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Standard Guide for Evaluating the Attributes of a Forest Management Plan[1]

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1. Scope

1.1 This guide provides a list of criteria and indicators that have been shown to be useful in achieving the goals of a sustainable forest management plan. This guide lists a set of criteria considered to be important for the following tasks:

1.1.1 To describe, assess, and evaluate progress toward sustainability of forest management at the national, regional, or individual forest level.

1.1.2 To inform the policy debate at regional, national, and international levels.

1.1.3 To evaluate the attributes of a forest management certification or evaluation system with a specific combination of forest management principles, practices, or adaptations, where such practices are evaluated against a set of prescribed standards. Although this guide provides a qualitative list of criteria for evaluation of forest conditions, it does not purport to recommend any specific forest management certification or evaluation system or subset of overall attributes. The guide does not replace forest certification or verification standards.

1.2 This guide will require compilation of information from multiple sources across various governmental and nongovernmental agencies. For this guide to be useful, it is recommended that the information collected is in alignment with that which is already collected for other purposes; otherwise these indicators may be too great an effort to combine in a timely fashion.

NOTE 1—Although this document provides general guidance applicable to forests and forest products from many countries, its initial application is expected to focus on North America.

1.3 This guide cannot replace education or experience and should be used in conjunction with professional judgment such as that provided by foresters, forest scientists, and wood technologists.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D9 Terminology Relating to Wood and Wood-Based Products

3. Terminology

3.1 *Definitions*—Standard definitions of wood terms are given in Terminology D9.

3.2 *Definitions of Terms Related to the Field of Forestry:*

3.2.1 *criterion, n*—a category of conditions or processes by which sustainable forest management may be assessed. A criterion is characterized by a set of related indicators which are monitored periodically to assess change. **Montréal Process**[3]

3.2.2 *criterion indicator, n*—a measure (measurement) of an aspect of the criterion. A quantitative or qualitative variable which can be measured or described and which when observed periodically demonstrates trends. **Montréal Process**[3]

3.2.3 *ecosystem, n*—a dynamic complex of plant, animal, fungal, and micro-organism communities and the associated non-living environment with which they interact. **Montréal Process**[3]

3.2.4 *forest management practice, n*—a specific activity, measure, course of action, or treatment. **USFS**[4]

3.2.5 *forest type, n*—a category of forest defined by its vegetation, particularly composition, or locality factors, or any combination thereof, as categorized by each country in a system suitable to its situation. **Montréal Process**[3]

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] "Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests," *The Montréal Process*, Third Edition, December 2007, Online, available, http://www.rinya.maff.go.jp/mpci/meetings/an-6.pdf, 1 December 2008.

[4] Available from the United States Forestry Service (USFS), 1400 Independence Ave., SW Washington, DC 20250-0003, http://www.fs.fed.us.

TABLE 1 Criteria 1–6

Criterion	Element	Indicator
1. Conservation of biological diversity	1.1 Ecosystem diversity	1.1a Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure 1.1b Area and percent of forest in protected areas by forest ecosystem type and by age class or successional stage 1.1c Fragmentation of forests
	1.2 Species diversity	1.2a Number of native forest associated species 1.2b Number and status of native forest associated species at risk, as determined by legislation or scientific assessment 1.2c Status of on site and off site efforts focused on conservation of species diversity
	1.3 Genetic diversity	1.3a Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes 1.3b Population levels of selected representative forest associated species to describe genetic diversity 1.3c Status of on site and off site efforts focused on conservation of genetic diversity
2. Maintenance of productive capacity of forest ecosystems		2.a Area and percent of forest land and net area of forest land available for wood production 2.b Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production 2.c Area, percent, and growing stock of plantations of native and exotic species 2.d Annual harvest of wood products by volume and as a percentage of net growth or sustained yield 2.e Annual harvest of non-wood forest products
3. Maintenance of forest ecosystem health and vitality		3.a Area and percent of forest affected by biotic processes and agents (for example, disease, insects, invasive species) beyond reference conditions 3.b Area and percent of forest affected by abiotic agents (for example, fire, storm, land clearance) beyond reference conditions
4. Conservation and maintenance of soil and water resources	4.1 Protective Function	4.1a Area and percent of forest whose designation or land management focus is the protection of soil or water resources
	4.2 Soil	4.2a Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources 4.2b Area and percent of forest land with significant soil degradation
	4.3 Water	4.3a Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources 4.3b Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical, or biological properties from reference conditions
5. Maintenance of forest contribution to global carbon cycles		5.a Total forest ecosystem carbon pools and fluxes 5.b Total forest product carbon pools and fluxes 5.c Avoided fossil fuel carbon emissions by using forest biomass for energy
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	6.1 Production and consumption	6.1a Value and volume of wood and wood products production, including primary and secondary processing 6.1b Value of non-wood forest products produced or collected 6.1c Revenue from forest based environmental services 6.1d Total and per capita consumption of wood and wood products in round wood equivalents
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	6.1 Production and consumption	6.1e Total and per capita consumption of non-wood products 6.1f Value and volume in round wood equivalents of exports and imports of wood products 6.1g Value of exports and imports of non-wood products 6.1h Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption 6.1i Recovery or recycling of forest products as a percent of total forest products consumption
	6.2 Investment in the forest sector	6.2a Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation, and tourism 6.2b Annual investment and expenditure in forest-related research, extension and development, and education
	6.3 Employment and community needs	6.3a Employment in the forest sector 6.3b Average wage rates, annual average income, and annual injury rates in major forest employment categories 6.3c Resilience of forest-dependent communities 6.3d Area and percent of forests used for subsistence purposes 6.3e Distribution of revenues derived from forest management

TABLE 1 *Continued*

Criterion	Element	Indicator
	6.4 Recreation and tourism	6.4a Area and percent of forests available or managed for public recreation and tourism, or both 6.4b Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available
	6.5 Cultural, social and spiritual needs and values	6.5a Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values 6.5b The importance of forests to people

3.2.6 *forestry, n*—forestry is the science and art of attaining desired forest conditions and benefits to sustain and enhance forest resources for diverse benefits in perpetuity.

Society of American Foresters[5]

3.2.7 *monitoring, n*—the periodic and systematic measurement and assessment of change of an indicator.

Montréal Process[3]

3.2.8 *sustainable forest management, n*—the practice of meeting the forest resource needs and values of the present generations with a goal of preserving the similar capacity of future generations. Sustainable forest management involves practicing a land stewardship ethic that integrates the reforestation, managing, growing, nurturing, and harvesting of tress for useful products with the conservation of soil, air, and water quality; wildlife and fish habitat; and aesthetics.

Dictionary of Forestry[6]

3.2.9 *sustained-yield, n*—the achievement and maintenance over multigenerational timeframes of a high-level annual or regular periodic output of the various renewable resources of the forest without impairment of its productivity. **USFS**[4]

3.3 *Additional Terms Related to Sustainability and Certification/Verification Programs:*

3.3.1 *biobased product*—a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable agricultural materials (including plant, animal, and marine materials) or forestry materials.

3.3.2 *certified forest content*—certified forest content is tracked through a chain of custody process either by physical separation or percentage based approaches.

3.3.3 *certified wood (or wood-based product)*—derived/manufactured from an acceptable content of raw material from certified forest, other acceptable sources and recycled content as determined by a credible and reliable forest certification programs. Certified wood or wood-based products comply with all applicable standards for their intended use as required by the International Building Code and related Codes.

3.3.4 *chain of custody (COC)*—a defined process that allows companies to make claims about how much of the fiber in their product comes from certified forests, how much fiber comes from acceptable sources, and how much of the fiber comes from recycled content. COC is typically third party audited in accordance with forest certification/verification programs.

3.3.5 *forestry materials*—materials derived from the practice of planting and caring for forests and the management of growing timber. Such materials must come from short rotation woody crops (less than ten years old), sustainably managed forests, wood residues, or forest thinnings.

3.3.6 *other acceptable sources*—other acceptable sources refers to forest content that, while not from a certified forest, can be verified as not coming from a non-acceptable source as defined by the certification program.

3.3.7 *non acceptable sources*—illegal or unauthorized harvesting as defined by the forest certification programs referenced in this guideline.

3.3.8 *procurement system*—a system requiring organizations buying raw materials to have an auditable procurement process designed to improve forest management on all suppliers' lands and ensure all fiber comes from known and legal sources.

3.3.9 *wood-based product*—any material which consist of a minimum of 90 % of forest materials as measured by either weight or volume.

4. Summary of Guide

4.1 The criteria and indicators listed under Sections 6 and 7 apply broadly to temperate and boreal forests. They are intended to provide a common understanding of what is meant by sustainable forest management. Section 6 provides a common framework for describing, assessing, and evaluating a country's progress toward sustainability at the national or regional level. Section 7 provides smaller-scale systems, plans, and practices to assess sustainability at the individual forest management level.

4.2 The criteria and indicators are intended to provide an international reference for policy-makers in the formulation of national and regional policies and a basis for international cooperation aimed at supporting sustainable forest management. Internationally agreeable criteria and indicators will help to clarify ongoing dialogues related to international trade in products from sustainably managed forests.

4.3 The additional terms related to sustainability and certification/verification systems (see 3.3) are included in this guide to provide a common reference for these terms that are commonly associated (either directly or indirectly) with products derived from sustainably managed forests.

NOTE 2—While the inclusion of the terms noted in 3.3 are peripheral to the main thrust of this guide, their "standardization" within an ASTM

[5] Available from the Society of American Foresters (SAF), 5400 Grosvenor Lane, Bethesda, MD 20814-2198, http://www.safnet.org.

[6] Helms, J. A., ed., *The Dictionary of Forestry*, Society of American Foresters, Bethesda, MD, 1998.

document provides enormous benefits for various groups of users of this document.

5. Significance and Use

5.1 This guide is intended to be used by developers of standards and other documents in the field of renewable resources and green building to evaluate whether the attributes of a specific forest management system meet the intent of sustainable forest management.

5.2 In addition to the attributes addressed by this document, some users may wish to impose other evaluation criteria intended to satisfy goals beyond maintaining sustained-yield and sustainable forest management. While these issues are not specifically addressed in this guide, some are discussed in Appendix X1, Commentary.

6. Criteria and Indicators Used to Assess a National or Regional Forest Management Program

6.1 The criteria and indicators provide a common framework to describe, monitor, assess, and report on national or regional forest trends and progress toward sustainable forest management. They also provide a common understanding of what is meant by sustainable forest management and may be understood to constitute an implicit definition of sustainable forest management.

6.2 The criteria and indicators help provide an international reference for policy-makers in the formulation of national policies and a basis for international cooperation aimed at supporting sustainable forest management.

6.3 Taken together, the criteria and indicators reflect a holistic approach to forests as ecosystems, addressing the full range of forest values. No single criterion or indicator is alone an indication of sustainability. Rather, individual criteria and indicators should be considered in the context of other criteria and indicators.

6.4 The seven criteria given in Tables 1 and 2 characterize the essential components of sustainable forest management (for example, biodiversity conservation). Each criterion is characterized by a set of indicators, which provides a way to measure or describe the criterion. No priority or order is implied in the listing of seven criteria or their associated indicators.

6.5 While many indicators are quantitative in nature, others are qualitative or descriptive. Some indicators can be readily

TABLE 2 Criteria 7

Criterion	Element	Indicator
7. Legal, institutional, and policy framework for forest conservation and sustainable management	7.1 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:	7.1a Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process 7.1b Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors 7.1c Provides opportunities for public participation in public policy and decision-making related to forests and public access to information 7.1d Encourages best practice codes for forest management 7.1e Provides-for the management of forests to conserve special environmental, cultural, social, or scientific values, or a combination thereof
	7.2 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:	7.2a Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information 7.2b Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and coordination 7.2c Develop and maintain human resource skills across relevant disciplines 7.2d Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management 7.2e Enforce laws, regulations, and guidelines
	7.3 Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:	7.3a Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services 7.3b Non-discriminatory trade policies for forest products
	7.4 Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:	7.4a Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with Criteria 1-7 7.4b Scope, frequency, and statistical reliability of forest inventories, assessments, monitoring, and other relevant information 7.4c Compatibility with other countries in measuring, monitoring, and reporting on indicators
	7.5 Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:	7.5a Development of scientific understanding of forest ecosystem characteristics and functions 7.5b Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems 7.5c New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies 7.5d Enhancement of ability to predict impacts of human intervention on forests 7.5e Ability to predict impacts on forests of possible climate change

measured (for example, percent of forest cover). Others may require the collection of new or additional data, the establishment of systematic sampling or even basic research.

6.6 When indicators are measured periodically over time, they indicate change and trends in conditions relevant to sustainable forest management, including natural, social, economic, and policy conditions. Monitoring these changes provides information needed to evaluate a country's progress toward sustainable forest management. This information is essential to making informed forest policy decisions.

6.7 Each country or region is different in terms of the quantity, quality, and characteristics of its forests. Countries also differ in terms of population and land ownership patterns, stages of economic development, governance structures, and expectations of how forests should contribute to society. These differences affect the capacity of countries to collect data, as well as the data collection methods employed. While the criteria and indicators facilitate harmonized approaches to forest assessment and reporting among countries, they also allow for flexibility in application to reflect national circumstances.

NOTE 3—Harmonization of information—collecting data for specific indicators in a common or comparable manner—among countries or regions is key to meeting the objectives of 1.1.

6.8 As national level assessment tools, the criteria and indicators provide a basis for reporting on all forests in a country, including public and private forests, tropical forests, and plantation forests. Although they are not performance standards or designed to assess sustainability at the forest management unit level, they provide a framework for developing policies, plans, and inventories at both national and regional levels and can serve as a model for monitoring and reporting on other natural resources, such as rangelands, freshwater, and minerals.

6.9 Tables 1 and 2 list the criteria and indicators for the measurement of conservation and sustainable management of temperate and boreal forests. They relate specifically to forest conditions, attributes, or functions and to the values or benefits associated with the environmental and socio-economic goods and services that forests provide. The intent or meaning of each criterion is made clear by its respective indicators. No priority or order is implied in the alphanumeric listing of the criteria and indicators.

7. Criteria and Indicators Used to Assess an Individual Forest Management Program

7.1 Table 3 lists the criteria and indicators for the measurement of conservation and sustainable management of individual forests. The intent or meaning of each criterion is made clear by its respective indicators. No priority or order is implied in the alphanumeric listing of the criteria and indicators. Elements of each criteria are also considered to be systems. Indicators are also considered to be plans or practices common to forest management principles.

7.2 Some users may wish to include forest management program attributes that extend beyond those normally associated directly with sustainable forest management. Examples of such optional program features include:

7.2.1 *Certification/Verification*—Documentation of fulfillment of specific criteria and indicators is ultimately the responsibility of the forest owner or forest product manufacturer. However, some programs provide the additional feature of independent verification or certification of conformance, or both.

7.2.2 *Other Forest Harvesting Restrictions*—To address specific forest related issues, some programs impose restrictions related to species type, tree age, or similar concerns.

7.2.3 Additional considerations related to specific societal concerns (not related to forest sustainability).

8. Keywords

8.1 criterion; forest management plans; forests; indicators; sustainability

TABLE 3 Criteria 1–7 for Individual Forests

Criterion	Element/System	Indicator/Plan/Practice
1. Contribute to the conservation of biological diversity of the forest and the landscape in which it resides	A. Available expertise is sought for assessing biodiversity considerations at the site and landscape levels	A. Necessary expertise (consultants, state forestry, natural heritage program staff, etc.) has been utilized to assess the biodiversity contribution of the property
	B. Rare and endangered species and plant communities are identified and their protection or enhancement is addressed	B. The forest's diversity, uniqueness, and risks (pests, fire, weather, etc.) have been identified and are a consideration in management
	C. Forest dynamics, major disturbances, and catastrophic events are factored into decision making	C. Forest dynamics, major disturbances, and catastrophic events are factored into biodiversity decision making
2. Maintain or improve productive capacity	A. Timber and non-timber products and habitats are identified for the forest	A. The productive capacity of the forest has been mapped for timber and significant non-timber products have been identified
	B. Long-term and short-term productive capacities and targets are established	B. Growth, mortality, and harvest rates of the forest types have been determined
	C. Targets are sustainable	C. Regeneration after harvest is planned and successfully implemented
	D. Appropriate science and technology is used	D. Long-term site capacity is maintained
		E. Harvest, utilization, and marketing are efficient
		F. Loggers and other contractors that have been trained are used
		G. Appropriate expertise is used regarding wildlife management
		H. Habitats, including sites at environmental risk and with ecological/cultural uniqueness, are identified and a consideration of management
3. Maintain the health and vigor of the forest and its landscape/watershed	A. Tree species selection, stocking levels, age-class distribution, integrated pest management, and fuel loadings are addressed with the objective of reducing the risk insect and disease outbreaks and unwanted wildfire and promoting long-term forest vigor	A. Tree species selection, stocking levels, spacing, age-class distribution, regeneration methods, insect and disease outbreaks, fuel loads, and wildfires are managed to reduce risk and insure long-term forest vigor
	B. Cooperation regarding forest risk assessments, monitoring, prevention, and incident response is encouraged	B. Fuel loads, insect and disease populations, and overall forest vigor are addressed
	C. Chemicals are used appropriately and safely within the manufacturer's recommendations	C. Approaches to monitoring, prevention, and incident response are in place and include cooperation with local, state, and federal agencies and neighboring landowners as appropriate
	D. Grazing is managed to prevent negative impacts	D. Grazing is managed to prevent negative impacts
		E. Introduction and spread of invasive non-native flora and fauna is addressed
4. Protect soil and water resources	A. Relevant mapped, soils, terrain, and water resources (streams, ponds, wetlands) data are used	A. Current mapped data on soils and terrain is included in the plan and used in management
	B. Management practices to insure soil stability and protect and enhance soil productivity and water quality are used	B. Storm dynamics are recognized and planned for
	C. Best management practices to protect soil and water during all management activities are used	C. Soil stability, water quality, and soil productivity are protected
		D. Appropriate guides and plans are in place and followed in road placement, design, maintenance, and retirement, especially at stream crossings
		E. Fire use, management, and response is appropriately planned and conducted
		F. State best management practices are understood and incorporated in plans and complied with during all phases of management activities
		G. Wetland hydrological function and aquatic habitat are a consideration in management

TABLE 3 *Continued*

Criterion	Element/System	Indicator/Plan/Practice
5. Consider carbon cycles	A. Forest biomass considerations by forest types, age classes, and successional stages are addressed	A. Carbon cycles are considered in the forest management plan
	B. The management of forest ecosystems in a manner that enhances carbon budgets and cycles is promoted	
6. Consider socio-economic benefits and impacts	A. The system recognizes that production and consumption of wood and non-wood products, their volume, value (including value added through downstream processing), their supply and consumption are important	A. Sound economic approaches, considering both long-term and short-term goals are used when harvesting both wood and non-wood products
	B. Recreation and tourism is promoted consistent with the health of the forest and the nature of the ownership and owner objectives	B. Available resources are used to identify, manage, and protect unique forest features
	C. Appropriate economic and social values of the forest are considered	C. Unique biological, ecological, geological, and cultural sites are considered in the forest management plan
7. Comply with laws and rules and implement applicable guidelines in states not using the regulatory approach	A. Conformance to all local, state, and federal laws is required	A. Local, state, and federal laws, regulations, and state BMPs are followed
	B. Appropriate input is expected	B. Operations are planned, conducted, and comply with safety rules
	C. Monitoring of implementation is expected	C. The impacts on neighbors and the community are considered during operations
		D. Aesthetics are considered in plans and operations
		E. Conversion to other land uses is only done according to local land use plans and ordinances

APPENDIXES

(Nonmandatory Information)

X1. COMMENTARY

X1.1 The following explanatory notes provide a further explanation or "rationale" as to what is meant by selected criteria and indicators and why they are considered important to assessing forest conservation and sustainable management. As noted, no single criterion or indicator is alone an indication of sustainability. Rather, individual criteria and indicators should be considered in the context of other criteria and indicators.

X1.2 Criterion 1: Conservation of Biological Diversity

X1.2.1 The ultimate objective of the conservation of biological diversity is the survival of species and the genetic variability within those species. Viable breeding populations of species and their natural genetic variation are part of interdependent physical and biological systems or processes—communities or ecosystems. The condition and distribution of forest communities are important to fundamental ecological processes and systems and the future of biological diversity associated with forests.

X1.2.2 *Ecosystem Diversity:*

X1.2.2.1 Ecological processes and viable populations of species that are characteristic of forest ecosystems are usually dependent on a contiguous ecosystem or ecosystems of a certain minimum size. Genetic diversity within a species population depends on the maintenance of subpopulations and the existence of forest ecosystems that cover a large part of their natural range. Forests may constitute all or a part of the habitat necessary to the survival of a species.

X1.2.2.2 Ecological processes and the species associated with those processes, within any forest ecosystem or forest type, are associated with vegetative structures (age of the vegetation, its diameter, and height) and successional stages (variable species of vegetation).

X1.2.2.3 The amount of a forest ecosystem reserved in some form of protected area is a measure of the priority being placed on maintaining representative areas of that forest ecosystem by society.

X1.2.2.4 The fragmentation of a forest type into small pieces may disrupt some ecological processes and availability of habitat. Such fragments of forest may be too small to maintain viable breeding populations of species. Distances between forest fragments can interfere with pollination, seed dispersal, and wildlife movement between patches of forest and breeding.

X1.2.2.5 Ultimately, excessive fragmentation can contribute to the loss of plant and animal species that are unable to adapt to these conditions. In areas converted in the past to agricultural purposes, remnant forest fragments of the original forest cover may provide refuges for many, although not all, components of the original diversity.

X1.2.3 *Species Diversity:*

X1.2.3.1 Surveys of species numbers are necessary in order to estimate biological diversity.

X1.2.3.2 Ecological processes and the species associated with those processes, within any forest type, may vary according to the extent, condition, or fragmentation of that forest type.

X1.2.4 *Genetic Diversity:*

X1.2.4.1 Forest dependent species with low population levels or significantly reduced range run the risk of losing important genetic traits (alleles) from their gene pools. In the case of species with a dispersed natural range, this can happen at the level of locally adapted subpopulations (provenances), resulting in a reduced ability by species to adapt to environmental changes.

X1.2.4.2 Monitoring the population levels of species representative of identified habitats, or ecosystems, across their range provides an indicator of the ability of those habitats to support other species, and subpopulations of those species, dependant on similar habitat.

X1.3 Criterion 2: Maintenance of Productive Capacity of Forest Ecosystem

X1.3.1 In many countries, traditional calculation of potential production of timber products is based on the forest area available for the production of commercial forest products. In those countries, forest lands are not available for timber harvesting if they do not meet minimal acceptable regeneration standards, minimal acceptable economic growing rates, or accessibility. High spiritual, recreational, scientific, or educational values may also be deemed a higher priority than commodity production. Comparison of net forest land available for timber production to total forest land will provide a measure of the suitability or availability of the forests for commercial forest production to meet society's demands for wood products. In reference to managed forests, some feel this is also an indicator of forest areas whose ecological or genetic character may be different.

X1.3.2 Measurements of merchantable and non-merchantable growing stock provides an indication of timber supply opportunities.

X1.3.3 Planted forests can be an important source of forest products and can replace or augment the use of natural forests for the production of wood and non-wood forest products. In some countries, natural forest management is used as an alternative to planted forests. The area of forest plantations provides one measure of forest management efficiency and reduced future dependence on natural forests for the production of commercial forest products. In addition, some feel this is also an indication of forest areas whose ecological and genetic character may be different. However, many planted forests have been established to reclaim degraded lands where the ecological and genetic character of the original forest had been lost.

X1.3.4 Monitoring the volume of wood and non-wood forest products annually removed relative to the amount which could be removed sustainably provides an indication of a forest's ability to provide a continuing supply of forest products and economic and forest management opportunities.

X1.4 Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

X1.4.1 People have multiple effects on forest ecosystems. Human impacts include land conversion, harvesting, species introductions, suppression of natural fire cycles and floods, and the introduction of non-native species (especially pathogens). These in turn influence ecological processes and ultimately forest dependent plant and animal species.

X1.4.2 Air pollutants are suspected to have a significant cumulative impact on forest ecosystems by affecting regeneration, productivity, and species composition. Correlating forest inventory and health statistics with air pollution data will provide more information on the effects of these pollutants. Increased ultraviolet radiation, caused by changes in the earth's atmosphere, also has been shown to damage plants.

X1.4.3 The monitoring of forest structure or macro species such as vertebrates (Criterion 1) will tend to detect changes in ecological processes decades after they have begun. Monitoring very short-lived species associated with specific ecological processes such as decomposition and nutrient cycling provides a more immediate indication of changes in ecological processes with potential importance to forests.

X1.5 Criterion 4: Conservation and Maintenance of Soil and Water Resources

X1.5.1 The soil resource is a basic component of all terrestrial ecosystems. The loss of soil will influence the vitality and species composition of forest ecosystems. Extensive areas of soil erosion can have a major effect on aquatic ecosystems associated with forests, recreational opportunities, potable water supplies, and the life span of river infrastructure such as dams.

X1.5.2 This indicator provides a measure of forest land allocated primarily for the protection of valuable environmental amenities associated with clean air, water, soil, flood and avalanche protection, etc. (public health and safety functions).

X1.5.3 Forests are an important part of the earth's hydrological cycles. They are particularly important in the regulation of surface and ground water flow. Changes in historic stream flow and the timing of flow, resulting in flooding or dewatered streams, or both, can reflect on the health of aquatic ecosystems and the management and conservation of associated forest areas and downstream agriculture areas.

X1.5.4 Soil organic matter is important for water retention, carbon storage, and soil organisms and is an indication of soil nutrient status. Changes in soil/organic matter can affect the

vitality of forest ecosystems through diminished regeneration capacity of trees, lower growth rates, and changes in species composition.

X1.5.5 Nutrient and water availability to forest vegetation is dependent on the physical ability of roots to grow and access nutrients, water and oxygen from the soil. This in turn is dependent on soil texture and structure. Subsurface hydrology can also be affected by soil compaction resulting from extensive human activities.

X1.5.6 This is frequently a measure of benthos populations, for example, organisms that live at the bottom of water bodies. Benthos fauna are sensitive to a variety of possible changes in aquatic ecosystems such as silt, oxygen levels, and temperature. These changes may be the result of changes in upland forest areas.

X1.5.7 Monitoring water quality over large areas serves as an initial indication that activities inside or outside a forest area may be affecting ecosystem health.

X1.6 Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

X1.6.1 The accumulation of biomass as living vegetation, debris, peat, and soil carbon (carbon pool) is an important forest function in regulating atmospheric carbon. The production rate of biomass is also a measure of forest health and vitality.

X1.6.2 The ecological and sustainable management of production forests and the long lasting use of forest products can be a factor in controlling the amount of carbon entering the world's atmosphere.

X2. INTERNATIONAL CONTEXT FOR THE DEVELOPMENT OF THIS STANDARD

X2.1 Forests are essential to the long-term well-being of local populations, national economies and the earth's biosphere as a whole. They provide food, fuel, shelter, clean water and air, medicine, livelihood, and employment for people around the world. They reduce concentrations of greenhouse gases in the atmosphere, minimize sedimentation in lakes and rivers, and protect against flooding, mudslides and erosion. Forests are home to 70 % of the world's terrestrial animals and plants. When managed sustainably, forests can provide a wide range of essential economic, social, and environmental goods and services for the benefit of current and future generations.

X2.2 The contribution of forests and sustainable forest management to sustainable development first received global recognition in 1992 when the United Nations Conference on Environment and Development adopted the "Rio Forest Principles" and Chapter 11 of Agenda 21. At about the same time, the International Tropical Timber Organizations (ITTO) did some pioneering work on "Criteria for the Measurement of Sustainable Tropical Forest Management."

X2.3 Following the Rio Earth Summit, the concept of "criteria and indicators for sustainable forest management" gained increasing international attention as a tool to monitor, assess, and report on forest trends at national and global levels. By 1995, the Ministerial Conference on the Protection of Forest in Europe (MCPFE) and the Montréal Process (MP) had adopted comparable sets of national level criteria and indicators for sustainable management of temperate and boreal forests.

X2.4 The importance of criteria and indicators as tools to assess national forest trends and progress toward sustainable forest management has been recognized by the Intergovernmental Panel on Forests (1995-1997) and its successor Intergovernmental Forum on Forests (1997-2000), the United Nations Forum on Forests (UNFF), and the Food and Agriculture Organization of the United Nations (FAO). They are also relevant to the forest-related programs of member organizations of the Collaborative Partnership on Forests, including the Rio conventions on biodiversity, climate change and desertification. Today, 150 countries are engaged in one or more regional and international criteria and indicators processes.

X2.5 In 2004 the UNFF identified the following seven "thematic elements of sustainable forest management," which are drawn from the criteria identified by the MP and other criteria and indicators processes, as a reference framework for sustainable forest management:

X2.5.1 Extent of forest resources.

X2.5.2 Forest biological diversity.

X2.5.3 Forest ecosystem health and vitality.

X2.5.4 Productive functions of forests.

X2.5.5 Protective functions of forests.

X2.5.6 Socio-economic functions of forests.

X2.5.7 Legal, policy, and institutional framework.

X2.6 These thematic elements of sustainable forest management have become the framework for the global Forest Resources Assessment coordinated by FAO. They are also enshrined in the Non-Legally Binding Instrument on All Types of Forests adopted by the UNFF in April 2007 and endorsed by the UN General Assembly in December 2007 as a framework for national action and international cooperation on forests.

X3. BRIEF HISTORY AND BACKGROUND ON THE MONTRÉAL PROCESS

X3.1 The Montréal Process Working Group on "Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests"—*The Montréal Process* [3]—was launched in 1994 as a response to the Rio Forest Principles. Today, the Working Group has twelve member countries: Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russian Federation, United States of America, and Uruguay. These countries account for 90 % of the world's temperate and boreal forests, 60 % of all forests, 45 % of international trade in timber and timber products, and 35 % of the world's population.

X3.2 In February 1995, member countries adopted the Santiago Declaration affirming their commitment to the conservation and sustainable management of their respective forests and endorsing the following 7 criteria and 67 associated indicators as guidelines for policy-makers to use in assessing national forest trends and progress toward sustainable forest management:

X3.2.1 Conservation of biological diversity.

X3.2.2 Maintenance of productive capacity of forest ecosystems.

X3.2.3 Maintenance of forest ecosystem health and vitality.

X3.2.4 Conservation and maintenance of soil and water resources.

X3.2.5 Maintenance of forest contribution to global carbon cycles.

X3.2.6 Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies.

X3.2.7 Legal, institutional, and economic framework for forest conservation and sustainable management.

X3.3 These MP criteria and indicators were the product of extensive consultations with forest managers and users, researchers, the private sector, and other stakeholders in member countries, as well as with technical and policy experts from other temperate and boreal countries and the international technical and scientific community.

X3.4 In 2003, MP member countries developed and published their first Country Forest Reports using the agreed MP criteria and indicators. Illustrative trends drawn from the twelve country reports are highlighted in the Montréal Process First Forest Overview Report 2003. Based on experiences gained in reporting and taking into account international developments, such as the establishment of the UNFF, member countries adopted the Quebec City Declaration in September 2003. The Declaration set forth a "Vision for the Montréal Process: 2003–2008," which identified a set of actions to enhance the effectiveness of the MP, including a major effort to review and refine the MP indicators.

X3.5 In November 2007 in Buenos Aires, the Working Group approved a revised set of indicators for Criteria 1–6. (Criterion 7 indicators are still under consideration as of 2008.) Member countries are using these improved indicators to prepare their second round of Country Forest Reports in 2009. In establishing an updated set of indicators, the Working Group reconfirmed the national and international relevance of the seven criteria adopted in 1995.

X3.6 Also in November 2007, the Working Group agreed on the conceptual framework for the Montréal Process Strategic Action Plan: 2009–2015. The Strategic Action Plan (SAP) will be based on the following five Strategic Directions:

X3.6.1 Enhance the relevance of the MP criteria and indicators for policymakers, practitioners and others;

X3.6.2 Strengthen member country capacity to monitor, assess and report on forest trends and progress toward sustainable forest management using the MP criteria and indicators;

X3.6.3 Enhance collaboration and cooperation with forest related regional and international organizations and instruments and other criteria and indicator processes;

X3.6.4 Enhance communication on the value of criteria and indicators and the accomplishments of the MP; and

X3.6.5 Enhance the effectiveness and efficiency of the Montréal Process Working Group and its Technical Advisory Committee and Liaison Office.

X3.7 Once finalized, the SAP will serve as the overall guiding document for the MP, as well as a tool for communicating MP objectives and priorities to member countries, domestic stakeholders, and the international community.

X4. OPERATION OF THE MONTRÉAL PROCESS WORKING GROUP

X4.1 The MP Working Group brings together countries with highly diverse ecological, economic, and social conditions to share experiences related to forest monitoring, assessment, and reporting. Regular meetings of the Working Group are hosted by member countries on a rotational basis and are open to representatives of other criteria and indicators processes, international organizations, non-governmental organizations and the private sector.

X4.2 The Working Group is supported by the MP Liaison Office (LO) established in 1995 and the Technical Advisory Committee (TAC) established in 1996. The LO is currently hosted by the Government of Japan. From 1995 to 2006, it was hosted by the Government of Canada. The LO facilitates communication among members, helps organize Working Group and TAC meetings, arranges for translation, printing, and dissemination of MP documents, maintains the MP website, and coordinates MP representation at regional and international meetings and events.

X4.3 The TAC is comprised of forest experts from all member countries and provides technical and scientific advice to the Working Group on issues related to data collection, indicator measurement and reporting. The work of the TAC, including the development of the revised MP indicators presented here, is coordinated and facilitated by the TAC Convenor, currently hosted by the Government of New Zealand. From 1997 to 2003, the TAC Convenor was hosted by United States. From 1996 to 1997, it was hosted by New Zealand.

X5. CONCEPTUAL BASIS OF THE MONTRÉAL PROCESS CRITERIA AND INDICATORS

X5.1 The MP criteria and indicators provide a common framework for member countries to describe, monitor, assess, and report on national forest trends and progress toward sustainable forest management. They also provide a common understanding within and across countries of what is meant by sustainable forest management, and may be understood to constitute an implicit definition of sustainable forest management at the country level.

X5.2 As such, the MP criteria and indicators help provide an international reference for policy-makers in the formulation of national policies and a basis for international cooperation aimed at supporting sustainable forest management.

X5.3 Taken together, the MP criteria and indicators reflect a holistic approach to forests as ecosystems, addressing the full range of forest values. No single criterion or indicator is alone an indication of sustainability. Rather, individual criteria and indicators should be considered in the context of other criteria and indicators.

X5.4 The seven MP criteria characterize the essential components of sustainable forest management (for example, biodiversity conservation). Each criterion is characterized by a set of indicators, which provides a way to measure or describe the criterion. No priority or order is implied in the listing of seven criteria or their associated indicators.

X5.5 While many MP indicators are quantitative in nature, others are qualitative or descriptive. Some indicators can be readily measured (for example, percent of forest cover). Others may require the collection of new or additional data, the establishment of systematic sampling or even basic research.

X5.6 When indicators are measured periodically over time, they indicate change and trends in conditions relevant to sustainable forest management, including natural, social, economic, and policy conditions. Monitoring these changes provides information needed to evaluate a country's progress toward sustainable forest management. This information is essential to making informed forest policy decisions.

X5.7 Each MP country is unique in terms of the quantity, quality, and characteristics of its forests. Countries also differ in terms of population and land ownership patterns, stages of economic development, governance structures, and expectations of how forests should contribute to society. These differences affect the capacity of countries to collect data, as well as the data collection methods employed. While the MP criteria and indicators facilitate harmonized approaches to forest assessment and reporting among countries, they also allow for flexibility in application to reflect national circumstances.

X5.8 An informed, aware, and participatory public is indispensable to promoting sustainable forest management. The MP criteria and indicators are a useful tool for involving stakeholders in data collection and forest discussions at national and sub-national levels and in improving the quality of forest-related information available to policy-makers and the public. Stakeholder involvement and awareness should help catalyze improved forest policies and practices.

X5.9 As national level assessment tools, the MP criteria and indicators provide a basis for reporting on all forests in a country, including public and private forests, tropical forests, and plantation forests. Although they are not performance standards or designed to assess sustainability at the forest management unit level, they also provide a framework for developing policies, plans, and inventories at both national and sub-national levels, and can serve as a model for monitoring and reporting on other natural resources, such as rangelands, freshwater, and minerals.

X5.10 Concepts of forest management evolve over time based on enhanced scientific knowledge about how forest

ecosystems function and respond to human interventions, as well as in response to changes in how the public views forest values. The MP Working Group will continue to periodically review and as needed refine the MP criteria and indicators to reflect new information, advances in technology and research, and improved understanding of sustainable forest management.

X6. CONCEPTUAL BASIS OF THE INDIVIDUAL FOREST CRITERIA AND INDICATORS

X6.1 The National Association of State Foresters issued a Position Statement in February 2003 which defined the "Principles and Guides of a Well-Managed Forest,"[7] based on the MP criteria. The document was design to help state forestry agencies, forest landowners, and other interested members of the public sort through the options available to determine which systems and programs meet widely accepted tests of appropriate content and outcomes.

X6.2 Size or scale of the management unit or ownership is an essential consideration in their use. The National Association of State Foresters developed these Principles and Guides as a means to assist in assessing the potential effectiveness of any system or program's capacity to guide a forest owner or manager in effort to achieve a well-managed forest while attaining his/her objectives.

X6.3 The individual forest criteria are provided in this standard as guidelines to help address the confusion that arises when scaling national/federal criteria down to a state/local/private forest assessment.

[7] "Principles and Guides of a Well-Managed Forest," *National Association of State Foresters Position Statement*, February 2003, Online, available, http://www.stateforesters.org/node/201, 1 December 2008.

X7. SUPPLEMENTAL DISCUSSION

X7.1 *Green Building Rating Systems*—Application of sustainability principles to buildings is typically provided in the form of green building rating systems. These rating systems typically reduce sustainability considerations to a series of discrete "credits." Examples of credit-related topics pertaining to sustainable forestry and forest products are provided in this section.

X7.2 *Biobased Products*—Rating system credits are typically provided for biobased products. For some types of products (such as composites or crop-derived lubricants), assessment of biobased attributes can be confusing. This confusion does not extend to forest-based products provided that the term "wood-based product" is defined in a manner to permit small amounts of non-forest-based materials.

X7.3 *Certified Wood*—Understanding of certification programs in North America is greatly enhanced when key terms are defined. Examples of these terms (for which certification system definitions are uniquely defined) include chain of custody, acceptable versus nonacceptable material sources, and procurement systems.