



**Draft 7 v.4 Principle 10 (Plantation Management) of the  
FSC-US Forest Management Standard  
Prepared for Public Consultation  
March 12, 2010**

This document represents Draft 7 v.4 Principle 10 of the National FSC-US Forest Management Standard. It has been prepared for the second public consultation period. This draft is the result of consultation and deliberation from the FSC-US Standards & Policy Committee of the FSC-US Board, the FSC-US Plantations Working Group, as well as from consultation and advice from partners with expertise in FSC certification of plantations, and stakeholders who commented during the first public consultation period. It has also been approved for this second public comment period by the Standards & Policy Committee of the FSC-US Board.

Stakeholder consultation is a core component of the standards revision process, and we invite you to provide comments on this draft. The 30-day public comment period extends until April 12, 2010. FSC-US is committed to a consensus-based, inclusive and balanced standards revision process, and all comments will be carefully considered by the FSC-US Board. All comments must be received by the close of the consultation period in order to be considered.

Certification of plantations requires compliance with Principles 1-9 of the Draft 8 v.1 National FSC-US Forest Management Standard, as well as requirements found in Principle 10. There are a few Indicators from Principles 1-9 that do not pertain to plantation management – these are identified in this draft. Definitions of some terms and elaboration on the role of applicability notes, intent statements, and guidance can be found in draft 8 v.1 of the National FSC-US Forest Management Standard. A copy of Draft 8 v.1 can be found on the FSC-US website. Please note that the definition of Plantation, and guidance on the classification of plantations, are included in this document and are part of this public comment phase.

**To submit comments** please email or mail a letter detailing your comments to:

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Please try to be as specific as possible in your comments – we encourage you to provide comments on specific Indicators and to provide alternative language where appropriate. Please do not submit comments in the form of track-changes to this document.

**Contact**

Please contact Karen Steer, FSC-US, with any questions or for more information about this process.  
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Thank you!

## **Definition of Plantation**

*[Note: This definition will be inserted in the glossary of the National FSC-US Forest Management Standard.]*

Forest areas lacking most of the principal characteristics and key elements of native ecosystems as defined by FSC-approved national and regional standards of forest stewardship, which result from the human activities of either planting, sowing or intensive silvicultural treatments (source: FSC-STD-01-001).

Except for highly extenuating circumstances the following are classified as plantations:

- cultivation of *exotic species* or recognized exotic sub-species;
- cultivation of clonally propagated trees in cases where the species do not naturally reproduce vegetatively (e.g. clonal propagation of conifers);
- cultivation of any tree species in areas that were historically non-forested ecosystems.

*Please see Appendix X for guidance and other information on the classification of plantations.*

## PRINCIPLE 10: PLANTATIONS

**Plantations shall be planned and managed in accordance with Principles and Criteria 1- 9, and Principle 10 and its Criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.**

Principle-level applicability of indicators from P1-9: Within the portion of the FMU being managed as plantations, the following indicators do not apply: 6.3.b, 6.3.d, 6.3.e, 6.3.f, and 6.3.g.1. All other indicators are pertinent. These indicators are implemented in the plantation portions of the FMU devoted to restoration (as covered by Criterion 10.5).

**C10.1 The management objectives of the plantation, including natural forest conservation and restoration objectives, shall be explicitly stated in the management plan, and clearly demonstrated in the implementation of the plan.**

**Indicator 10.1.a** Consistent with all the indicators within Principle 10 and requirements of Principle 7, the management plan contains clear descriptions of the management goals and prescriptions for plantations on the FMU, of the rationale for plantation management within the FMU, and the relationship between the plantations and natural forest conservation and restoration objectives within the unit.

**C10.2 The design and layout of plantations should promote the protection, restoration and conservation of natural forests, and not increase pressures on natural forests. Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods shall be used in the layout of the plantation, consistent with the scale of the operation. The scale and layout of plantation blocks shall be consistent with the patterns of forest stands found within the natural landscape.**

**Indicator 10.2.a** For plantations established on soils capable of supporting natural forests, harvest units shall be arranged to provide or maintain areas of vegetative cover that allows populations of mid to late successional and sedentary native plant and animal species to survive or be reestablished within the plantation.

Applicability: this Indicator only applies to plantations established on soils capable of supporting natural forests.

Guidance: Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods are addressed in the layout of harvest units and may be used to achieve this Indicator or parts of this Indicator. This Indicator addresses the FMU in its entirety and the arrangement of plantations and natural ecosystems within the FMU.

**Indicator 10.2.b** New plantation establishment does not replace, endanger, or otherwise diminish the ecological integrity of any existing natural ecosystems on the FMU, including primary, natural, or semi-natural forests on the FMU. Plantations can be established on the following sites: former plantations and forest sites that lack the vast majority of the native forest ecosystem components; agricultural lands; and non-forested lands that were historically forested but have been used for non-forest purposes since before 1994 (see additional conditions in Criterion 10.9). New plantations are not established on rare or threatened non-forest habitats or ecosystems.

Intent: “*Forest sites that lack the vast majority of the native forest ecosystem components*” are those sites that have existed in this condition for an extended period (i.e. since before 1994); and are not otherwise likely to be returned to a natural forest condition. Recent management activities (e.g., clearcuts) or natural disturbances (e.g., fire or tornado) that create conditions lacking native forest ecosystem components do not comprise acceptable conditions for plantation establishment.

Guidance: Refer to Criterion 6.10 for all restrictions regarding conversion of FSC-certified lands. Conversion of natural and semi-natural forests to plantations is prohibited in all regions of the US. Conversion of degraded, semi-natural stands to restoration plantings is acceptable.

**Indicator 10.2.c** Opening sizes are consistent with natural landscape patterns, disturbance regimes, and wildlife habitat needs. Openings lacking within-stand retention are limited to a 40 acre average and an 80 acre maximum. Openings larger than 80 acres must have retention as required in Indicator 10.2.d and be justified by *credible scientific analysis*. The average for all openings (with and without retention) cannot average more than 100 acres.

Guidance: For harvest openings of all sizes in the Pacific Coast region, a minimum average of four dominant and/or co-dominant trees and two snags per acre should be retained. Where sufficient snags do not exist, they are recruited.

**Indicator 10.2.d** On openings larger than 80 acres that are justified by *credible scientific analysis*, live trees and native vegetation are retained in a proportion and configuration that are consistent with the characteristic natural disturbance regime in each community type, unless retention at a lower level is necessary for restoration or rehabilitation purposes.

Guidance: Retention for protecting present ecological values, such as streams is of primary importance. Retention for wildlife purposes is based on the needs of species native to and naturally present at the site. The levels of green-tree retention depend on such factors as habitat connectivity and needs of representative plant and animal species. Retention is distributed as clumps, strips, and dispersed individuals, appropriate to site conditions. Retained trees comprise a diversity of species and size classes, which includes large and old trees, when available.

**Indicator 10.2.e** In all regions except the Southeast, before an area is harvested, regeneration in adjacent forested areas (either natural forest or plantation) must be of the subsequent advanced successional habitat stage, or exceed ten feet in height, or achieve canopy closure along at least 50% of its perimeter.

In the Southeast Region, harvest units are arranged to support viable populations of native species of flora and fauna. For hardwood ecosystems, regeneration in previously harvested areas reaches a mean height of at least ten feet or achieves canopy closure before adjacent areas are harvested. For southern pine ecosystems, (e.g. upland pine forests, pine flatwoods forests, sand pine scrub), harvest areas are located, if possible, adjacent to the next youngest stand to enable early successional or groundcover-adapted species to migrate across the early successional continuum.

Applicability: An area adjacent to a regeneration harvest may be harvested prior to these green-up conditions providing that the sum area of the opening is not greater than the opening size restrictions stated in Indicator 10.2.c (e.g., 80 acres). The first paragraph of Indicator 10.2.d applies to all regions except the Southeast, and the second paragraph only applies to the Southeast Region.

Intent: The goal is to create or enhance a mosaic of habitat types and ages. In the Southeast, the goal is to provide suitable habitat for early successional species.

**C10.3 Diversity in the composition of plantations is preferred, so as to enhance economic, ecological and social stability. Such diversity may include the size and spatial distribution of management units within the landscape, number and genetic composition of species, age classes and structures.**

**Indicator 10.3.a** Plantation management alone or in combination with natural forest management contributes to the economic stability of the local community, or helps the owner maintain the property as a working forest.

**Indicator 10.3.b** On plantations established on soils capable of supporting natural forests, the forest owner or manager maintains, conserves, and/or restores forest health and diversity, including wildlife habitat and soil productivity, by maintaining appropriate diversity of size, structures, age classes, species and genetics across the plantation FMU.

Applicability: This only applies to plantations established on soils capable of supporting natural forests.

Intent: The goal of the Indicator is *in part* to create and maintain structural and species diversity that results in high quality early- and mid-successional wildlife habitat.

Guidance:

- Thinnings provide light to the forest floor to enhance the diversity of understory species.
- Coarse woody debris and snags are retained and/or recruited for wildlife habitat.
- Islands of vegetation and advanced regeneration are retained, and are spatially arranged to provide refugia for wildlife and plant species.
- An herbaceous layer, shrub layer, and mid-story is retained in selected areas and allowed to develop.
- Genetic diversity is maintained as justified by credible scientific analysis to buffer against pests and extreme environmental conditions.

**C10.4 The selection of species for planting shall be based on their overall suitability for the site and their appropriateness to the management objectives. In order to enhance the conservation of biological diversity, native species are preferred over exotic species in the establishment of plantations and the restoration of degraded ecosystems. Exotic species, which shall be used only when their performance is greater than that of native species, shall be carefully monitored to detect unusual mortality, disease, or insect outbreaks and adverse ecological impacts**

**Indicator 10.4.a** Species shall be used for planting that are suitable and appropriate to the site and are consistent with maintaining FMU health and productivity. Species native to the region are preferred to other species (not native to the region).

**Indicator 10.4.b** For the Northeast, Ouachita/Ozark, Rocky Mountain, Southwest, Pacific Coast and Lake States regions, the use of *exotic species* (i.e. species not native to the region) is contingent on

*credible scientific analysis* confirming that the species in question is non-invasive, will not create significant risk to forest health, and performs better than species native to the region. If exotic plants are used, their provenance and the location of their use are documented and their ecological effects are monitored.

In the Pacific Coast region, on soils capable of supporting natural forests, only species native to the site are planted.

In the Mississippi Alluvial Valley Appalachian, and Southeast regions, the planting of exotic species is used only for site remediation. Justification for such plantings is provided. The species in question shall be non-invasive, shall not create significant risk to forest health, and shall perform better than native species. Their provenance and the location of their use are documented and their ecological effects are monitored.

Applicability: The first paragraph applies to all regions except for the Mississippi Alluvial Valley, Appalachian and Southeast regions. The second paragraph of Indicator 10.4.b applies only to the Pacific Coast; the third paragraph applies only to the Mississippi Alluvial Valley, Appalachian, and Southeast regions.

Guidance: See additional conditions under Indicator 10.2.b and Criterion 10.9 addressing where plantations may be established or re-established and still be considered for certification.

**C10.5 A proportion of the overall forest management area, appropriate to the scale of the plantation and to be determined in regional standards, shall be managed so as to restore the site to a natural forest cover**

Applicability: The Criterion was written under the assumption that the plantation site was historically natural forest as opposed to a non-forest ecosystem and, thus, a portion could be restored to natural forest cover. In cases where the plantation was established on non-forest ecosystems, restoration efforts should be focused on native ecosystems and prioritized to local conditions and environmental priorities. Those portions of the FMU that are being maintained and/or restored as natural or semi-natural forest cover are subject to all requirements in Principles 1-9 of this Standard.

Intent: SMZs and other protected forest areas maintained or restored as natural or semi-natural forests within the FMU may be included as part of the natural forest cover required to be maintained or restored. An FMU that has more than these minimum designated percentages in natural or semi-natural forests may not convert these areas to plantations without addressing requirements in Criterion 6.10.

**Indicator 10.5.a** Areas of forest and/or plantation to be restored to natural conditions are chosen through a landscape analysis that focuses on enhancing principle characteristics of the native ecosystem or providing important ecological benefits at the stand or landscape level. Management plans should clearly state the extent and location of areas selected for such restoration, as well as the rationale for their selection.

Guidance: For example, areas that are best suited for restoration include riparian areas, migration corridors among areas of existing natural forest, unstable slopes and natural communities, etc.

**Indicator 10.5.b** Areas of forest and/or plantation to be restored or maintained as natural forests are managed to provide a diversity of community types, wildlife habitats, and ecological functions native to the site.

**Indicator 10.5.c** The ratio and spatial distribution of plantations, with respect to natural and semi-natural forests, maintains and/or restores the landscape diversity of community types, wildlife habitats, and ecological functions similar to a mosaic of natural forests.

**Indicator 10.5.d** Where natural ecosystems were previously converted to plantations, a percentage of the total area of the FMU must be maintained and/or restored to natural or semi-natural cover. The minimum percentage area that is maintained and/or restored in natural or semi-natural state is:

- For 100 acres or less, at least 10 percent
- For 101-1,000 acres, at least 15 percent
- For 1,001-10,000 acres, at least 20 percent
- For > 10,000 acres, at least 25 percent

In the Pacific Coast region, at least half of the area maintained in natural cover is maintained as or is being restored to late seral stages.

**Indicator 10.5.e** In the Pacific Coast region, plantations on forest soils on public lands are managed to restore and maintain natural forest vegetation, structure, function, and habitats, and fully meet, at the earliest possible time, all aspects of Principles and Criteria 1-9 that are relevant to natural forests for the area.

Applicability: this Indicator is only applicable to public lands, and only in the Pacific Coast (PC) region.

**C10.6 Measures shall be taken to maintain or improve soil structure, fertility, and biological activity. The techniques and rate of harvesting, road and trail construction and maintenance, and the choice of species shall not result in long term soil degradation or adverse impacts on water quality, quantity or substantial deviation from stream course drainage patterns.**

**Indicator 10.6.a** Forest operations do not result in long-term adverse impacts to soil productivity, water resources, and hydrology. Soil disturbance is minimized during road/trail work and site preparation, and site preparation is done in accordance with BMPs.

Guidance:

- Intensive practices, such as windrowing and/or bedding, are used only when alternative practices are deemed inadequate and when ecological impacts of these intensive practices are necessary and justified.
- Methods of site preparation are based on terrain, soil conditions, native ground cover, intensity of vegetative competition, and anticipated response of vegetation and planted trees.
- Mechanical site preparation is conducted with the minimum soil disturbance necessary to achieve the objective of site preparation.
- There is little or no evidence of soil erosion and no sedimentation of waterways resulting from recently planted harvest units.

**Indicator 10.6.b** Tree seedlings are planted in a way that minimizes damage to the soil, while facilitating seedling survival. Tree seedling species are selected appropriate for maintaining long-term site productivity.

Guidance: If mechanized tree planting is used, on slopes greater than five percent, it is carried out on the contour.

**Indicator 10.6.c** Thinning is implemented in a manner that minimizes site disturbance and damage to the residual stand of crop trees and other desired vegetation (See Criterion 6.5).

**Indicator 10.6.d** Fertilizer is applied only when all the following conditions are met:

- 1) Soil classification or foliar analysis indicates one or more nutrients are a limiting factor for forest productivity.
- 2) Data and/or scientific literature suggest that the response to fertilization is economically justified.
- 3) Where necessary due to topography, soils, or other conditions, measures are taken to prevent damage from fertilizer runoff or leaching. This includes preventing influences on native low-nutrient ecological systems, such as pitcher plant bogs, or on ground and surface water quality.
- 4) Fertilizer application maintains or enhances soil condition and site productivity.

**Indicator 10.6.e** Sufficient woody debris and other organic matter is retained within plantation stands to ensure adequate soil structure and nutrient recycling.

Applicability: This Indicator does not apply to plantations that use fire to achieve natural understory and soil conditions.

**C10.7 Measures shall be taken to prevent and minimize outbreaks of pests, diseases, fire and invasive plant introductions. Integrated pest management shall form an essential part of the management plan, with primary reliance on prevention and biological control methods rather than chemical pesticides and fertilizers. Plantation management should make every effort to move away from chemical pesticides and fertilizers, including their use in nurseries. The use of chemicals is also covered in Criteria 6.6 and 6.7.**

**Indicator 10.7.a** Outbreaks of pests and disease are controlled by maintaining plantation vigor. Management regimes in plantation areas are designed to minimize forest damage from fire, pests, diseases, wind and other factors. Where applicable:

- Periodic thinnings are scheduled and conducted to reduce competition for light, water, and nutrients.
- The forest owner or manager is aware of potential pest problems associated with the tree species in the plantation and region, and has some knowledge of control procedures.
- Habitat for predators of plantation pests is maintained within or adjacent to the plantation.
- Diversity of tree species is encouraged in the stand.
- Management techniques are used that minimize reliance on chemicals.

Guidance: In the absence of biological controls, the use of pesticides to control pests is allowed.

Methods for controlling outbreaks include:

- A diversity of species or clones is maintained within and among stands.
- A diversity of age classes is maintained across the landscape.
- Sufficient habitat for native species of predators is maintained within or adjacent to the stand.

**Indicator 10.7.b** A strategy is in place to control fire damage. Where applicable, prescribed burns are conducted according to BMPs and with adequate planning, equipment, training and weather conditions to maintain control of the burn within the burn plan area.

Guidance:

- Natural breaks and/or fire lanes are present and functional.
- Periodic prescribed burning keeps plantation fuel loads low.
- Personnel are adequately trained in fire control or protocol and are aware of available assistance.

**Indicator 10.7.c** Populations of invasive plants are controlled, minimized, or eliminated (see also Indicator 6.3.j). Records of control measures are maintained.

**C10.8 Appropriate to the scale and diversity of the operation, monitoring of plantations shall include regular assessment of potential on-site and off-site ecological and social impacts, (e.g. natural regeneration, effects on water resources and soil fertility, and impacts on local welfare and social well-being), in addition to those elements addressed in principles 8, 6 and 4. No species should be planted on a large scale until local trials and/or experience have shown that they are ecologically well-adapted to the site, are not invasive, and do not have significant negative ecological impacts on other ecosystems. Special attention will be paid to social issues of land acquisition for plantations, especially the protection of local rights of ownership, use or access.**

**Indicator 10.8.a** Monitoring of the impacts of plantations, both on and off-site, is conducted in the same manner as the monitoring of natural forests, in accordance with Principles 4, 6, and 8.

Guidance: All requirements of monitoring, as stipulated in Principles 4, 6, and 8, except those exempt from plantation management (see list at Criterion 10.6) pertain to plantation management.

**C10.9 Plantations established in areas converted from natural forests after November 1994 normally shall not qualify for certification. Certification may be allowed in circumstances where sufficient evidence is submitted to the certification body that the manager/owner is not responsible directly or indirectly of such conversion.**

Applicability: This Criterion only applies to plantations established in areas converted from natural forests. Plantations that are established in other ecosystems (steppe, grassland, etc.) are not covered by this Criterion. See additional conditions regarding plantation establishment on rare or threatened non-forest habitats in Criterion 10.2.

Intent: The November 1994 cutoff date refers to the date of conversion, not the date of plantation establishment. The subsequent requirements do not address plantation areas (or harvested units) that have been harvested and replanted as plantation since 1994 if the date of conversion was prior to the cutoff date.

**Indicator 10.9.a** For plantations established in areas converted after 1994, the forest owner or manager demonstrates to the CB that the manager/owner was not directly or indirectly responsible for the conversion of the natural forest to the plantation.

**Indicator 10.9.b** For plantations established in areas converted after 1994, the forest owner or manager develops and implements a plan to restore the plantation stands to conditions characteristic of natural forests and to manage those stands in compliance with all Indicators of P1-P9 as quickly as feasible.

Intent: The intent is to limit certification of plantations established in areas converted from natural forests after November 1994.

Guidance:

Younger plantations with significant capital invested may need to be managed with a moderate level of intensity to recoup investment before full or significant restoration measures are fully implemented. In these cases, restoration may be phased in as stands reach merchantable ages. Contractual supply obligations and binding supply agreements are generally not acceptable as rationale for delaying restoration.

Examples of activities that are carried out in restoration plantations include:

- modification of the management plan from commercial to restoration;
- enrichment plantings of native species;
- management of soils and coarse woody debris to restore or enhance soil fertility;
- restoration and/or enhancement of native wildlife habitats;
- restoration and/or enhancement of *structural diversity* by recruiting mid-story and/or understory components;
- control of unwanted vegetation is limited to levels that allow restoration of native species;
- restoration of the fire regime common to natural stands is implemented when feasible.

## Appendix X

[Note: This guidance is meant to help with the classification of plantations. In the coming months, FSC-US will continue to work towards strengthening and augmenting the information herein so that it serves as a valuable tool to help landowners in classifying plantations. FSC-US welcomes feedback on the information that will be most useful towards this end.]

### Guidance on the classification of plantations

From the definition of plantation it is clear that the presence of ***principal characteristics and key elements of native forest ecosystems*** is primary and if a forest does not “lack most” of the characteristics and elements, the amount of human activity is irrelevant. Therefore, a "planted forest" is not necessarily a "plantation" since it may have most of the principle characteristics and key elements of native forest ecosystems indigenous to an area. Since we are concerned with native forest ecosystems, there are two situations, except for highly extenuating circumstances, where planted forests are always considered plantations.

Otherwise, a forest must be determined to be natural or a plantation depending upon the degree to which it has and provides the ***principal characteristics and key elements of native forest ecosystems*** as compared to a natural stand of similar forest type and development stage; further, to the extent that a particular forest does NOT provide these attributes, it must be clear that the absence of the attributes is a result of silviculture treatments. Since almost all of the noted characteristics and elements are very difficult to measure directly, especially in the short time frame of an audit, forest managers and CBs must use professional judgment to evaluate sites for these characteristics and elements as well as keep abreast of research that is designed to specifically measure the effects of various silviculture treatments on these attributes. Forest managers should be prepared to provide the results of research appropriate to their forest types and forest management practices.

This guidance must be used for both short-term certification evaluations and as the basis for the development of more detailed guidance specific to forest types.

#### **Guidance on *principle characteristics and key elements of native forest ecosystems*:**

The term “***principle characteristics and key elements of native forest ecosystems***” refers to the suite of attributes that ***natural forests*** have and provide for the environment and society.

These characteristics are dependent on the forest type/forest habitat type, temporal nature of forest stand development, and the past management history of the site. In the context of the progressing stage of stand development (e.g., stand initiation, stem exclusion, understory reinitiation, and old growth – per *Oliver and Larson 1996*) there are ***principle characteristics*** of natural forests, which are not present in plantations, as these terms are defined in this standard. This approach is based on the generalization that native forest ecosystems are also typically characterized by survival through at least the mid-development stage, given allowances for historic range of natural variation. These characteristics include:

- changes in tree morphology and understory plant community associated with mid-development stages of a stand (e.g., understory reinitiation);
- stand structure that is consistent with the natural disturbance regimes of the region;
- native plant species abundance and distribution associated with the corresponding stage of development;
- a suite of characteristic ***ecological functions associated with forest ecosystems***

These characteristics are further elaborated as:

- tree size, species composition, and age class distribution consistent with the concomitant stage of stand development for native forests types occurring on similar sites;
- variability in tree density and spacing consistent with the concomitant stage of stand development for native forests types occurring on similar sites;

- herbaceous and shrub species diversity, structure, and density consistent with the concomitant stage of stand development for native forests types occurring on similar sites;
- stand level habitat elements including snags, den trees and downed woody debris consistent with the concomitant stage of stand development for native forests types occurring on similar sites;

Collectively, these characteristics are fundamental to native forest ecosystems throughout the US. However, the "abundance" of each of these attributes on a given site exist along a spatial and temporal continuum ranging from abundant to marginally present depending on the forest type, stage of development, the range of natural variation associated with the forest type, past natural disturbance and past management.

This guidance should be used as a framework to guide regional decision-making in lieu of additional FSC-US guidance specific to regions and forest types.

**Guidance on *ecological functions associated with forest ecosystems*:**

All forest ecosystems, including natural forests and plantations, play a valuable role in providing essential environmental services especially compared to non-forest ecosystems and other land uses. Some of the central ecosystem services of all forest ecosystems include the following:

- *water quality and cycling*: water draining forested watersheds generally is of higher quality than any other land use. Quality includes low amounts of dissolved chemicals such as nitrogen and phosphorus. Water draining forested watersheds also generally exhibits the most stable runoff pattern of any land use. Stable runoff pattern means the most continuous streamflow year-round and low peak flows; both of these characteristics follow directly from the high infiltration rates in forests compared to other land uses.
- *soil stabilization and erosion control*: forested watersheds generally have the lowest erosion rates of any land use, especially when compared across similar soil types and slopes. Forest vegetation helps control both mass wasting and surface erosion.
- *nutrient balance and cycling*: forested watersheds are generally highly conservative of nutrients. This is a corollary to the discussion above on water quality and cycling.
- *carbon cycling*: carbon is a particular element of concern with respect to climate change. Forests tend to sequester carbon over long time periods as they develop toward maturity. Carbon is often released through catastrophic events such as wildfire that reset stand development. Carbon sequestration diminishes rapidly and may reverse as forests mature and net growth stops.
- *genetic and species diversity (plants and animals)*: genetic and species diversity provide the template for adaptation of populations and species and are therefore an important attribute of forest ecosystems.
- *within-stand structural diversity*: forested areas generally exhibit within stand structural diversity as a result of remnant features surviving recent disturbances. These features include live and dead, standing and down large wood. Small patch disturbances, too small to be considered a "stand" by themselves, also provide structural diversity.
- *between-stand structural diversity*: forested landscapes generally exhibit between stand structural diversity as a result of various disturbances. Because these disturbances are generally limited in spatial scale and variable in intensity (such as fire, windthrow, disease, insects) forested landscapes generally consist of numerous stands that represent different forest development stages and responses to disturbances.
- *wildlife habitat*: wildlife habitat encompasses a broad range of scales, from individual plants (or trees) to entire forested landscapes. Within-stand and between stand structural diversity (discussed above) are the main drivers of wildlife habitat. Forested landscapes with large amounts of structural diversity generally provide habitat for a wide range of animals.