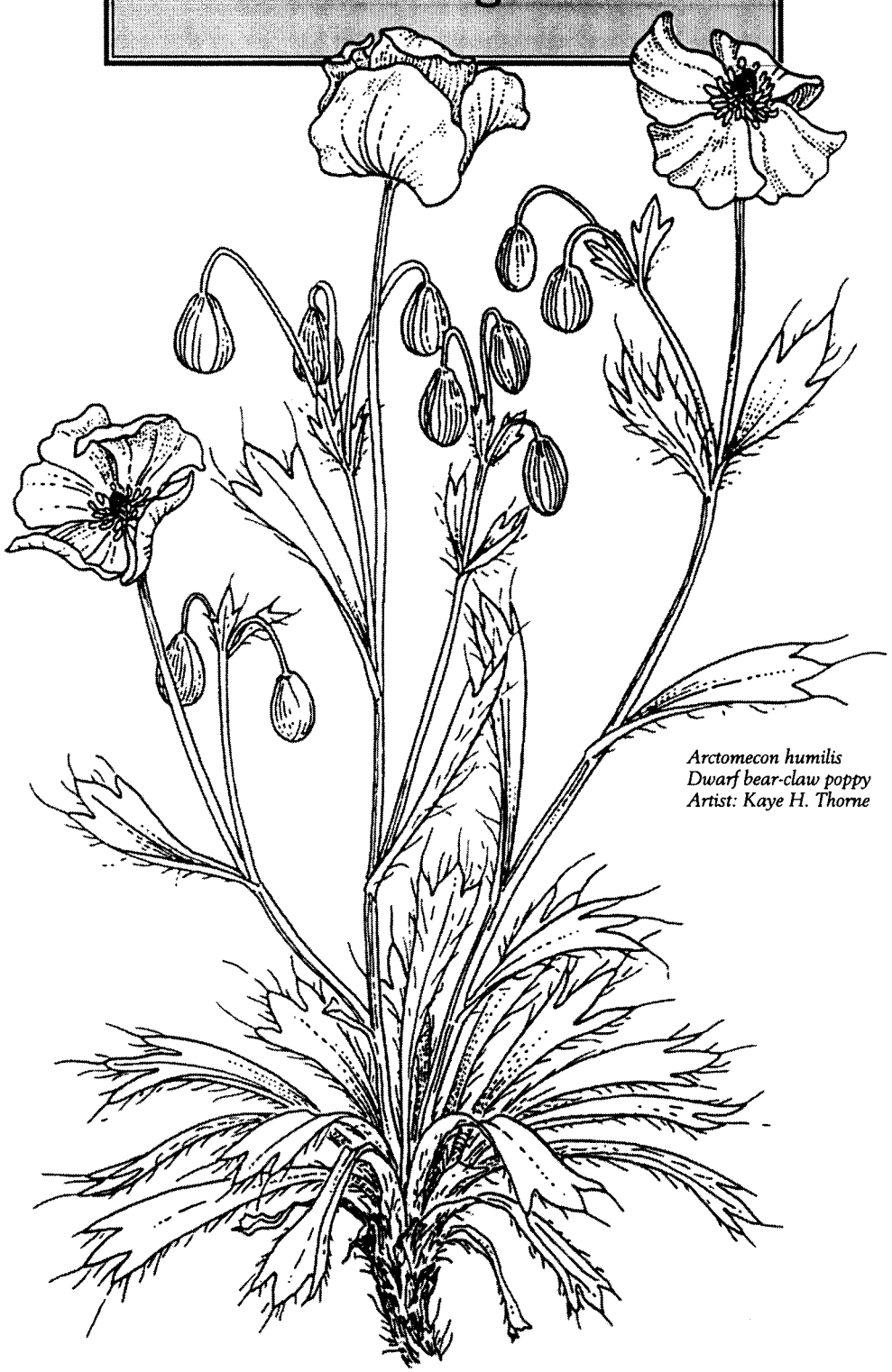
CHAPTER 15
Communication and Monitoring Plans



Arctomecon humilis
Dwarf bear-claw poppy
Artist: Kaye H. Thorne

A successful monitoring project is characterized by three traits. First, it is well designed and technically defensible. Second, it is implemented as planned in spite of personnel changes, changes in funding, and changes in priorities. Third, the information from a successful monitoring program is applied, resulting in management changes or validation of existing management (Gray and Jensen 1993).

Monitoring projects that are implemented to completion and applied to decision making will complete the adaptive-management cycle described in Chapter 1. All three of these traits depend on good communication and documentation over the life of the project. Good design is usually the result of collaboration with stakeholders and other specialists and help from experts. Consistent implementation requires the support and knowledge of managers and documentation of methods to survive personnel changes. Finally, application to management decisions requires communication of results. A monitoring project that simply provides additional insights into the natural history of a species, or that languishes in a file and is read only by the specialist, does not meet the intent of monitoring.

COMMUNICATION

Communication does not start when the monitoring results have been analyzed. Beginning with the planning stage, those who will be making decisions based on the monitoring and those who may be affected by those decisions must be included in the design of the monitoring project. You will increase the likelihood of seeing needed management actions implemented by involving all interested parties in developing the management objective and in designing the monitoring, as well as by reaching agreement that all parties will abide by the results (Hirst 1983; Johnson 1993). Objectives, written as Management Objectives–Management Response pairs (see Chapter 14), should clearly identify the management changes that will be implemented based on monitoring results (Gray and Jensen 1993). This point cannot be stressed enough, especially when potential decisions may adversely affect some parties or interests. If you fail to include all who should be involved in the initial stages of objective setting and monitoring design, adversaries against implementing new management may appear once monitoring is completed.

Several classes of participants that may be involved in the development of a monitoring project are described in Box 15.1. The number of people and groups to involve in a monitoring

Box 15.1 *PARTICIPANTS IN A MONITORING PROJECT*

Decision-makers *(managers or management teams) are the most important audience. They will decide the amount of resources to devote to the monitoring project and, once monitoring is completed, decide whether management should change or continue. Each manager's "comfort level" varies for making decisions based on monitoring data. Some managers feel confident making decisions based on photographs and their specialist's judgment. Others require much more information.*

Agency specialists *(in-house). Other resource specialists may have information critical to the design of the monitoring (e.g., the area containing the population is likely to be rested from grazing for the next 3 years; the timber stand is set aside from cutting because it is in a protected watershed). These other specialists also tend to be advocates for the resource they manage and may potentially disagree with the management changes resulting from monitoring. Including these specialists in the design creates ownership in the monitoring and reduces the potential for in-house disagreements later.*

Regulatory decision-makers *(e.g., U.S. Fish and Wildlife Service, state agencies). Participation by these agencies is required for species listed under the Endangered Species Act or state laws and may be helpful for other species of concern.*

Nonregulatory agencies. *State agencies that maintain statewide conservation databases such as the Heritage Program or conservation programs often have information about the same species on private lands, on other federal lands, or on lands in other states. Many of these database agencies also maintain a monitoring database; participation in it can reduce redundancy in monitoring efforts. In the United States, for example, local Natural Resource Conservation Service personnel and County Extension agents may function as advocates for agricultural interests. Their participation and support of the monitoring project increases the credibility of the monitoring data with traditional federal land users such as grazing permittees.*

Traditional land users. *These are primarily commodity producers such as miners, loggers and timber companies, and livestock operators. If the monitoring potentially will affect these interests, you should include them throughout the process. Not only does their involvement from the beginning diffuse much of their disagreement when assessing results, but their involvement will also improve the quality of the monitoring. Because their economic interests are potentially at stake, they will be interested more in false-change errors (e.g., concluding that a decline took place when it really did not), whereas you may be more concerned with missed-change errors (e.g., failing to detect undesirable changes that in fact did occur). The explicit balancing of the two errors is important. In addition, individuals involved in commodity production on federal lands often know facts about a population area or an activity that you do not. A rancher, for example, may know that cows have not used an area for the last 10 fall seasons because of a nonfunctioning water source. A logger may know that his grandfather cut a patch of timber using horses in the 1930s. These bits of information may improve your ecological model.*

Nontraditional land users. *Newer users of public lands, for example, off-road recreationists, hikers, hot-spring visitors, and others whose use of the federal land may be affected by changes in management resulting from monitoring, should be included.*

Environmental and conservation groups. *Include groups that have an interest in native flora and biodiversity, especially if local representatives are available. Native plant societies not only have a special interest in the preservation of the diversity of native vegetation within a state, but may also have specialized skills or volunteer labor that will improve the quality of monitoring. Hunting and fishing enthusiasts are often willing to help with conservation projects. Environmental groups may be the source of information and support.*

Professional and academic botanists and biologists. *These people may have much to contribute to the development of ecological models, objectives, and monitoring designs. Their contribution to and review of the monitoring strategy will improve the quality and increase the credibility of the monitoring effort.*

project depends on the potential impacts of the management changes that may occur based on monitoring results. Developing objectives for populations in areas that are not affected by commodity extraction or recreational use may require little interaction with interest groups or other agency specialists. Large populations, populations with controversial land use activities, or populations in high-use/high-visibility areas, may require extensive communication efforts before management and monitoring is initiated.

Establishing communication and considering alternative points of view can be time-consuming and difficult. An apparently easier route often followed by some specialists is collecting "really good data" to prove a point and attempting to use the data to influence management changes. In practice, monitoring that is specialist-driven rarely results in a management change for three reasons. The most common is that the specialist who spearheaded the monitoring leaves and the managers suspend the monitoring project because it never had institutional support and now lacks an advocate. A second reason is that, without commitment by management, other priorities take precedence over the monitoring project and divert the limited resources and time available to the specialist. Third, a lack of consensus on objectives and methodology almost ensures that a decision-maker will not use the monitoring data because of continued controversy. You need to involve people early in the process to ensure a cooperative effort and the application of monitoring results to the decision-making process (Hirst 1983). At a minimum, potential internal antagonists should be involved and supportive by the time field data collection begins.

Effective facilitation of public participation is not easy, but successful examples do exist (Yaffee and Wondolleck 1997). Shindler and Aldred Cheek (1999) identified six characteristics of a program of effective communication and solicitation of public involvement:

1. Allows all who wish to participate open access
2. Includes people with leadership and interpersonal skills who are able to develop ongoing relationships with participants
3. Demonstrates institutional and personal flexibility by agency and technical personnel to explore innovative approaches
4. Carefully designs a process that describes how public participation will be incorporated into the decision-making process and applies that process at the initial stages
5. Delivers tangible products demonstrating that participation leads to meaningful progress (e.g., the construction of a project, a change in a service)
6. Creates trust by demonstrating consistent, open and honest behavior; by delivering the promised products; and by clearly incorporating the participant's ideas

You may not have the particular responsibility of ensuring effective public participation, but you must recognize the importance of the process to successful application of the adaptive-management cycle of which your monitoring is a part, and you must support the process in any way you can. If you do find yourself responsible for the public participation process (perhaps because in your position as, for example, a preserve manager, you bear responsibility for the whole program), recognize the process as integral, rather than ancillary, to the success of an adaptive-management and monitoring project.

Communication about monitoring projects associated with noncontroversial management actions can safely be limited to decision-makers and internal resource specialists. For example, often you will know too little about populations and their interactions with management activities to develop Management Objective–Management Response pairs that identify a specific management response. Many management responses in the examples in Chapter 14 specify a second stage of more intensive monitoring and perhaps research if the population is declining or failing to increase. Such two-tier monitoring requires only the involvement of the decision-maker and resource specialists within the administrative unit in the first stage because implementing increased monitoring or research may be expensive but is rarely controversial among stakeholders outside the agency.

Even in noncontroversial situations, however, you may want to enlist involvement and/or review by a broader spectrum of participants. Review by user groups during the development of objectives will inject fresh perspectives and often provide useful, local knowledge. Review during the design phase by academic specialists, statisticians, experienced professional biologists, and peers may help you avoid potential technical problems.

MONITORING PLANS AS A COMMUNICATION TOOL

Communication with these participants is facilitated by a monitoring plan that explains the rationale for the monitoring project, documents objectives and the management response, and describes the monitoring methodology in enough detail to direct continued implementation.

Monitoring plans serve five important functions:

1. A draft plan provides a full description of the ecological model, the objectives, and the proposed methodology.
2. Draft monitoring plans provide a means to solicit input from many participants.
3. A final monitoring plan consolidates all information into a single document that can be easily accessed and referenced.
4. A final monitoring plan documents the location and techniques of the monitoring in sufficient detail that a successor can continue the monitoring.
5. A final monitoring plan documents the agency's commitment to implementing a monitoring project and the management that will occur based on monitoring results. A monitoring plan can also be signed by all participants to demonstrate their support for the project and acceptance of the proposed management changes that may result.

Monitoring plans must be complete, providing all the information needed to judge the quality of your proposed monitoring and to continue it in your absence. Box 15.2 summarizes the elements to include in an extensive monitoring plan for a complex project. Less complex projects may require less extensive explanations and fewer elements. A short (one- to two-page) summary at the beginning of the plan will be useful to decision-makers, other specialists, and user groups.

Do all monitoring projects require a monitoring plan? Does a qualitative monitoring project that simply involves taking a picture of the population each year require a full-scale document such as the one summarized in Box 15.2? Some form of documentation of the management objective, sampling objective (if sampling), management response, location, and methodology is necessary for all monitoring projects, no matter how small or simple. (The field-monitoring cover sheet described in Chapter 6 lists many of these elements and may be adequate for some situations if an introduction that describes the objectives is included.)

The flow chart in Chapter 2 suggests writing the monitoring plan before the pilot study. There is a valid concern, however, that if the pilot study demonstrates that the monitoring approach needs significant revisions, the monitoring plan will need to be rewritten. We suggest drafting the plan early in the process, perhaps just including the analysis of the problem, the ecological model, and some ideas on management, objectives, and monitoring methods. Use the draft as a communication tool and a means of soliciting comments and suggestions. Finalize it after the monitoring methodology proves effective.

Clearly, a significant investment of resources is required to complete all the elements of a monitoring plan, and most biologists prefer fieldwork to writing plans. The temptation is great to skip this stage and get on with "more important" work such as counting plants in plots or frogs in ponds. Resist the temptation. A monitoring plan is critical to successful, long-term implementation of monitoring.

COMMUNICATING RESULTS

Evaluating Results at the End of the Pilot Period

In this handbook, we have advocated the use of pilot studies to avoid the expense and waste of a monitoring project that yields inconclusive results. After the pilot period you should consider several issues before continuing the monitoring project:

Box 15.2. *ELEMENTS OF A MONITORING PLAN*

I. Introduction (general)

Species, need for study, management conflicts.

II. Description of ecological model

Life history, reproductive biology, causes of distribution, habitat characteristics, known or suspected threats (e.g., herbivory of flower heads by cattle, competition from invasive species, off-highway vehicle impacts). The model should describe known biology (based on natural history observations) and conjectural relationships and functions. Relationships that are hypothesized and sources of information should be identified. The purpose of this section is to identify the sensitive attribute to be measured and to describe the relationships between species biology and management activities. This section is the biological basis for the development of objectives.

III. Management objective

Includes rationale for the choice of the attribute to be measured and the amount of change desired or target population size.

IV. Monitoring design

A. Sampling objective (if sampling)
Include rationale for choice of precision and error rates.

B. Sampling design
Describe methods clearly. What size are the sampling units? How are sampling units placed in the field? How many sampling units?

C. Field measurements
What is the unit counted (for density)? How are irregular outlines and small gaps treated (for line-intercepts)? How are plots monumented (if permanent)? Include all the information needed for someone else to implement or continue the monitoring in your absence.

D. Timing of monitoring
What time of year, both calendar and phenologically? How often?

E. Monitoring location
Include clear directions, maps and aerial photographs describing the study location, and the location of individual sampling units (if permanent).

F. Intended data-analysis approach

V. Data sheet example

VI. Responsible party

VII. Funding

VIII. Management responses to potential results

Can the Monitoring Design Be Implemented as Planned?

The pilot period should answer several questions about field design and implementation: If sampling units are permanent, can they be relocated? Are sampling units reasonably sized, or do they contain hundreds of individuals? Is it difficult to accurately position a tape because of dense growth? Are the investigator impacts from monitoring acceptable? Is the skill level of field personnel adequate for the fieldwork, or is additional training needed? Projects rarely work as smoothly in the field as anticipated in the office. Nearly all monitoring projects require some modification for effective field implementation. Occasionally, you may find that the planned method does not work at all, and a major overhaul of the monitoring project is required.

Are the Costs of Monitoring Within Estimates?

The pilot period is important as a reality check on required resources: Does the monitoring take much longer than planned? Will the data entry, analysis, and reporting work take more time than allocated? If the monitoring project as designed requires more resources than originally planned, either more resources must be allocated to the project, or you will need to redesign the monitoring to be within budget.

Do the Assumptions of the Ecological Model Still Seem Valid?

Your understanding of the biology and ecology of a species may improve as you spend time on the site collecting data. Does new information suggest that another attribute would be more sensitive or easier to measure (cover instead of density, for example)? Is the change that you have targeted to monitor biologically significant, or is the natural annual variability that results from weather conditions so extreme that it masks the target change? Does the frequency of monitoring still seem appropriate?

Were Precision and Power Objectives Met (for Sampling Situations)?

After analyzing the pilot data, you may discover that you need many more sampling units than you planned to achieve the standards for precision, confidence, and power that you set in your sampling objective (see Chapter 14). You have six alternatives:

1. Reconsider the design. The pilot study should improve your understanding of the population's spatial distribution. Will a different sampling-unit shape or size improve the efficiency and allow you to meet the sampling objective within the resources available for monitoring?
2. Reassess the scale. Consider sampling only a single management unit or perhaps only one or a few macroplots.
3. Lobby for additional resources to be devoted to this monitoring project. Power curves such as those shown in Chapter 7 may help to graphically illustrate the tradeoffs of precision, power, and sampling costs for managers (Brady et al. 1995).
4. Accept lower precision (in target/threshold objectives) or larger levels of minimum detectable change (in change/trend objectives). It may be prohibitively expensive, for example, to be 90% confident of being within 10% of the estimated true mean, but it may be possible to be 90% confident of being within 20% of the estimated true mean using available monitoring resources. You may not be able to detect a 5% change with a power of 90%, but you may be able to detect a 10% change.
5. Accept higher error rates. You may not, with the current design and expenditure of monitoring resources, be 90% certain of detecting a specified change, but you may be 80% certain. You may have to accept a 20% chance that you will make a false-change error, rather than the 10% level you set in your sampling objective. You may not be within 10% of the estimated true mean with a 95% confidence level, but your current design may allow you to be 90% confident of being within 10% of the

estimated true mean. Look at the results from your pilot study, and consider whether the significance levels that can be achieved with the current design are acceptable, even though the levels may be less stringent than you originally set in your sampling objective.

6. Start over. Acknowledge that you cannot meet the sampling objective with reasonable precision or power within the budgetary constraints of the project.

The results from the pilot period should be reported even if your design and project require significant revision. Your audiences for this report would include all those who reviewed your initial project proposal or monitoring plan. A report to managers is especially important to describe the recommended changes in design. Your report is also important to your successor and possibly other ecologists or botanists who work with similar situations or species. Reporting failures of techniques will help others avoid similar mistakes.

Assessing and Reporting Results After the Pilot Period

Three possible conclusions result from a monitoring study: 1) objectives are (being) met; (2) objectives are not (being) met; or 3) the data are inconclusive (see Chapter 9 for interpretation of statistical analyses). The pilot period should eliminate the problem of inconclusive results caused by a poor design, but such results may occur even with an excellent design.

Objectives Are Met

Two management responses should result for objectives that have been met. First, the objective should be reevaluated and changed based on any new knowledge about a species and population. Second, both management and monitoring should be continued, although the latter perhaps less frequently or less intensely.

It is important that monitoring does not automatically stop when objectives are first met. Measured success over short time frame may not be related to management, but simply a lucky correlation of an increasing population size or a condition within the management period that is caused by unknown factors. Fluctuations in population size caused by weather can give the appearance of success, especially with annuals and short-lived perennials. If monitoring data shows stable or increasing trends, you may scale back the frequency and intensity of monitoring, but do not consider the job done and ignore the population or species permanently. Current management may in fact be detrimental, but its negative effects masked by fluctuations related to weather. In addition, conditions change— weeds invade, native ungulate populations increase, livestock-use patterns change with the construction of a fence or water trough, and recreational pressure increases. All these things and more may pose new threats.

Objectives Are Not Met

As described in Chapter 1, according to the adaptive-management approach, failure to meet an objective should result in the change in management that was identified as the management response during the objective development phase (see Chapter 14). Rarely, however, is resource management that simple. We need to remember that the inertia that resists changing management is very difficult to overcome. Managers will generally continue implementing existing management, the path of least resistance, unless monitoring or some other overriding reason clearly indicates a change.

Unfortunately, the data from most monitoring will not conclusively identify causes of failure to meet objectives or the corresponding corrective action (see the discussion on monitoring versus research, Chapter 1). The biologist who is monitoring the population may feel confident of the cause, but decision-makers may be uncomfortable making changes in management, especially unpopular ones, that have a basis only in the biologist's professional opinion.

Thus, the most common response in land-management agencies is to first reevaluate the objective. Was the amount of change too optimistic and biologically unlikely? Was the rate of

change too optimistic? While such assessment is necessary, it can too often result in changing the objective rather than implementing necessary management changes.

This scenario is extremely common, but often may be avoided by two techniques. The first is to articulate the management response along with the management objective (as suggested in Chapter 14). This clearly states the response to monitoring results before monitoring is even started. It represents a commitment by the agency to stand by its monitoring results and to use them to adapt management. The second technique is to reach consensus among all interested parties concerning the monitoring and the management response before monitoring data are collected (Johnson 1993).

You should analyze results of monitoring each year (or each year data are collected) and report them in a short summary. Analyzing data as soon as they are collected has several benefits. The most important is that analysis is completed while the field work is still fresh in your mind. Questions always arise during analysis, and the sooner analysis takes place after the field work, the more likely you can answer those questions. You may also find after analysis that you would like supplementary information, but it may not be possible to collect this in the middle of the winter or 5 years after the monitoring data were collected. You will have lost a valuable opportunity. Analysis after each data collection episode also means that you will assess the monitoring approach periodically. Although many problems will surface during the pilot period, some may not until after a few years of data collection. Periodic assessment ensures a long-term monitoring project against problems of inadequate precision and power and problems of interpretation.

Final Monitoring Reports

At the end of the specified monitoring period, or when objectives are reached, you should summarize the results in a formal monitoring report (Box 15.3). Much of the information needed for the report can be lifted directly from the monitoring plan (Box 15.2), although deviations from the proposed approach and the reasons for them will need to be described. The final report should be a complete document, so you should include all pertinent elements from the monitoring plan. You can either cut and paste electronically from the monitoring plan or simply append the report to existing copies of the monitoring plan. The preparation of the report should not be a major task. If you have been completing annual data analysis and internal reporting (as you should), summarizing the entire monitoring project should be straightforward.

Completing the monitoring project with a final formal report is important. This report provides a complete document that describes the monitoring and its results for distribution to interested parties. It provides a complete summary of the monitoring activity for successors, avoiding needless repetition or misunderstanding of the work of the predecessor. Finally, a professional summary lends credibility to the recommended management changes by presenting all of the evidence in a single document.

If the results would be interesting to others, consider sharing those results through a technical paper or symposium proceedings. Much of the preparation work for a presentation has already been done with the completion of the monitoring plan and monitoring report documents. Sharing the results has three important benefits: 1) it increases the audience, possibly helping more people and improving other monitoring projects (similar problems, similar species, etc.); 2) it increases the professional credibility of the agency or organization that conducted the monitoring; and 3) it contributes to your professional growth.

MANAGEMENT IMPLICATIONS

Successful monitoring projects are part of an adaptive-management cycle. To function within that cycle, monitoring must be technically defensible, consistently implemented to completion, and applied to decision-making. Communication with all parties facilitates the development of

Box 15.3. *MONITORING REPORTS*

I. Introduction

II. Description of ecological model

III. Management objective(s)

IV. Monitoring design
- *A. Sampling objective*
- *B. Sampling design*
- *C. Field measurements*
- *D. Timing of monitoring*
- *E. Monitoring location*
- *F. Intended data-analysis approach*

V. Data sheet example

VI. Responsible party

VII. Funding

VIII. Management response to potential results

IX. Summary of results

Include tables and figures communicating the results, as well as general natural history observations.

X. Interpretation of results

Describe potential causes for the results observed, sources of uncertainty in the data, and implications of the results for the resource.

XI. Assessment of the monitoring project

Describe time and resource requirements, efficiency of the methods, and suggestions for improvement.

XII. Management recommendations
- *A. Change in management*
  Recommend changes based on results and the management implications identified in Section VIII.
- *B. Change in monitoring*
  Analyze costs versus information gain, effectiveness of current monitoring system, and recommended changes in monitoring.

XIII. References

Include grey literature and personal communications.

XIV. Reviewers

List those who have reviewed drafts of the report.

management objectives, the design of the monitoring study, and the interpretation and application of the monitoring data. Failure to include stakeholders in development of a monitoring project generally results in failure of the adaptive-management cycle. Monitoring plans are effective tools for communication, both among stakeholders and among internal specialists. Monitoring plans represent a commitment to completing a monitoring study and using the data. They also ensure that monitoring design specifications are not lost as a result of personnel changes. Monitoring reports are important tools for summarizing and disseminating results.