19 Landscape Management Plans

Plans. You probably have some for the weekend … for the semester … for your life. The more complicated the plans and the longer the timeframe, the less certain that you can be that you will realize your plans. There is uncertainty, but to move forward without a plan, to manage haphazardly, probably will not allow you to reach a goal or a set of goals either for your life or for biodiversity.

ESTABLISHING GOALS

In order for society to achieve biodiversity goals, the filter approach (Chapter 18) or some other comprehensive approach must be described in a plan that is then implemented and monitored to ensure that the risk of losing species from a region is minimized. Plans must have goals. Goals are developed by the landowner, land manager, and/or stakeholders who have a vested interest in the future of the land. Goals are a reflection of the desires and actions of stakeholders, such as affected publics and nongovernmental organizations (NGOs). These goals usually reflect the priorities for ecosystem structure and composition, plant communities, and individual species, as defined in Chapter 18, and also by the economic, aesthetic, or cultural goals for the region. Although involving interested publics in plan development is imperative, under contentious circumstances, the initial investment in stakeholder involvement can be significant. In the long run, it is usually worth the effort.

Regulatory Goals: Although private forest landowners may have goals for their forests that are not driven primarily by biodiversity protection, they must still abide by federal and state laws (see Chapter 24). Some goals are prescribed in federal, state, and occasionally local policies. Probably the most powerful environmental protection law in the United States is the Endangered Species Act (ESA). The ESA is a species-by-species approach to addressing species at risk of being eliminated from all—or a significant portion—of its geographic range. Once listed, a species recovery plan must be developed, implemented, and monitored to provide the basis for recovery and removal from the list. Habitat restoration to allow species to recover from risk of extinction represents one type of fine-filter goal that can be combined with other fine-filter goals. Coarse-, meso-, and fine-filter strategies combine to minimize adverse effects of human actions on biodiversity loss (see previous chapter).

Landowners must consider the effects of their actions on protected species, especially those protected under the ESA. Private landowners, corporations, state or local governments, or other nonfederal landowners who wish to conduct activities on their land, that might incidentally harm (or "take") wildlife species listed as endangered or threatened under ESA, must first obtain an *incidental take permit* from the United States Fish and Wildlife Service. To obtain a permit, the applicant must develop a *Habitat Conservation Plan* (HCP) designed to offset any harmful effects that the proposed activity might have on the species. An approved HCP allows management to proceed, while continuing to promote the conservation of the species of concern. This approach is allowed under the "No Surprises" regulation in the ESA and provides assurances to landowners participating in these efforts that they will be allowed to proceed with management after an HCP has been approved without a "surprise" that new regulations or other restrictions will be imposed on them.

The "incidental take permit" allows the managers to manage forests as described under an HCP that has been approved by the regulatory agency (usually the United States Fish and Wildlife Service). In this instance, *take* does not mean directly killing the animal but, rather, means removal of *critical habitat* for the species, at least in the near term. The agency must designate critical habitat following peer review by scientists (Greenwald 2012). Court battles have resulted from the debate over the issue of removal of critical habitat constituting “take,” leading to judicial decisions that have broad implications (e.g., the Sweet Home Decisions). The outcome of those battles was the HCP approach that is consistent with the required Recovery Plan for the listed species. Specific decisions regarding what constitutes “take” of species through habitat modification, often requires that site-specific decisions be made to address particular issues (e.g., timber sales). Species Recovery Plans and HCPs require an understanding of not only the effects of management actions on the target species over large multi-ownership areas, but also the effects on other species, including people, both regionally and locally.

HCPs are often used to ensure that both the landowner(s) and regulatory agencies are in agreement about the goals and objectives for the land, the resulting level of “take,” and the likely effects of “take” on the portion of the population covered by the plan. Landscape management plans may or may not be HCPs, depending on the goals of the landowner and the presence or absence of federally listed species. The United States Forest Service has long used harvest-planning models, wildlife–habitat relationship(s) models, and other tools to assist with development of forest plans, required under the United States National Forest Management Act.

States also address complex planning problems using landscape management plans. For instance, habitat issues on the Elliott State Forest in Oregon prompted the Oregon Department of Forestry to develop a landscape management plan that interfaces with an HCP to meet the habitat requirements for northern spotted owls, marbled murrelets, and other species, while also considering economic effects on local communities (Oregon Department of Forestry 2006). Many states have natural heritage programs and lists of sensitive species at risk of being lost from the state or province. Some, such as Massachusetts, have their own state lists of endangered species requiring landowners to take particular actions to avoid habitat damage for state-listed species. Because land managers often are faced with more than one species that is of regulatory concern, multispecies management plans and HCPs are becoming more common.

Nonregulatory goals: Goals usually do not stop with species of conservation concern. Game species, ecological keystone species, and others may be the focus of a particular landscape, and clearly, human interests must also be accommodated. Protection of cultural sites, recreation areas, aesthetics, and economic income must all be balanced with the habitat management approaches chosen by the planners and managers. Without a formalized plan in place, the myriad possible effects of management on all of these values can be overwhelming to those managing a landscape. Without a plan, the risk of taking an action that has long-lasting adverse consequences is likely to increase.

Nongovernment organizations (NGOs) also are using landscape management plans to aid in large-scale planning efforts. The Nature Conservancy uses models of ecoregion structure and composition, in combination with principles of landscape ecology, to identify areas of potential high priority for protection or recovery (Poiani et al 2000, Groves et al. 2002). More species-specific groups, such as the Ruffed Grouse Society and the Wild Turkey Federation, may employ landscape management plans at times to facilitate management on public and private lands (Yahner 1984, Ferguson et al. 2002). In so doing, these groups are ensuring, to the degree possible, that the needs of those species of most concern to their constituents are met, though they also freely recognize the need to consider many other species, ecosystem services, and social values as well.

Goals reflecting conservation of biodiversity may also be driven by economics. Forest industries now often seek green certification (see Chapter 23) as a way of assuring that forest practices are sustainable, including measures taken to conserve biodiversity.

Large-scale ecoregional assessments are often used as the context for landscape management plans that address biodiversity protection, among other social values. Often, these assessments rely on landscape management plans as the mechanism to implement the regional plan. Strategies for biodiversity protection are often established at regional scales, which guide the development of landscape plans, which guide the development of stand prescriptions. Regional strategies are realized by implementing stand prescriptions over landscapes and implementing landscape plans over regions. Guidance comes from large spatial scales, and implementation is cumulative over small spatial scales. Although one can argue the details of effectiveness and subsequent use of the information, efforts such as the Northwest Forest Plan (FEMAT 1993), the Columbia Basin Ecoregional Assessment (Wisdom et al. 1999), the Willamette Valley Alternative Futures analysis (Hulse et al. 2002), and the Sagebrush Ecoregional Assessment (Knick and Rotenberry 2000, Connelly et al. 2004), all contributed to a foundation or framework within which more local decisions could be made to contribute to broader goals and objectives. Each of these assessments has relied on landscape management plans to achieve long-term goals.

CURRENT CONDITIONS

Classification of vegetation into plant communities and successional stages provides the basis for assessing coarse-filter goals and subsequent identification of under- or over-represented communities on the landscape. This information, and an estimate of conditions that are likely to occur on the ownerships outside the boundaries of the landscape (the context) being managed, can help to guide the articulation of the desired future condition.

Stand maps for each ownership of the forest (cover type and age), in combination with information on roads, streams, underlying geology, known locations of sensitive species, and culturally important sites, can provide the basis for describing the current conditions for many ecological conditions and social values. This information clearly should include an assessment of the distribution and connectedness of plant communities and seral stages, the levels of certain habitat elements associated with focal species, and availability of habitat for each focal species. Collectively, this information is used to describe the *current condition* of the area and is the basis for development of a desired future condition for the landscape.

Once the coarse-filter goals have been established and the species of concern have been identified, then the specific habitat elements needed by each species can be assessed over space and projected over time to understand how management alternatives might lead to changes in habitat quality for these species. The particular elements related to reproduction and foraging, including the spatial requirements, connectivity, and other attributes associated with habitat quality for each species, should be identified and structured in a way that allows large-scale assessment of habitat for each species (McComb et al. 2002, Spies et al. 2007). In some cases, population viability analyses may need to be conducted, a topic that we will cover in detail in Chapter 21. With the use of geographic information systems (GISs), remotely sensed data interfaced with ground plots, and LIDAR images, rapid assessments of current habitat availability for a suite of species is possible. In addition, these tools can help the planners design a desired future condition (DFC) that meets the coarse-, meso-, and fine-filter goals.

DESIRED FUTURE CONDITIONS

Given the list of values generated by stakeholders, a number of questions should be addressed as you develop a description of the desired future condition:

- Are there plant communities or seral stages that are underrepresented on the landscape now, as determined by comparison of current proportions to proportions represented in some reference condition (often the historical range of variability, if appropriate)?
- Are levels of specific habitat elements, within and among stands, sufficient to minimize a risk of losing species from the landscape? These levels may also be compared to a reference condition or to known habitat relationships (e.g., to DecAID, Mellen-McLean et al. 2009).
- What pattern of habitat availability for each focal species would best contribute to the regional habitat for the species? This is especially important for regulated species. How much latitude do you have in managing habitat for these species without risk to populations inside and outside of the landscape?

- Are there species or values that you would like to favor on the landscape in the future that currently may not be provided for now?
- What species or species groups provide the greatest opportunity for contributing to local or regional populations?
- Are there any species or values that are sensitive to land-use that would likely be eliminated from the area in the future, if current management practices continued?
- Could these species or values be accommodated wholly or in part on your landscape?

Once the questions listed above are addressed, they become the basis for developing a Desired Future Condition (DFC) for each ownership that collectively achieves the DFC for the landscape. Just as no single stand condition will meet the needs of all wildlife species or values, neither will a single DFC for a landscape meet the needs of all species and values. There are always tradeoffs to assess. Habitat for some species will decline over time, while habitat for others will increase. Careful planning of stand treatments over space and time will move a landscape toward a desired future condition in an attempt to meet multiple goals (Bettinger et al. 2001, Öhman et al. 2011).

Often, it is useful to consider a set of DFCs, in which one DFC leads to another over time, to achieve a series of objectives over both space and time. This approach also allows the planner to think about how each DFC can be achieved, while still providing a high likelihood that future DFCs can occur later in landscape development, even in the face of uncertain events such as natural disturbances or social change.

Life history information, habitat suitability models, or habitat relationship(s) models can help to ensure that these conditions are provided over sufficient areas with sufficient connectivity (see Chapter 16). Bettinger et al. (2001) and Öhman et al. (2011) demonstrated how harvest planning can be integrated with habitat goals for selected species to achieve multiple objectives in an economically efficient manner. Once these conditions have been described, then one or more DFCs for the landscape can be articulated by describing in writing what you want and by mapping these conditions to ensure that they are indeed feasible, given other constraints and opportunities (Bettinger et al. 2001, Oliver et al. 2011). These maps and descriptions of the desired future conditions should be developed in cooperation with stakeholders and vetted by all stakeholders affected by plan implementation.

PATHWAYS TO DESIRED FUTURE CONDITIONS

Once you know what the current conditions are and have described the DFCs, then it is important to understand how you will implement the management in a manner that will likely reach the DFC. It is important, at the very least, to develop a set of maps that clearly indicate how you will plan to move the forest from its current condition to the desired future condition through harvest planning, reserves, and other management approaches. There are several possible tools that you can use to project the future conditions of the forest. Interfacing stand growth models (e.g., Forest Vegetation Simulator, Teck et al. 1996) with GIS tools can allow simulation of landscape change over time (Figure 19.1). The Landscape Management System developed at the University of Washington and Yale University provides many opportunities for understanding changes in forest structure and composition over time and has been linked to habitat models for several species that allow an understanding of habitat changes over time (Marzluff et al. 2002, Oliver et al. 2011). These sorts of tools help you to understand if there is, or is not, a clear and achievable path from the current condition to each of the desired future conditions and allow comparisons with past conditions and likely achievement of goals (Figure 19.2).

DEVELOPING THE LANDSCAPE MANAGEMENT PLAN

With knowledge of current conditions, what conditions you would like to achieve, and how you might be able to change the landscape to achieve your goals, you are now ready to write a landscape

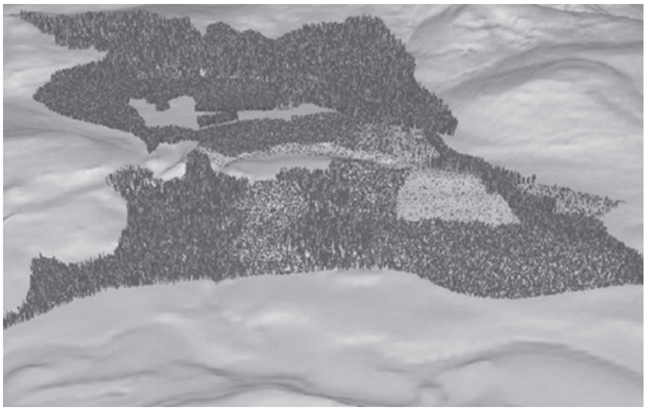

FIGURE 19.1 Example of one-time step in forest landscape pattern. Information on each stand and information among stands allows planners to understand if a desired future condition will likely be met. (From McGaughey, R.J. 2001. Using data-driven visual simulations to support forest operations planning. Pages 173–179 in *Proceedings of the First International Precision Forestry Cooperative Symposium*. Precision Forestry, Seattle, Washington; Landscape Management Systems; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

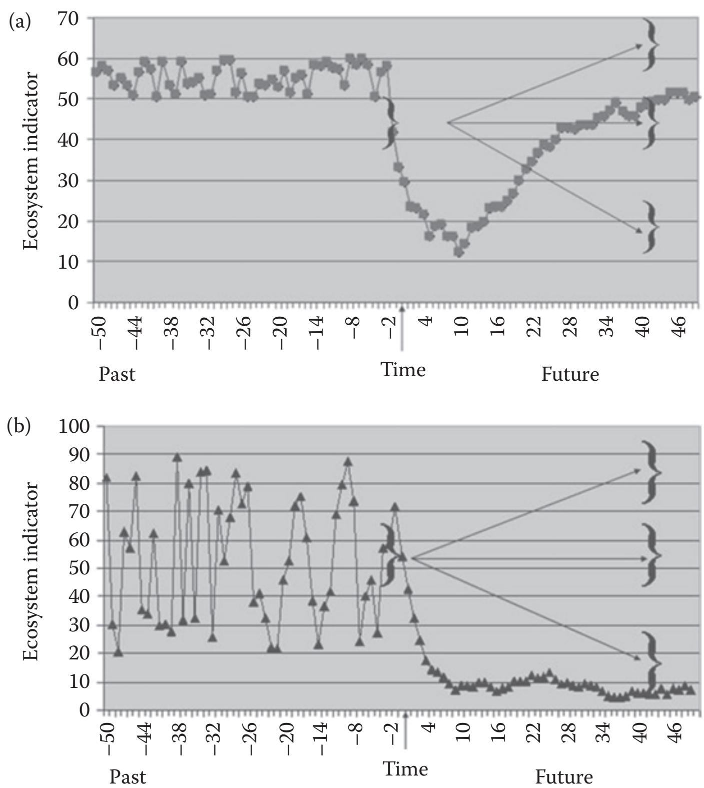

FIGURE 19.2 By understanding historical changes in ecological indicators such as habitat availability through present (time = 0) and likely future changes in the indicators, we can begin to see if future conditions are or are not likely to meet societal goals (brackets) for the indicator. Note that the trajectory (a) indicates a recovery following a lag period while (b) indicates a new indicator state in the future.

management plan. You may write several plans, each feasible, but with different emphases in different plans (including a "no action" plan), so that stakeholders, shareholders, and constituents, can understand possible alternatives, and choose among them.

Policy Guidelines for Habitat Conservation Plans

When a landscape management plan also is a Habitat Conservation Plan, as defined under section 10 of the ESA, then certain guidelines apply when developing the plan. Paraphrasing from Oregon Department of Forestry 2006, four tasks must be completed to determine the impacts that are likely to result from the proposed taking of a federally listed species:

1. Delineate the boundaries of the plan area.
2. Collect and synthesize the biological data for all species covered by the HCP.
3. Identify the proposed activities that are likely to result in incidental 'take.'
4. Quantify anticipated 'take' levels.

Usually, an impact assessment must be developed, that meets requirements for an Environmental Assessment under the National Environmental Policy Act (NEPA) as well as Section 10 of the ESA. This assessment includes techniques that will be used to monitor, minimize, and mitigate impacts on the listed species, the funding available to implement the plan, and the procedures to deal with uncertainty. Section 10(a) of the ESA requires that permit issuance does not 'appreciably reduce the likelihood of the survival and recovery of the species in the wild.' (Oregon Department of Forestry, 2006). The ESA does not require that HCPs result in the recovery of species covered under such plans. Since most landowners manage only a portion of the geographic range of a species, they may contribute to population change, but do not directly control it. Each HCP must contain measures that result in impacts that are consistent with the long-term survival of the listed species. Long-term survival includes the maintenance of genetically and demographically viable, well-distributed populations throughout the geographic range of each listed species. Actions that will meet the intent of long-term survival, will vary from one species to another, and must be approved by the regulatory agency.

Until recently, the effects of climate change were not explicitly considered when developing HCPs. Bernazzani et al. (2012) recognized the need to include climate change effects on the likelihood of achieving HCP goals, and offered the following guidelines when developing an HCP:

1. Identify species at-risk from climate change.
2. Explore new strategies for reserve design.
3. Increase emphasis on corridors, linkages, and connectivity.
4. Develop anticipatory adaptation measures.
5. Manage for diversity.
6. Consider assisted migration.
7. Include climate change in scenarios of water management.
8. Develop future-oriented management actions.
9. Increase linkages between the conservation strategy and adaptive management/monitoring programs.

It should be apparent from this list of recommendations that, in many instances, active management, in concert with reserve design, will be needed to meet HCP objectives for many species.

The effectiveness of the HCP can only be assessed based on monitoring information. Section 10(a) of the ESA requires that an HCP describe the specific monitoring measures the applicant will conduct to ensure that the plan is being implemented as described, and is effective in achieving its goals. Such an approach also helps both the land manager and the regulatory agency to deal with unforeseen changes in habitat or populations, such as those that might result from climate change (Bernazzani et al. 2012). This approach also lends itself well to an *adaptive management* strategy where monitoring data may allow managers and regulators to agree on mid-course changes in the plan to better meet the goals of both parties (see Chapter 22).

The HCP should consider alternative management strategies, including at least one that would not usually result in 'take' (usually a 'no-action' alternative, although in some cases no action could result in 'take' as well), and the reasons why that alternative is not selected. The no-action alternative may not be selected for economic reasons, or for ecological reasons, if disturbance, climate change, disease, or other exogenous factors are likely to affect the target population(s). The regulatory agency may also place additional requirements on the land managers, including an implementation agreement, which is a legal contract that describes the responsibilities of all HCP participants.

General Structure of the Landscape Management Plan

A landscape management plan can be structured in many ways similar to a stand management plan or prescription. It is important to have a written plan that provides a general schedule of predicted activities and treatments because people charged with implementing the plan will likely change over time, especially on multiowner landscapes. Management actions and the schedule may need to be modified somewhat, as new information becomes available through monitoring and additional research, so the plan should be viewed as a strategic plan (a general strategy for achieving goals), and not a tactical plan (a specific set of actions to be taken in certain places at certain times). A harvest plan that may result from a landscape management plan would be an example of a tactical plan. The plan should include:

Context: What is the historical, spatial, and temporal context for the forest? What opportunities and restrictions exist that influence development of a landscape plan? What policies drive current actions on the property? What are the physical, biological, and social resources that must be considered? This information can include the goals and purposes for having a plan, and the process used to arrive at the goals (e.g., public meetings and stakeholder involvement).

Current Forest Condition: What are the current conditions with regard to areas of vegetative communities, seral stages, and stand sizes? What conditions exist for those species or resources that you would consider as part of your fine-filter approach? To comply with National Environmental Policy Act (NEPA) requirements, this section should include a description of the affected environment. This section should include at the very least:

1. The current state of vegetation (plant communities and seral stages)
2. Species of plants and animals likely to be affected by proposed treatments
3. Habitat requirements of threatened or endangered species or other focal species of concern to stakeholders
4. Location and extent of wetlands or other sensitive ecosystems
5. The underlying geology and soils and the potential of those conditions to maintain the current species assemblages
6. Current land-use patterns within the planning area and the influence of patterns outside of the area on conditions in the planning area
7. Air and water quality issues apparent now, especially if they are contributing to impaired watersheds and airsheds, under the Clean Water Act, and the Clean Air Act, respectively. If any impairments are noted, then remedial measures that are underway should be described (e.g., Total Maximum Daily Load restrictions under the Clean Water Act)
8. Significant cultural resources, especially those that are protected under antiquities acts. Any ongoing management designed to restore or maintain these resources should be described

Desired Future Conditions: All of the factors listed above should be addressed in the DFC as components of the affected environment. What are the conditions that you would like to produce over time for each of several alternative plans? One of the alternatives should be the "no-action" alternative that can be compared to other alternatives. Often a *preferred alternative* is also described and is one that the developers of the plan find most desirable. Providing alternatives allows stakeholders the opportunity to comment on the alternatives and to compare the costs and benefits of various alternatives. This approach is required if the plan involves federal lands or impacts federal resources (e.g., endangered species) in the United States, and, therefore, must follow NEPA policies. Specifically, the DFCs in each alternative should include

1. Coarse-Filter Goals and Objectives: What are the general goals and objectives with regard to plant community representation, seral stages, and stand sizes? What is the rationale for these goals (based on the context above)? Was the Historical Range of Variability or some other reference condition used, and if so, how was it chosen?
2. Meso-Filter Goals and Objectives: Standards and guidelines should be included to provide the manager with the numbers, levels, and distributions of habitat elements that should be provided in the seral stages within each plant community. A rationale for these goals should be provided.
3. Fine-Filter Goals and Objectives: What species are considered explicitly in the management strategy? How do these goals complement coarse- and meso-filter goals? A rationale for selecting these species should be provided.

Management Actions to Achieve Desired Future Conditions: What will you do to achieve your desired future conditions? How long do you think it will take to achieve them? How long will they last? How much will it cost? The answers to these questions can best be answered following projections of the landscape forward in time, to understand if there are realistic pathways of forest development to allow DFCs to be realized over space and time.

Monitoring Plans: What will you measure and how often will you measure to determine whether your management plan was implemented correctly, and whether the actions were effective? How will you decide if you need to change your management plans? What thresholds must be reached before you make a change? See Chapter 22 for more guidance on developing monitoring plans.

Budget: What will implementation and monitoring of the plan cost? Where will the funds come from? In the event of a budget shortfall, what contingency plans are in place?

Schedule: What management actions are scheduled to occur during each decade for the next few decades? How will these actions be moving the forest toward the desired future condition? Remember that a plan such as this should be revisited and revised periodically—often every 5–10 years—to allow incorporation of information gained through monitoring and through publications in the scientific literature.

References: Use references from refereed journals (journals that require that papers published have been reviewed by peers, and that only the very highest quality papers are published) as much as possible to support any assumptions that were made in articulating the desired future condition. Contemporary approaches to finding information often involves searching the web, using a readily available search engine, but information from unknown sources should be viewed with caution—it is far too easy to find incorrect information. Search engines that search the refereed literature such as Google Scholar can be quite helpful, but be sure to check the original literature before citing it.

Considering Alternative Plans

When considering alternatives to large complex plans, such as the Northwest Forest Plan (NWFP) the landscape dynamics and resource outputs from a large area must be analyzed. The NWFP was developed to address biodiversity concerns on public lands over the geographic range of the northern spotted owl. Species that fell into a high-risk fine-filter group that needed particular attention to ensure that the plan met their needs, included spotted owls, marbled murrelets, red tree voles, and many others. Indeed, over 1000 species were assessed to understand the risks of implementing one of 11 land management options under the NWFP. The species-by-species assessments constituted the fine-filter assessment designed to ensure that those species that may not be captured by the coarse-filter planning strategy (moving more forest into later successional stages) would still be addressed and protected. But additional questions arise with a planning process like this. As older forests are allowed to develop, young forests decline in abundance, and so do the species associated with younger forests. In particular, young forests that are structurally or compositionally complex (as would occur after a natural disturbance) may decline to an even greater degree, as timber production is intensified on the remaining land-base. Hence, focal species that are known to be associated with particular conditions (snags in young forests, hardwoods, shrubs, etc.) in early seral stages are selected as examples of how a species might respond to changes in forest conditions (Betts et al. 2010, Swanson et al. 2010). By projecting habitat availability for these species forward in time, we can see how their habitat might change under current and alternative policies. Examples for early successional snag associates (western bluebirds) and high-contrast forest edge associates (olive-sided flycatchers) are provided in Figures 19.3 and 19.4. In these cases, we can see that current policies either maintain or increase habitat for the species over time, but that some policies are likely to be better than others in providing these conditions. Inferences can be made to other species that also might be associated with these conditions. It is important to remember, though, that these are not indicator species. Since each species has its own habitat requirements, the responses of one species will never accurately reflect the responses of other species.

Finding Solutions to Land Management Planning Problems

With any forest consisting of multiple stands, there are several acceptable plans (plans that will meet goals at varying costs), and a number of unacceptable plans (plans that will not meet goals or will only succeed at unacceptable costs). Usually, there is more than one way of managing a landscape to achieve the desired future conditions. If each of ten managers designed a management plan to achieve one set of DFCs, the ten plans probably would all be different in some ways. So, given these

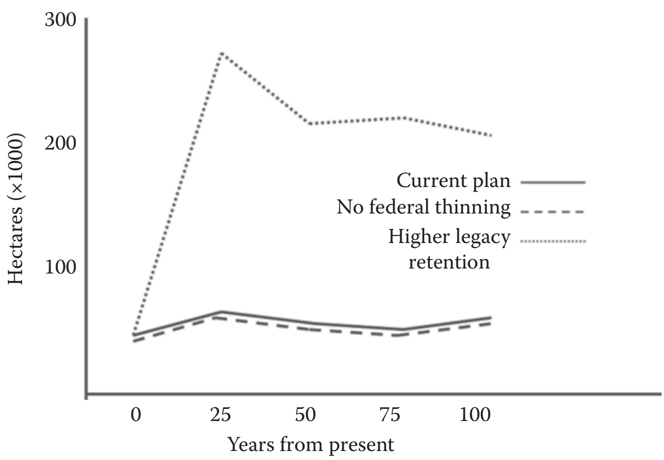

FIGURE 19.3 Projected response of western bluebirds to the Northwest Forest Plan and two alternative policies, Oregon Coast Range. Note that two alternatives had the same likely influence on habitat availability over time, and produced identical projections. (Redrafted from Spies, T.A. et al. 2007. *Ecological Applications* 17:48–65. With permission from the Ecological Society of America.)

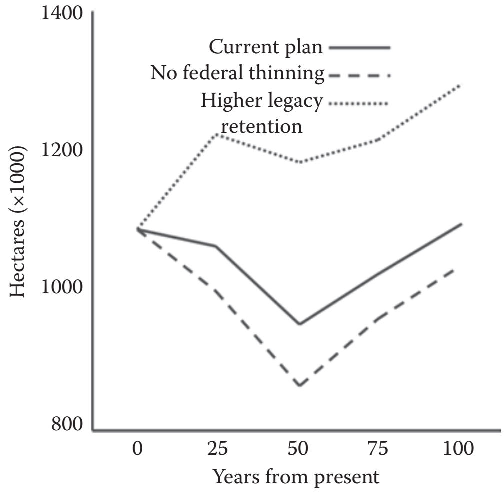

FIGURE 19.4 Projected response of olive-sided flycatchers to the Northwest Forest Plan and two alternative policies, Oregon Coast Range. (Redrafted from Spies, T.A. et al. 2007. *Ecological Applications* 17:48–65. With permission from the Ecological Society of America.)

multiple alternative plans, how can we find the best plan? Well, the best plan depends on who is doing the judging. About all we can usually hope for is a plan that is mutually acceptable to a group of stakeholders.

One way of finding not only an acceptable solution, but also a good one, is to develop a number of plans that are all considered acceptable. Each solution can then be ranked from highest to lowest for any number of values that the manager (or society) places on the landscape. Those plans with the lowest cumulative ranks are those that are likely to be better than those with higher total ranks (Table 19.1). Given a clearly articulated and agreed upon set of goals and constraints, harvest planning software can generate a suite of plans that meet goals and fall within constraints, and these can then be evaluated by stakeholders. This approach also has the value of being able to map the projected changes in landscape structure and composition over time, allowing stakeholders a better understanding of how the landscape might appear in the future (Oliver et al. 2011). Care must be taken not to overwhelm stakeholders with too much information; information overload can result in stakeholders not being able to make clear choices among alternatives (Robson et al. 2010).

TABLE 19.1
Example of a Process of Prioritizing Values Associated with Four Resource Values in Each of Five Alternative Plans

Plan	Turkey	Timber	Aesthetics	Trout	Sum
A	3	2	3	3	11
B	4	4	1	1	10
C	5	1	4	5	15
D	1	3	2	2	8
E	2	5	5	4	16

Note: If the stakeholders included turkey hunters, forest products industry, hikers, and fly-fishers, and each group ranked each alternative (1 = best, 5 = worst), then the sum of the ranks can provide an idea of which plan represents the best compromise (lowest sum = plan D). Note that weights are not assigned to alternatives in this example.

I provide a very simple example considering five plans developed to meet a set of DFCs for four resources in Table 19.1. Of the five plans, all of which are acceptable, plan D would seem to be the most desirable option from the standpoint of the four resources being considered. We could have any number of resources represented, and we could use different rules on which to base our selection of the preferred alternative (no resource must rank below 3, for instance). These rules will be based on the values assigned by stakeholders in an iterative fashion until those involved can agree that the selected alternative is the one most likely to address public values over multiple ownerships now, and into the future. Indeed, the most difficult (and most informative) part of the planning process can be the social debate necessary to ensure that the selected alternative is most likely to meet social goals.

Comparisons among alternative plans should be done jointly with affected constituents and planners, and scientists should be available to assist with interpretation of assumptions. It is entirely possible, and indeed quite likely, that arguments might ensue among the constituents, planners and scientists, once a set of options has been assessed. The arguments could result in a determination that none of the alternative plans are socially acceptable, and that the planning process should start anew. A similarly likely outcome, especially given the number of assumptions upon which future projections are based, is that the affected parties reach agreement on a preferred alternative and implement it; but based on monitoring data, the observed responses are not likely to be what was expected. Gachechiladze-Bozhesku (2012) found that rarely are stakeholders involved in follow-up assessments of the progress of a plan toward meeting DFCs. Should important societal values not be sustained due to these departures from predictions, there may yet again be a reason to start the planning process anew with a greater understanding of the assumptions that must be changed. Even if the system responds as anticipated, and current social values are sustained, social values, including biodiversity goals, are not static. As societal expectations evolve, so do biodiversity goals. Stuff happens. Evolution of cultural mores, in addition to unanticipated events (9/11, tsunamis, wildfires, disease), can drastically alter the perceived values and importance of biodiversity in our cultures. It should be accepted that assessments will need to be revisited as new social issues emerge, due to the dynamic nature of cultural values.

PLAN EFFECTIVENESS

Plans abound, but do they achieve the intended goals? Recently, there have been several assessments of the effectiveness of species recovery plans and HCPs in preventing further declines in populations of threatened species. Shilling (1997) noted that the number of threatened and endangered species in the United States is increasing monthly, and critical habitat (as defined in the ESA is habitat required for continued existence of the species) is constantly being destroyed. Shilling (1997) contends that the application of HCPs may be making things worse, not better, for these species. Bingham and Noon (1997) also questioned the logic of allowing incidental "take" by having an approved HCP. They found that mitigation solutions are often arbitrary and lacked a basis in the habitat requirements for the species. They proposed that the concept of "core area" (that portion of an animal's home range that receives disproportionate use) be used as the basis for mitigating habitat loss within an HCP. Clearly, habitat requirements need to be addressed at an appropriate scale when mitigation measures are involved. Despite concerns raised by Bingham and Noon (1997) and Shilling (1997), Langpap and Kerkvliet (2012) found that single-species HCPs have been effective in contributing to species recovery, but that was not necessarily true for multispecies plans. They found that plans that covered larger areas were more likely to be successful than plans that covered smaller areas (Langpap and Kerkvliet 2012).

Plan effectiveness is always in doubt. All of the uncertainties described in Chapter 18 can rear their ugly heads in the face of the best-made plans. Wilhere (2002) made the case that HCPs entail a compromise between regulatory certainty and scientific uncertainty, and previous authors indicated that many HCPs do not adequately address scientific uncertainty. Monitoring the implementation and effectiveness of the plan is one way of acquiring and applying information to allow continual improvement of the plan (Wilhere 2002). Adaptive management has been promoted as a means of managing in the face of uncertainty, but few HCPs incorporate genuine adaptive management (see Chapter 22). Developing and implementing HCPs and other landscape management plans are costly, both in monitoring the effectiveness of the plan and in the economic value of resources forgone to meet habitat needs. Wilhere (2002) proposed that economic incentives might encourage implementation of more effective plans because it would enable adaptive management. Incentives might include direct payments or tax deductions for reliable information that benefits a species. Indeed, it is quite possible that incentives are more likely to induce creativity in developing and implementing effective plans than regulations; regulations tend to homogenize systems, while incentives can encourage creativity.

SUMMARY

Goals for a landscape are usually set by stakeholders representing different social values, ecosystem services, and economic values associated with the landscape. Because the landscapes are often large and complex, with many competing values, landscape management plans are essential to reducing the risk of not achieving goals during management. Some goals are established by law; Habitat Conservation Plans are among the regulations that allow "take" of critical habitat for federally listed species in the United States. The ability of a land manager to meet legal requirements and achieve biodiversity goals is dependent on developing plans, identifying a good acceptable plan, implementing it, and monitoring its effectiveness.

REFERENCES

Bernazzani, P., B.A. Bradley, and J.J. Opperman. 2012. Integrating climate change into habitat conservation plans under the US Endangered Species Act. *Environmental Management* 49:1103–1114.

Bettinger, P., K. Boston, J. Sessions, and W.C. McComb. 2001. Integrating wildlife species habitat goals and quantitative land management planning processes. Chapter 23 in D. H. Johnson and T. A. O'Neill (managing eds). *Wildlife Habitat Relationships in Oregon and Washington*. OSU Press, Corvallis, OR. 768pp.

Betts, M.G., J.C. Hagar, J.W. Rivers, J.D. Alexander, K. McGarigal, and B.C. McComb. 2010. Thresholds in forest bird occurrence as a function of the amount of early-seral broadleaf forest at landscape scales. *Ecological Applications* 20:2116–2130.

Bingham, B.B., and B.R. Noon. 1997. Mitigation of habitat "take": Application to habitat conservation planning. *Conservation Biology* 11:127–139.

Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. *Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats*. Western Association of Fish and Wildlife Agencies. Unpublished report. Cheyenne, WY.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*. USDA, USDI, Portland, OR.

Ferguson, R., A Huckabee, and C. McKinney. 2002. *South Carolina's Forest Stewardship Management Plan*. National Wild Turkey Federation. Edgefield, SC.

Groves, C.R., D.B. Jensen, L.L. Valutis, K.H. Redford, M.L. Shaffer, J.M. Scott, J.V. Baumgartner, J.V. Higgins, M.W. Beck, and M.G. Anderson. 2002. Planning for biodiversity conservation: Putting conservation science into practice. *BioScience* 52:499–512.

Gachechiladze-Bozhesku, M. 2012. Towards improving strategic environmental assessment follow-up through stakeholder participation: A case of the Pasquia-Porcupine Forest Management Plan, Saskatchewan, Canada. *Journal of Environmental Planning and Management* 55:1058–1074.

Greenwald, D.N., K.F. Suckling, and S. L. Pimm. 2012. Critical habitat and the role of peer review in government decisions. *BioScience* 62:686–690.

Hulse, D., S. Gregory, and J. Baker. 2002. *Willamette River Basin Planning Atlas: Trajectories of Environmental and Ecological Change*. Oregon State University Press, Corvallis, OR.

Knick, S.T., and J.T. Rotenberry. 2000. Ghosts of habitats past: Contribution of landscape change to current habitats used by shrubland birds. *Ecology* 81:220–227.

Langpap, C., and J. Kerkvliet. 2012. Endangered species conservation on private land: Assessing the effectiveness of habitat conservation plans. *Journal of Environmental Economics and Management* 64:1–15.

Marzluff, J.M., K.R. Millspaugh, K.R. Ceder, C.D. Oliver, J. Withey, J.B. McCarter et al. 2002. Modeling changes in wildlife habitat and timber revenues in response to forest management. *Forest Science* 48:191–202.

McCarter, J.M., J.S. Wilson, P.J. Baker, J.L. Moffett, and C.D. Oliver. 1998. Landscape management through integration of existing tools and emerging technologies. *Journal of Forestry* 96(6):17–23.

McComb, W.C., M. McGrath, T.A. Spies, and D. Vesely. 2002. Models for mapping potential habitat at landscape scales: An example using northern spotted owls. *Forest Science* 48:203–216.

McGaughey, R.J. 2001. Using data-driven visual simulations to support forest operations planning. Pages 173–179 in *Proceedings of the First International Precision Forestry Cooperative Symposium*. Precision Forestry, Seattle, Washington.

Mellen-McLean, K., B. G. Marcot, J. L. Ohmann, K. Waddell, S. A. Livingston, E. A. Willhite, B. B. Hostetler, C. Ogden, and T. Dreisbach. 2009. *DecAID, the Decayed Wood Advisor for Managing Snags, Partially Dead Trees, and Down Wood for Biodiversity in Forests of Washington and Oregon*. Version 2.1. USDA Forest Service. Pacific Northwest Region and Pacific Northwest Research Station, Portland, OR.

Öhman, K., L. Edenius, and G. Mikusinski. 2011. Optimizing spatial habitat suitability and timber revenue in long-term forest planning. *Canadian Journal of Forestry Research* 41:543–551.

Oliver, C.D., J.B. McCarter, J.M. Comnick, K. Ceder, and C.S. Nelson. 2011. Simulating landscape change using the landscape management system. Pages 339–366 in Millspaugh, J., and F.R. Thompson, (eds.). *Models for Planning Wildlife Conservation in Large Landscapes*. Academic Press, Burlington, MA.

Oregon Department of Forestry. 2006. *Final 2006 Elliott State Forest Management Plan (FMP)*. Oregon Department of Forestry, Salem, Oregon.

Poiani, K.A., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Biodiversity conservation at multiple scales: Functional sites, landscapes, and networks. *BioScience* 50:133–146.

Robson, M., J. Rosenthal, R.H. Lemelin, L.M. Hunt, N. McIntyre, and J. Moore. 2010. Information complexity as a constraint to public involvement in sustainable forest management. *Society & Natural Resources* 23:1150–1169.

Shilling, F. 1997. Do Habitat Conservation Plans protect endangered species? *Science* 276:1662–1664.

Spies, T.A., B.C. McComb, R. Kennedy, M. McGrath, K. Olsen, and R.J. Pabst. 2007. Potential effects of forest policies on terrestrial biodiversity in a multi-ownership province. *Ecological Applications* 17:48–65.

Swanson, M. E., J. F. Franklin, R.L. Beschta, C.M. Crisafulli, D.A. DellaSala, R.L. Hutto, D.B. Lindenmayer, and F.J. Swanson. 2010. The forgotten stage of forest succession: Early-successional ecosystems on forest sites. *Frontiers in Ecology and the Environment* 9:117–125.

Teck, R., M. Moeur, and B. Eav. 1996. Forecasting ecosystems with the forest vegetation simulator. *Journal of Forestry* 94:7–10.

Wilhere, G.F. 2002. Adaptive management in habitat conservation plans. *Conservation Biology* 16:20–29.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, D.C. Lee, C.D. Hargis, V.A. Saab, W.J. Haan et al. 1999. *Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-Scale Trends and Management Implications*. USDA For. Serv. PNW Res. Sta., Portland, OR.

Yahner, R.H. 1984. Effects of habitat patchiness created by a ruffed grouse management plan on breeding bird communities. *American Midland Naturalist* 111:409–413.