Figure 3–145—Tracking percent survival is easier if the site broken into smaller units, such as the area between checkdams. This project was at Lake Mary in the Alpine Lakes Wilderness, WA.

an indicator that a site may be on its way to becoming self-maintaining.

Factors such as ongoing erosion, effectiveness of erosion-control structures, and effectiveness of barriers should be monitored. An effectiveness monitoring protocol also should consider whether use has been displaced, and if so, what the impacts of the displaced use might be. Use may shift locally, to other nearby locations, or to areas farther away.

Other Monitoring Design Considerations

In some cases, information such as percent cover by species may not be important. A project may aim simply to eliminate human use and allow natural recovery. In that case, the percent screening between the work site and a passing trail may be the best indicator of success. On the other hand, if a project aims at true ecological restoration, technical factors, such as soil bulk density or litter depth, may be better indicators of success.

In projects that do not aim for full restoration in the short term, monitoring may be best designed with incremental objectives in mind. For instance, rebuilding soils or soil structure may be a more attainable goal than reestablishment of natural vegetation. In such projects, monitoring the depth of trail erosion (or the level of deposition behind checkdams) might be indicators of success. In other cases, qualitative measures could be used as indicators of success—perhaps simply monitoring public compliance with “Keep Off” signs, or monitoring the reappearance of fire rings or litter.

Some projects may focus on eradicating weed species or altering vegetative composition. The percentages of different species growing on the site, or the mere presence of certain species, may serve as the best basis for monitoring. Projects that transport plant material or soil into the wilderness should always include some monitoring for the accidental introduction of nonnative species.

In any case, the project’s goals and objectives should determine the levels and methods of monitoring used. Although many projects will focus on effectiveness monitoring, some combination of implementation, effectiveness, and validation monitoring is desirable.

3.13.3 Establishing Monitoring Procedures for a Project

Solicit interdisciplinary input when establishing procedures for monitoring (figure 3–146). For validation monitoring, consult trail maintenance and design specialists, wilderness specialists, hydrologists, engineers, botanists, recreation planners, NEPA specialists, or others with technical backgrounds.

Figure 3–146—Three separate attempts have failed to restore this wilderness campsite. Monitoring can help us learn from our failures as well as our successes.

For effectiveness monitoring, consult resource specialists with direct working knowledge of the site and the project's physical and social objectives, such as botanists, ecologists, wilderness rangers, soil scientists, range conservationists, and others with similar expertise. Workers with hands-on field expertise need to be involved, because effectiveness monitoring tends to be the most detailed and take the most time of the three types of monitoring.

3.13.4 Incorporating Monitoring Into a Project

Project monitoring will help determine whether the site restoration goals have been met.

Planning Phase

A critical aspect of monitoring is the need for feedback to be provided in sufficient detail and in a timely fashion. Validation monitoring may begin during a project's initial planning stages. If a project's costs or its logistical problems begin to seem unreasonable, it may be necessary to reexamine standards and guidelines that mandate the proposed action. As a project progresses and implementation and effectiveness monitoring are taking place, validation monitoring should be used to ensure that policy matches reality. Validation monitoring can contribute to policy change at high levels that can save large amounts of work time and funds.

Implementation Phase

While validation monitoring may continue throughout the project's life, implementation monitoring becomes key during all phases with on-the-ground work. Implementation monitoring should guide daily work schedules, ensuring high-quality results. Implementation monitoring must be ongoing with a short response time, enabling crews to adjust their work methods and allowing project leaders or contract administrators to make corrections to schedules or specifications as needed. Remember that the goal of implementation monitoring should be to ensure that objectives are met, not to analyze why they were not.

Implementation monitoring includes documentation of the work accomplished: location of restoration sites, stabilization treatments, soil treatments, planting treatments, plant protection measures, signs, and so forth. Photopoints should be established that document conditions before work began, and after the treatment is in place. These photopoints will continue to be used as part of effectiveness monitoring.

As part of implementation monitoring, consider having crews keep a daily journal of work activities and other useful observations. For example, if crews keep track of how much time they spend on each component of their work, the records will help you judge the accuracy of your original budget estimates. Consider incorporating additional information in the journal. This information might include daily encounters with visitors, campsite occupancy data, or even wildlife sightings. A well-kept field journal can help answer questions years after a project has been completed (see figure 3–143).

Followup and Maintenance Phase

Effectiveness monitoring may begin while the project is being implemented. However, the most important factor when incorporating effectiveness monitoring is to think long term (figures 3–147a, 147b, 147c, and 147d). Restoration often

spans many years or decades. A project that appears to be an immediate success or failure may not be over the long term. Effectiveness monitoring may be done annually, on a 3-year rotation, or over even longer intervals. Annual monitoring may be appropriate during the early years of a project, but monitoring may be scaled back during later years. In all cases, effectiveness monitoring should be done in a fashion that allows managers to respond to problems with project design and to improving or deteriorating conditions.

This series of photographs documents 8 years of progress during restoration of one of the two trails accessing Lake Mary in the Alpine Lakes Wilderness, WA. The restoration crew installed rock steps on the open portion of this trail that is used only by hikers. The other half of the trail was restored using checkdams, fill, greenhouse-grown transplants, and an excelsior erosion-control blanket.

Figure 3–147a—A high school student had the pleasure of planting the plants he grew for his senior project.

Figure 3–147b—The erosion-control blanket is the most obvious sign of restoration in this 1995 photo.

Figure 3–147c—Conditions were still good in 1997. Two rock steps had come loose and needed fixing or replacement. Plants were surviving and erosion was largely stabilized. A second application of erosion-control blanket would be beneficial.

Figure 3–147d—By 2002, the rock steps really needed some help. The vegetation continued to mature and fill in. Other plants seeded themselves from the nearby meadow and had become established.

Monitoring Methodologies

Monitoring methodologies range from taking simple qualitative observations to more complex quantitative measurements. Design your methods based on the questions you need to answer and the resources available to accomplish the work. It helps to break restoration sites into smaller units for documentation and monitoring. For example, you might keep track of the number of plantings between each check-dam, with the checkdam serving as a reference point. Appendix E, *Forms*, contains sample forms you can modify when designing your own approach.

A simple approach is to notice and document obvious factors that contribute to the project's success and trends that point toward recovery or failure. Most wilderness restoration projects are so small that the entire site can be evaluated. Sample questions might include:

- Is water flowing around or through the site as planned?
- Are erosion-control measures working?
- How many transplants have survived?
- What seeded species have become established?
- Which species have volunteered?
- What is the overall vigor of each species? Are the plants stunted? Discolored? Flowering? Fruiting? Spreading? Is an additional treatment needed to improve plant health?
- Are plants being disturbed by animal activities such as herbivory? Do such problems need to be mitigated with an additional treatment?
- Are sites being disturbed by human activities? Does this disturbance need to be addressed through further engineering, education, or enforcement?
- Are signs and barriers still in place?
- Does the site include any introduced plant species (weed them out!) or diseased transplants?
- What are the changes in species composition?
- What is the percent ground cover? Canopy cover?
- Are plants at the prescribed stocking levels? Do you need to plan for additional plantings?

Some projects might require more detailed methods of monitoring. Techniques that have been used to measure species composition and percent cover include line-intercept transects, radial transects, and quadrats (Potash and Aubry 1997; Redente 1993; Rochefort 1990). Projects outside wilderness might use engineered structures to measure active erosion. Some projects may track individual plantings. Larger projects will require a sampling procedure (figure 3–148) rather than a complete census. An ecologist and statistician can help you design appropriate protocols.

Figure 3–148—Wilderness research scientist David Cole, coauthor of this guide, goes to extraordinary lengths to prevent further impact to vegetation while counting plants during a study in the Eagle Cap Wilderness, OR.

Designing and Analyzing Vegetati Sampling Procedures

Two standard texts explaining vegetative sampling dures may help:

- *Aims and Methods of Vegetation Ecology* by Meuller-Dombois and Ellenberg (2003) is the classic text on selecting and implementing an appropriate vegetation sampling technique based on your analysis goals. Fortunately, this text was recently brought back into print.
- *Statistical Ecology: A Primer on Methods and Computing* by Ludwig and Reynolds (1988) is a good companion to the previous text that will help explain the statistical basis for applications of ecological sampling.

The Bureau of Land Management has an excellent free publication, *Sampling Vegetation Attributes* by Coulloudon and others (1999), that can be ordered hard copy or downloaded from *http://www.blm.gov/*

Recording and Reporting Monitoring Results

When designing the monitoring for a restoration project, include concrete steps that will be taken to manage and report on the data collected through the monitoring process. Think ahead to consider how monitoring results may be a catalyst for changes in policy, ongoing management of your project area, or the design of future projects.

Information related to validation monitoring should be passed along to appropriate decisionmakers or planning staff. Any significant discrepancies found through validation monitoring could be included in annual forest plan monitoring reports or similar reports that will bring these situations to the attention of others.

Information pertaining to implementation monitoring needs to be acted on promptly. Problems should be identified and explained to contractors or work crews, noted in work logs or inspection reports, and dealt with in a manner that will ensure situations are corrected before further loss of productivity or project quality. It is important to document the findings of implementation monitoring properly, but it is perhaps more important to relay those findings in a timely manner to persons responsible for implementing the work.

Data collected during effectiveness monitoring may be the most difficult to analyze, requiring technical skills and a long-term vision of how project objectives will be met. Because data collection will be ongoing in most cases, it may be wise to develop a database (or at least a good filing system) for data that will accumulate over several years. The data should be summarized periodically and used in planning maintenance of this project or similar projects. Summaries of this kind of data will be especially useful to those developing budgets and work plans or to resource specialists involved in restoration. Consider making this data more widely available to researchers and practitioners of restoration. Refer to appendix D, *Case Studies*, for an example of a monitoring report.

Monitoring Summary

A key element to any restoration project is developing a monitoring process. Monitoring should be thought of in terms of the three types: validation, implementation, and effectiveness monitoring. The monitoring process should be tailored to the objectives and scope of the project, as well as to the ecological and vegetative components of the site. Technical help from specialists should be used to develop specific procedures for each project. If the true benefits of monitoring are to be realized, data from monitoring must be analyzed, summarized, and reported to appropriate personnel.

3.14 Project Maintenance

Plans for restoration projects should include time and money for maintenance. Identifying funding can be tricky, because a restoration project may have a special project funding source that ends once the initial work has been completed.

Based on either formal or informal observations and monitoring, you will determine whether your treatments are likely to succeed. If the desired plant species are thriving, soils are stable, and the signs and visitors are in the proper places, you can jump for joy and walk away. But some of your treatments may need additional work to address ongoing erosion, lack of plant vigor, or ongoing impacts from human use.

Because of high turnover among seasonal staff, new employees may take over a long-term maintenance program. It is important to document the site-specific maintenance tasks in an action plan, including any specific concerns and where signs need to go. Otherwise, your new wilderness rangers will visit your project area and be unable to spot details that need attention.

3.14.1 Site Management

Site maintenance might require ongoing treatments (such as irrigating and mulching plantings, or amending the soil), repairs, or even modifications to the treatment.

3.14.1a Irrigation

Plantings may need several years of watering before deep root systems become established. Unless plantings are watered by hand, irrigation systems will need regular inspection to fix leaky, broken, or malfunctioning components. An irrigation log should be kept to document the amount and frequency of watering.

The Respect the River program on the Okanogan and Wenatchee National Forests has a unique approach to getting this job done—restoration sites have a small sign inviting forest visitors to help out with watering! This approach seems to be working and helps visitors become part of the solution (figure 3–149).

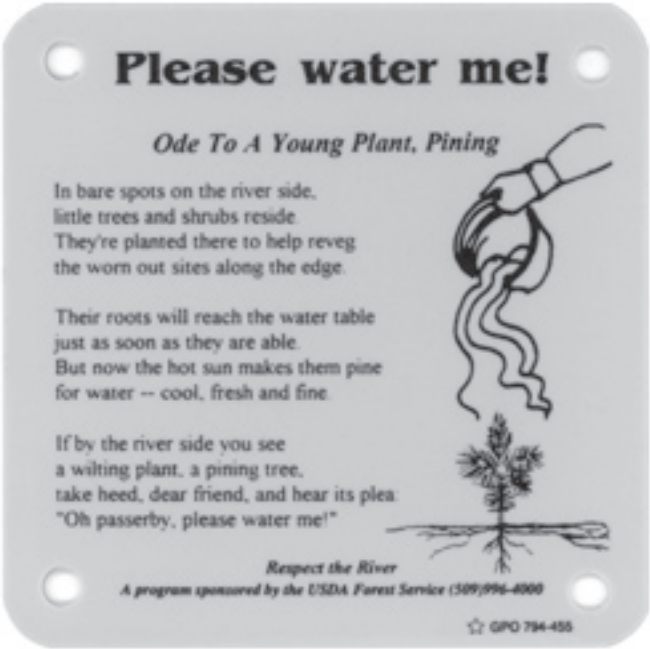

Figure 3–149—Visitors can help with watering if they are encouraged to do so.

3.14.1b Mulching

Depending on the material, mulch loses its effectiveness after a few years. Unless plantings have become fairly well established by then, a new layer of mulch may have to be added to preserve soil moisture and to provide protection from the elements.

3.14.1c Soil Amendments

If plantings look stunted or discolored, this may be a sign of a nutrient imbalance. A feeding of nitrogen may be needed because nitrogen disappears rapidly from the soil. Until the site has an adequate supply of litter, native nitrogen sources may be lacking. See section 3.2.3c, *Amending Altered or Depleted Soils*, to determine an approach that is appropriate for your site.

3.14.1d Stabilizing Erosion

Ongoing erosion damage could take many forms, requiring different solutions. Running water may be causing further damage to a restoration site, or perhaps your attempts to move water away from your site have created a new problem somewhere nearby. Maintenance work might include directing water away from a site, spreading water out more effectively across a site, repairing malfunctioning erosion-control structures such as siltbars or checkdams, adding structures to slow water and collect silt, or adding mulch.

3.14.1e Wildlife Damage

Structures put in place to prevent animals from eating plants may need to be repositioned or replaced. Nutrient-rich plantings can be attractive to animals. Ants can march away with all your seed. Section 3.12, *Plant Protection and Establishment*, offers suggestions for managing these problems.

3.14.1f Frost Heave

Some plantings may be forced out of the ground by frost. If the plants are still alive, they will need to be reset. Set plants back into a shallow depression and firmly compress the soil around each plant. Additional mulch also may be applied to prevent frost heave.

3.14.1g Interplanting or Replanting

Additional plantings may be necessary if goals for the desired abundance and species diversity have not been met. But this problem may be an indicator that Mother Nature has different ideas of what is feasible than you do. Before replanting, work with your team to figure out what went wrong and how it might be corrected. The *Limiting Factors* chart in appendix A, *Treatments To Manage Factors Limiting Restoration*, will help you think through such problems.

Here are some examples. Perhaps the reference community is not appropriate for your site—a plant species only found in open meadows may not survive in shade (The author speaks from experience!). Perhaps you were trying to move toward the reference condition too quickly and need to start with early successional species. Perhaps the plant stock type was not well suited to your site. The list goes on and on. If a planting has failed to perform, do your best to figure out why, devise a new strategy, and replant.

It may be that adding additional species would help meet the reference community's plant structure. Try direct sowing seed onto your site during the same period when seed would fall to the ground naturally, or use other onsite propagation techniques. You may need to collect additional plant material for propagation offsite.

3.14.1h Exotic Species

Be sure to have a botanist or someone else who can recognize wayward plant species visit your site. Weed out any exotic species! Record their loathsome presence in your monitoring logs, and try to determine how they got into the wilderness. Chances are the invaders stowed away with plant materials or soil brought in from offsite. Or you may have released dormant seed from the soil's seed bank when you loosened and watered the soil.

One helpful tool is a weed finder—a little field guide with colored photos of potential weed species for your site (figure 3–150). Include photos of plants at different life stages—seedlings, plants in flower, and plants in fruit. This guide might include any nonnative plant species found

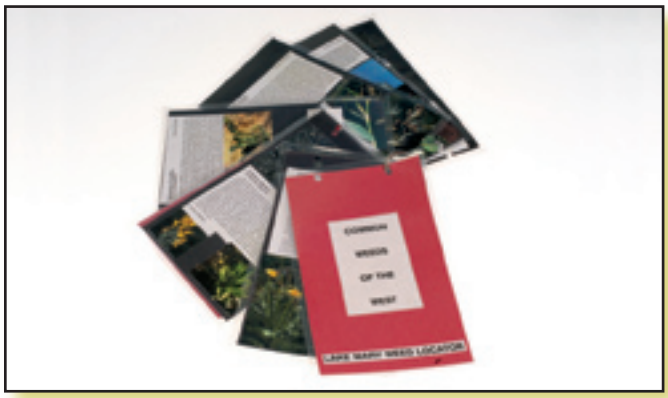

Figure 3–150—Site monitoring and maintenance require careful attention to spot introduced plant species. An area-specific weed finder depicting nonnative species that may have been stowaways on plant stock or other materials will help members of your crew.

growing near where your plant materials were propagated and stored. It should also include any weed species known to be in that portion of the backcountry or at the trailhead. This weed finder will be a tremendous asset to anyone who checks the site but lacks botanical expertise.

3.14.2 People Management

Managing continuing recreation use of the area is another part of the maintenance battle. Your goal is to concentrate the use where you want it and to keep the use off of your fragile restoration site.

3.14.2a Signs

Signs need to be maintained until they are no longer needed. Just one group tying stock up in your restoration site might undo thousands of dollars of backbreaking work in two quick hours—the voice of experience again. If your project is in a remote area, but not in wilderness, it may be helpful to lay in a small stash of extra signs there, or to have visiting personnel carry extra signs so problems can be remedied when they are spotted.

At some point, use patterns at a project site may have established themselves so that the signs are no longer needed. For example, it is more important to keep signs at the site when plantings are small than after they have become established. If you take signs down, monitor your success fairly soon to determine whether they may need to be replaced.

3.14.2b Barriers

It may be necessary to maintain or add barriers to keep folks where you want them. Some barriers may get rearranged or carted off. Perhaps they just weren't big enough in the first place.

3.14.2c Replacing Structures That Fail

Structures installed to check erosion, or to harden campsites or trails, can fail. It may be necessary to reposition or replace some of your work.

3.14.2d Maintaining Social Trails

Part of your planning effort was to figure out which social trails to keep. Provide these trails with enough maintenance to keep use on the trails, and off fragile vegetation. This may mean providing drainage, cutting brush, cutting fallen logs (figure 3–151), or maintaining barriers.

Figure 3–151—The restored trail to the left was recovering quite well until the heavily limbed subalpine fir fell across the main social trail to the right. Because the fallen tree was on a social trail, it wasn't included in the maintenance contract in the Alpine Lakes Wilderness, WA. Wilderness personnel removed limbs with a pruning saw, hoping to redirect use onto the proper trail.

3.14.2e New Impacts Caused by Displaced Use

Preventive maintenance should be done quickly if impacts shift to other locations. For example, users may decide to start new campsites, or walk across vegetated areas, forming new trails. It may be necessary to implement a variety of strategies to absorb the change appropriately, or to stop the damaging practice.

Reassessing the Minimum Tool

Sometimes, creating an unnatural appearance can help stabilize or close a restoration site (figure 3–152). Signs may need to be heavy handed at first to gain user compliance, but signs don't need to be on every closed area once vegetation discourages use. Perhaps a facility, such as a hitchrack, was provided to concentrate impacts but use patterns or improved user choices had made it unnecessary. Consider when it may be appropriate to peel back some of the obvious signs of the restoration work so your efforts become "substantially unnoticeable," meeting the intent of the Wilderness Act of 1964.

Figure 3–152—Use was shifted off this fragile meadow onto a hardened surface by laying a row of rock to block the trail and building cairns on the alternate route. About 30 years later, vegetation has grown in between the rocks, but the rocks themselves create an unnatural appearance. About half the rocks were removed and the resulting divots were filled with soil to protect exposed roots. Someday, perhaps the remaining rocks can be removed from this restored trail at the Enchantment Lakes in the Alpine Lakes Wilderness, WA.

3.14.3 Scheduling Maintenance

In general, maintenance needs to be more intensive during the first few years after a project while problems are being addressed and new plantings are gaining a toehold. Afterward, maintenance may become more periodic. Keep in mind that even something as simple as a missing sign can have great consequences.

It is important to visit restoration sites when runoff is at its peak to assess erosion problems. If the public frequents the area during snowmelt, it is important to assess potential problems then. It also is a good idea to check restoration sites during peak-use periods when crowding can lead to problems. If ongoing irrigation is critical to the project's success, the site needs to be visited during droughty times of the year.

3.14.4 Concluding Thoughts on Maintenance

Restoration work requires long-term maintenance. While the intensity of maintenance tapers off with time, most projects require upkeep for many years, if not decades. Remember to leave good tracks for those who follow in your footsteps, and have fun and stay humble in your role as wilderness guardian.

Chapter 4

Restoration Program Development and Support

Even with volunteer assistance, restoration programs require a big commitment of our corporate energy and funding. This section discusses ideas that will help you build your program. Most Forest Service wilderness restorationists do not have a consistent program, but lurch from project to project as funding or other opportunities present themselves.

4.1 Funding, Workforce, and Partnerships

There is no magic funding source for wilderness restoration projects—roll up your sleeves and figure out your best options. Networking with other wilderness restorationists will help you see how they plan their budget and workforce. Let your allies know what you are seeking; you may gain ideas from other specialists or citizen advocacy groups. Learn by doing—keep good records of your costs, including the hidden costs such as your staff time, to refine future project planning.

4.1.1 Funding

If you are lucky, you are planning a restoration project that already has some funding. It's more likely that you will need to seek out sources of funding and leverage your limited budget with volunteer labor (figure 4–1). Small projects can be accomplished with your existing workforce using appropriated dollars to cover a few material costs. Obtaining additional funding can be discouraging—the Forest Service has no readily available pot of funds for wilderness projects. Many units seek outside funding sources, such as grants for their projects.

Figure 4–1—Two teenage volunteers on a Student Conservation Association high school work crew pause while hauling fill.

4.1.1a Forest Service Sources of Funding

Recreation—If the impacts you are treating are related to recreation, the recreation budget is an appropriate funding source.

Recreation Fee Dollars—The national recreation fee programs may allow funds to be used for restoration projects. If your local fee program's business plan allows for restoration, you may be able to lobby for some funding.

Capital Investment Program (CIP)—Wilderness restoration projects can be submitted to the CIP program. There is no telling what year (or decade) your project will

rise to the surface for funding. But this is a nice funding source when it comes through, because the funding is in place for several years.

Soil and Water—If the impacts at your project location are contributing sediment to streams with native species of fish, approach your fish biologist or hydrologist about tapping into soil and water funds.

Knutson-Vandenberg (KV) Act Funding—Outside wilderness, a restoration project may be part of the mitigation from a timber sale, such as restoring a logging landing back to a trailhead. Include this mitigation in the timber sale decision and make sure it is included in the KV plan. Be forewarned that "nonessential" KV items often remain unfunded.

4.1.1b Other Funding Sources

Federal agencies are not eligible to compete for many grants, but you may be able to partner with a not-for-profit organization, such as a native plant society, to help acquire funds. Some States have grant programs that fund a variety of improvement or restoration projects on public lands. If you apply for grants, develop your proposal to give you as much latitude as needed. For example, if you only include labor and materials in your grant, you may not be able to fund important aspects of your program, such as planning, transportation, and equipment. Your local library may have information on sources of grants for restoration projects.

4.1.2 Budgeting

Project planning is the first cost incurred in a restoration project and can be the most difficult to fund. It may be possible to attract the help of kind-hearted specialists pining for a wilderness trip.

In general, the project implementation budget is developed based on materials, equipment, and labor. You may also want to budget for training. Materials include items such as plant materials, erosion-control materials, soil amendments, and signs. Equipment will include any tools, camping supplies, and items needed for transporting materials or workers.

For projects outside wilderness, labor costs are often relatively low because of the efficiency of motorized equipment and large machinery. In wilderness, labor costs are much higher, but can be offset with volunteer labor. Don't be surprised when a task takes far longer than envisioned. For example, if your crew is using buckets to collect soil for fill, it may take up to a week to collect enough soil to restore one site or closed trail.

The following box lists potential budget items. While this list is not exhaustive, it will help you think of a variety of costs. Keep in mind that it is far more efficient to overprepare than to be underprepared. Having a thorough site assessment and restoration plan will make the budgeting process fairly easy. Planning also helps to set priorities for each component of the project so that the most important portions of the project are finished first, an important factor if funds run short and the project cannot be completed.

Items To Consider Including in a Restoration Project Budget

This summary is based on Belnap and Furman (1997) and St. John (1995).

Planning Phase

- Collecting and analyzing wilderness inventory or monitoring data.
- Site assessment (personnel wages and per diem, soil samples, species lists, mapping).
- Developing a proposed action and site prescriptions.
- NEPA analysis and consultation with other agencies.
- Developing a budget and procuring funding.
- Recruiting labor.
- Training.

Implementation Phase

Transportation costs: May include stock, vehicles, helicopters.

Labor costs: May include volunteer stipends and housing.

Plant material collection: The main cost is travel time. It may be necessary to make several trips at the proper time for each of the species being collected.

Plant propagation: First-year plants may cost 55 cents to $2. Larger plants will cost considerably more. Additional costs may include delivery, seed cleaning, seed testing, seed storage, and plant holding costs. Mt. Rainier National Park estimates the full cost of propagation to be $4 per plant.

Tools

- Buckets
- Come-alongs
- Gardening forks
- Gloves
- Hand pruners
- Hardhats
- Kneepads or kneeling pads
- Log carriers
- Loppers
- Mallets
- McLeods
- Pick hoes or trowels
- Picks
- Rebar
- Rock bars
- Safety glasses
- Saws
- Shovels
- Sickles
- Sledge hammers
- Soil thermometers
- Tree spades
- U-bar diggers

Site stabilization and preparation: Retaining devices such as logs or rocks, fill material, topsoil, soil amendments, and plastic sheeting.

Camping equipment: Any additional gear that will be needed, plus replacement for items that will become unusable because of wear and tear. Crews that are out for a long time will want larger tents, perhaps a screened tent, and a means of storing food away from critters. In colder, wetter climes, a portable heater, such as a propane heater, will help to dry out wet gear from day to day. Wet weather is a strong possibility when planting during the rainy season.

Site protection and plant establishment:

- 2- by 2-inch (50- by 50-millimeter) stakes
- Barriers
- Devices to prevent animals from eating seed or seedlings
- Erosion-control blankets
- Fertilizer
- Irrigation devices
- Jelly-roll fabric
- Parachute cord
- Plant tubes
- Rooting hormone
- Shade cards
- Signs
- Shade cloth
- Transplant shock fluid (Upstart)
- Wire staples (for securing erosion control blankets)

Crew training: This could vary from on-the-job training to sending crew members to restoration workshops or having them visit successful restoration projects.

Monitoring and Maintenance

Provide regular monitoring and maintenance for several years after implementation and at less frequent intervals afterward. Also provide public contact and enforcement.

Ongoing maintenance supplies: signs, erosion-control materials, tools, and possibly fertilizer (until an organic soil layer is reestablished).

4.1.3 Workforce

If you do not have a restoration program in place already, it will take a little extra effort to develop your workforce. Skill development begins during the planning phase—take the time to educate your team if they haven't already been involved with restoration projects. Team members will benefit from reading this guide and other literature relevant to your habitats and plants, by listening to talks by other successful restorationists, and by attending a restoration course. You might consider inviting restorationists to provide training or present a case study for your team and work crews.

Don't just assume that the trail crew or wilderness crew will make a good restoration crew, although they certainly will have good skills to contribute. It helps if your restoration crew has lots of perseverance. The work goes slowly and is hard on the back and knees (figure 4–2) because of all the bending and kneeling. The crew needs an eye for detail, precision, and thoroughness in tasks such as installing erosion-control features, identifying plant species, and transplanting plants. The crewleader needs to have good technical skills, be good at quality control, and work well with people. Crewmembers with a background in gardening, landscaping, or working with plants are good choices. Folks more interested in moving through a project quickly are not good choices. Even motivated workers may need a pep talk to get through the more monotonous or uncomfortable parts of a project.

Give the crewleader time to become prepared. Perhaps the crewleader was involved in the planning and already has ownership in the project. Consider sending the crewleader to a restoration training course at the Arthur Carhart National Wilderness Training Center in Missoula, MT. Other ways to increase a crewleader's skills include reading publications such as this guide, attending other restoration workshops (check with the Society for Ecological Restoration), and visiting other units with successful restoration programs. Take a reconnaissance trip to the restoration site with your crewleader so the leader clearly understands each aspect of the project.

Figure 4–2—All restoration projects include lots of uncomfortable bending and endlessly monotonous tasks—choose your crew carefully.

Once the crew is onboard, provide them with on-the-job training. Show them pictures of the various steps of the restoration process, and explain the principles involved in each step. Be sure to include any other expectations you may have for the project, such as practicing *Leave No Trace* principles, preventing further damage to the project site, working a split shift to beat the heat, or any other concerns. If your work crew is small, consider recruiting a larger group during the first few days to help move heavier items (logs and rocks) and to create a sense of momentum. Unless your project area is close to a trailhead, consider having the crew work long hitches to maximize the hours they spend working

on the project relative to the time spent in travel. If you aren't supervising the project yourself, be sure to at least visit while the work is underway for the sake of the crew's morale and to allow you to make any midcourse corrections that may be needed.

4.1.4 Partnerships

Lots of folks care about wilderness and restoration of damaged wild places. Project dollars can be maximized and public good will can be enhanced by building partnerships. This section specifically discusses the role of volunteer partnerships. The next section discusses the use of professional services.

Volunteer relationships can be developed for any aspect of a project—from monitoring and planning, to growing plants, to project implementation and maintenance. Depending on the skill level of the volunteers, you will need to invest a considerable amount of mentoring, training, coordination, supervision, and quality control when working with them. Responsible, motivated, mature individuals are almost a prerequisite for restoration projects; avoid using the 1-day volunteer Scout or school group as your planting crew unless they already have a lot of ownership in the success of your project.

There are many ways to recruit volunteers. Tap into organizations in your area that enjoy service projects. Examples might include hiking clubs, the Back Country Horsemen, environmental clubs or organizations, and native plant societies. Many college students need internships. Interns could help during the various phases of a restoration project (figure 4–3). Also consider recruiting graduate students who need a thesis project. Build relationships with teachers or professors who might be a source of interns or graduate students.

Be creative and develop any natural alliances. For example, one of the wilderness rangers in the Selway-Bitterroot Wilderness is a retired school teacher from Iowa. She developed a partnership where teachers from Iowa receive continuing education credits for helping with wilderness restoration projects. The following section lists several national organizations that act as clearinghouses for volunteers.

Figure 4–3—Students fulfilling internships can be motivated restoration workers. If they volunteer, do your best to defray their expenses.

Volunteers need care and tending. Be sure they receive the rewarding experiences they are seeking. When recruiting volunteers, let them know how important their contribution will be to wilderness management. Provide for their basic needs by providing assistance with transportation, housing, and gear. Offer a stipend if you can.

Treat volunteers with the same respect you would a paid crew and be clear on relationships, including who is in charge

of a project. Handle differences of opinion or morale issues with good cheer. While volunteers are working on the project, arrange for site visits from dignitaries, such as the district ranger. If an assignment takes longer than 5 days, include free days for volunteers to take time off and explore or relax. Counsel students regarding career ladders and career options; offer to write letters of reference. Recognize the crew's accomplishments with nonmonetary awards, an end-of-project social event, and followup correspondence or pictures.

4.1.5 National Sources for Recruiting Wilderness Volunteers

Costs were based on 2003 price schedules.

American Hiking Society (AHS) Volunteer Vacations
1422 Fenwick Lane
Silver Spring, MD 20910
Phone: 800–972–8608
Web site: *http://www.americanhiking.org*
E-mail: *shearn@AmericanHiking.org*

Types of volunteer offerings: 1- or 2-week trips with an emphasis on trail work and shelter maintenance. This might work well for a trail relocation project where restoration of the old trail is part of the project design.

Agency expectations and costs: Free to the agency. The agency provides at least partial supervision (directing work) and transportation from the airport, as well as group cooking supplies, tools, safety equipment, two-way radios, and first-aid supplies. An AHS crewleader can be requested to take care of logistics such as menu planning, grocery shopping, and camp management.

Cost to volunteers: $80 for members and $100 for nonmembers, plus transportation costs.

Earthwatch Institute
3 Clock Tower Place
Suite 100, Box 75
Maynard, MA 01754
Phone: 800–776–0188
Web site: *http://www.earthwatch.org*
E-mail: *info@earthwatch.org*

Types of volunteer offerings: Trips are to conduct meaningful field research projects. Volunteer fees help fund the research. This program is designed to assist researchers who have less access to funding.

Agency expectations and costs: The agency provides a salary for principal research personnel. The agency provides food, lodging, and onsite transportation.

Cost to volunteers: Varies by project, ranging from $700 to $2,500. For example, an average 2-week trip costs $1,800. Food and accommodations are included in the cost.

Elderhostel
11 Avenue de Lafayette
Boston, MA 02111–1746
Phone: 800–454–5768
Web site: *http://www.elderhostel.org*
E-mail: *registration@elderhostel.org*

Types of volunteer offerings: While most of their trips are for educational purposes, Elderhostel does offer service trips (and backpacking trips).

Agency expectations and costs: The agency provides supervision and tools.

Cost to volunteers: Costs vary, but $115 per day appears to be an average. Limited scholarships are available.

Sierra Club Volunteer Vacations
85 Second St. 2d Floor
San Francisco, CA 94105
Phone: 415–977–5500
Web site: *http://www.sierraclub.org*
E-mail: *national.outings@sierraclub.org*

Types of volunteer offerings: Service trips run from 7 to 10 days and help with tasks, such as restoration, trail work, cleanup, and noxious weed control. The group will have a cook and a leader who handles logistics. Recreation days are part of each trip.

Agency expectations and costs: Free to the agency, although if funding is adequate, a stipend for volunteers is

appreciated. The agency directs the work, provides tools, and provides support to pack food, tools, and gear (participants carry their own personal gear).

Cost to volunteers: Varies by project, ranging from $375 to $500, plus transportation. Food is included in the cost.

Student Conservation Association (SCA)
689 River Rd.
P.O. Box 550
Charlestown, NH 03603–0550
Phone: 603–543–1700
Web site: *http://www.thesca.org*
E-mail: *rauger@thesca.org*

Types of volunteer offerings: Three basic program offerings have a variety of options with a variety of costs.

- SCA Conservation Internships—College students and other adults can volunteer for 12 weeks, 6 months, or 2 years to perform most types of resource management work, including wilderness restoration.

Agency expectations and costs: A 12-week internship costs the agency about $2,400. This cost varies, depending on transportation, uniform needs, and other incidental costs. The agency provides housing, training, supervision, gear, tools, and so forth.

Cost to volunteers: Volunteers receive a stipend of $50 per week for food and incidentals from the SCA and reimbursement of transportation and uniform costs. Students who complete their program may be eligible for an Americorps education grant.

- SCA Diversity Internships—This program is similar to the conservation internships, but actively recruits persons of color and women. A 12-week internship costs the agency about $3,175.
- SCA Conservation Crews—A high school work crew (figure 4–4) of six to eight students is supervised by two paid highly trained crewleaders. They live at the project site for 21 to 30 days, including a recreational trip (usually a backpacking trip) at the end of their study.

Figure 4–4—An impromptu team-building exercise for a Student Conservation Association high school work crew.

Agency expectations and costs: Costs vary, based on the crew size and the length of the assignment. For example, a two-leader, six-person crew costs $17,615 for 30 days. The agency provides assistance with transportation from the airport, a place to camp the first night, transportation of gear to and from work locations, tools, two-way radios, a food resupply, and periodic contact to coordinate with leaders, bring in mail, and interact with participants.

Cost to volunteers: Transportation (financial aid is available).

Wilderness Volunteers
P.O. Box 22292
Flagstaff, AZ 86002–2292
Phone: 928–556–0038
Web site: *http://www.wildernessvolunteers.org*
E-mail: *info@wildernessvolunteers.org*

Types of volunteer offerings: Generally, week-long trips with a focus on wilderness work, including restoration projects.

The a**gency expectations and costs**: No cost to the agency. The agency directs the work and provides the tools.

Cost to volunteers: Varies by trip, about $200 for a 7- to 10-day trip, plus transportation.

4.1.6 Using Professional Services

A variety of professional services are available to help you accomplish your restoration project goals. This section discusses potential resources beyond those of your team, including additional Forest Service expertise, skilled help available from other agencies or organizations, and contractors.

4.1.7 Learning From Others

Network to find out who has experience with restoration projects in environments similar to your own. If you can, find out the types of restoration prescriptions that work for them and the methods they use to propagate plants and plant them successfully. Visit their projects. Potential contacts include other Forest Service wilderness managers, employees of other agencies, such as the National Park Service or Bureau of Land Management, university professors, and research scientists. You may wish to consult with agency specialists who are not assigned to your team, such as a geneticist or fire rehabilitation specialist.

Contact managers of restoration projects in similar environments where native species may have been used to restore lands at ski areas, road projects, or visitor centers. Contractors and consultants are a potential source of information, but be sensitive in pressing for their trade secrets!

The Society for Ecological Restoration can steer you to members who live in your area. Your local native plant society can put you in touch with restorationists. A list of helpful organizations, along with their Web sites, is included in chapter 5, *Tools of the Trade and Other Resources*.

4.2 Options for Growing Plants

Very few Forest Service units have direct access to a greenhouse facility for propagating native plants. Fortunately, you have a number of options for working with professional growers. Don't be surprised if growers have not worked directly with your selected plant species—many wilderness areas are in environments very different from those with which they are familiar. Your grower may be learning by trial and error.

Supply the grower with any known propagation methods for your species. Explain your goals for genetic diversity, including any specific practice you prefer, such as not overcleaning seed, using all plants produced (without selecting just the superior plants), seed storage, and careful greenhouse management.

4.2.1 Forest Service Nurseries

Forest Service nurseries (figure 4–5) are diversifying their programs to include propagation of plant species other than trees. Discuss your project needs in advance because your project will not be the equivalent of a tree-planting

Figure 4–5—Forest Service nurseries have been producing a variety of native plant species in response to increasing demand.

operation. For example, dormant bareroot stock seedlings are planted in the spring, so Forest Service nurseries might want to deliver your plants at this time. Most subalpine or alpine restoration projects are more likely to be successful if they are completed in the fall right before the seasonal rain and snows.

4.2.2 Plant Material Centers

The Natural Resources Conservation Service has plant material centers located regionally. These centers are staffed by professionals who grow a wide array of native plants for restoration and reclamation projects. Their mission is to produce protocols for large-scale production. Normally, they do not grow plants for small applications, but in some locations they have been working with national parks to provide plants. Talk to other agency restorationists in your area to see if they have worked successfully with the plant material centers.

4.2.3 Other Agency Nurseries

Sometimes, other agencies have greenhouses (figure 4–6) and are happy to help grow plants. If you have a national park near your unit, see if it has a greenhouse. If it does, you may benefit not only from use of the greenhouse, but from networking with other restoration professionals.

Figure 4–6—Many national parks, such as North Cascades National Park, WA, have greenhouses with plant propagation staff. Park employees are a terrific source of expertise and sometimes are able to help out other agencies.

4.2.4 Contract Growers

Fortunately for restorationists, native plant nurseries are on the rise. Check to see if one is near you. Local nurseries may already have experience in working with your selected species. Often, a local grower is willing to experiment with propagating a small batch of plants at no charge to develop a successful propagation protocol. A restoration project may be the beginning of a long-term working relationship.

4.2.5 School Horticulture Programs

Many high schools (figure 4–7) and colleges have horticulture programs. They might consider becoming partners on your project at a cost savings to you. You may

Figure 4–7—After spending the better part of the school year propagating many flats of plants for 1 hour a day, this high school student was able to take part in the planting at Lake Mary in the Alpine Lakes Wilderness, WA.

only need to pay the cost of materials. Or the plants may cost slightly less than those grown commercially. Make sure an experienced teacher is supervising the project and that your goals for management of the plants are clear. Crop failures may be more likely when plants are grown in an instructional setting because of the lack of adult skills and conflicts with band field trips, spring break, and so forth. You might not end up with all the species and the genetic diversity that you planned for in your planting design. An advantage of this option is that it can create a wonderful learning opportunity for students.

4.2.6 Working With Contractors

Working with contractors can be an excellent means to accomplish all or part of a wilderness restoration project. Many contract restorationists can bring a wealth of expertise to your project.

This section will cover some general principles of contracting (Potash and Aubry 1997; St. John 1995). Check with your contracting officer or other units that use restoration contractors to obtain a sample contract so that you don't have to write one from scratch.

To find reliable contractors, check with sources, such as the Society for Ecological Restoration, local or regional native plant nurseries, your native plant society, other units with restoration projects, and your botanist. You can contract all or part of the project: project planning and design, seed and plant material collection, plant propagation, project implementation and outplanting, site maintenance, and monitoring. For instance, wilderness programs might contract for plant propagation, using a mix of project crews and volunteer labor to implement the project.

4.2.7 General Principles for Successful Contracting

Acquaint yourself with agency contracting guidelines. Each agency has strict procedures that must be followed, including the method of contracting (depending on the amount to be awarded), cutoff dates for submitting requests, and lists of interested contractors that must be notified of bid solicitations.

Work with your contracting office to make definitions, bid items, and other clauses as specific as possible. If items are vague, contractors automatically inflate their bids, raising project costs. In addition, bid-item contracts usually will generate lower bids than lump-sum contracts because the contractor will get paid for each component successfully completed. If your project is in wilderness or a remote setting, be clear about the difficulty of access and potential limitations on the types of tools, such as motorized tools or wheelbarrows. Most professional restorationists do not deal with small hand projects; they are accustomed to using large pieces of machinery (figure 4–8) to treat many acres.

Figure 4–8—Most contractors are accustomed to accomplishing their work with dozers, rippers, imprinters, tractors with drills, and water tenders.

Develop standards for weed control, pathogen and insect control, watering, and signs. Provide a format or forms for project documentation.

Address the things that might go wrong. Provide contingencies for propagation losses, late plant deliveries, bad seed lots, and natural disasters. Plan for ways to handle

excess plant materials that may be propagated—perhaps you will opt to buy up an agreed amount of plants and allow the contractor to sell the rest.

Develop your own cost estimates for each bid item. Reject the low bid if it is unrealistically low to deliver the desired result.

Include qualifications for contractors and their personnel to assure project success; qualifications may require previous experience in working with your plant species and in your environment. You may consider preparing a small contract, such as a procurement contract (for less than $2,500), to help a local contractor develop skills in working with your plant species and in your environment.

Performance standards need to be developed to measure success for each bid item. Put yourself in the contractor's shoes—you want your project to succeed, but if your standards are too stringent, you will drive your costs up or create an adverse situation for contract administration. Do your homework—ask other units what type of success can be expected during various stages of your project. For example, if a plant species is difficult to work with, you cannot expect a high rate of survival once seedlings are outplanted.

Sometimes the contract includes remedial measures. For example, if monitoring performed up to 2 years later reveals certain deficiencies in project installation, a contractor can be required to fix it. This can include replanting. If you forced the contractor to follow poor techniques, the failure may not be the contractor's fault.

Build checkpoints into your contract to assure that work is progressing as planned. Careful oversight by an inspector will prevent shoddy work. Adjustments can be negotiated along the way if needed, especially if difficulties arise in working with certain plants. Payments should be made at specified checkpoints, with a portion of the payment saved until the end to assure quality work.

Once a contract is awarded, you will have a prework meeting. If the contractor will be working in the field, be sure to express your expectations for the practice of *Leave No Trace* principles, adherence to wilderness regulations, and campsite locations. Contractors may think they are exempt from pertinent regulations such as restrictions on bringing dogs into the area, having an oversize group, living on public land, or having a campfire. Be sure to discuss any exceptions to regulations in advance and work out potential problems.

Chapter 5