how we make sense of the world, but how we take action...Why are mental models so powerful in affecting what we do? In part, because they affect what we see. Two people with different mental models can observe the same event and describe it differently, because they’ve looked at different details. When you and I walk into a crowded party, we both take in the same basic sensory data, but we pick out different faces. As psychologists say, we observe selectively. This is no less true for supposedly “objective” observers such as scientists than for people in general. As Albert Einstein once wrote: “Our theories determine what we measure.”*⁵¹

And in a similar fashion, Argyris and Schön state:

*When the task is large and complex, most members are unable to use face-to-face contact in order to compare and adjust their several images of organizational theory-in-use. They require external references. There must be public representations of organizational theory-in-use to which individuals can refer. This is the function of organizational maps. These are the shared descriptions of organization which individuals jointly construct and use to guide their own inquiry. They include, for example, diagrams of work flow, compensation charts, statements of procedure, even the schematic drawings of office space...they describe actual patterns of activity, and they are guides to future action.*⁵²

Many of the practitioners that we spoke with agreed that models were useful for bringing different perspectives together. Brian Nyberg of the BC FORESTRY INITIATIVE said that, “Many of the people who come to our meetings already have a common model of how they think things work. The more heterogeneous the group, the more important the jointly-developed model.” He went on to say that the nature of the model is not important, but that, “What is important is that people have a common understanding of their assumptions, be it a model or boxes and arrows, or literally pictures. It is crucial to have a model that everyone understands.” Other practitioners that we interviewed had not necessarily developed explicit models of their project. But these practitioners agreed that they had at least implicit models. For example, Dale Lewis of the ZAMBIA ADMADRE PROJECT said, “there is a shared model that is implicit in every key person’s mind — a kind of internal conceptual model.” Furthermore, in talking about the problem of getting new project staff to understand the vision, Lewis said, “Boy it would be great to have something like that.”

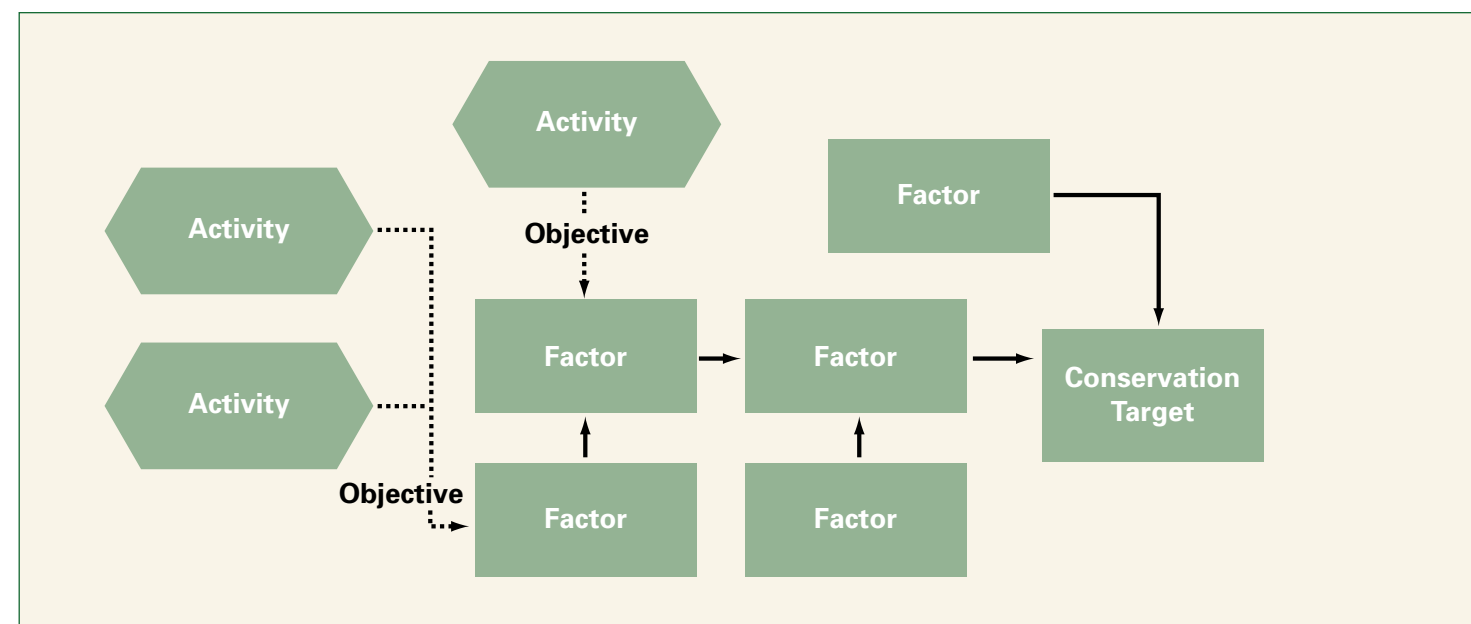
STEP B: Develop a Management Plan That Maximizes Results and Learning

After you have developed a model of your site, the next step in adaptive management involves figuring out what actions you are going to take. If you were starting your project with this step, trying to figure out what actions to take would undoubtedly be an overwhelming process. In any given system, there are generally hundreds if not thousands of different things you can do. Despite the wealth of options, you only have limited staff, limited money, and limited time. You can’t do everything. Furthermore, you will probably be unsure what a given action will produce. So how do you decide what to do? In some of the worst cases, practitioners seem to just try

different actions more or less blindly, hoping that they will work. At the other extreme, some practitioners seem to have settled on a small subset of actions — like environmental education, sustainable agriculture, or strict protection — that they believe will necessarily lead to conservation in all situations. Not surprisingly, the results of these interventions are usually mixed at best.

However, if you’ve developed a conceptual model of your project site that shows your target condition and the threats to it and other factors that affect it, then you are in a much better position to figure out what steps to take. The key here is to develop a *project management plan* that outlines the factors that you want to affect and the specific actions that you will undertake to change them. Instead of focusing on the actions that you will ultimately take, first think about the specific results that you want to achieve and then base your selection of activities on how best to achieve them. By doing so, you can maximize your potential to leverage change on the system with the resources you have. You can also set up experiments that will help you learn which actions work and which do not. And finally, you can make more informed decisions as to how to balance the risks of action and inaction.

Developing a management plan starts by ranking the various threats that you have identified in your model and deciding which are causing the biggest problems and which are most easily addressed. Once you have selected which threats you think you might want to address, you then use your model to determine which factors linked to those threats you might be able to change to thus change the threat. After selecting a factor that you think you can affect, the next step is to develop a specific *objective* for that factor. As outlined in *Measures of Success*, objectives are specific statements detailing the desired accomplishments or outcomes of a project in relation to specific factors.⁵³ Once you have developed the specific objectives that you want to accomplish, the next step is to develop the activities that will enable you to accomplish this objective. Activities are specific actions undertaken by project staff to reach each of the project’s objectives.⁵⁴ The key to the management plan is that each objective is targeted at a specific factor in the model that is linked to the target condition. If the theory is correct, completing all of the activities will enable the project to meet its objectives and ultimately change the target condition. In simplified form, a final conceptual model that includes activities and objectives looks like:



Maximize Leverage

Using your model to select your actions can help your team to figure out which threats you need to address. It also enables you to figure out how to most effectively use your resources to counter these threats. Ideally, it will let you determine how you think that you can get the most impact on the system for the least effort. Perhaps even more importantly, you can also use your conceptual model to decide what actions you are not going to take. For example, if your model shows that using a certain tool is not going to impact the key threat factor or is not going to have sufficient impact, then you don’t want to be wasting your project’s money and time using that tool.

The theoretical sources that we reviewed underscore that too often managers seem to make decisions in an unsystematic fashion. As Senge writes:

Many American managers are too busy running to “think on their feet.” Even when there is ample time for reflection and the facility for retrieving all manner of relevant information...most managers do not reflect carefully on their actions. Typically managers...adopt a strategy, then as soon as the strategy starts to run into problems, they switch to another strategy, then to another and another...managers may run through three to six different strategies, without once examining why a strategy seems to be failing or articulating specifically what they hope to accomplish through a change in strategy. Apparently, the “ready, fire, aim” atmosphere of American corporations has been fully assimilated and internalized by those who live in that atmosphere.⁵⁵

To counter this problem, the sources we reviewed emphasized the need to select actions based on your model. For example, Argyris and Schön discuss how one of the most important parts of the planning process is to figure out what you are going to do, saying that all groups need three maps:

The first is a map of where the organization is; the second is a map of where it wishes to go; the third is a map of how to get from here to there. Without the third map, knowing where you are may be interesting, but not helpful for change; knowing where you would like to go becomes an exercise in abstractions; and knowing only both can lead to frustration and a sense of helplessness.⁵⁶

Most of the sources also discuss how it is important to select these actions in a systematic fashion to maximize your impact on the system. Senge emphasizes that small, well-focused actions can sometimes produce significant, enduring improvements, if they’re in the right place. Senge refers to this principle as “leverage” and states that “tackling a difficult problem is often a matter of seeing where the high leverage lies, a change which — with a minimum of effort — would lead to lasting, significant improvement. He goes on to describe how the most effective way to change a system is to “change the behavior of the system...[by] identifying and changing the limiting factor.”⁵⁷ Likewise, Holling and his colleagues realized that although ecosystems are complex, everything is not strongly connected to everything else. Instead, ecosystems are non-uniform over space and time.⁵⁸ As a result, actions changing one part of the system can have dramatic effects on another part of the system. The key is to understand the system well enough so that you know where these high leverage points exist.

Robert Bino of the PNG PROJECT team echoes this concept when he said, “Our conceptual model assists project managers and planners to consider all factors affecting and influencing the project instantaneously and holistically. An important advantage is that an intervention activity that impacts a variety of factors instead of one can be

identified and capitalized on. This benefits the project by reducing the costs of project activities and maximizing the scope and intensity of the leverage.”

For the most part, however, the project teams that we spoke with put a fair amount of thought into deciding what actions to take, but had *not* necessarily been completely systematic in this process. For example, Brenda Taylor of the BC FORESTRY INITIATIVE described how members of their agency went about trying to solve a problem caused by destructive parties that were being held at campsites that they were managing. She said that the team certainly considered various options and responses ranging from hiring on-site supervisors to having police conduct spot-checks to physically “hardening” the site against potential damage. But as she said, “I don’t think we went about it in a systematic way looking at the linkages, but I think we did think about them.” She goes on to describe how they used cost and potential effectiveness as their primary criteria for selecting actions.

Treat Your Actions as Experiments

Although ideally you will be looking for high leverage actions, in most cases it may not be completely clear what the best activity to take might be. This problem typically occurs when your understanding of the situation is not complete or uncertain. In these cases, you will want to at least try one action and make predictions as to what the results will be. If it works, great. If not, however, then you can learn from the results and try something else in the future. You might even want to try implementing two or more different actions to be able to compare them more systematically. Taking action while confronting uncertainty is what adaptive management is all about.

This difficulty in finding the high-leverage actions is perhaps best summed up by Senge who says, “the only problem is that high-leverage changes are usually highly *nonobvious* to most participants in the system.”⁵⁹

Because of this uncertainty, it becomes necessary to experiment through one’s actions. As Schön says, “in the most generic sense, to experiment is to act in order to see where the action leads to.” Holling and his colleagues agree, stating that if a policy is viewed as a hypothesis, then the implementation of that policy becomes the mechanism by which the hypothesis is tested or evaluated. As Lee puts it, “adaptive management is highly advantageous when policy makers face uncertainty.” He goes on to say:

*Because human understanding of nature is imperfect, human interactions with nature should be experimental. Adaptive management applies the concepts of experimentation to the design and implementation of natural resource and environmental policies. An adaptive policy is one that is designed from the outset to test clearly formulated hypotheses about the behavior of an ecosystem being changed by human use...If the policy succeeds, the hypothesis is affirmed. But if the policy fails, an adaptive design still permits learning, so that future decisions can proceed from a better base of understanding.*⁶⁰

To deal with the problem posed by uncertainty, the theoretical sources that we consulted all emphasize the importance of experiments and discuss different types of experiments that can be undertaken. Holling and his colleagues describe two main types of experimentation.⁶¹

- **Passive experimentation** does not involve experimental manipulation of the system being studied. Instead, passive experimentation works best in systems that have a high degree of variation. This variation creates “natural” controlled experiments enabling managers to test the validity of their assumptions without

intervening themselves. For example, a patch of forest being harvested using state-of-the-art methods can be compared to a similar patch of forest that is not being harvested. A major advantage of the passive approach is that it tends to be simpler and cheaper to implement. A disadvantage, however, is that it ignores the uncertainty surrounding the policy and basically assumes that it is correct.

- **Active experimentation**, on the other hand, embraces both uncertainty and deliberately experimental management policies. In pursuing an active experimentation approach, a manager will try multiple strategies to determine which one is most effective. For instance, the forest manager may try several different harvesting options in different sections of the forest. This deliberate experimentation is more expensive to implement. Furthermore, trying multiple policies necessarily means that sub-optimal ones are being tried which will impose a short-term cost in terms of resource output. The pay-off, however, comes in enhancing the long-term learning about the system. Holling and his colleagues emphasize that adaptive management fundamentally involves active experimentation.

There are many ways in which to do active experimentation. Schön identifies several types of experiments that the practitioner can undertake including:

- **Exploratory Experiments** — When action is undertaken only to see what follows, without accompanying predictions or expectations.
- **Move-Testing Experiments** — When action is taken in order to produce intended change.
- **Hypothesis Testing Experiments** — When action is undertaken to discriminate among competing hypotheses.⁶²

Schön states that reflection-in-action involves a combination of all of these types of experimentation, “When the practitioner reflects-in-action...his experimenting is at once exploratory, move testing, and hypothesis testing.”⁶³

The practitioners that we spoke with who were familiar with the theoretical background of adaptive management endorsed the idea of trying something and then learning whether or not it worked — exploratory and move-testing types of experiments. For example, Robert Bino of the PNG PROJECT described how they tried sending local community members on a tour of other areas that had been logged so they could see the effects. As he said, “We didn’t know what it would be like when we went the first time. The result was quite good. As a result, we decided to keep doing the tours to expose other villagers to the effects of logging.” He also described how the project would pilot an activity in one village — for example putting women on the management committee board — and then wait and see if it worked before trying it in all of the villages.

The BC FORESTRY INITIATIVE team members also described a number of move-testing and hypothesis-testing experiments that they had undertaken. For example, Norm Bilodeau and his colleagues described how they were concerned about the effects of logging road bridges on the fish populations of the streams that the bridges were built over. One set of experiments revolved around the testing of “best management practices” to develop road and bridge designs. It involved monitoring sedimentation and water temperature upstream and downstream from bridges, effectively using the bridge crossing as a “point source” to assess the success of different bridge construction and management options. Another set of experiments involved cutting timber on different stands at different densities — removing 30% of the trees on some plots and 60% on others — to see what the effect was on

wildlife using migratory bird nesting and brood success. This experiment generated some interesting results. For example, Norm Bilodeau and Doug Steventon of the BC FORESTRY INITIATIVE described how they found they could generate an increase of up to 185% in available timber supply by instituting a partial cutting regime on at least 50% of a working area because of the way the clearcutting is regulated by legislation. As Steventon put it, “this kind of innovative management flies in the face of convention. It has to be tested on more than one watershed to really know if it’s going to work.”

For the most part, however, the practitioners that we spoke with had not done many hypothesis-testing experiments. In some cases, this was because they hadn’t worked up to it yet. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, “We did not test alternatives, but it would be fascinating. We are just now becoming aware of what actions to apply where — and that these actions are not uniform across the whole area.” In other cases, the practitioners said that they found the idea of formally experimenting and trying alternative courses of action was a hard concept to implement with the stakeholders that they were working with. As Brenda Taylor of the BC FORESTRY INITIATIVE said:

Laying out alternative outcomes and alternative actions is a good idea in theory. It just doesn’t always work out that way when you actually try to do it. People don’t come to these workshops with all the background knowledge of adaptive management and all these mental models of adaptive management that we have. Sometimes, it’s hard even getting them to define objectives and define indicators and define actions for the primary program they are going to do, let alone other actions. I guess I think that it is great to do it — if you can get people to do it, I think it should be done. But, it doesn’t always get done.

Balance the Risks of Action and Inaction

Adaptive managers are somewhere between pure practitioners and pure researchers. A pure practitioner (if such a thing exists) is only interested in taking action to change the world. A pure researcher, on the other hand, is only interested in learning about the world, regardless of what happens to it. An adaptive manager is somewhere between these two endpoints and has to balance the risks of taking the wrong action in the face of uncertainty and the risk of not acting when action is necessary.

The theoretical sources that we reviewed extensively discuss the difference between a traditional “objective and unbiased” researcher and an adaptive manager who seeks to change the world. As Schön writes, unlike the traditional researcher:

- *The practitioner [seeks to] make his hypothesis come true.*
- *The practitioner violates the canon of controlled experiment, which calls for objectivity and distance.*
- *But, although the practitioner seeks to make the situation conform to his hypothesis, he remains open to the possibility that it will not.*⁶⁴

One consequence of this different attitude between researchers and adaptive managers has to do with the amount and type of risk that they are willing to accept. Kai Lee discusses this problem by comparing scientists and fire fighters. A traditional scientist is, in Lee’s words, “an idealist, someone who does not want to claim that something

is true that turns out later to be false.” Scientists strive to avoid what are known as Type I errors — affirming a statement that turns out to be false. For a fire fighter, by contrast, “the cost of responding to a false alarm (making a Type I error) is much less than not responding to a real fire (making a Type II error).” As a result, the fire fighter answers all calls, even if most of them turn out to be false alarms. Lee’s point here is that both conservationists and adaptive managers need to be somewhere between the extremes posed by the scientist and fire fighter. On the one hand, you don’t want to state something as being true when it isn’t. On the other hand, you have to be willing to act in the face of uncertain knowledge — even if it turns out to be false. As Lee points out:

The problem is, we live in a changing world. It is a world in which forces already in play will bring about unwelcome results unless they are channeled or regulated...there is a cost to not acting.

One example of this challenge that Lee goes on to give is determining what policy to pursue to save the California condor from extinction. As Lee states, “The problem is whether to risk a Type II error — allowing the condor to go extinct when it could have been saved — or to chance a Type I error — killing the last condors in an attempt to preserve their kind, when they might have survived unaided.”⁶⁵

The practitioners we interviewed also talked about how being a good adaptive manager requires the ability to stomach some degree of risk in taking action. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT talked about the benefits of taking risks saying:

My father is a stockbroker. He is a gambler. I’m not a gambler. I learned not to gamble. But it is fun to take risks. The key is to use it to push you into the new unknown where there are opportunities for new insights. I look for the intellectual excitement that comes when you’ve learned something new. It is these types of risk that help us to shape our understanding and perception of how ADMADE could evolve.

Likewise, Norm Bilodeau of the BC FORESTRY INITIATIVE described their use of bird nesting and brood success for wildlife monitoring relative to the experimental removal of different densities of timber. “Obviously, the whole premise is that the scoping exercise and the bracketing exercise were used, formulated and implemented in such a way to try to minimize risk to wildlife. But the reality is that I think there is still an underlying risk in our assumptions that we have to embrace, and that is just the way it is. Stuff happens.” In a similar way, John Ericho of the PNG PROJECT described some risks that they took in terms of their different project activities. He said “At some point, we just have to move forward and do what we think is right.”

STEP C: Develop a Monitoring Plan to Test Your Assumptions

Once you have selected the actions you are going to undertake, the next step in adaptive management involves determining how you will monitor the assumptions behind your actions. “Monitoring” and “evaluation” are becoming increasingly common words in conservation projects. Unfortunately, in many conservation projects, people have a hard time figuring out what they should be monitoring. So in many cases project team members start out by trying to monitor a long list of indicators. They send out an army of researchers who collect lots of data that then ends up collecting dust in big piles on office shelves. The project team then gets frustrated and goes back to not monitoring anything.

Many of the problems people have with monitoring result from the fact that they are not clear why they are doing monitoring. There are two primary reasons for monitoring a project. The first is so that you can convince other people that you are doing what you set out to do. This type of monitoring is typically done to satisfy donor requirements or to help your boss or board of directors conduct a performance evaluation. The second is so that you can learn whether your actions are working or not working so that you can take corrective action if needed. From an adaptive management perspective, you should be much more interested in the second reason. You undertake monitoring because you want to see whether you are being effective and to learn how to improve. In particular, adaptive management requires testing explicit *assumptions* about your project and collecting only the data that you need to test these assumptions.

As described in more detail in *Measures of Success*, if you’ve developed a conceptual model of your project site and have selected activities that are focused on key factors, then figuring out what to monitor becomes much easier. In particular, you will want to focus on your key assumptions — the cause-and-effect chains that lead from a certain activity to a factor and ultimately to your conservation target as shown in Figure 4. Identifying information directly related to your assumption is relatively straightforward. To do this, you simply think about what *indicators* you might need to confirm that each link along the chain is or is not occurring. For each indicator, your complete *monitoring plan* will also contain what method you will use to collect data on the indicator, and how, where, and by whom these data will be collected.⁶⁶ In addition to factors related to your key assumptions, you may also need to use your conceptual model to determine what other contextual information you need to collect. The challenge here is to avoid collecting too much data, and instead focus on the critical factors that are most relevant to your project.

FIGURE 4. A Sample Cause-and-Effect Assumption Chain



Make Your Assumptions Explicit

The starting point for monitoring is determining what information you need. The most important data that you will collect are those that will tell you whether your actions are having their desired effect. To this end, you need to make your assumptions explicit. As discussed above in the section on models, too often people seem to think that other people view the problem in the same way as they do. Making your assumptions explicit enables you to be clear about what you are predicting.

The theoretical sources that we reviewed agreed with the need to formally and explicitly state assumptions or hypotheses. A key part of problem setting involves developing your hypotheses, or as Pirsig puts it, formal statements of your assumptions as to what is causing the problem.⁶⁷ This explicit statement is necessary because as Argyris and Schön state, in many cases the theory that organizations or individuals say they have may be different than the theory that they actually use. To this end, Argyris and Schön distinguish between *espoused theory* — that which is stated, and the *theory-in-use* — that which is carried out.⁶⁸ Senge echoes this thought, when he quotes Deming as saying “If we cannot express our assumptions explicitly in ways that others can understand and build upon, there can be no larger process of testing those assumptions and building public knowledge.”⁶⁹

The practitioners that we spoke with agreed that it is important to lay out your assumptions. Perhaps Brian Nyberg of the BC FORESTRY INITIATIVE said it best:

I think it is very important that people have a common understanding of what their assumptions are. However you do that, whether you do it by box and arrow diagrams or whether you actually use the simulation model or whether you just talk about it, whether you draw little graphs or even pictures, there are a bunch of different ways you can get people to represent what their assumptions are. I think it is worthwhile trying to get them to do that because sometimes people don't realize what their own assumptions are until they hear what someone else's are and realize theirs are different.

In a similar fashion, Robert Bino of the PNG PROJECT said:

When assumptions are explicit, project managers get a better sense of the general outcome of the nature of the impacts of their intervention activities. In our project, we get a better picture of local landholder reactions to the level of income earned through the established eco-enterprises. We can then gauge whether their complaints about not receiving enough money are due to actual low income levels or are related to other factors such as the handout mentality that seems to have been cultivated in the community.

In some of the other projects, the practitioners had not formally laid out their assumptions, but were able to state some of them during our conversation. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said, “We do not explicitly lay out assumptions but recognize them internally. We test assumptions intuitively, adaptively.” One specific assumption that Dale mentioned was a belief that they had early on, that clan chiefs would be good role models and leaders for the community. They found over time, however, that this turned out not to be true and had to modify their actions accordingly. Other examples of key assumptions that the ADMADE project identified included:

- By expanding the safari industry, the local economic resource base will improve,
- Economic incentives from safari hunting will be sufficient to make people stop poaching,
- The income that can realistically be derived from safari hunting (which is limited by the nature of the resource) will be of sufficient importance to the community to make them want to manage the wildlife.

Dale was also clear that the main reason for testing these assumptions was to learn whether their actions were working. As he said, “you have to get to cause-and-effect in conservation — that’s the science of it. That’s what drives what we do. We (Nyamaluma) provide the objective analysis of information to make good decisions.”

Some of the people we interviewed also noted that while laying out assumptions was important, in the words of Brian Child of the ZAMBIA SLAMU PROJECT “it takes a long time and is difficult to do.” This problem is particularly evident when as Brenda Taylor of the BC FORESTRY INITIATIVE said:

It comes back to what I said at the beginning about models and how that’s been our weakness — all these steps all kind of relate to each other. If you don’t have your conceptual model with specific assumptions laid out, then you can’t test those assumptions explicitly. Laying out assumptions has been our weak area. It may be because we’ve been trying to get something going on the ground and we didn’t want to get hung up too much on talking about assumptions. Or maybe because it’s hard to get people to understand the ideas in the limited amount of time that we have. Or in some cases because we haven’t needed to — the assumptions have been more or less explicit and we’re dealing with people who haven’t radically disagreed with each other.

Collect Only the Information You Need

Stating your assumptions in a clear fashion will enable you to figure out what data you need to collect to test them. This includes designing the appropriate comparison and selecting the right indicators to measure. In figuring out what indicators to use, you need to keep in mind that having lots of data does not necessarily translate into having good information. In fact, you may find that having lots of data on unrelated topics may actually make it harder to find and use the specific bits of data that you actually need to test your key assumptions.

Pirsig states that the key skill for researchers “consists of using experiments that test only the hypothesis in question, nothing less, nothing more.”⁷⁰ Perhaps not surprisingly, however, the other theoretical sources that we reviewed do not spend a lot of time discussing the practical problem of figuring out how to collect only the data you need. They all seem to assume that data will come if an experiment is well designed.

The practitioners that we consulted with, on the other hand, all felt that determining what data to collect is a major problem. They strongly agreed that as a rule, projects collect too much data. Stephan Forster of the ZAMBIA KANTIPO PROJECT said, “I have seen data collection that is huge — piles of questionnaires filled in by enumerators and that’s it — no analysis, no use of the information — it’s a waste of paper and manpower.” He goes on to say “there is certainly no point developing a log frame filled with indicators that you’re never going to be able to collect, analyze, and use.”

Brenda Taylor of the BC FORESTRY INITIATIVE agreed, saying, “People, especially scientists, they all have their pet things they like to measure, and they all think they need to measure 50 things in order to really understand it, but in order to make a decision sometimes you really only need to measure two.” Her colleague Brian Nyberg echoed this thought when he said:

We have been trying to develop an approach that is replicable in many other settings, in many other groups of people. We’ve been trying to develop examples of what were realistic and feasible approaches to doing things, and because of limited people and limited resources in every case, we knew that we have to keep things very simple. Get the minimum amount of information that is useful for understanding how the system works or for making future decisions, and get only that. And, force people to back away from their preferred option or preferred set of indicators if they couldn’t show how each of them was going to be used to contribute to either understanding or decision. So, we’ve been fairly tough on some people. One scientist who was involved in the discussions about McCully Creek must have taken two or three hours of attack on his proposed indicators before he finally recognized that everybody else was going with only two, so why should he have 23?

Likewise, the PNG PROJECT describes how they set up an ambitious monitoring program, but that they have, to date, not been able to use most of the data. The project team was very enthusiastic about collecting different variables. Not enough thinking went into what might actually be useful — or how it would be used.

To solve these problems, the practitioners agreed that you have to focus on a simple set of indicators that are tied to the assumptions you are making. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, “It is much more important to have indicators that are simple, simple, simple — and measurable.” He goes on to say that, “In KANTIPO, all monitoring is linked 100% to management of the project.” Likewise, Brenda Taylor of the BC FORESTRY INITIATIVE said, their focus has been:

What is going to work, and what are you going to measure to figure out if it worked or not? That’s I guess what our emphasis has been. And that’s how we come up with indicators. What is the minimum you need to know in order to evaluate whether it worked or not?

At the same time, however, it is also important to understand the limitations of the indicators that you do decide to go with. As Norm Bilodeau of the BC FORESTRY INITIATIVE said:

Indicators are a contentious concept for many scientists. There is a tacit assumption that their use will preclude the need to consider the systematics involved. Clearly it is in the way they are used. Indicators are essentially qualitative measures with enough quantitative value to be dangerous if used inappropriately. It’s like using a watch without a second hand to time a race. As long as you are not trying to determine a winner with the watch it is not a problem. I like to think of indicators as a compass guiding us towards better decisions.

STEP D: Implement Your Management and Monitoring Plans

Up until this point, the steps in the process of adaptive management have involved planning — developing a broad goal, a conceptual model, a project management plan outlining the actions you will take, and a monitoring plan. This planning is important and takes a great deal of work and energy. But in the end, plans are only pieces of paper with ideas on them. The key is to turn this planning into action and to then make sure that you collect the data that you have identified as being important in your monitoring plan.

As we said in *Measures of Success*, there is not a whole lot of advice that we can give practitioners about implementing your management plan, other than just do it!

Do It!

Adaptive management is not a theoretical exercise. Instead, it is fundamentally about taking action. As a result, the most critical step in the entire process involves implementing your management plan.

The theoretical sources that we reviewed agreed that action is a fundamental component of adaptive management. Lee describes how adaptive management “applies the concept of experimentation to the design and implementation of natural-resource and environmental policies.”⁷¹ And for Schön, the analytical part of reflection-in-action takes place in the context of the everyday work of professional practice:

*When someone reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique, but constructs a new theory of the unique case...He does not separate thinking from doing, ratiocinating his way to a decision which he must later convert to action. Because his experimenting is a kind of action, implementation is built into inquiry.*⁷²

As Schön points out, the practitioner’s experimentation is different from that of the traditional scientist:

*The practice context is different from the research context in several important ways, all of which have to do with the relationship between changing things and understanding them. The practitioner has an interest in transforming the situation from what it is to something he likes better. He also has an interest in understanding the situation, but it is in the service of his interest in change.*⁷³

The practitioners that we spoke with agreed with the need to take action. To this end, they identified a major problem that we might call “planning paralysis.” People get so preoccupied with planning that they never move forward with implementation of the project. As Brenda Taylor of the BC FORESTRY INITIATIVE said, “often the stuff you hear or read in the literature is about how they get stuck in the modeling stage. They spend all this time and effort and money and energy producing a model and then they don’t do anything else. We wanted to get beyond that and actually get into the management, to actually getting stuff going on the ground.” Her colleague Brian Nyberg echoed this sentiment when he said:

Because we have been anxious to get projects going we may have not spent enough time on working on the model. This was a reaction to the current [adaptive management] practice that spends most of the time on

the model. We have had an emphasis on action and not wringing our hands. The people we work with have “had it up to here” with planning. They were sick of it and wanted to get on with doing something. The purpose of this program was to do adaptive management, not build models.

A second related problem that emerges is what we might term “model rigidity.” Often when a group spends a great deal of time and energy building a conceptual model, for some reason they can begin to regard it as being “set in stone.” As a result, the group becomes reluctant to change it over time. The key is to remember that the model has to change as the situation where you are working changes. For example, Norm Bilodeau of the BC FORESTRY INITIATIVE talked about the importance of creating a living model when he described some new work that they were undertaking with forest products such as mushrooms. He felt that in doing so, they avoided both the trap of “not starting work until the model is finished” and the trap of not taking on new activities because “they are not specified in the plan.” As Bilodeau said, “you’ve got to be good jugglers in this business.”

Set Up a Data Management System That Fits into Everyday Work

In addition to implementing your management plan, you also need to implement your monitoring plan. As you do so, you need to figure out what to do with all the data streaming in. To this end, each project needs to set up a data management system. In developing documentation systems, you need to think about both the ease of input and export of your information. If you store your information on a Web site using a computer located far away from your field site, chances are that it may be hard to record your experiences on a regular basis. If, however, you write your information down in a notebook, then it may get lost or be hard for other people to read. The key is to find ways of recording your findings that are both part of your normal routine and yet accessible to others.

The theoretical sources that we reviewed agreed that it is important to keep track of not only your final results, but also the steps in the process of getting there. For example, Pirsig describes how most research scientists keep a lab notebook in which they write their hypothesis, objectives, methods, results, and conclusions for each experiment that they conduct. As Pirsig says, by doing so, “you know at all times where you are, where you’ve been, where you’re going, and where you want to get...sometimes just the act of writing down the problems straightens out your head as to what they really are.”⁷⁴ When something goes wrong, this written record also enables the researcher to go back and “debug” the process to figure out what happened. In a similar fashion, Lee emphasizes the need to create an “intellectual paper trail, a way of understanding the chain of reasoning that leads from database to output.” He goes on to say that, “the paper trail is crucial if learning is to be possible” since without it, it is “impossible to go back and improve understanding when reality fails to agree with prediction.”⁷⁵

The practitioners that we spoke with agreed that it is important to keep a record of what the project has done. As Brian Nyberg of the BC FORESTRY INITIATIVE said, “because people turn over so fast and because a lot of these projects are run by volunteers, we need to have some way of maintaining awareness of the project, its history, and needs for future action. So obviously there has to be some permanent record kept in the local office where the project leadership is housed.” In Zambia, Brian Child of the SLAMU PROJECT agreed,

pointing to the extensive plans that each of the communities have developed, saying “it is really important for each group to develop their plan — these things are our collective memories.” And likewise, Stephan Forster of the ZAMBIA KANTIPO PROJECT talked about the early days in which the park was being managed without keeping records. As a result, “no one knew where the critical spots were — nothing had been put in a systematic framework.”

Although the practitioners that we spoke with recognized the importance of compiling their data and information, they all also said that it was hard to find time to do this work. For example, Charlotte Harland of the ZAMBIA ADMADDE PROJECT said that everyone is so busy working that, “Documented learning does not happen much for internal use. Processes are not explained or mandated and things just don’t get written down.” The practitioners said that part of the solution to this problem is, as discussed above, to collect only the data you need. A second part of the solution is to try to set up effective data management systems. To deal with this problem, three of the projects that we visited have set up extensive computerized databases to store monitoring data. In these cases, however, the data were either not entered into the system, or were not used to their full potential. Dale Lewis of the ZAMBIA ADMADDE PROJECT said that the computer was definitely helpful — “with the use of Microsoft Access, it is not so scary to see so much data.” He also felt that “When data are in a form that can be used, it’s more democratic — everyone has access.” But even so, the amount of data threatens to overwhelm the project. As Lewis said, “We keep track of so many questions — then these generate assumptions — these assumptions generate data — data generate assumptions.” Robert Bino of the PNG PROJECT agreed, saying, “I think the monitoring system that we set up can become a very powerful tool, but it is not one yet because we are not accessing the data.”

Some of the other practitioners we spoke with had not yet set up extensive databases, but talked about the importance of doing so, especially as their organization expands in the future. For example, Brian Nyberg of the BC FORESTRY INITIATIVE described how his central office got lots of information from field offices, saying:

What we’d get from them is raw data, lots of information in what we’d call progress reports and other kinds of summaries of their success or their interpretation of what they’ve done. We certainly talked about the notion of needing a central database and repository for both the raw information itself as well as all the interpretive reports, but we haven’t pursued that to any great extent because we’ve had a relatively small number of projects around the province. It hasn’t been so overwhelming that if somebody is looking for information that I would have no idea how to get it to him. If we had a much more comprehensive program across the province, however, there would need to be a much more effective way of coordinating and tracking all the data and the results that are coming out of it. I can see how for any organization that’s involved with a lot of projects in a lot of different places around the world, it’s valuable to have some sort of a tracking system for keeping that kind of information available and handy and making sure that it’s not lost through whatever surprises may happen at the field level.

STEP E: Analyze Data and Communicate Results

The second to last step in adaptive management involves taking all of the data that you have collected in your databases and turning it into useful information. Many projects collect tons of “ore” that contains “golden information” about what works, what does not, and why. Unfortunately, like real gold ore, this data will not do you any good if you don’t purify it to produce concentrated nuggets of information. It also won’t do you any good if you only keep the information in your head. If you don’t record the information, you will over time forget important details about what you have learned. Furthermore, a lesson stored in your head will generally not be available to other people working on your project either now or in the future. And it certainly won’t be available to other people working on similar projects in other places. All too often, it seems that projects generate information, but fail to retain or communicate it.

Analyzing your data on a regular basis enables you to extract the useful information from it. Analysis also enables you to boil down large quantities of information into useful principles. Documenting these findings — writing them down or otherwise recording them — enables you to use them in the future and to share them with other people so they can benefit from your experience.

Most practitioners seem to feel that they are too busy with day-to-day work and problems to analyze and deal with the data that they collect. To overcome this challenge, it is important to find ways to fit analysis and communication efforts into your work plan. This may actually be easier than it sounds. For example, if you have planned your project properly, then much of your documentation should already be completed. Your conceptual model and management plan should contain the questions you’re asking, the assumptions you’re making, and the interventions you’re using to test them. Your monitoring plan should outline what data you have been collecting. And your database should contain the information that you have collected. You thus now only need to interpret what these results mean and then communicate them in a way that addresses the needs of your key audiences.

Analyze Your Data

Analysis is fundamentally a process of transforming raw data into usable information. Analysis is most effectively done in the context of specific questions you are asking or assumptions that you are testing. On one hand, you want to make sure that you are using all the data you have collected and to learn as much as possible. On the other hand, you also want to make sure that you are not trying to conclude more than the data justify. In particular, it is important to try to boil your data down so that you are left with only the most important lessons.

The theoretical sources that we consulted emphasize the importance of the analysis process in producing useful information. For example, Lee describes how adaptive management is fundamentally about obtaining information to improve results. He describes how:

Adaptive managers take special care with information. First, they are explicit about what they expect, so that they can design methods and apparatus to make measurements. Second, they collect and analyze

information so that expectations can be compared with actuality. Finally, they transform comparison into learning — they correct errors, improve their imperfect understanding, and change action and plans.

In a similar fashion, Pirsig discusses how one of the key steps in the scientific process is to “analyze and draw conclusions from the results of the experiment about your hypothesis.” He goes on to say that “skill comes in stating no more than the experiment has proved.”⁷⁶ Pirsig also emphasizes the need to distill your data into general and simple statements. He cites the French philosopher of science Henri Poincaré, saying that what a scientist seeks to do is find the facts that convey the most information. As Pirsig states, “the more general a fact is, the more precious it is.” Furthermore, “general facts are also simple...a scientist does not choose at random the facts that he observes. He seeks to condense much experience and thought into a slender volume.”⁷⁷

All of the practitioners that we spoke with agreed that analysis is a key step in the overall adaptive management process. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, “Our assumption was that with more information, we could do better conservation.” They also, however, all said that their project faces a number of challenges in doing analyses. One major problem is having too much data flowing into the project office from various field sites. For example, Brian Nyberg of the BC FORESTRY INITIATIVE described how his central office got lots of information from field offices, saying that while they have received lots of raw data in progress reports and summaries, “in terms of using the actual raw data itself, we haven’t actually gotten to the stage of doing a lot of detailed statistical analysis yet.” In a similar fashion, Robert Bino of the PNG PROJECT said, “I think the monitoring system that we set up can become a very powerful tool, but it is not one yet because we are not accessing the data — we have not yet analyzed that last two years’ results.” He goes on to say:

One of the key challenges of our project is identifying the appropriate analytical tools to employ in evaluating and making a better scientific sense of the data collected. There is the tendency to quickly identify monitoring tools with ease from the outset and not having the foresight to consider and weigh out how the data can be effectively processed for a better appreciation of any trends that may exist.

To overcome this problem, some of the practitioners we spoke with said that it was important to make sure that local field staff members don’t merely record data, but also attempt to process and analyze the information. As Brian Nyberg of the BC FORESTRY INITIATIVE says:

We’ve got to make it clear to people, first of all, what we think needs to be recorded and then give them an appropriate format for it. So we developed a template for project establishment and project plans and another template for progress reports. They just basically have different topic headings and a few details as to what we expect should be included in each one of these things. We then give these templates to everybody who starts one of these projects and say, “This is the model we’d like you to follow.” Sometimes they do and sometimes they don’t, but at least it stresses the points that we think need to be included, such as the understanding of how the system operates, the model, and who’s responsible for doing what over what time schedule or what the uncertainties are that they are trying to address, what the indicator variables are, and so on. So, we give them the templates just to provide some structure.

The practitioners that we spoke with also agreed that it is important to take large amounts of information and boil them down into simple principles that can encapsulate the lessons learned. For example, Dave Maloney of the BC FORESTRY INITIATIVE told the story of how his office was concerned with the effects of tree shade on the

temperature of small streams used by salmon. Because of this concern, forestry workers were going to each potential timber harvesting site and marking the specific trees along each stream that would need to be cut or left to achieve the proper stream shading. Over time, however, as they analyzed their data, they began to realize that owing to their high Northern latitude, trees on the north side of an east-west segment of stream would have very little effect on the amount of shade reaching the stream. As Maloney put it, turning this learning into a principle, “don’t worry about trees on the north side of a stream bank” turned what was an extensive two-person field exercise into a simple one-person office mapping exercise.

Document and Communicate Key Lessons

Once you have analyzed your information, you still need to document your results and communicate them to the people who can use them. To do so, you first need to identify your key audiences — including you and your colleagues, the stakeholders that you work with, your donors and supporters, as well as your peers. For each audience, you then need to think about what information they need and how they want to receive information. The traditional way to communicate information is through a written report. Unfortunately, as we all know, a lot of times project reports seem to pile up on people’s shelves without getting read. The challenge is to thus find ways of communicating information that people can use.

The practitioners that we spoke with also agreed that while communicating the lessons that you’ve learned is an important part of adaptive management, you also have to find a way to do it that is both easy for you to do and meets the needs of your audience. For example, Brian Nyberg of the BC FORESTRY INITIATIVE said, “I think the biggest concern that we have is that because our staff turns over so much and because people are so busy trying to do the day-to-day things that they are expected to do to earn their paycheck, they often don’t put the time into documenting.” He went on to say:

So we should be doing more documentation, no question about it. But again, I can only do so much, so I decided to put the priority on oral presentations and one-on-one discussions and meetings with people and specific project activities and training, as opposed to publication, writing, distribution, and so on. We used to put out a newsletter. In fact, we tried to do it three or four times a year and while Brenda was here, we were on more or less that schedule. Since she left, I haven’t even been able to get a new edition of that out, just again because it’s nice to do, but it’s not the most critical thing to do.

The practitioners that we spoke with also emphasized the need to not just rely on written reports, but to use other venues for communications. For example, Dale Lewis of the ZAMBIA ADMADDE PROJECT said that there can be too much emphasis on trying to write manuals that then quickly go out of date. As Dale said:

We train our staff to have knee-jerk reactions to the situation at hand. We don’t have rote training programs and manuals. I refuse to. I prefer knee-jerk reactions. We need to base our actions on the knowledge that we accumulate. But my guys are smart — we need to stop writing manuals that are a waste of time. We move much faster than that — it is unimaginative to teach people out of a book.

To solve this problem, all of the projects that we visited used meetings as a regular method for sharing lessons among project members and community stakeholders. These meetings have the advantage of providing two-way

information flow. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said, “Workshops and forums are the best way for us to communicate our results to the communities.” Stephan Forster of the ZAMBIA PROJECT said “Ideally we do the planning process and feed the results back into our plan. Much of our communication and learning is through our periodic and annual meetings.” Similarly, the PNG PROJECT uses both regular staff meetings and an annual meeting among stakeholders to share lessons. As Robert Bino said, “at the meetings, the reports from one community are copied and distributed to RCF people in other communities. At the biannual meetings there is a lot of sharing of experiences.” These meetings will only preserve learning, however, if careful minutes of the meetings are kept and are available for staff in the future.

ITERATE: Use Results to Adapt and Learn

Finally, you’ve come to the last step in the adaptive management process. Despite all the hard work that you have done, this is not the time to sit back and relax. Instead, you have now come to the most crucial step in the whole process. It is now time to use the results of all your hard work. Unfortunately, all too often it seems that project teams don’t make use of all the gold that they have mined and refined.

To make full use of your gold, you have to use your results to adapt and to learn. To do so, you have to go back to your original conceptual model and to the assumptions that you laid out and then tested experimentally. If your experiments turn out exactly as you predicted, then you will have confirmed your assumptions — you can now be a bit more confident about them. Chances are, however, that your experiments will not have turned out exactly as you predict. In this case, you need to then use these results to change the actions that you are taking. If your results signal the need to change, by all means, do it. Remember, you collected all those data and information for something, so use them!

You also need to use your results to change your model. By doing so, you will be capturing the learning that you have done and incorporating it into your project’s institutional knowledge. You will also probably be initiating a new round of assumptions that you can now start thinking about how to test. In effect, the end of one round of the cycle is also the start of the next round. Over time, you will go through the cycle multiple times, hopefully growing and learning as you do so, and ultimately, leading to better conservation.

Incorporate Adaptation Into Decision-Making Structures

In a conservation project context, adaptation is about systematically using the information obtained through your monitoring to take action to improve your project. If your project intervention did not achieve the expected results, it is because either your assumptions were wrong, your interventions were poorly executed, the conditions at the project site have changed, your monitoring was faulty — or some combination of these problems.

Adaptation involves changing your assumptions and your interventions to respond to the new information

obtained through your monitoring efforts. It means staying flexible, examining your past actions, and looking for key opportunities to leverage change.

Many of the theoretical sources that we reviewed strongly emphasized the need to use the results of your inquiry to change. As Pirsig writes, once a motorcycle mechanic has used the scientific method to figure out that his electrical system is not working:

He does know that the motorcycle isn’t going to run until the electrical system is working and he sets up the next formal question: “Solve problem: what is wrong with the electrical system?” He then sets up hypotheses for these and tests them. By asking the right questions and choosing the right tests and drawing the right conclusions the mechanic works...until he has found the exact specific cause or causes of the engine failure, and then he changes them so that they no longer cause the failure.⁷⁸

Likewise, Schön writes, the key to reflection-in-action is that the process takes place when it is still possible to take action to change the situation:

A practitioner’s reflection-in-action...is bounded by the “action-present,” the zone of time in which action can still make a difference to the situation. The action-present may stretch over minutes, hours, days, or even weeks or months, depending on the pace of activity and the situational boundaries that are characteristic of the practice.⁷⁹

Indeed, change is not only desired, it is an imperative in an environment in which the world is changing around us. Senge relates the “parable of the boiled frog” in which if you place a frog in boiling water, it will immediately try to jump out. However, if you put the frog in a pot of warm water on the stove and gradually heat it up, the frog will stay put until eventually it is too groggy to move. As Senge states, “the frog’s internal apparatus for sensing threats to survival is geared to sudden changes in his environment, not to slow, gradual changes.”⁸⁰

The practitioners that we spoke with also agreed that it is important to use the results of their work to change over time. Dale Lewis of the ZAMBIA ADMADE PROJECT said simply, “That’s what we’re here for — using data to make decisions.” As an example, he described how the project invests in monitoring their teaching programs. They can then adjust the teaching and training based on the results. Similarly, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how, “Based on data we collected and our analysis, we changed our geographic focus — we changed where we work. We found that the more presence we have in an area, the less poaching will occur — simply with our presence.”

The practitioners also said, however, that it can be difficult to get people to use information to change — that there is an inertia that keeps people from modifying their actions. For example, the BC FORESTRY INITIATIVE staff describe how they conducted an experiment to see whether wooden bridges or metal culverts were more effective at providing stream crossings for timber trucks with minimal effects on water quality. Based on the experiment, it was pretty clear that the wooden bridges were both “substantially cheaper and more fish-friendly.” Nonetheless, it was hard to get the timber companies to switch from the culverts to the wooden bridges. As Brian Nyberg says, this is “partly because of a lack of effort in extension and training” but also partly due to an attitude of not

expecting to use results — in the sense that “well, we’ve got the results and the question is resolved, so let’s get on to the next thing.”

One way of overcoming this inertia is to plan from the start how the results will be used in decision-making processes. For experimentation to lead to change, there must be a clear framework and process for decision making, or as Charlotte Harland of the ZAMBIA ADMADE PROJECT said, “When we make decisions, we need to make sure that there is sufficient and good data with an organized decision-making structure rather than ‘seat of the pants’ reaction to the information.”

In the ZAMBIA KANTIPO PROJECT for instance, the project team has organized regular meetings to work with stakeholders to modify the annual work plan. This process is known, systematic, predictable, transparent, and includes a wide range of stakeholders. All stakeholders know what they are going to do with the information generated from experimentation — they know how data can influence the way the project will go in the future — and understand how information will be used for decision making. Likewise, Brenda Taylor of the BC FORESTRY INITIATIVE said how in the initial project workshop, it is important for project teams to ask themselves, “well if we got this result, how would we change?” If people have discussed in advance what they will do if they get one result versus another, then “you can get people to refer back to the discussion when it actually does come to change.” But she and her colleagues then went on to say that they had not actually done this — and doubted whether people would make decisions based on a discussion that had been held years ago.

And of course, there is no point in changing just for the sake of change. As Dale Lewis of the ZAMBIA ADMADE PROJECT said, “Once you find things that work you need to stick with them. That is why ADMADE is becoming more structured — we know more about what we are doing.”

Use Results to Learn

In a conservation project context, *learning* requires your organization to have a commitment to figuring out how to do your work better and to using and benefiting from your mistakes rather than hiding them. It is also about systematically documenting the process that your team has gone through and the results you have achieved. This documentation will help your team avoid making the same mistakes in the future. Furthermore, it will enable other people in the broader conservation and development community to benefit from your experiences. Other practitioners are eager to learn from your successes and failures so they can design and manage better projects and avoid some of the hazards and perils you may have encountered. By sharing the information that you have learned from your project, you will help conservation efforts around the world.

All of the theoretical sources that we reviewed, emphasized the need to promote learning. For example, for Pirsig, good science is not about achieving positive results, but about expanding understanding. As Pirsig puts it:

*An experiment is never a failure solely because it fails to achieve predicted results. An experiment is a failure only when it also fails adequately to test the hypothesis in question, when the data it produces don’t prove anything one way or another.*⁸¹

The key here is to start with the vast body of information that is already known and to try to move the frontier forward — adding another brick to the pyramid of human knowledge. Pirsig goes on to describe how the primary work that a motorcycle mechanic does involves constructing and testing mental models to expand learning:

*Actually, physical labor is the smallest and easiest part of what the mechanic does. By far the greatest part of his work is careful observation and precise thinking. That is why mechanics seem so taciturn and withdrawn when performing tests. They...are concentrating on mental images, hierarchies, and not really looking at the physical motorcycle at all. They are using the experiment as part of a program to expand their hierarchy of knowledge of the faulty motorcycle and compare it to the correct hierarchy in their mind. They are looking at underlying form.*⁸²

In an organizational context, one of the key premises behind the social learning concept is that learning does not just occur to solve immediate problems. Instead, learning should be aimed at trying to solve more long-term problems. This more long-term learning can only take place if it is incorporated into the group’s organizational maps. Argyris and Schön state:

Organizational learning occurs when members of the organization act as learning agents for the organization, responding to changes in the internal and external environments of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared maps of organization.

Argyris and Schön go on to say that there are two types of learning:

*When the error detected and corrected permits the organization to carry on its present policies or achieve its present objectives, then that error-detection-and-correction process is single-loop learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information (the temperature of the room) and take corrective action. Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization’s underlying norms, policies, and objectives.*⁸³

In effect, double-loop learning involves not only dealing with the situation at hand, but also changing the very fundamental ways in which the organization functions, so as to be able to deal with other similar situations in the future. Adaptive management is fundamentally about double-loop learning.

The practitioners that we spoke with emphasized the importance of learning. For example, Robert Bino of the PNG PROJECT described how he used to live and work in the village, but had recently been promoted and was now living in the town. As a result, he said he needed to find ways of sharing what he learned so that the project could avoid making all the mistakes he had made. As he said, “many people are very interested in the way that we have combined conservation and development...we really need to make sure that we make this knowledge available for ourselves and for the wider community.” In a similar fashion, Brian Nyberg of the BC FORESTRY INITIATIVE said “adaptive management is a systematic process that involves continually improving management policies and practices by learning from the outcomes of operational programs.” But perhaps this thought is most eloquently summed up by Dale Lewis of the ZAMBIA ADMADE PROJECT who said “adaptive management should

become the common standard. The basic idea behind it is so simple that it is hard to argue with it. Even if you don't do it perfectly, it is hard to argue that you shouldn't learn.”

Keep Going Through the Cycle

Perhaps the most important point to keep in mind as you go through the preceding steps is that you don't just go through the cycle once. Instead, as shown in Figure 2, you need to go through the steps in the cycle over and over again. The key to adaptive management is that it is an ongoing and iterative process. You develop a model and experiment with an action and collect and analyze data about this action. You then use the results to modify your model and to suggest new actions. You then collect and analyze data about these new actions, and use them to adapt and learn again. Each pass through the cycle will hopefully enhance your ability to do effective conservation.

The theoretical sources that we reviewed agreed that learning is an iterative process. Pirsig describes how at its core, the scientific method involves weaving together two kinds of logic. *Inductive inference* involves starting with observations of the natural world and then arriving at general conclusions based on these observations. Induction is thus reasoning from particular experience to general truths. *Deductive inference* involves starting with general knowledge and predicting specific results. Deduction is thus reasoning from general truths to particular experience. The scientific method involves combining long strings of mixed inductive and deductive inferences over time to build up our understanding of the natural world.⁸⁴

In a similar fashion, for Schön, reflection-in-action is not a one-time event. Instead, it is part of an ongoing two-way dialogue between the practitioner and the system he or she is working with. In effect, the practitioner is shaping the situation through his or her actions, but is also modifying and shaping his or her understanding of the world as a whole. Schön speaks of this as a conversation between the practitioner and the problem:

*In the reflective conversation, the practitioner's effort to solve the reframed problem yields new discoveries which call for new reflection-in-action. The process spirals through stages of appreciation, action, and reappreciation. The unique and uncertain situation comes to be understood through the attempt to change it, and changed through the attempt to understand it.*⁸⁵

The practitioners that we spoke with echoed this sense of an ongoing iterative process of going through the steps of adaptive management. As Brian Nyberg of the BC FORESTRY INITIATIVE said in talking about the cycle that they use:

If somebody is doing adaptive management, then they have to be doing all of the steps in the cycle over and over again...if people are not doing all of these steps, they really aren't doing adaptive management. If you're just doing monitoring alone, or planning and modeling alone, they are useful, but on their own, they are not adaptive management.

The practitioners also emphasized, however, that in real life this process is never quite as neat and clean as when laid out in a guide like this one. For example, Brenda Taylor of the BC FORESTRY INITIATIVE said:

I guess when you lay out the procedure, it's always very clean in the way you do step one and then step two and step three and step four. When you think about it in your mind it's clean that way. But, when you actually come down to doing it, I guess I get frustrated, it's never that clean. It's always kind of nasty and you're always juggling how much time do you devote to different things. It's really iterative. Nothing ever seems to go according to the kind of template or the ideal case, that goes through all the steps really cleanly. In reality it's messy.