"Real" vs. "Fake" Forests: Why Tree Plantations Are Not Forests

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Abstract

Tree plantations make up some 4% of the world's forests and are increasing as native forests are cut down to meet rising wood product demands. An additional 30% of the world's forests are in "production," as defined by the Food and Agriculture Organization (FAO) of the United Nations. Compared to native ("real") forests, plantations ("fake") are often characterized by genetically modified tree genomes, over simplified forest structures (deficient in snags, down wood, large trees, and understory vegetation), single species monocultures, and greatly altered ecosystem processes (e.g., natural disturbances, hydrology, nutrient cycling, pollination, and food-web dynamics). Existing plantations can be managed to improve ecological integrity by enhancing structures otherwise absent in intensively managed systems. Conversion of native forests to plantations, however, needs to cease along with reducing wasteful consumption, increasing reliance on alternative wood fibers (e.g., hemp), recycling, and the use of engineered wood products that do not come from native forests.

What Exactly is a Forest?

Is a forest merely a collection of trees forming a canopy overstory (i.e., tree cover)? If we plant trees, does that make it a forest? How much of the Earth's forests is planted (more correctly termed "tree farms")? How do planted forests differ from native forests? Can we meet wood demands while minimizing our ecological footprint?

To begin, when it comes to a forest, we each see what we want.

A forester sees a crop of trees to be extracted for timber-profit as soon as possible—the economic bottom line. An ecologist sees an ecosystem where the parts are interwoven and uniquely sculpted by natural processes; deforestation is antithetical to the sum-of-the parts.

When I take a hike into a native (unlogged) forest, I see a rich tapestry of life. This intimidate dance of plant and animal, form and function, process and outcome is lacking in a plantation, especially plantations embedded in a sea of industrialized forestry. A walk in an industrial landscape has a different feel, smell, and much fewer dance partners. Wally Menne, a member of the Timberwatch coalition (http://www.timberwatch.org.za), aptly calls timber plantations "fake" forests (http://wrm.org.uy/oldsite/countries/SouthAfrica/difference.html). I adopt his terminology to distinguish real from fake, native from plantation, natural from engineered. In science, terminology matters—in this case, do we see forests as living, self-willed ecosystems or a crop to be manipulated for the bottom line?

How Are Forests and Plantations Defined and Counted?

To get at the root of the issue (literally), let's first explore some basic definitions.

Early Forest Definitions

The term "forest" has many origins (https://en.wiktionary.org/wiki/forest). From Latin—"foris" means outside and "forestis silva," wood outside. Old French and Middle English terminology refer to forests as a wooded area kept for hunting. The Proto-Germanic word is "furho" for fir-pine, and Proto-Indo European "perkus" means oak, to name a few. Ancient European cultures managed forests and woodlands as hunting grounds for royalty while also clearing woodlands for pasture and wood for building materials, heating, smelting, and leather production. Aboriginal peoples applied spiritual connection to forests (e.g., see http://www.native-languages.org/legends-forest.htm). In sum, forests and woodlands have been in cultivation for thousands of years, ultimately leading to widespread deforestation (Williams, 2003) and contributing to the collapse of early civilizations (Diamond, 2005). Deforestation and forest degradation is rapidly consuming the world's native forests (Williams, 2003; Mackey et al., 2014).

Common Forest Definitions

According to Merriam, a forest is "a usually large group of plants and especially trees under cultivation." The Food and Agricultural Organization (FAO, 2010) of the United Nations defines forest as "a land area of greater than 0.5 ha, with a tree canopy cover of greater than 10%, which is not primarily under agricultural or other specific nonforest land use. In the case of young forests or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m in situ, and of meeting the canopy cover requirement" (https://www.cbd.int/forest/definitions.shtml). However, FAO's definition is based on minimum forest cover only (quantity) and lacks attention to forest quality.

Ecological Forest Definitions

Most standard text books of forest ecology (e.g., Perry et al., 2009) define forests as a community of interacting species organized by *structural* elements and species *composition* that perform specific *functions*. Structure refers to the physical aspects of a forest, such as the overstory canopy. Notably, from a structural standpoint, trees can be alive or dead and standing or down. Some forests, such as mature (>80 years) Douglas-fir (*Pseudotsuga menziesii*)/western hemlock (*Tsuga heterophylla*) in the Pacific Northwest are comprised of a continuous, multilayered canopy from the ground up—shrubs, lower, mid, and overstory strata. Composition refers to the actors, the characteristic species and genomes. Functions are the inner workings of a forest that orchestrate processes like photosynthesis, nutrient cycling, carbon sequestration (photosynthesis), disturbance dynamics, and food-web interactions. A native forest has all the parts working together—structure (all age classes especially older), composition (the natives), and function (e.g., natural disturbances, food-web dynamics). It should be noted that a forest is not just a collection of plants. The animals codesign the fundamental elements. For instance, the waste pellets of flying squirrels (*Glaucomys sabrinus*) are packed with fungal spores that inoculate top soil with mycorrhizae fungi that then form underground networks that aid plants in uptake of water, minerals, and vital nutrients (a sort of *Avatar* communication subhighway). Invertebrates aid in decomposition and nutrient cycling. Bats, birds, and insects disperse seeds and pollinate flowers. In turn, these codependent relations determine the structural elements of the forest community (Maser, 1994). When we tinker (or engineer) with the parts in forestry operations, we lose most of the key structural elements, which in turn affects forest relations and functions.

Common Plantation Definitions

Wikipedia defines a plantation as a large-scale farm that specializes in cash crops. In particular, tree plantations (tree farms) have an explicit purpose—high-yield production of wood fiber in the shortest time. This often includes one or two commercially valuable or crop species (e.g., Douglas-fir, *Pinus*, *Eucalpytus*, *Poplar*, *Picea* spp.) (Fig. 1A and B). Tree seedlings are grown in tree "nurseries,"

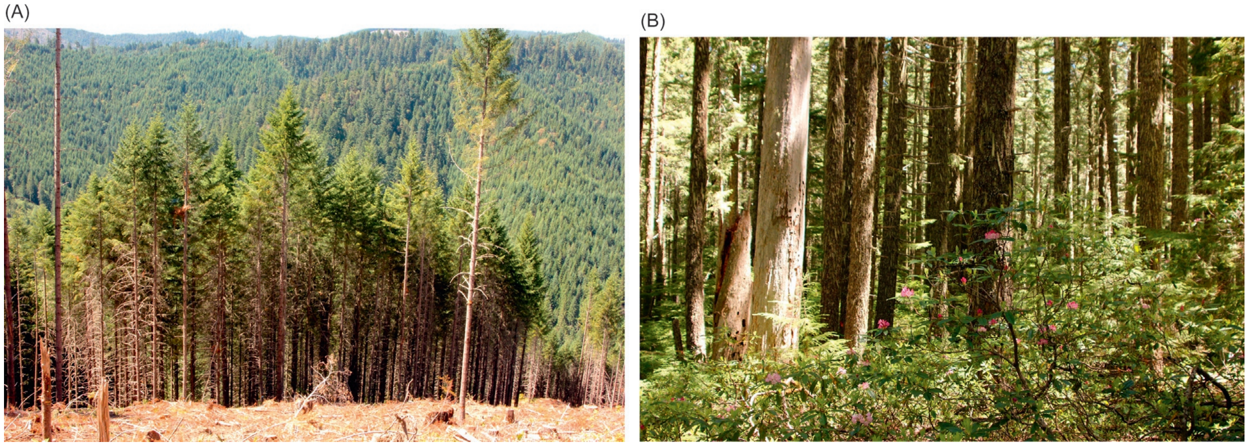

Fig. 1 (A) Douglas-fir timber plantation (foreground) on US Department of Interior Bureau of Land Management lands in western Oregon showing extensive clear-cuts and plantations (background) within an industrial landscape matrix. (B) Old-growth Douglas-fir/hemlock stand showing vertical (tree-size class variability, snags) and horizontal (shrubs, forbs) complexity. Canopy gaps created by tree fall from natural causes provide diverse successional stages within the forest stand that are not present in plantations. Photo: D. DellaSala.

sometimes genetically manipulated for certain growth features (straight stem, rapid wood accumulation) and resistance to disease. Seedlings are planted in tight rows to maximize yield. In some places (e.g., southeast Alaska), tree planting is not necessary because a natural seed source is available and ideal growing conditions are sufficient without propagation. In other regions (e.g., Indonesia), tree regeneration is not even attempted leading to deforestation and widespread conversion (e.g., palm oil or slash and burn agriculture of the tropics).

The Forest Stewardship Council (FSC) (n.d.) defines plantations as:

> 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).

FSC Explicitly States That Plantations Include

> the use of establishment or subsequent management practices in planted forest stands that perpetuate the stand-level absence of most principle characteristics and key elements of native forest ecosystems will result in a stand being classified as a plantation.... Except for highly extenuating circumstances the following are classified as plantations: cultivation of exotic species or recognized exotic sub-species; block plantings of cloned trees resulting in a major reduction of within-stand genetic diversity compared to what would be found in a natural stand of the same species; cultivation of any tree species in areas that were naturally non-forested ecosystems.

Site Preparation

Preparing a site for a plantation often involves the use of herbicides to reduce tree competition with shrubs and other noncommercially valuable species. Plantation management can include fertilizers and pesticides to enhance tree growth and reduce tree mortality. After the dense tree canopy closes (1–2 decades depending on site factors—i.e., "pole" stage), this is often followed by precommercial thinning (although some commercial value is possible as pulp or woody biomass) to reduce competition among tree stems. Decades later a commercial thin can be performed to further reduce competition and extract economic value. Once past the point of maximum growth (referred to as cumulative mean annual increment), trees are then logged again to maximize profit and jumpstart the commercial process (note: some landowners may skip the culmination phase and harvest trees even sooner). Fast growing trees on short logging rotations replace the diversity of natural successional stages with fake forests kept in a perpetual stage of young growth, clearcut harvest, and regrowth.

Planted Forest

According to FAO (2010), forest plantations are a subset of planted forests consisting primarily of introduced species that make up nearly 4% of total forest area, or 140 million hectares globally. Productive forest plantations, primarily established for wood and fiber, account for 78% of forest plantations, and "protective" forest plantations, primarily established for conservation of soil and water, 22%. The area of forest plantations increased by about 2.8 million hectares annually from 2000 to 2005, 87% of which is productive forest plantation. Additionally, while not plantations per se, FAO (2015) reports 1.2 billion (30%) of ~4 billion hectares of forests world-wide are in "production" (Fig. 2). As noted, FAO defines a forest as having tree cover >10%.

Carle and Holmgren (2008) define "planted forests" as: (1) forests of native species established through planting, seeding, or coppice of planted trees; (2) forests of introduced species, and in some cases native species, established through planting or seeding mainly for production of wood or nonwood goals; and (3) forest of native or introduced species established through planting or seeding mainly for provision of services. They provide an overall estimate of planted forests summed for all three categories and projected forward under different management scenarios (Fig. 3). For instance, planted forest projections show the current global

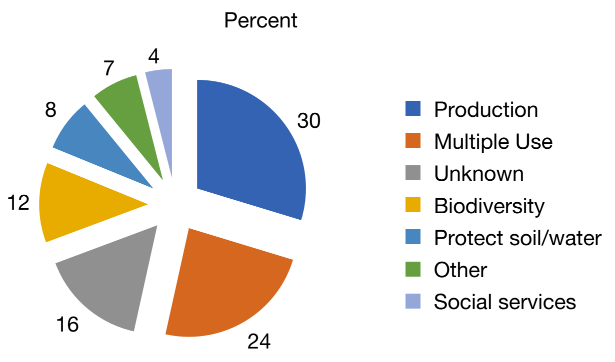

Fig. 2 The world's forests by management category (FAO, 2010).

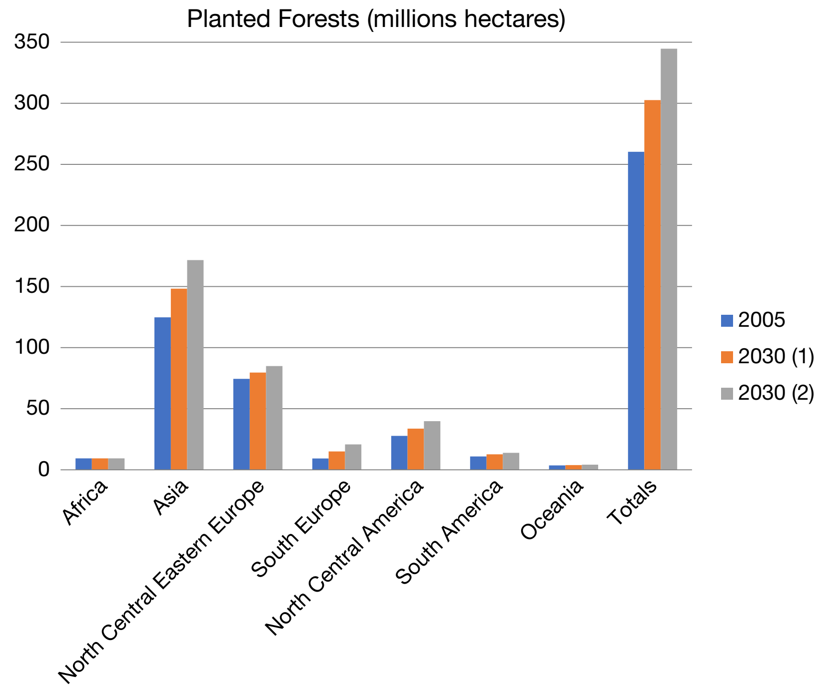

Fig. 3 Area of planted forests ($\times 10^6$ ha) in 2005 (*blue*) vs. two projected scenarios for 2030 (from Carle and Holmgren, 2008). Scenario 1 (*orange*) assumes no increase in productivity and the current expansion of planted forests slows down. Scenario 2 (*gray*, combined scenarios 2 and 3 of Carle and Holmgren, 2008) assumes planted area continues at the current rate and/or increases as a result of genetic modifications and technological improvements.

increase may continue at least until 2030, particularly in Asia (e.g., palm oil production). It can be assumed that, as planted forests increase, so too will deforestation of native forests.

How Do Real vs. Fake Forests Differ Ecologically?

While this article focuses on comparing plantations to native forests, other forest manipulations, such "seminatural" and "modified natural," deserve recognition given their global prominence. For instance, Carle and Holmgren (2008) define modified natural as forest naturally regenerated with native species where there are visible signs of human activity. Additionally, seminatural is considered a forest where silvicultural practices are in place for intensive management (e.g., selective or high-grade logging). Thus, the level of human intervention can be illustrated along an ecological integrity gradient from highest (native) to lowest (plantation; Fig. 4). Integrity refers to native species, functions, and processes expected for a specific ecosystem type based on historic or reference conditions.

Regional and site-specific factors need to be considered in any comparison of fake vs. real forests; however, some general patterns emerge (Table 1). Real forests are much more complex at all levels of biological organization: genetic (genomes are highly variable compared to nursery "stock"), native species richness, and ecosystem processes—the latter both above and below ground. In this case, the sum-of-the-ecosystem parts is greater than the whole while plantations sum to much less than the whole.

Can Plantations Be Managed (Restored/Enhanced) for Ecological Integrity?

The first principle of restoration is to stop the loss (hemorrhaging) of integrity before it even happens—that is—conversion of real to fake. However, for plantations already in production and lacking key elements, restorative actions can make plantations as "seminatural" as possible by planting with diverse native seeds and enhancing structures present on site. For instance, forest thinning (e.g., precommercial) in a dense stand of young trees (thicket or "dog-hair" stands) can enhance structural diversity by opening forest canopies to increased sunlight that stimulates understory development (Fig. 5A and B). Girdling (killing) trees for snag creation provides nesting, foraging, and dens sites for wildlife, while felling trees and leaving them on site provides downed logs (along with moist microclimates and nutrient cycling) for amphibians, invertebrates, and aquatic species when logs fall into streams. Horizontal diversity also can be enhanced via stops and gaps in thinning (i.e., unthinned trees alternating with created openings). While restoration can improve integrity at the site level, the net effect at the landscape scale is small especially given chronic impacts (e.g., to aquatics) from an extensive road network needed to access plantations (Fig. 6).

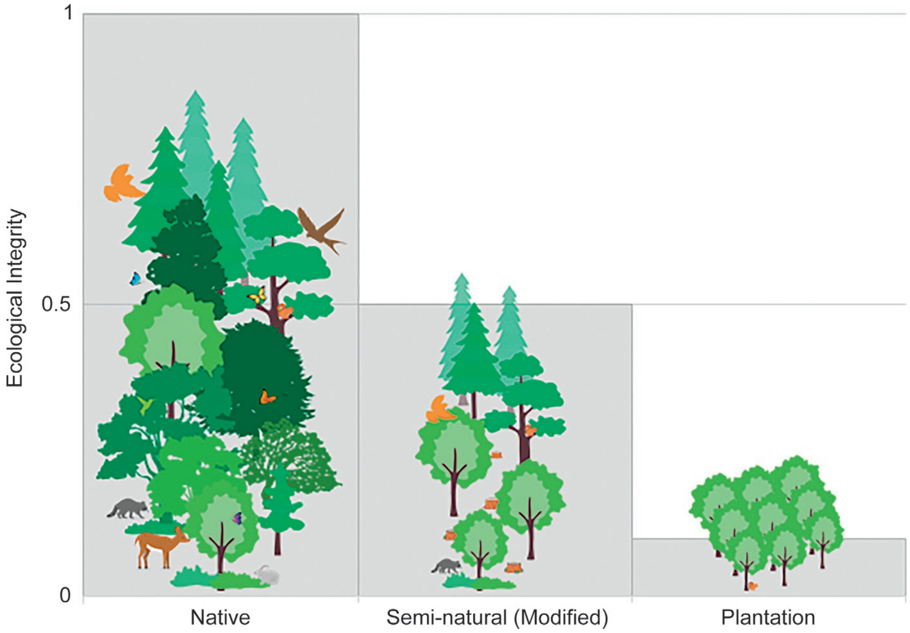

Fig. 4 Hypothetical integrity (native species, structure, function/processes) gradient based on degree of alteration of composition, structure, and function. Graphics created by Freepik, modified by Christina Mills.

Table 1 Generalized characteristics and differences between "real" vs. "fake" forests

Characteristic	*Real Forest*	*Fake Forest*
Genetic diversity	Highly varied and adaptive/ resilient to climate change	Greatly simplified and low resilience to climate change
Tree and other plant species richness	Medium-exceptional depending on site factors and forest type (tropical, temperate, boreal)	Low, monoculture
Animal richness	Medium-high-extraordinary (e.g., tropics)	Low
Apex predators	Important habitat	Highly degraded and typically absent
Imperiled species	Important/critical habitat	Highly degraded and typically absent
Soils and below-ground processes	Productive, well-developed soil horizons, soil biota (e.g., decomposers, mycorhizzae, native seed sources), abiotic processes (nutrient cycling, decomposition) (although soil nutrients deficient in tropical rainforests and forests on ultramafic substrates)	Often damaged, depleted and requiring fertilization
Snags and down wood	Abundant with diverse size and decay classes	Scarce/rare
Structural diversity (vertical, horizontal complexity)	Generally abundant depending on site factors, forest types, age classes	Little to none
Forest age classes	Full successional gradient often present at site or landscape scale, especially rare types such as structurally complex young and old growth stages	Even aged
Climatic refugia (e.g., relatively cool, moist microclimates)	Present and functional	Highly altered or absent
Hydrological cycle	Intact	Dysfunctional especially in areas of high road densities
Carbon sequestration and storage	Medium-high-extraordinary depending on site and forest type (carbon sink)	Sequestration but very low carbon stores and limited carbon retention (carbon source initially)
Natural disturbances	Functional (e.g., fires, floods, insects) with many resistant and resilient forest properties	Highly altered with low levels of resilience/resistance often amplifying or compounding natural disturbances (e.g., more intense forest fires due to dense planting of small trees that act as tinder)
Societal benefits	Myriad ecosystem services (multi-functional) but often de-valued (clean air, clean water, recreation)	Economics predominate decision making (one dimensional)
Invasive species, diseases, insect outbreaks	Absent or in low numbers with high levels of resistance	Present or in high numbers with little resistance
Intactness/connectivity (landscape scale)	Corridors, elevation and latitudinal gradients	Highly fragmented especially when combined with roads and industrial-scale logging
Deforestation/degradation pressure	High-extreme pressures across all forest biomes	Highly degraded and likely not being used to relieve pressure to native forests
Integrity (sum of native species composition, function, process)	High to exceptional	very low (see Figs. 2, 3)

Relative differences depend on regional and local site factors, forest types, and management intensity.

Fig. 5 (A) Dense “dog-hair” stand of Douglas-fir that was planted on an industrial landscape after clearcutting coast redwood (*Semipervens sequoia*) in northern California. (B) Redwood National Park thinning of young Douglas-fir to increase growing space for restoring previously logged redwood stands, the native forest type in this region. Note light penetrance in thinned area. Photo: D. DellaSala.

Fig. 6 Deforestation and roads in Borneo. No amount of restoration can recover this landscape destroyed from cumulative (chronic) effects of industrial logging rampant in Malaysia. Photo: D. DellaSala.

Notably, the FSC has developed 10 principles and related criteria and indicators for forest certification to address ecological, social, and economic interests in forest management. Principle 10, in particular, is specific to plantations (Appendix 1). FSC assumes plantations managed this way provide necessary wood fiber while reducing pressures to native forests that otherwise would not need to be logged. While this is important in principle and should be encouraged, it is not occurring at a scale sufficient to reduce deforestation globally.

Conclusions

Plantations are fake forests because they lack the integrity of real forests. Fake forests are expanding globally, at the expense of real forests. Notably, it is often claimed that tree plantations have an indirect conservation benefit in reducing pressures to native forests as in the case of New Zealand, where native forest logging has ceased and logging is restricted to existing plantations. However, this is the exception rather than the rule. Nonetheless, Sedjo and Botkin (1997) estimated that, in order to meet global demand for wood products, some 5% of the world forests would need to be maintained in plantations. We are nearly at the 5% level, as plantations continue to increase globally along with rising population and consumption levels. Plantation and planted forests are projected to increase or slow down through 2030, resulting in even more deforestation, unless remaining native forests are conserved. Reduction in wasteful consumption, use of alternative wood fibers (e.g., hemp), recycling, and engineered wood products can all play an increasing role in reducing pressures to the world's native forests. In the meantime, existing plantations can be managed to limit their ecological footprint by enhancing structures, planting with native seed sources, and FSC certification or equivalent management. Moreover, real forests are grossly under-valued for myriad ecosystem benefits and biodiversity values that they provide to society, as pressures to log them continue to mount.

Appendix 1 FSC Principle 10 for Plantation Management (Note: more specific regional guidance, intent, and application is provided by FSC but not included here for simplicity)

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.

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 (forest management unit), 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.
- Indicator 10.1.b The forest owner or manager demonstrates clear progress in implementation of the components of the management plan addressing natural forest conservation and restoration objectives as they pertain to plantation management.

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.
- 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 seminatural forests on the FMU. Note that restoration plantations may be established on degraded forests.
- Indicator 10.2.c In all regions except the Pacific Coast, openings lacking within-stand retention are limited to a 40-acre average and an 80 acre maximum. Harvest 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) does not exceed 100 acres. Departures from these limits for restoration purposes are permissible but also must be justified by credible scientific analysis.
- 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 purposes.
- 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) on the FMU must be of the subsequent advanced successional habitat stage, or exceed 10 ft in height, or achieve canopy closure along at least 50% of its perimeter.

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.

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.

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.

- 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.
- Indicator 10.5.b Areas to be restored to natural conditions are prioritized where the analysis indicates the greatest conservation gain and are designed for long-term restoration.
- Indicator 10.5.c Management plans should clearly state the extent and location of areas selected for such restoration, as well as the rationale for their selection.
- Indicator 10.5.d 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.e The ratio and spatial distribution of plantations, with respect to natural and seminatural 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.f 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 seminatural cover. The minimum percentage area that is maintained and/or restored in natural or seminatural state is:
    For 100 acres or less, at least 10%.
    For 101–1000 acres, at least 15%.
    For 1001–10,000 acres, at least 20%.
    For >10,000 acres, at least 25%
- Indicator 10.5.g All 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.

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.
- 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.
- Indicator10.6.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:
    Soil classification or foliar analysis indicates one or more nutrients are a limiting factor for forest productivity. Data and/or scientific literature suggest that the response to fertilization is economically justified. 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. 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.

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.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.
- Indicator 10.7.c The forest owner implements a strategy to prevent or control invasive species, as noted in Indicator 6.3.h

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.

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.

- 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 Principles 1–9 as quickly as feasible.

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