10 Desired Future Conditions

To effectively manage habitat for a species, a group of species, or to contribute to biodiversity conservation, we need goals or targets toward which management will be directed. This may involve a condition that will occur on its own in the absence of active management, or it may require intervention to guide the development of the stand or landscape toward your goal. Describing the structure, composition, and scales of a condition that you think will meet the needs for species on your site is one of the first steps in developing a habitat management plan for a stand, forest, or landscape. Landres et al. (1999) described *desired future conditions* (DFCs) as expressions of ecosystem conditions preferred by stakeholders and managers. Kessler et al. (1992) also referred to an articulation of a DFC as a goal in ecosystem management. This may be a reference condition, or more appropriately it may be a set of reference conditions that currently achieve some desired objectives, or it may be a sequential set of future conditions that achieve different objectives for different species over time. Given inherent uncertainty in achieving goals in the face of stochastic disturbances, ecological pathways, and novel stresses on forest dynamics (e.g., climate change, spread of invasive species), monitoring to assess progress toward a DFC is probably a reasonable strategy for achieving habitat objectives. Adaptability to unexpected outcomes is also important. Joyce et al. (2009) described developing a set of practices that would build resistance and resilience into current ecosystems, while also managing for change in system function and adaptability to new system states. Despite the uncertainties of the future, having a goal or DFC helps to direct management actions while keeping options open for unexpected changes. Goals for habitat are typically set at large scales (regions) and achieved at small scales (stands). Foresters typically develop plans for managing stands that contribute to some overall forest-level goal.

However the DFCs are described, they must be implementable; that is, the site must be capable of producing those conditions. All of the factors described in the previous chapters come into play when considering if current conditions, past actions, and likely future changes will result in achievement of a set of DFCs. Models of forest development under alternative management strategies can help guide development of management plans for a stand or landscape.

DEVELOPING THE STAND PRESCRIPTION

Foresters write *prescriptions* or silvicultural management plans for stands to achieve a DFC. Personally I find the term “prescription” unfortunate because to the lay public it implies that the stand is unhealthy and needs fixing! Which may or may not be the case. Nonetheless, once the DFC is deemed achievable, the prescription for the current stand can be developed. It is important to have a written prescription that clearly describes the current condition, the DFC, management actions, schedule for anticipated future entries, and a monitoring plan. For many prescriptions the DFC may not be attained for several decades. Consequently, it is important that there is a written record for the rationale behind the prescription. Future managers of this stand may be able to make more informed decisions based on written records for the stand.

Your prescription should include a description of any of the stand summary information (species, basal area, tree diameter distribution, site index, stocking, etc.) that would be needed to develop marking guides. In addition, to achieve habitat objectives, the prescription should contain each of the following sections.

Species Background

What plant and animal species goals are intended for this stand? Are individual species or groups of species to be managed? What are their habitat needs? Over what spatial scale (e.g., nest sites, foraging patches, home ranges) must they be met? How do these goals complement goals for adjacent stands?

Current Stand Condition

What are the habitat conditions in the stand now for the species that you intend to manage? What factors are limiting habitat suitability for the species? What is the tree and shrub species composition? Site index? Stocking? Existing or possible future regeneration? What are the physical conditions or cultural history that lead to the current condition?

Desired Future Condition

What are the habitat conditions that you would like to produce? Be specific and describe the plant species composition, size classes, basal area, and any predictions of future stand development that you can develop. Stand growth models such as the forest vegetation simulator (FVS) (Dixon 2003) or forest disturbance and succession models (Shifley et al. 2008) are particularly useful for understanding if your DFC can be met.

Management Actions to Achieve the Desired Future Condition

What will you do to the stand now and over time to achieve your DFCs? How long do you think it will take to achieve them? How long will they last? Is it possible to maintain the DFCs with or without management? How much will it cost?

Monitoring Plans

What will you measure and how often will you measure to determine if your management plan was implemented correctly and if the actions were successful? How will you decide if you need to change your management plans? For more details on developing monitoring plans see McComb et al. (2010).

Budget

What will implementation and monitoring of the plan cost? Regardless of the landowner, cost becomes a factor when implementing a prescription to achieve a goal. For most landowners, there must not be a net loss, and for some landowners there must be a maximum profit. Understanding the products that can be derived from implementing the prescription, both economical and ecological, can help the manager decide if the trade-offs are acceptable.

Schedule

When will each step in the plan be completed? Of course the monitoring of stand development may lead to changes in the schedule, but there should be a plan for when actions will occur.

References

Scientific references should be used to support assumptions used in the development of the prescription. Since new information is always becoming available to guide management, it is important to understand why decisions were made at this point in time. As stands develop and plans are altered, it is important to review the literature yet again. Changes in scientific knowledge can alter the plans developed even a few years ago and can help you interpret your monitoring data.

Once a prescription has been developed, then it can be implemented and monitored over time. If the monitoring data indicate that the stand is developing over time differently from what was predicted in the prescription, then midcourse corrections can be made. By having a prescription for each stand that you manage, and keeping it on file, then future managers can understand how the stand developed and if it is developing as intended to achieve a DFC. If a new DFC should be developed at some time in the future, then the manager at that time can learn from the past efforts. Documentation of plans, actions, and results is critical.

CASE STUDY: GROWING RED-COCKADED WOODPECKER HABITAT

Red-cockaded woodpeckers are listed as threatened under the U.S. Endangered Species Act. Their numbers are a fraction of what they were historically. The decline in numbers and distribution is considered to be largely a product of past timber liquidation and current short-rotation forestry for pulp and small sawtimber production in the southern yellow pine region of the United States. This example prescription is developed for a 7 ha pine stand on the Kisatchie National Forest in Louisiana. The stand data were provided by Jo Ann Smith, Forest Silviculturist on the Kisatchie, but I use them merely as an example of managing this stand to achieve a DFC for red-cockaded woodpeckers. Managers of the Kisatchie quite likely would have a different prescription based on their goals, their personal knowledge of the stand, its history, and its context on the forest. I simply use the data to demonstrate how a prescription could be developed for red-cockaded woodpeckers and several associated species, Bachman's sparrows, and brown-headed nuthatches.

Species Background and Management Options

Red-cockaded woodpeckers have long been associated with mature southern yellow pine forests containing old trees with red heart disease, a fungal decay softening the heartwood of living pines. Red-cockaded have a broad geographic range throughout the Gulf Coastal Plain and Piedmont north into southern Kentucky. Home range sizes vary from 25 to over 100 ha (Delotelle et al. 1987, Doster and James 1998), being somewhat larger during the time when they are not nesting (Wood et al. 2008). Because our stand is only 7 ha, any plans for habitat improvement must consider the conditions of the surrounding stands, which should be managed to complement the conditions in our 7-ha stand. This is especially important as we consider one pair as part of a larger metapopulation that may need 800–200 ha of habitat (Mitchell et al. 2009).

Within their home range, they defend a somewhat smaller territory around a central nest tree. Home ranges must be large enough to provide resources for young in the nest as well as additional helpers at the nest. Red-cockaded woodpeckers are similar to acorn woodpeckers by having a social structure known as a clan, in which nonreproducing members of the clan assist the reproducing pair with raising young. They feed primarily on insects and fruits and forage on trees >60 years of age and on trees >25 cm dbh (diameter at breast height) more than would be expected by chance (Zwicker and Walters 1999). The nest tree is usually >100 years of age and >40 cm dbh (Conner and O'Halloran 1987). Cavities are excavated in live trees, unlike most other woodpecker species, and they typically make shallow excavations around the cavity entrance into resin wells, causing a flow of sticky resin around the cavity entrance and down the tree. This behavior is presumably to reduce risks of predation by rat snakes (Conner et al. 1998).

The stand around the nest tree typically is dominated by pines (basal area averages 16 m^2/ha) with a few midstory pines (average = 1.1 m^2/ha) and very few if any midstory hardwoods (Conner and O'Halloran 1987). James et al. (1997) found that variation in the size, density, and productivity of clans was related to the ground cover composition and the extent of natural pine regeneration, both of which are indirect indicators of local fire history.

Bachman's sparrows also are associated with mature pine woodlands characterized by widely spaced pines, an open midstory, and a dense understory of grasses and forbs (Plentovich et al. 1998). They have territory sizes of 2–3 ha (Dunning 2006). Populations of the Bachman's sparrow began declining in the 1930s, reflected in a reduction in geographic range and local extinctions (Plentovich et al. 1998). Areas suitable for red-cockaded woodpeckers were not always suitable for Bachman's sparrows. Red-cockaded woodpeckers appear to be more tolerant of a hardwood midstory although they do not require a dense cover of grasses and forbs; however, they may be more successful in forests with frequent fires that produce this understory condition. Prescribed burning seems to be a key factor in development and maintenance of the dense herbaceous understory preferred by Bachman's sparrow (Dunning 2006, Jones 2008). Bachman's sparrow populations disappear 4–5 years after a burn (Dunning 2006). In areas managed for red-cockaded woodpeckers, frequent (3–5 year interval) burning early in the growing season appears to be the best way to increase habitat suitability for Bachman's sparrows.

Brown-headed nuthatches are also associated with loblolly–shortleaf pines of the Upper Coastal Plain and the longleaf-slash pines association of the Lower Coastal Plain (Withgott and Smith 1998). They have a territory size of about 3 ha and create nest cavities in pine snags typically >20 cm dbh (Harlow and Guynn 1983) but most often forage on live pines (Withgott and Smith 1998). This species is most often found in open, mature, old-growth pine forest, particularly where natural fire patterns have been maintained and where snags are present for nesting and roosting (Withgott and Smith 1998). This combination of vegetation characteristics occurs in mature pine forest in which fire has kept understory open and created snags (Withgott and Smith 1998).

On the basis of the life history characteristics of these three species, several management options seem possible. James et al. (2001) suggested that smaller size classes of trees in closed-canopy stands should be thinned, creating patchy openings in the forest that will promote natural pine regeneration. This can be achieved by uneven-aged management such as group selection regeneration methods in conjunction with maintaining a low basal area (Outcalt 2008) or through irregular shelterwoods (Conner et al. 1991). Since longleaf pine was once a dominant species on the Kisatchie and since red-cockaded woodpeckers are often associated with longleaf pine savannah forests, management actions that allow recovery of longleaf into managed stands might also be beneficial to red-cockaded woodpeckers and other species.

Management approaches suggested for recovery of red-cockaded woodpeckers have included both short and long-term strategies (Rudolph et al. 2004). Nearly all populations require immediate attention in the short term, including manipulation of midstory and understory conditions (Rudolph et al. 2004). Management techniques including prescribed fire and mechanical and chemical control of woody vegetation are often used to achieve these needs. In the long term, cost-effective management of red-cockaded woodpecker populations requires a timber management program and prescribed fire regime that will produce and maintain the stand structure characteristic of high-quality nesting and foraging habitat, so that additional intensive management specific to the woodpeckers is no longer necessary (Rudolph et al. 2004). Management that achieves this goal and still allows substantial timber harvest is feasible. With some attention to understory conditions and availability of snags, these approaches would benefit Bachman's sparrows and brown-headed nuthatches as well. Effects on other species probably would be negative for ground-nesting birds (Wilson et al. 1995) and possibly those associated with midstory conditions, though when done at a small scale, negative effects on these other species may be minimal (Lang et al. 2002).

Current Stand Condition

The stand is currently dominated by loblolly and shortleaf pines both in basal area and tree density (Table 10.1). Approximately 8% of the basal area is in hardwoods, primarily oaks. Tree diameters range from 30 to 60 cm (12–24 in) dbh, averaging 38 cm dbh. There are about 200 trees/ha and the stand basal area is approximately 23 m^2/ha (101 ft^2/acre). The stand has understory shrub and

TABLE 10.1
Summary Statistics for an Example 7-ha Pine Stand from the Kisatchie National Forest, Louisiana, 2005

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Loblolly pine	40.6	126	16.5
Shortleaf pine	33.9	54	6.0
Oaks	38.5	15	1.8
Total	38.6	195	23.3

hardwood cover but little regeneration (Figure 10.1) and little grass or herbaceous cover. The presence of hardwoods in the stand suggests that it has not been burned for some time, and that there may not be adequate fine fuels to carry a burn through the stand. Or worse, suspended fuels (needles in shrub crowns) may allow fires to scorch the crowns of the overstory trees. If a thick duff layer exists, then the slow-burning hot fire may kill pines and release hardwoods. The stand currently could serve as foraging habitat for red-cockaded woodpeckers but would not likely be adequate nesting habitat. The stocking is too high, there are hardwoods in the midstory, and the trees are likely not old enough to have heart rot. The stand is quite likely not a habitat for Bachman's sparrows, because there would be insufficient sunlight to support a dense grass–forb condition in the understory. The area could support brown-headed nuthatches now, especially if inter-tree competition has created snags (no snag data were available).

Desired Future Condition

To provide nesting habitat for red-cockaded woodpeckers, brown-headed nuthatches, and Bachman's sparrows, we would need to have a stand in which the dominant trees were >100 years of age (increasing the probability that some had red heart disease), had a basal area closer to 16 m^2/ha or less to provide grass–forb understory conditions, a few midstory pines, and no hardwoods. Since the area once supported longleaf pine, we would want to reestablish longleaf as a functional component in the stand. We also will want to ensure that tree mortality is likely to occur at some times during stand development to provide snags as potential nesting sites for brown-headed nuthatches. Since pine basal area will be kept somewhat low, and dominant trees well-spaced for Bachman's sparrows, snags may be created either from fire or by killing a few dominant trees per hectare periodically,

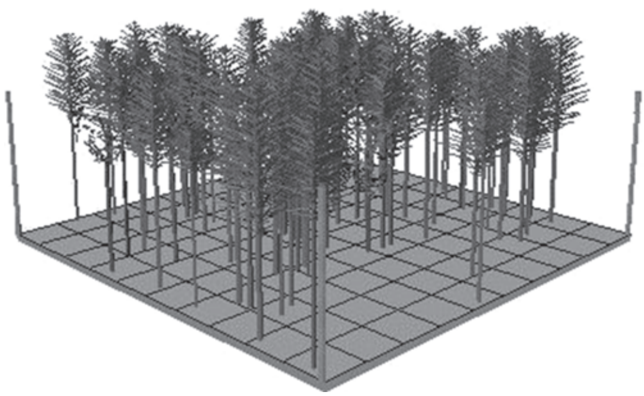

FIGURE 10.1 Schematic of the current stand condition dominated by loblolly and shortleaf pines, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

depending on tree mortality and snag fall rates. Once the DFC was reached we would like to maintain the condition for the forseeable future to contribute to red-cockaded woodpecker population recovery and maintenance.

Management Actions to Achieve the DFC

Although the specifics of management approaches for these species vary from one author to another, the general theme is that stands be managed using either group selection (McConnell 2002) in longleaf systems or irregular shelterwood regeneration methods in loblolly–shortleaf systems (Rudolph and Conner 1996, Hedrick et al. 1998). Use of an irregular shelterwood approach displaces red-cockaded woodpeckers that might use the site for foraging, suggesting that group selection regeneration, planting of longleaf pine, and frequent prescribed fire could be used to manage the site (personal communication, Dr. Robert Mitchell, Jones Center, Georgia). But to illustrate how both even-aged and uneven-aged systems can be used to manage habitat, I will initiate management with an irregular shelterwood. Irregular shelterwood methods retain all or a part of the overwood well into the next rotation and can provide older and larger trees as habitat from one rotation to another. Management practices that reduce litter, maintain relatively low tree and shrub densities, and that encourage the growth of forbs and grasses are recommended for Bachman's sparrows (Haggerty 1998). Haggerty (1998) suggested that a combination of thinning and burning would contribute to the most suitable habitat for this species. Similarly, brown-headed nuthatches also find suitable habitat in mature pine forests, but with snags present. For this example, I propose initiating management with an irregular shelterwood to remove hardwoods and establish longleaf pine, then managing stand density and hardwood competition through a combination of thinning and prescribed burning. The series of management actions needed to produce a DFC that follows is based on use of the Southern version of the Forest Vegetation Simulator (SN) (Dixon 2003) and the Landscape Management System (McCarter et al. 1998).

Year 2015: We will initiate stand management with an irregular shelterwood retaining 25 pines/ha (8 m^2/ha, Boyer and Peterson 1983) and cutting all hardwoods. Following harvest, we will prepare the site for planting using a cool winter burn to remove fine fuels and then plant 250 longleaf pine seedlings per ha. Since the overwood is dominated by loblolly and shortleaf pines, I will also assume that natural regeneration of these two species will become established following harvest. There should be no prescribed burning for the first few years after longleaf pine establishment (Boyer and Peterson 1983), and then early spring burns (prior to bird nesting) should be initiated to control hardwoods. Once longleaf regeneration is well established, we can continue with prescribed burning every 2–3 years to control hardwoods, shortleaf pine regeneration, and any brownspot disease that might become established on the longleaf pine seedlings (Haywood 2007). Longleaf persists in a "grass stage" for several years during which it puts on root growth but not shoot growth. Dense long needles protect the terminal bud from fires at this time, and fires remove needles infected with brownspot fungus.

Year 2025: By 2025, I would anticipate that the new stand would be much lower in basal area with a high density of pine regeneration (Table 10.2, Figure 10.2). Note that although we thinned

TABLE 10.2
Summary Statistics for a 7-ha Pine Stand Projected to the Year 2025, 10 Years after Initiating an Irregular Shelterwood, Kisatchie National Forest, Louisiana

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Longleaf pine	8.3	250	1.35
Loblolly pine	23.9	71	6.3
Shortleaf pine	6.9	50	0.1
Total	11.2	371	7.9

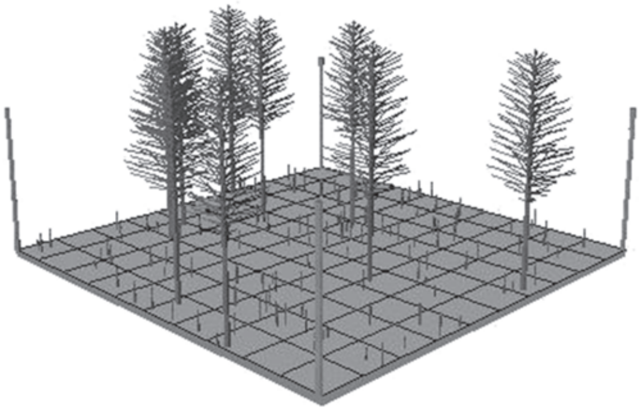

FIGURE 10.2 Schematic of the stand condition at year 2025, 10 years after initiation of management, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

from below, the average dbh declined. This is because the stand is no longer even-aged. By 2025 there are 20 trees/ha that are >56 cm dbh along with many that are small seedlings. Hence average dbh may not be a good indicator of tree sizes in the stand. Also note that the basal area is far below our target. This low basal area is necessary to allow longleaf pine to become established while still retaining some trees that can become potential nest trees in the future. With the initiation of prescribed burning, habitat for Bachman's sparrows has likely improved tremendously. Finally, note that although we retained 25 trees/ha in the overwood, only 20/ha were predicted to survive the following 10 years. We will assume that 5/ha have become snags, some of which may remain after burning and provide potential nesting habitat for brown-headed nuthatches.

Year 2035: With continued prescribed burning, hardwoods should be kept under control and longleaf pine will initiate height growth. The overstory trees now released from inter-tree competition will also continue to grow. Although red-cockaded woodpecker nesting habitat likely has not yet developed, habitat for Bachman's sparrows and brown-headed nuthatches is available. However, as basal area increases, overstory cover will reduce the production of grasses and forbs following burning. If frequent fire does not allow adequate production of grasses and forbs, then we may need to initiate a light thinning of the overstory by creating snags and a precommercial thin of the seedlings and saplings to ensure continued tree growth while providing growing space for grasses and forbs.

Year 2045: If regeneration of longleaf was not adequate, we can create gaps in the stand and replant longleaf adding to the uneven-aged character of the stand. Otherwise we will let the stand grow, with early spring burns every 3–4 years (Table 10.3). Note though that regeneration may again

TABLE 10.3
Summary Statistics for a 7-ha Pine Stand Projected to the Year 2045, 30 Years after Initiating Management, Kisatchie National Forest, Louisiana

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Longleaf pine	12.2	120	1.4
Loblolly pine	37.8	59	9.1
Shortleaf pine	20.8	25	0.3
Total	20.6	203	10.8

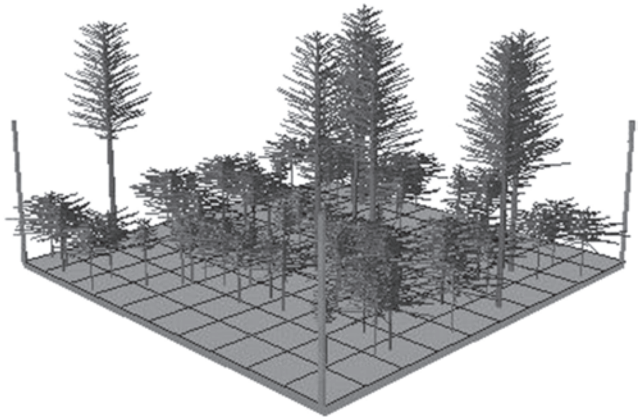

FIGURE 10.3 Schematic of the stand condition at year 2045, 30 years after initiation of management, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

reduce the availability of grasses and forbs and that some precommercial thinning may be necessary simply to maintain Bachman's sparrow habitat (Figure 10.3).

Year 2055: In addition to prescribed burning to reduce hardwoods and to maintain a grass–forb understory, density management is now necessary to ensure that growing space is available for regenerating trees as well as the grass–forb layers. We will initiate a precommercial thin, reducing the density of the regeneration by 50% if necessary to ensure continued stand development.

Year 2065: With the precommercial thin in the previous decade and the site maintained with fire, additional regeneration may become established in the understory (Figure 10.4). Stand basal area has increased to nearly 15 m^2/ha (Table 10.4).

Year 2075: We will continue to manipulate the density of all tree sizes and by this time have entered a group selection regeneration system. Group sizes will vary and cutting cycles of 10–15 years will be needed to ensure that all size classes of longleaf pine continue to develop. We also will retain some of the large loblolly pine in the stand as potential nest trees. The stand is now at

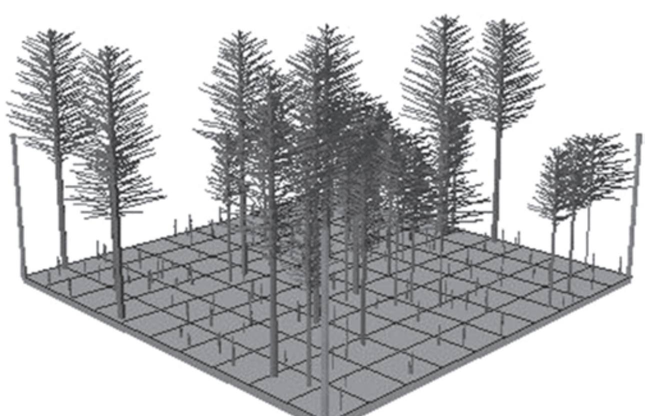

FIGURE 10.4 Schematic of the stand condition at year 2065, 50 years after initiation of management, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. Journal of Forestry 96(6):17–23.)

TABLE 10.4
Summary Statistics for a 7-ha Pine Stand Projected to the Year 2065, 50 Years after Initiating Management, Kisatchie National Forest, Louisiana

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Longleaf pine	9.0	274	1.8
Loblolly pine	30.1	108	12.8
Shortleaf pine	6.9	50	0.2
Total	14.0	431	14.9

TABLE 10.5
Summary Statistics for a 7-ha Pine Stand Projected to the Year 2105, 90 Years after Initiating Management, Kisatchie National Forest, Louisiana

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Longleaf pine	24.1	58	2.8
Loblolly pine	56.1	25	6.2
Total	33.5	83	9.0

the stage that red-cockaded woodpeckers could likely begin using the stand for nesting if adjacent stands provide adequate foraging habitat.

Years 2085–2105: Management will continue as needed in a maintenance mode by managing stand density to ensure rapid tree growth, retaining potential nest trees, and burning to maintain a grass–forb understory (Table 10.5, Figure 10.5).

Year 2115: Additional density management may or may not be needed at this point. Monitoring data should be used to ensure that habitat elements needed by the three species are persisting.

Year 2125: By this time the DFC should be reached or nearly so (Figure 10.6). Monitoring data will help determine if these stand growth projections produced a reasonable schedule toward development of the DFC. Basal area is now just below our target of 16 m^2/ha (Table 10.6), the stand is 80% longleaf by density, and comprises nearly half the basal area. Loblolly pines are

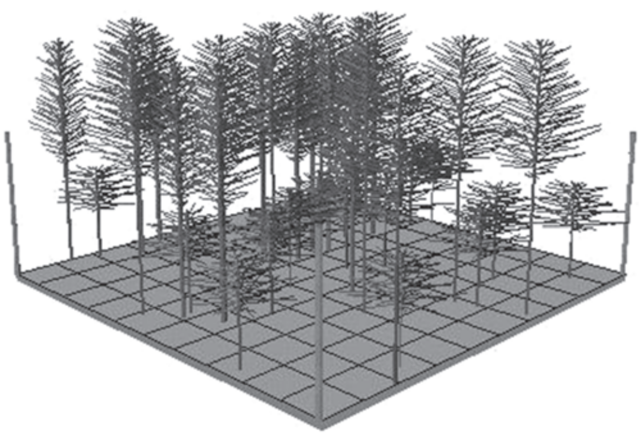

FIGURE 10.5 Schematic of the stand condition at year 2105, 90 years after initiation of management, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

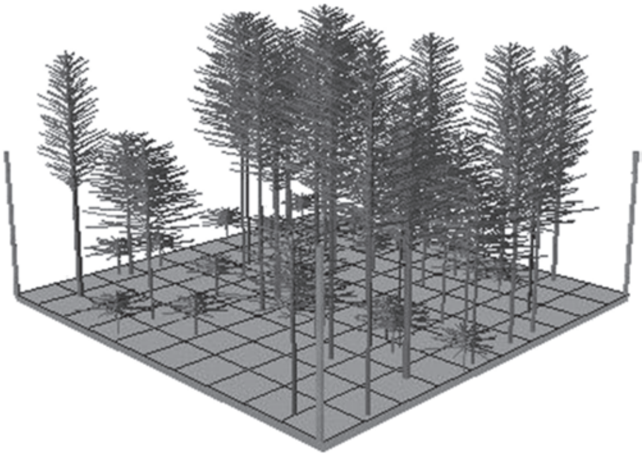

FIGURE 10.6 Schematic of the stand condition at year 2125, 110 years after initiation of management, Kisatchie National Forest, Louisiana. (Based on simulations from the Landscape Management System; McCarter, J.M. et al. 1998. *Journal of Forestry* 96(6):17–23.)

now over 60 cm dbh and over 150 years old. Continued burning has allowed persistence of a grass–forb understory to provide habitat for Bachman's sparrows. Either through natural mortality or by actively killing trees, loblolly pines can be a source of snags for brown-headed nuthatches. Stand density can be reduced even further by cutting some, but not all, of the large loblolly pines to release longleaf pines.

Monitoring Plans

The above plan is a hypothesis. We cannot be sure that the stand will respond as intended, but on the basis of the species, sizes, and site conditions, the steps outlined above represent a reasonable approximation of how we might achieve our DFC. As we initiate management, however, we also should initiate a monitoring plan to see whether the stand is developing as predicted. Because the stand prescription has a number of steps, including regeneration cuts, thinning, and burning, it is important that each step be implemented correctly and in a timely manner. Implementation monitoring would be conducted to ensure that the plan is implemented correctly. Questions that you might address in your implementation monitoring might include: Were any unmarked trees harvested? Were burns conducted in the correct seasons? Was the fire return interval as prescribed?

In addition to implementing the prescription correctly, we would want to know whether we were effective in achieving both the stand structure as well as function. *Effectiveness monitoring* may take two parts. First we would monitor the survival, growth, and development of the vegetation to

TABLE 10.6
Summary Statistics for a 7-ha Pine Stand Projected to the Year 2125, 110 Years after Initiating Management, Kisatchie National Forest, Louisiana

Species	Average dbh (cm)	Trees per ha	Basal Area (m^2/ha)
Longleaf pine	22.4	101	5.3
Loblolly pine	64.1	25	8.2
Total	30.6	126	13.5

ensure that the habitat structure goals were being met. Regeneration surveys to assess survival can be done at 10–20 randomly established circular plots in the stand for the first 5 years after planting. Once seedlings are established and free to grow, then tree growth and survival should be monitored. Tree growth and survival is typically monitored on continuous forest inventory (CFI) plots and may be a fixed plot or a variable radius (wedge prism) sample. Measuring tree growth and survival every 5–10 years would be adequate to see whether the stand is developing as predicted. These samples will provide data on growth, basal area, density, and species composition, and should include information on snag densities, and understory cover. Understory cover estimates can be used to assess whether hardwoods are being effectively controlled by burning and if the grass–forb cover needed by Bachman's sparrows is developing.

We also want to know if the stand is functioning as we intended. We will want some indication of species use of the stand over time. Conducting a census of red-cockaded woodpecker nest trees in the stand every 5 years can be quite easily done by searching for resin flows on trees. In addition, 3–5 variable circular plots can be established in association with the CFI plots to sample bird density. Plots would be visited 4–6 times during the breeding season during the early morning. All birds seen or heard are recorded at each plot, and the distance from plot center to the bird is estimated. These data not only provide evidence of birds using the plot, but can also estimate densities. If our focal species are using the stand, then more intensive nest searching may be needed to document reproductive success in the stand (and more closely estimate potential fitness). Samples taken every 5 years would allow estimates of trends in use of the stand over time. If structure is not developing as intended or if species are not using the stand as predicted, then the prescription can be revised to increase the probability of producing functional habitat for these species.

Budget

Cost almost always becomes a factor when implementing a prescription to achieve a goal. For most landowners, there must not be a net loss, and for some landowners there must be a maximum profit. Understanding the products that can be derived from implementing the prescription, both economic and ecological, can help the manager decide if the trade-offs are acceptable.

I developed a budget for our prescription based on a number of assumptions:

1. I assumed that pine sawtimber would sell for at least $200/MBF and pine pulpwood for $20/cord as stumpage. Stumpage is the value of the wood before it has been cut and is the price paid by a logger for standing trees.
2. That site preparation burning would cost $425 and that in-stand burning would cost $175 each time the stand is burned.
3. That a fire line can be established for $100.
4. That planting stock, planting, and herbicide applications would collectively cost approximately $250/ha.
5. That labor costs associated with marking tallying, sale oversight, and monitoring cost $20/h.

On the basis of these assumptions and our prescription, we would anticipate two sales that could be sold as stumpage: an irregular shelterwood in 2015 and produce 49 MBF/ha of pine sawtimber and 66 cords of pulpwood per ha. Group selection and thinning in 2095 would yield similar volumes (49 MBF/ha and 47 cords/ha). Income and expenses are outlined in Table 10.7 and clearly indicate the potential for having incomes exceed expenses while managing habitat for these three animal species. And I did not include interest earned on income over the life of the plan, which would make the plan even more feasible for private landowners. Are profits maximized? Clearly not. But for a nonfederal forest landowner, both habitat objectives and timber income can be realized in this example. For federal managers there is a positive net return on the investment of taxpayer dollars with a net present value of $69,333 over a 100-year period.

TABLE 10.7
Estimated Income and Expenses Associated with Managing a 7 ha Pine Stand on the Kisatchie National Forest to Improve Habitat for Red-Cockaded Woodpeckers, Bachman's Sparrows, and Brown-Headed Nuthatches

Decade	Activity	Income	Expenditure
2005	49 MBF/ha sawtimber	$68,000.00	
	66 cords pine pulpwood/ha	$9,225.00	
	Tree marking and tally		$2,700.00
	Site prep burn		$425.00
	Fire line		$100.00
	Planting, weed control		$1,700.00
	Implementation monitoring		$200.00
	Monitoring regeneration success		$200.00
	Prescribed burn		$187.00
2015	Prescribed burn (3)		$561.00
	Monitoring tree survival and growth		$200.00
	Monitoring animal use		$700.00
	Snag creation (if necessary)		$1,000.00
2025	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2035	Prescribed burn (3)		$561.00
	Precommercial thin		$1,700.00
	Snag creation (if necessary)		$1,000.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2045	Replant longleaf as necessary		$1,700.00
	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2055	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
	Precommercial thin		$1,700.00
2065	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2075	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2085	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2095	49 MBF/ha sawtimber	$68,000.00	
	47 cords/ha of pulpwood	$6,401.00	
	Tree marking and tally		$2,700.00
	Implementation monitoring		$200.00
	Prescribed burn (3)		$561.00
2105	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
2115	Prescribed burn (3)		$561.00
	Monitoring tree growth and snag recruitment		$200.00
	Monitoring animal use		$700.00
Total		$151,626.00	$30,683.00

Note: Numbers in parentheses indicate the number of activities during the designated time period.

SUMMARY

Developing a prescription or plan for a stand or landscape entails articulating a set of goals and objectives. These objectives usually come in the form of describing a DFC, or set of conditions, that will likely produce both stand structure and function in the future. The challenge for the forest manager is to understand the potential of a site to achieve the DFC, the opportunities and constraints imposed by the current stand conditions, and the silvicultural approaches that should logically be applied to guide stand development toward one or more DFCs. Use of stand growth models can aid in visualizing future stand conditions and may help in developing a schedule and budget to help ensure that a DFC is attainable. Finally, since any plan is a hypothesis, monitoring of stand structure and function must be conducted and data used to refine future management actions.

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