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Sustainability in Forestry:
Origins, Evolution and Prospects

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Foreword

The conservation and sustainable management of forests is one of several key components in the global pursuit of development goals that are ecologically, economically and socially sustainable. In many areas of natural resource management and environmental protection, the concept of "sustainability" is regarded as a substitute or successor to the earlier concept of conservation. Conservation, in these contexts, is viewed as the measured and careful and "conservative" utilization of essential resources to maximize their availability to society over time. There is an emphasis on increasing the efficiency of utilization to stretch out a limited supply, of oil for example, or on protection from any current use at all, say in the setting aside of reserves as a hedge against depletion of a given resource. Sustainability, on the other hand, implies the determination of a sort of equilibrium between society and the natural resources on which it depends. The emphasis is on limiting the use of a resource to a level that can be replenished and maintained in perpetuity, and on technological development of renewable resources, solar energy for example, to take the place of nonrenewable resources that will eventually become exhausted or no longer economically feasible to extract.

In the context of forestry, however, "conservation" has subsumed these modern concepts of sustainability for at least a century in the US, and far longer if one considers the origins of sustained-yield forest management dating back to late-medieval Europe. Indeed, it was a concern that local consumption of forest resources would exceed local supply that first gave rise to the science and practice of forest management. And it was a recognition of the potentially disastrous consequences of forest resource depletion at the community level that established economic and social considerations, together with the first glimmers of an ecological understanding of forest biology, as the core primordial concepts of sustainability in forestry.

During the past century, the concept of sustainability in forestry has evolved to a greater depth and richness. Our vastly expanded understanding of the complex functioning of forest ecosystems, and a recognition of the full range and diversity of resources, values and ecological services that forests represent, has created new challenges and opportunities. The global reach and immediacy of international trade and communications has given forest management, whether in Oregon or in the Congo, a spotlight on the world stage. Forests large and small are now seen as local representatives of one of the planet's largest and most important natural biomes, with the ability to significantly influence our climate at the global scale.

This growing recognition of the importance of forests, and their vulnerability to being inadvertently as well as deliberately destroyed, has lent a new sense of urgency to determining how best to ensure their perpetuation. Pitched battles over forest resource use have pitted forest industries against their own communities, and governments against their own citizens, exhausting their energies and their trust for one another. Out of this exhaustion, however, has come renewed efforts to discover opportunities for cooperation toward shared goals for sustainable forest management. Innumerable local meetings, and almost as many international summits, have led to a convergence of views on a few basic precepts for what constitutes sustainable forest management. These generally accepted principles of sustainable forest management have begun to provide a common basis for assessing forest conditions and trends, determining actions needed to move forest management closer to the goals of sustainability, and to secure the financial resources and political capital needed to successfully implement these actions—from the level of individual forests to that of nations.

From these assessments, each nation and each forest landowner takes their own lesson and commits to their own set of actions. Seeing forests in their regional, national and global contexts provides new insights into individual responsibilities and opportunities to protect forests and the range of values they represent, but also to manage forests as perpetually renewable sources of these values. And seeing forests in the context of generally accepted principles of sustainable forest management—arrived at through broadly democratic processes locally, nationally and internationally—offers new opportunities for managers of the smallest woodlot or community forest to directly contribute toward achieving common goals for sustainability at the global scale.

Many of today's environmental challenges are so immense that we as individuals feel overwhelmed in our ability to "do anything about it." But those who have a role in managing the world's forests, no matter how large or small, are indeed fortunate. They have within their hands the power and the means to make real and measurable progress toward a noble cause, that of sustaining a crucial component of earth's living systems for this and future generations.

Sustainability in Forestry: Origins, Evolution and Prospects

by V. Alaric Sample[1]

Introduction

Sustainability has always been a central concern in the science and practice of forestry. Indeed, it was concern that forest resources would be inadvertently depleted, leading to unacceptable social and economic impacts, that first gave rise to the systematic study of forests and a scientific approach to the long-term management of forests as renewable resources. What has changed most in recent years, and formed the basis for "sustainable forest management" as we define it today, is the range and diversity of resources that forests are seen to represent, and the societal values associated with the protection and perpetuation of this array of resources.

Originating with the simple aim of avoiding local timber shortages, sustained-yield forest management evolved to a highly technical process of modeling growth, mortality, and risk in order to set timber removals at a level that theoretically could be maintained in perpetuity. Changing scientific understanding of the ecological functioning of forest ecosystems has challenged the notion that a sustained yield of timber is equivalent to sustaining all the components and natural processes necessary to maintain the long-term health and productivity of these ecosystems. Continuing uncertainty over what is socially and economically acceptable, as well as ecologically sustainable, will make optimality in forest management much more difficult to achieve than in the past.

There is an ongoing public debate, both in the United States and abroad, as to what actually constitutes sustainable forest management. This paper will briefly summarize the historical evolution of sustainability in forest management, examine the ways in which natural resource policy development in the US has promoted forest conservation, and explore additional possibilities for policy development to achieve sustainable forest management at the local level, and in the global context..

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Origins of sustained-yield forest management

Sustainability in forest management began as a socioeconomic as well as biological concept. Early forest managers developed an understanding of natural forestry productivity--and how it might be enhanced through silviculture--to maintain a continuous supply of wood, game, and other products for human use and consumption. The concept was fundamentally driven by the desire to avoid the social and economic disruption associated with shortages timber, whether for local use or as the basis for a community export economy. Forest products clearly held the potential of being a perpetually renewable resource, and foresters undertook the responsibility of making this so.

The origins of sustained-yield forest management can be found in late-medieval Europe (Heske 1938). The lack of well-developed systems for transportation and communication at this time resulted in a system of small, independent political units with high customs barriers that prevented any significant degree of regional trade (Waggener 1977). Local consumption was almost entirely dependent on local production, and communities had to be largely self-sufficient. There was a distinct possibility of exhausting local timber resources unless collective use was strictly controlled, and the production and consumption of forest products became highly regulated. This applied not only to the cutting of timber and fuelwood, but to the gathering of leaf litter and grazing of livestock, both of which were understood to affect long-term soil productivity in forests. It has been argued (Adams 1993) that the concepts of secure land tenure for private property owners, mutual coercion by mutual consent under common law, and government intervention in free markets to protect the broader public interest—principles basic to the development of a constitutional democracies—had their origins in communities such as these, seeking to avoid a “tragedy of the commons” (Hardin 1968). Perhaps because of the opportunities it afforded for stable employment and income in rural communities, this approach to sustained-yield forestry persisted long after improved transportation and communication systems had reduced the need for local self-sufficiency and turned wood into a widely traded economic commodity.

It was in this context that the concept of the "regulated forest" came into being. A regulated forest is one managed to yield a regular, periodic and sustainable harvests of timber. The objective of sustained-yield management by itself does not indicate a single specific harvest level, since a forest can be sustained at a range of different management intensities. However, the objective of *maximizing* the sustainable volume of the timber harvest does generate a unique result. For even-aged stands, such an approach sets the length of rotation according to a biological rule, which determines that harvest occur when the mean of the annual increment of growth in the stand reaches a maximum ("culmination of mean annual increment") (Smith 1962). This approach recognizes that as trees increase in size they add volume at an increasing rate, until at maturity the annual increase in volume falls below the average growth rate

calculated over the life of the tree (Davis 1966). The "culmination of mean annual increment" rule gives the rotation age at which the sustainable harvest volume from the forest will be maximized. The harvest level is determined using "Hanzlik's Formula," which divides the net growth over the entire area of the economic enterprise by the rotation length and indicates the average annual volume of timber that can be removed on a sustainable basis.

This harvesting rule was complicated as far back as the middle of the 19th century when careful observers recognized that commercial timber production and harvesting would have a financial, not a strictly biological objective. Although harvesting at the "culmination of mean annual increment" maximized the physical volume of the harvest, it almost never maximized the financial returns from the forest. Faustmann (1849) showed that, in a world with positive interest rates, the optimal financial rotation length was shorter than the biological rotation length. With a profit objective, the sustainability of timber production is a by-product of achieving financial maximization. On the assumption that the highest-value use of the land is timber production, forest management will involve a regime of harvests and regeneration that maximize the financial returns from the forest as an economic asset. Similarly, the level of additional investments of labor and capital, such as thinning or fertilization, requires that the marginal return from each activity exceed its marginal cost (Duerr 1993).

Sustained-yield forestry in the United States

These European concepts of sustained-yield forest management were transplanted to the United States in the late 19th century at a time of growing concern over the possibility of a timber famine—nationally as well as locally. Forests in the United States had been regarded as both an inexhaustible resource and an obstacle to the westward expansion of agriculture. At the time, wood was still the major building material and the predominant source of fuel. Vast areas of forest had been cleared but not reforested, and there was a very real concern that a timber shortage would begin to seriously limit the prospects for future economic growth.

Forest policy in the United States began with a reservation approach—withdrawing and protecting the remaining forests from private exploitation, to be used at some time in the future for public purposes (Adams 1993). Under a reservation-oriented policy , forests were treated as nonrenewable resources, their supply conserved and stretched over as much time as possible, with little regard for their dynamic nature. Federal forestry reserves were established in the US by the Forest Reserve Act in 1891 (26 Stat. 1103), securing nearly 39 million acres out of public domain lands, mainly in the western states and territories. At about the same time, however, the basic notions of sustained-yield forest management—indefinitely replenishing forests through strictly controlled timber harvests, reforestation

and protection from insects, disease and fire—were making their way from Europe to North America with the immigration of the first European professional foresters, and the education of the first American professional foresters at European universities.

As introduced in the United States by Bernhard Fernow, Gifford Pinchot, and others at the end of the 19th century, forestry was largely a technical undertaking. It was broadly assumed that by maintaining a continuous supply of timber and protecting the basic productivity of soils and watersheds, the broader set of forest uses and values would automatically be protected for the American people as a whole. The forest reserves were symbolically transferred in 1905 from protection under the Department of the Interior, to active management under the new US Forest Service in the Department of Agriculture. The national forests, as they were now called, grew to comprise more than 194 million acres by 1910. With forester Gifford Pinchot as its first chief, the US Forest Service was given the charge of managing the national forests to provide "the greatest good for the greatest number in the long run." (Pinchot 1947). Sustainability in a broad sense—ecological, economic, and social—had been established as the fundamental concept underlying forest policy in the US.

Custodial management

Management of the national forests was largely custodial until the mid-1940s. Preventing theft and wildfire was the major activity on the national forests of the western U.S. In the East, large areas of land deforested and abandoned during the Dust Bowl years were acquired by the U.S. Forest Service and gradually restored. Conversion of forest to other land uses was generally prohibited. Little timber was cut on the national forests during this period, due in part to political pressure from timber companies seeking to minimize competition in the wood products industry and maintain favorable prices for private timber. Management of public forests emphasized maintaining the land in its native forest cover and relying upon natural regeneration following disturbances. The underlying biological and ecological systems were not well understood, however, as evidenced by the way the wildfire was viewed at the time. Rather than recognizing that wildfire was part of a natural disturbance regime integral to the functioning of the forest ecosystem, the policy was to eliminate fire whenever and wherever it occurred in the forest. Thus, even custodial management requires a thorough understanding of natural disturbance regimes and other complexities of forest ecosystem functions.

By the 1940s, many private timber companies had also come to embrace the idea of sustained-yield forest management. Previously, the standard practice had been to acquire forest land, liquidate the timber assets, and abandon it--an approach often referred to as "cut out and get out." With the leadership of corporate pioneers such as Frederick Weyerhaeuser, private timber companies began to recognize the

benefit of holding land, reforesting it, and harvesting the timber on a continuing basis. The management of many private forestlands in the U.S. reflected the sustained-yield forestry of 19th-century Europe, although utilizing modern technology that facilitated timber harvesting at a far greater scale.

Multiple-use forestry

With wood supplies from private forests lands largely depleted during World War II, the federal forest reserves became a major supplier of timber for economic expansion and the suburban housing boom in the late 1940s and 1950s. Increased leisure time and improved transportation systems brought more Americans in contact with the national forests, increasing demand for recreation, wildlife, and other non-commodity resource values. With growing frequency, large-scale timber harvesting activities came into conflict with these other uses, challenging the operational utility of the traditional concept of sustained-yield as the maximization of timber yield constrained only by the biophysical limits of the land itself.

The Multiple-Use Sustained-Yield Act (1960) was an important turning point in foresters' interpretation of their responsibility for sustainable forest management. It defined sustained-yield as "the achievement and maintenance in perpetuity of a high level annual or regular periodic output of the *various renewable resources* of the national forests without impairment of the productivity of the land." (16 U.S.C. 528) [emphasis added]. It has long been recognized that forests generate a host of goods and services. Medieval forests where commonly valued for their game and forest foods, as well as wood for both fuel and construction (Westoby 1989). Even when forests are managed for timber, other values are commonly produced as by-products. Wildlife, recreation, water and water quality, and other outputs are commonly generated incidentally to the production of timber.

The Multiple-Use Sustained-Yield Act provided the statutory basis for the application of this approach to U.S. public forests. Public controversies over the Forest Service's implementation of multiple-use forestry have led to additional statutory direction for sustainable management of the national forests. The Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) required the development of periodic national assessments of the supply and demand for a large array of resource uses and values, and a strategic plan detailing how the Forest Service intended to address all demands simultaneously (16 U.S.C. 1600). The agency's response to Congress was to project significant increases in funding. Substantially higher investments in intensive resource management would allow the Forest Service to accommodate all the uses and demands the national forests--several of which competed and conflicted with one another—and sustain the forests indefinitely (Sample 1990a).

In the decade following the passage of the Multiple-Use Sustained-Yield Act, the public grew increasingly dissatisfied with the balance the Forest Service had struck in balancing these competing goals. The predominant focus on timber production that had developed in the agency during the 1950s persisted. Criticism from the scientific community as well as concerned citizens suggested that such high levels of timber removal not only imposed unacceptable impacts on the non-timber resources, but threatened the long-term sustainability of timber production as well (LeMaster 1984). The Forest Service's indomitable optimism and increasing estimates of the level of timber harvesting that could be sustained on the national forests were based on technical assumptions that included a vigorous program of reforestation and silvicultural treatments aimed at increasing tree growth rates. Year after year, however, Congress funded higher timber sale levels but did not adequately fund the kinds of reinvestments in forest management needed to support this level of harvesting (Hirt 1995). Local public challenges over issues such as large-scale clearcutting eventually boiled over into a national controversy over the Forest Service's management of the national forests. Several successful legal challenges brought timber harvesting on the national forests to a virtual standstill, forcing Congress to take legislative action (LeMaster 1984). Policy changes proposed by the Forest Service would provide a new statutory basis for timber harvesting from the national forests, public confidence in the Forest Service's ability to manage these public resources sustainably and in the broader public interest had been severely shaken. Congress determined that more sweeping changes were needed.

Non-declining even-flow

In 1976, the National Forest Management Act (NFMA) placed numerous additional statutory limits on timber harvesting on the national forests, and required the development of detailed management plans with ample opportunity for public involvement in national forest management decision making (16 U.S.C. 1600 (note)). Many of these limitations were aimed at reducing the impacts of timber harvesting on non-timber resources. But concern over the sustainability of timber production itself led Congress to add a new wrinkle to its definition of sustained yield, specifying that the sale of timber from each national forest be limited to "a quantity equal to or less than a quantity which can be removed from such forest annually in perpetuity" (16 U.S.C. 1600, § 13(a)). This so-called "non-declining even-flow" constraint was criticized by some economists as inherently inefficient in managing the extensive areas of native forest "old-growth" that remained on many western national forests at the time (Clawson 1983).

Previously, policies aimed at promoting sustainable forestry were stated primarily in terms of staying within the limits of biological and physical resources. But in practice, considerations of socioeconomic sustainability have been implicit and intertwined (Dana 1918). The non-declining even-

flow constraint was intended to meter out the remaining volume of old-growth until forest areas harvested and regenerated decades earlier had reached maturity, so that there would be no significant interruption in the supply of timber to communities where the local economy revolved around the processing of wood from national forests (Schallau 1974). For many forest products companies, however, even a small decline in timber supply in the near term was less acceptable than the prospect of a larger decline in the more distant future, and NFMA included a provision allowing departures from the non-declining even-flow requirement (16 U.S.C. 1611).

A decade later, additional concerns over endangered species brought sudden and immediate court-imposed reductions in timber supply in many national forests. In the Pacific Northwest in particular, this resulted in the determination of near-term decreases in timber harvest levels that, even though less severe than could be expected in a continuation of the boom-and-bust approach, still resulted in severe economic disruptions at the local and regional scale. This has led to a political impasse and a fundamental re-examination of what forest managers are to sustain, for whom, and to what purpose (Shands et al. 1990).

Recent evolution in the concept of sustainable forest management

This re-examination is leading to a further evolution in the definition of sustainability in forest management, one that explicitly rather than implicitly includes social and economic--as well as biological--objectives. A key tenet of an ecosystem-based approach to forest resource management--often abbreviated to "ecosystem management"--is that it must be not only ecologically sound but also economically viable and socially responsible (Aplet et al. 1993). If it is lacking in any one of these three areas the system will sooner or later collapse. Each of these three considerations represents a circle of possible options. Where all three circles overlap with one another delineates the subset of options that define sustainable forestry.

Is sustainability biocentric or anthropocentric?

From one perspective, this approach to sustainability is overly biocentric. Forest condition has become the dominant objective rather than forest outputs. Since management is defined as the "judicious pursuit of means to accomplish an end," it is impossible to manage without identifying specific objectives of management is required (Sedjo 2000). An ecosystem-based approach to forest management may involve "the abandonment of the dominant management objective of a stable flow of wood from the land" and its replacement by "management of whole systems for a variety of purposes" (Gordon 1994). Ecosystem management means "thinking on a grander scale than we're used to . . . [I]t means sustaining

forest resources over very long periods of time . . . and from that will flow many goods and services, not just timber..." (Thomas 1994).

From another perspective, if one focuses on the ends rather than the means, the ecosystem management approach is ultimately anthropocentric. It can be argued that the greatest beneficiaries of this approach are human societies, whether of this or future generations. The greater attention to cumulative environmental effects over time and larger spatial scales is aimed primarily at sustaining the ability of natural ecosystems to meet human wants and needs, now and in the future. To some degree, concerns over threatened or endangered animals and plants reflect an expanded ethical consideration for the intrinsic rights of non-human species to survive, regardless of their utility to human societies (Sample 1990b). It can be argued, however, that the most successful attempts to date to rescue endangered species habitat have been motivated overwhelmingly by an anthropocentric focus on maintaining genetic potential for new pharmaceuticals and crop strains, or preserving wildlands for a variety of human uses.

Societal limitations on the current rate of forest resource use and consumption reflect a broader scientific understanding of the full effects of human activities on natural ecosystems, and the recognition that there is substantial continuing uncertainty in this area (Grumbine 1994). A more cautious, conservative approach serves as a sort of insurance policy to increase the likelihood that productive, functionally-intact forest ecosystems will still be there to meet the needs of human societies for the foreseeable future (Callicott 1991). Thus, even though an ecosystem-based approach to sustaining forest ecosystems might focus operationally on guaranteeing hospitable environments for the diversity of non-human species, the ultimate objective is to guarantee the continued functioning of forest ecosystems as a basic life support system for *Homo sapiens*. Coal miners may be intensely interested in the health and well-being of their canary, but the canary is not their ultimate concern.

Ultimately, the question of whether sustainable forest management is biocentric or anthropocentric is rather moot. Despite the built environments in which most of us live, humans are an integral component in the natural environment. Our fate is inextricably intertwined with that of every other life form on Earth. Sustaining forests, along with all the other terrestrial and aquatic biomes, is to sustain life itself, human and otherwise.

Forest sustainability in a global context

During the past decade, an important shift has taken place in the discussion of sustainability in forest management. The discussion itself has moved from the local arena to the world stage. Relatively localized debates over specific forest management practices such as clearcutting now take place in the context of global issues such as biodiversity conservation and mitigation of global climate change. More

than at any other time in history, forest policy discussions in the US and around the world explicitly recognize that forests are essential to the long-term well-being of local populations, national economies, and the Earth's biosphere as a whole.

What is emerging from this debate is a remarkable global convergence of views on a few basic precepts for sustainable forest management. These basic precepts are gradually forming the basis for (1) assessing current forest conditions and trends in terms of their sustainability, (2) determining the adequacy of existing forest management activities for moving closer to the goal of sustainability, (3) identifying particular actions needed to improve upon the existing management activities, and (4) monitoring progress on implementation of these actions.

Most importantly, these generally accepted principles for sustainable forest management are now being used to guide this kind of assessment-action-monitoring process not only at the national level, but at the local "forest management unit" level on individual public, private and communal forests in the US and in developed and developing nations around the world.

Criteria for assessing forest sustainability at the national scale

The controversies that arose in forestry in the US in the 1970s and afterward were but a microcosm of emerging global issues in natural resource conservation and environmental protection. These conflicts are often characterized as "jobs versus the environment," particularly in the context of protecting habitat for threatened or endangered species in regions where local economies were largely centered around resource extraction.

To address this apparent conflict between the interests of economic development and the interests of environmental protection, the United Nations in 1983 appointed an international commission to propose strategies for improving human well-being in the short term without threatening the local and global environment in the long term. Norwegian Prime Minister Gro Harlem Brundtland chaired the Commission, and its report "Our Common Future," was widely known as "The Brundtland Report" (World Commission on Environment and Development 1987). The Brundtland Report helped popularize the term "sustainable development," which it defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This landmark report helped trigger a wide range of actions, including the UN Conference on Environment and Development (UNCED, or the "Earth Summit") in 1992 in Rio de Janeiro.

The single most important outcome of the Earth Summit in Rio in terms of defining sustainable forestry was a set of Forest Principles, with linkages to several other new international conventions on biodiversity, climate change and desertification (United Nations General Assembly 1992). The Forest

Principles, in turn, served as the basis for several subsequent important developments in international forest policy. At a conference in Helsinki in 1994, most of the tropical timber consumer nations made a joint commitment to maintain, or achieve, sustainable management of their forests by 2000 (International Institute for Sustainable Development 1994). At a 1993 meeting in Montreal, many of the world's industrialized nations developed a comprehensive set of "Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests" which, following their ratification in Santiago in 1995, became what are now commonly referred to as the Montreal Process Criteria and Indicators (Castañeda et al. 2001), or simply the C&I. The seven criteria are as follows:

1. Conservation of biological diversity.
2. Maintenance of productive capacity of forest ecosystems.
3. Maintenance of forest ecosystem health and vitality.
4. Conservation and maintenance of soil and water resources.
5. Maintenance of forest contribution to global carbon cycles.
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies.
7. Legal, institutional and economic framework for forest conservation and sustainable management.

(Source: Castañeda, F., Palmberg-Lerche, C., and Vuorinen, P. 2001.Criteria and Indicators for Sustainable Forest Management: A Compendium. Working Paper FM/5. Rome: UN Food and Agriculture Organization. For a complete listing of the Montreal Process Criteria and Indicators, see Appendix 1. Also available at: http://www.fao.org/DOCREP/004/AC135E/ac135e08.htm.)

The seven criteria and 67 indicators in the C&I provide an internationally agreed upon framework for nations to measure their progress toward sustainable forest management—a major achievement. In 2001, the US published its first forest assessment using the C&I framework (USDA Forest Service 2001). In 2004, the US published a more comprehensive National Report on Sustainable Forests, reflecting the involvement of a broad and diverse array of public, private and nongovernmental organizations in its evaluation of conditions and trends in US forests (USDA Forest Service 2004). Several state governments within the US have also now issued assessments of conditions and trends in their own forests, utilizing the C&I as their framework.

Forest assessments based on the C&I are not action oriented. The C&I simply provide a basis for assessing current conditions and trends; they do not in themselves provide a basis for evaluation of the adequacy of current efforts to conserve forests, nor are they a basis for identified specific actions to correct any perceived shortcomings in current efforts. There is a parallel international process for accomplishing this, however. In the years following the Earth Summit, an array of developed and

developing nations requested that the UN serve as convener for an Intergovernmental Panel on Forests (IPF), whose purpose was to develop "Proposals for Action"—specific activities aimed at moving nations forward toward achieving sustainable forest management. The IPF, and its successor the Intergovernmental Forum on Forests (IFF) which represented a broader array of participants, eventually produced a set of 270 Proposals for Action. Each of the Proposals for Action can be linked to specific indicators of sustainable forest management in the C&I (Washburn and Block 2001). In 2000, the Economic and Social Council of the UN (ECOSOC) voted to create a new office, the United Nations Forum on Forests (UNFF), with a five-year (2001-2005) program of work to facilitate nations' monitoring, assessment and reporting of progress in implementing the Proposals for Action (United Nations Economic and Social Council 2000).

The US National Report to UNFF details all of the current policies, programs and activities in the US that address each of the Proposals for Action (United States of America 2003). Unlike many of the reports from other countries, which describe only the actions by their central governments, the US country report details the actions by federal agencies—but also those of state and local governments, industry, tribes, NGOs and private forest owners—all of which make their own contributions toward the collective US response to the Proposals for Action, and progress toward sustainable forest management. This unique approach to the development of the US report for UNFF is intended to enhance the role that this report can play in facilitating a national dialogue within the US to discuss the adequacy of our current efforts to achieve sustainable forest management, possible further actions that may be needed, and how we might prioritize among these potential actions so that the most urgent are addressed as soon as possible (Sample and Kavanaugh 2003).

So although the C&I themselves do not require nations to take specific actions to achieve sustainable forest management, the national-level and other assessments utilizing the C&I do help to promote a common understanding of the current status of a nation's forests. Indirectly this helps to stimulate timely and effective action, so that the next assessment that is conducted in the years ahead will serve to document substantial progress to the sustainable forestry goals that the US and other countries have set for themselves.

Standards for assessing forest sustainability at the forest level

Progress toward sustainable forest management at the national level depends upon the collective progress made in the management of individual forests—on federal and state lands, on forest industry timberlands, and perhaps most importantly on the private forests that constitute nearly two-thirds of all the forest land in the US. The gradual convergence on a set of generally accepted principles for

sustainable forest management, facilitated by the increasing familiarity with and use of the C&I, is leading to a greater understanding by forest managers of all kinds for practices that will lead to better management of the forests under their stewardship. Improved forest management at the forest management unit (FMU) level provides the building blocks for progress toward sustainable forest management at the national level, and ultimately at the global scale.

One of the more interesting mechanisms to develop out of this process is forest certification based on independent third-party assessments, using generally accepted principles of sustainable forest management as the yardstick by which current forest management practices are evaluated. What distinguishes certification from previous rule-based approaches to improving forest management practices is that it is private rather than governmental, voluntary, and aims to provide a positive incentive for sustainable forest management rather than punishment for violations (Cashore et al. 2004). Certification originally grew out of a consumer-led ban on the import of tropical timber into several European countries, aimed at reducing the rate of tropical deforestation (Sample 2000). At the request of tropical nations that were making substantial investments toward replacing forest exploitation with sustainable forestry practices, independent third-party certification was developed as a means to differentiate sustainably harvested tropical timber, and ensure its continued access to consumer markets in Europe.

The 1992 Earth Summit helped stimulate interest on the part of forest industry and private forest owners, as well as environmental NGOs, in articulating a set of principles and criteria describing forest management practices that are ecologically sound—but also financially viable and socially responsible. The Forest Stewardship Council (http://www.fsc.org/fsc) was established in 1993 by a diverse group of representatives from environmental NGOs, forest industry, indigenous peoples' organizations and community forestry groups from 25 countries (Upton and Bass 1996), based on such a set of principles and criteria:

> PRINCIPLE #1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES
> Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.
>
> PRINCIPLE #2: TENURE AND USE RIGHTS AND RESPONSIBILITIES
> Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.
>
> PRINCIPLE #3: INDIGENOUS PEOPLES' RIGHTS
> The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.
>
> PRINCIPLE #4: COMMUNITY RELATIONS AND WORKER'S RIGHTS
> Forest management operations shall maintain or enhance the long-term social and economic well being of forest workers and local communities.

PRINCIPLE # 5: BENEFITS FROM THE FOREST
Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

PRINCIPLE #6: ENVIRONMENTAL IMPACT
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

PRINCIPLE #7: MANAGEMENT PLAN
A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated.

PRINCIPLE #8: MONITORING AND ASSESSMENT
Monitoring shall be conducted -- appropriate to the scale and intensity of forest management -- to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

PRINCIPLE # 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS
Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

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.

(Source: Forest Stewardship Council of the US. Principles and Criteria for Forest Management. http://www.fscus.org/images/documents/FSC_Principles_Criteria.pdf. For a complete listing of the Principles and Criteria, see Appendix 2)

Other certification organizations have also developed since then, each with their own principles and procedures, but most following the same general model of independent third-party review of forest management practices, and evaluation against a set of criteria and specific standards. In the US, these organizations include the American Forest & Paper Association (Sustainable Forestry Initiative program, http://www.aboutsfi.org/core.asp), American Forest Council (Tree Farm program, http://www.treefarmsystem.org/cms/pages/26_19.html) and the National Woodland Owners Association (Green Tag program, http://www.greentag.org/) (Rana et al. 2003). The US programs are generally not international, although the American Forest & Paper Association has agreed to mutual recognition of programs similar to its own in several other countries.

Another important aspect of forest certification programs that is of particular value in the management of public forests is that establishes a clear set of principles, and directly or indirectly offers a number of positive incentives for adhering to these principles. Through much of the controversy over

forest management in the US, particularly that relating to management of forests on federal and other public lands, the public response has been to protest specific forest management activities that were felt to be unacceptable. Environmental NGOs in particular have made effective use of the judicial system to halt timber harvesting and related activities, from the forest level to the national scale. Forest managers were often left with a rather spotty picture of what was regarded as unacceptable, but determining what was actually *acceptable* involved a significant amount of guesswork and trial-and-error. The articulation of a comprehensive set of principles, criteria and specific standards for what constitutes sustainable forest management has made forest managers' jobs much easier, particularly given that the standards were consciously developed to support the financial viability of a forestry enterprise as well as its ecological soundness. Most of the public forestry agencies in the US that have sought certification have discovered that the certification principles, criteria and standards are generally congruent with the statutes and other public policies with which they are already required to comply (Sample et al. 2003). While certification may or may not result in higher values for the wood these public agencies sell, many have found that the resulting decrease in public challenges and controversy has reduced their operating costs and freed financial resources for other important needs (Mater et al. 1999).

The pathway to defining sustainability in forest management in the US has been long and often difficult, but it has been productive. Fears on the part of environmental activists and forest industry alike that one or the other would dominate in a winner-take-all outcome have proven largely unfounded. Influenced strongly by approaches represented by efforts such as the Brundtland Commission, the Earth Summit, the World Business Council for Sustainable Development and others, there has been a gradual convergence toward a basic set of generally accepted principles of sustainable forest management that are both practical and effective. It is important to note that none of these various efforts to describe sustainable forest management, whether in national-level assessments based on the C&I or forest-level assessments based on certification standards, assume that all forest lands will be managed in the same way for the same objectives. On the contrary, there is growing recognition that some forest areas with unique or significant conservation values will need to be largely protected, and that other areas can be well-suited to management for a moderately high level of sustained wood production.

Sustainable forestry and the particular challenge of biodiversity conservation

Sustainable forest management as we understand it today, can be seen as a logical extension and further evolution of the multiple-use forest management approach that developed in the US in the mid-20th century (Fedkiw 2004), and was codified in law by the Multiple-use Sustained-yield Act of 1960 (16 U.S.C. 528). Multiple-use forest management has been a versatile, flexible, and largely successful

approach in the US, and has become the prevailing approach on private forest lands as well as public. Focusing initially on securing a sustained supply of wood, multiple-use forest management has expanded its scope to protecting watersheds, wildlife, recreation, and grazing and even wilderness.

However, the need to conserve biological diversity—and especially to protect habitat for threatened and endangered species—represents a fundamentally different challenge to the multiple-use model of forest management. Scientific uncertainty as to just where the limits of sustainability lie, and the degree of sensitive species' resilience to recover should these limits be exceeded, have resulted in a conservative approach to biodiversity conservation. In many instances, this precautionary approach means that even a modest level of human manipulation in the ecosystem may exceed the limits of what can be sustained. With the boundaries of sustainability thus so tightly drawn, it is difficult for forest managers to discern a future pathway by which biological diversity can be conserved within the context of actively managed forests.

Accommodating biodiversity

We are now in an era in which the downward trend in biodiversity, and the potential of forest protection to slow that decline, is seen by many as sufficient reason to cease any and all forest management activities that potentially interfere with that objective. This presents a particular challenge to defining and practicing sustainable forest management in a developed nation like the US, one of the largest per capita consumers of wood products, and a net importer of wood and wood fiber. The determination of what constitutes sustainable forest management in the US must consider not only the nation as a whole, but how the US interacts with other regions of the world in the global forest sector.

Many of the world's most recognized and respected biologists believe that we are now in the midst of a biodiversity crisis, with extinctions of animal and plant species taking place at a rate not seen since the dinosaurs were wiped out 65 million years ago. Harvard biologist Edward O. Wilson has estimated the current rate of species extinctions at approximately 27,000 per year, or an average of 74 each day, out of a worldwide total of perhaps 10 million species (Wilson 1992). The normal "background" extinction rate is about one species per one million species a year (Raup and Sepkoski 1984). More than 20,000 taxa are globally rare or threatened and as many as 60,000 face extinction by the middle of this century (IUCN 1988). According to E.O. Wilson, "Human activity has increased extinction between 1,000 and 10,000 times over this level . . . clearly we are in the midst of one of the great extinction spasms in geological history." (Wilson 1992, 280).

The world's greatest concentration of biological diversity in forest ecosystems—and the greatest threats to conserving that diversity—is in the tropics (Raven 1997). Because of the means by which

tropical rain forests cycle their nutrients, these seemingly lush and irrepressible forests are much more vulnerable to ecological damage than most temperate-zone forests, and much slower to recover from deforestation (Wilson 1992, 274). The galloping losses of forest area in the tropics are the single greatest threat to global biodiversity, a trend that is exacerbated by population growth rates in many tropical nations that far exceed those in most temperate-zone nations. "An awful symmetry binds the rise of humanity to the fall of biodiversity: the richest nations preside over the smallest and least interesting biotas, while the poorest nations, burdened by exploding populations and little scientific knowledge, are stewards of the largest." (Wilson 1992, 272).

The importance of conserving biological diversity in forest ecosystems has generated policy proposals aimed at minimizing the conversion and fragmentation of the remaining large areas of native forests, and preventing the diminishment of remaining biological diversity by development for commodity production. E.O. Wilson estimates that the 4.3 percent of world's land surface currently under legal protection should be expanded to 10 percent (Wilson 1992, 337). Many eminent biologists and other scientists support a proposal to set aside 50 percent of the North American continent as "wild land" for the preservation of biological diversity (Ehrlich 1997). The largest grassroots environmental organization in the US is actively working to ban all commercial timber harvesting on federal public lands, and signed up nearly a quarter of the members of the 106th Congress as sponsors of legislation to accomplish this (Sierra Club 1999).

Many conservation biologists today point to the need to think beyond "the reserve mentality" in designing strategies for conserving biological diversity (Brussard et al. 1992). But it is also clear that reserves will continue to be a major component of any successful biodiversity conservation strategy (Hunter and Calhoun 1996), particularly with regard to species endemic to late-successional forest ecosystems (Spies and Franklin 1996).

Protection and production: dual conservation responsibilities

The global nature of the biodiversity crisis points up the need for a strategy that integrates the management of temperate, tropical and boreal forests with world demand for wood. Current global industrial roundwood demand is estimated at 1.6 billion cubic meters per year, and is expected to rise to 2.5 billion cubic meters per year by 2050 (FAO 2000). Industrialized nations account for a disproportionate share of this global demand (Figure 1). Even among the developed nations, the United States stands out as one of the world's largest consumers of wood. US per capita consumption of major wood products (lumber, plywood, and paper) is about double that of Germany, seven times that of Brazil, and 15 times that of China (FAO 2000). The US has one of the lowest average population densities

among the developed nations (e.g., Oregon has a population of less than 3 million people; Germany, with a geographic area slightly larger than that of Oregon, has a population of more than 82 million), and some of the most productive forests. In spite of this, the US continues to import more than a quarter of its wood—114 million cubic meters in1997—from harvesting in both tropical and boreal forests (Howard 1999).

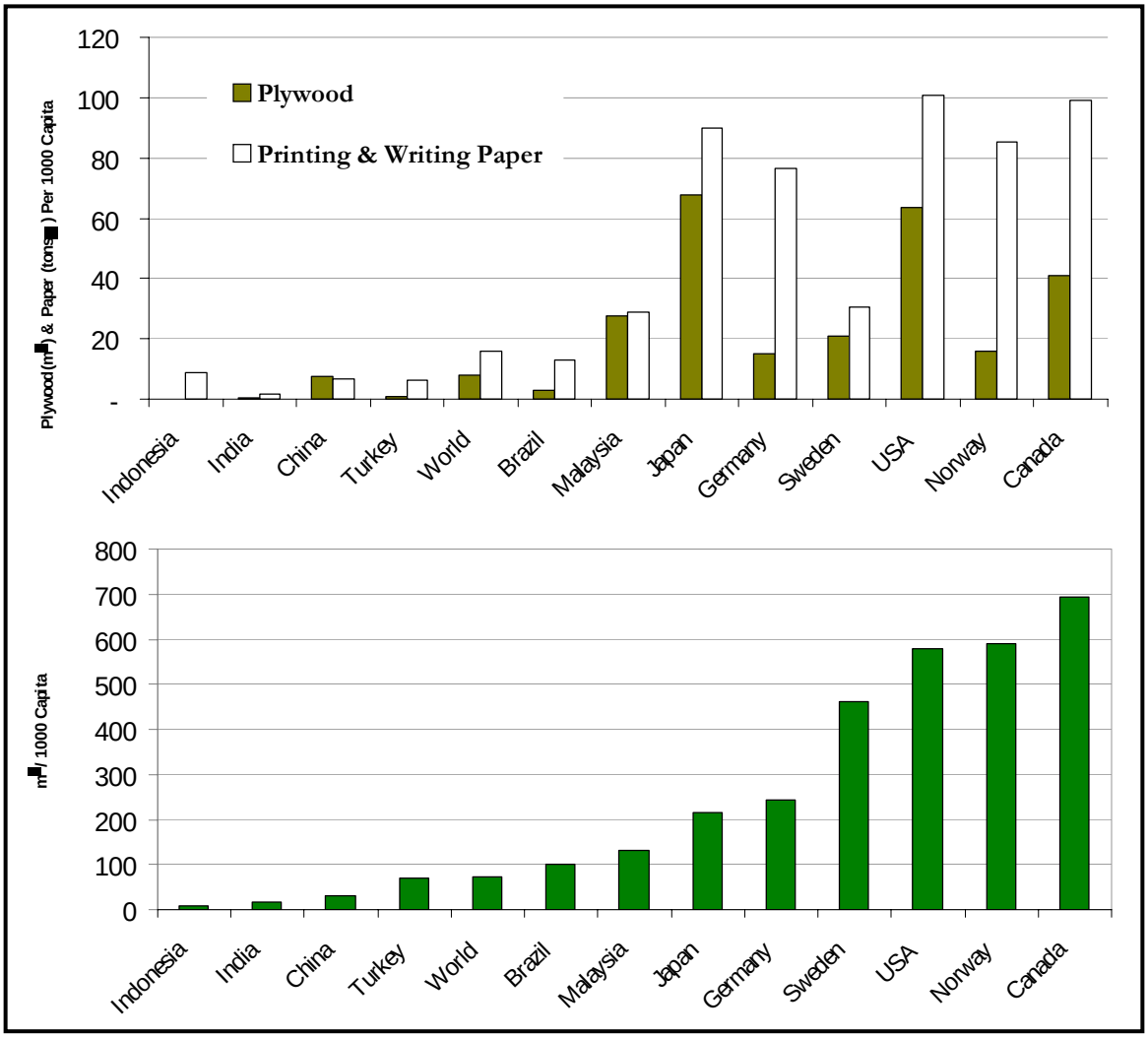


Figure 1. National per capita consumption of selected categories of forest products (FAO, 2000)

While temperate forests are comparatively less biologically diverse, "hot spots" with extraordinary concentrations of species diversity exist, particularly where there are large, contiguous areas of largely undisturbed native forest (Ricketts et al. 2000). For wealthy, temperate-forest nations like the US to support a credible and ethical program for biodiversity conservation in the poorer tropical nations, their own policies for sustainable forest management must encompass a two-pronged strategy of (1) protecting their own biodiversity hot spots where they exist, even when it means sacrificing economic values that could have been derived through resource development, and (2) sustainably utilizing productive forest areas of relatively low biodiversity value to help alleviate the pressure on tropical and boreal forests to meet global needs for wood fiber and other renewable resources.

US forest policy appears to presume that all forests are to be managed to provide a wide range of uses and values, with only the particular mixture of these uses varying from place to place and ownership to ownership. We have quested after the holy grail of sustainable forest management as if there were a one-size-fits-all formula—a single set of standards that could be applied equally well to forests everywhere. Multiple-use forest management has proven enormously durable in many different circumstances. This flexible, adaptive approach has for the most part allowed forest managers to balance a wide variety of demands on forests while keeping within the bounds of sustainability. But most "all-purpose" tools, though convenient, are of limited value in any specific task, particularly when compared with other more specialized tools developed for that particular application. Multiple-use forest management is an all-purpose tool in a world in which the demands on forests are also requiring the development of more specialized tools with greater precision and more direct application.

Today, the clear need to greatly improve our conservation of biological diversity in forests worldwide, while at the same time managing these renewable resources to help meet the material needs of an expanding human population, demands recognition in both policy and practice that (1) all forests are *not* equally suited to the same intensity of management and (2) there are important forest uses and values that are clearly *not* compatible with one another, and cannot be adequately protected under management aimed at accommodating a wide range of commodity and noncommodity uses.

A systems approach to sustainable forest management

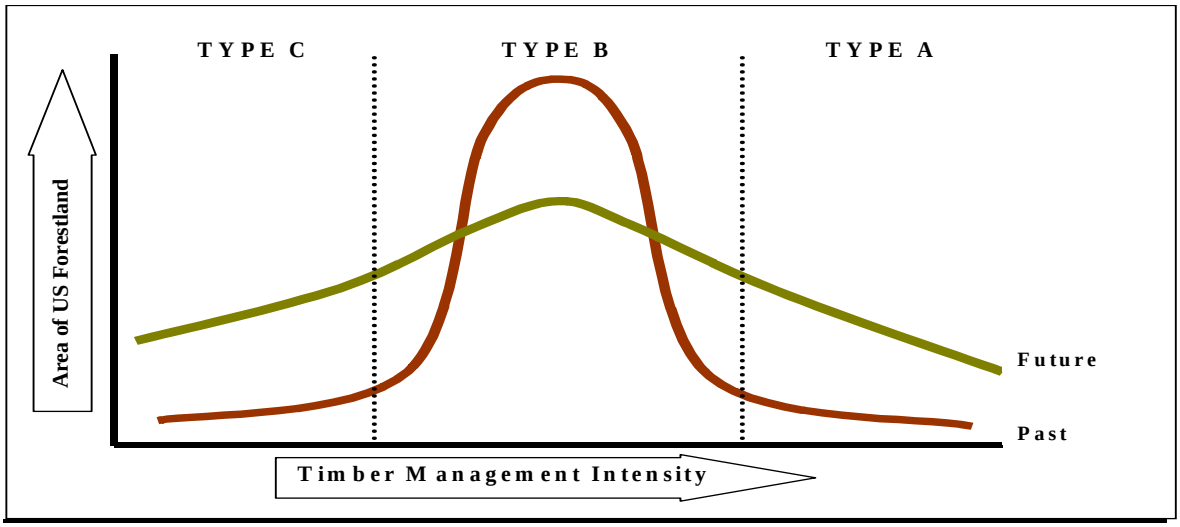
The necessity of *simultaneously increasing* both biodiversity conservation and wood production, is accelerating the evolution toward three separate and distinct types of forest management (Hunter and Calhoun 1996):

- Commercial forest plantations intensively managed for the production of wood and wood fiber-based commodities—what Leopold alluded to as "Group A" forestry (Leopold, 1949). This approach will likely be centered on highly productive private lands with relatively low value or potential value as habitat for rare or sensitive species due to their small tract size and/or history of past land use; these primarily private lands would be largely exempt from federal requirements for biodiversity conservation, particularly where the plantations derive from the afforestation of lands reclaimed from nonforest uses.
- Forests managed at a moderate or low intensity for a wide variety of goods, services, and natural values, not unlike the New England "working forest" concept, or Leopold's "Group B" forestry. These "working forests" would provide habitat primarily as a function of being maintained in forest land use; these lands, both public and private, would encompass the majority of the forest area of the

US, with the broad diversity of management approaches on individual tracts of varying size providing an accompanying diversity of habitats in terms of age, successional stage, vegetative composition, climate and landform.

- Native forest reserves managed first and foremost for conservation and restoration of biological diversity—what Leopold might have termed "Group C" forestry. Management of these forests would be centered on identified biodiversity hot spots of global and national significance, and will likely encompass most of the remaining large tracts of undeveloped native forest on federal public lands, some state parks, and private lands where this style of management is consistent with landowner goals and objectives.

A systems approach to defining sustainable forest management must encompass all three categories—bioreserves and plantations as well as "working forests" managed for multiple values and purposes (see Fig Figure 2).



TYPE A	Plantations = Highly intensive forest management for wood production
TYPE B	Working Forest = Moderately intensive forest management for wood production
TYPE C	Protected Areas = Limited or no management for wood production

Figure 2. Forest Management Intensity Spectrum

Reinforcing the scientific foundation for sustainable forest management will require a continued high level of research activity in support of management in all three categories of forests. Substantial resources have been devoted to understanding all aspects of bioreserve delineation, consolidation and management, from the relative advantages of large and small reserves (Diamond and May 1976; Soulé

and Simberloff, 1986; Robinson and Quinn 1992) to the rates and size of disturbance needed to maintain the ecological characteristics of old-growth forests (Spies and Franklin 1991). Decades of traditional forestry research in the US have focused on maximizing wood and fiber yields from intensively-managed plantations, but it has been only recently that scientists have recognized the contributions that even industrial timberlands can make to biodiversity conservation (O'Connell and Noss 1992; Pimentel et al. 1992). Perhaps the greatest need—and greatest opportunity—for creating new knowledge in biodiversity conservation is on lands in "Group B", those public and private lands managed for multiple uses in an almost infinite variety of combinations.

It is important that public forest management agencies remain fully engaged in this kind of management. In spite of a century of experimentation, scientists today are keenly aware of the inadequacy of our current understanding of forest ecosystems and our limited ability to predict the outcomes of human interventions in these ecosystems (National Research Council 1992). The need is greater than ever for public forestry agencies to conceptualize, facilitate, and conduct research relating to the management of developed forest areas, experiment with different approaches in a variety of biophysical and socioeconomic settings, and provide a model for continuously improving forest stewardship on both public and private lands, in the US and abroad.

A national policy framework that facilitates sustainable forestry

More than any other forest use or value, biodiversity conservation has narrowed the bounds within which forest managers can accommodate all society demands within the limits of sustainability. In the case of the national forests in the US, measures to protect biodiversity have greatly constrained the long-standing multiple-use mandate for the management of these resources. This may not be the dilemma it has seemed to be. We are beginning to recognize that practicing forestry in more or less the same way everywhere should not necessarily be the most desirable goal—that such a one-size-fits-all approach sacrifices important forest values that can only be achieved with a more specialized approach to forest landscapes and forest ecosystems.

In forest areas characterized by extraordinary biodiversity values, particularly large contiguous areas of native forests primarily on public lands, we are likely to see management essentially as a bioreserve. In areas of relatively low biodiversity value, but with high productivity for meeting societal demands for wood and fiber, we are likely to see intensively managed forest plantations constrained by little more than basic principles of good land stewardship and protection of water quality. And in the majority of public and private forests, we are likely to see an infinitely varied array of approaches to multiple-use forest management that will produce moderate levels of wood and fiber while protecting a

range of ecological values, including habitat for rare, sensitive, threatened or endangered animal and plant species.

None of these three elements alone can be regarded as sustainable forestry. It is the overall system—with all its elements represented at the national, regional, and local levels—that will constitute sustainable forest management in the future. There is no single set of standards to define how forestry should be practiced in every location and in every circumstance. Any set of standards purporting to describe a system of sustainable forestry must take into account the need for bioreserves and intensively-managed forest plantations as well as "working forests" managed to provide an array of forest values, renewable resources, and ecological services (see Figure 3).

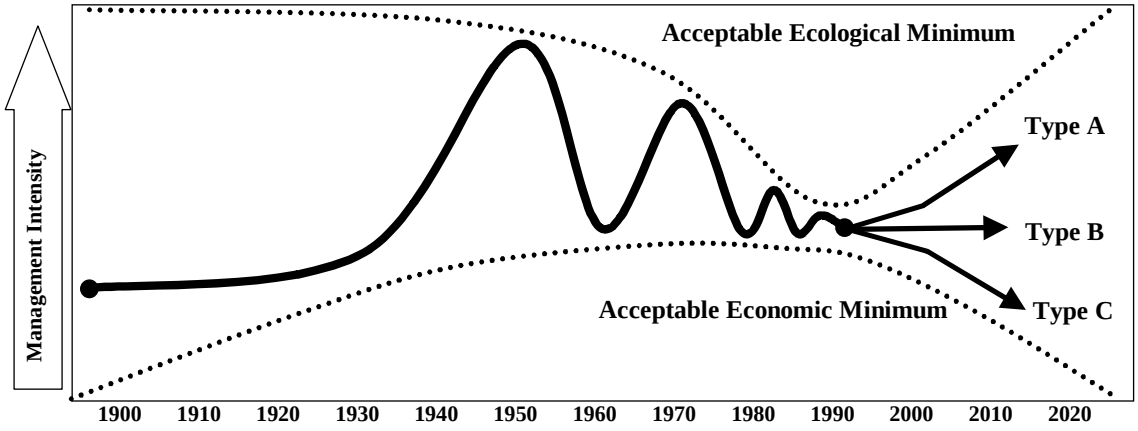


Figure 3. Forest Management and the Changing Bounds of Sustainability

A recent report by the World Wildlife Fund suggests that a significant expansion of the area of intensively-managed forest plantations could allow the world's major forest products companies to meet a substantial share of the global demand for industrial roundwood from a relatively small proportion of the world's forest area, and open up new opportunities to provide outright protection to high conservation value forests, particularly those with globally-significant biodiversity values (Howard and Stead 2001). WWF is so convinced of the value of this approach that they have called upon the world's ten largest forest products companies to collectively increase the area of intensively-managed forest plantations by 5 million hectares per year—for the next 50 years (World Wildlife Fund 2001). With this level of investment, WWF estimates that as much as 80 percent of the world demand for industrial roundwood in 2050 can be met from less than 20 percent of the world's forests. Furthermore, WWF asserts this can all be done consistent with the Forest Stewardship Council (FSC) criteria for forest certification, meaning

that much of that 20 percent will be new planted forests on retired marginal crop and pasture land, rather than plantations created by converting natural forests.

What would such an approach mean for the United States? In some ways, we are already tending in this direction, with wood production shifting increasingly to industrial timberlands and other private forests, and biodiversity conservation becoming a primary management goal in many public forests. Nevertheless, significant policy and political barriers remain to achieving either of these objectives efficiently or effectively. We are perhaps within reach of a new political consensus—one in which both the forestry community and the environmental community actively support the idea that intensively-managed forest plantations *and* protected areas in high conservation value forests have an essential place in a comprehensive strategy for sustainable forest management.

Policymakers have an opportunity—and a responsibility—to further develop this potential for broad public consensus on forests and forestry, and to shape a policy framework that will support and facilitate this kind of practical approach to accomplishing sustainable forest management. It has been suggested (Binkley 2001) that a consensus agreement might include considerations such as:

- devoting 20-30 percent of the landbase of plantation projects to ecological services
- strict control of offsite impacts of plantation-based timber production, especially the movement of silt, fertilizer or herbicides into waterways or groundwater
- agreed upon limits on the use of yield-enhancing chemicals such as fertilizers and herbicides, focused on minimizing use and maximizing impact
- agreed upon limits on the use of genetically modified organisms (GMOs) to instances in which it can be demonstrated that gene flow out of the plantation is not possible
- a commitment not to log old growth forests

Numerous opportunities exist to create a policy framework that enables and encourages public and private forest land managers to make rational choices that will tend to be consistent with and supportive of this general approach. Developed temperate-forest nations like the US, particularly those with high per-capita consumption of wood, have a dual conservation responsibility to fulfill. The have an obligation to protect their remaining "hot spots" of biological diversity—and bear their share of the local, short-term economic effects of doing so—and at the same time meet their share of the demand for renewable wood and fiber that they themselves generate, without shifting an undue burden on biologically rich forests in other regions of the world.

Toward a shared vision of sustainability in forest management

Sustainable forest management involves a simultaneous pursuit of ecological, economic and social objectives that, rather than mutually exclusive, are in fact mutually *dependent*. The modern definition of sustainable forest management requires meeting three conditions simultaneously; it must be ecologically sound, economically viable, and socially responsible. Reflecting a difficult lesson learned in developing countries around the world, conservation interests are recognizing that it is not possible to get long term protection of forest ecosystems without incorporating the economic and social needs of the local people into conservation strategies. Economic development and commercial interests are recognizing that ensuring the ecological soundness of their activities not only helps to assure raw material supplies for the future, but also helps maintain essential social and political support (Schmidheiny 1992). Communities are no longer willing to accept the social disruptions and family dislocations that have always accompanied a boom-and-bust approach. They are recognizing that government policymakers alone cannot lead the way toward stable, resilient, and economically diverse communities--that there is an important role for partnerships between business interests and the communities themselves in finding a new basis for sustainable resource use and sustainable communities.

These stark realities are causing conservation interests and business interests alike to reconsider their previous adversarial approaches to one another. Without setting out to do so, these two segments of society are finding themselves on new paths that are no longer divergent, but in many ways are converging toward one another. This convergence--a new sense of common purpose and goals among environmental interests, communities, and the business sector--holds the potential for forming a strong working consensus for conservation such as has not been seen in the U.S. for at least a generation. This is beginning to illuminate a new array of rational, implementable policy options that offer hope for finding a way out of the current political and legal impasse over forest conservation. .

Sustainability in forest management is a dynamic, evolving concept, reflecting changing social values and changes in our scientific understanding of the effects of human activities on the functioning of forest ecosystems. As an increasingly broad cross-section of forestry interests comes to accept that truly sustainable forestry must reflect ecological, economic and social objectives, the most challenging tradeoff for policymakers may be between short-term needs and long-term assurances.

The central idea behind "sustainable development," i.e., meeting the needs of present human society without unduly compromising the capacity of future human societies to meet their needs (World Commission on Environment and Development 1987), is not materially different from the basic motivating concept behind sustained-yield forestry in medieval Europe or sustainable forest management in 20th-century America. From a policymaking and operational management perspective, the sustainability challenge will always be to protect the long-term productivity of forest ecosystems--to the best of our biological, social, and economic understanding--without unduly limiting the utilization of

forests to meet current needs. From an analytical perspective, it is to operate as close to the margin as is socially and politically acceptable, neither exceeding ecological capacities nor leaving significant ecological capacity unutilized. How conservative a "margin for error" is incorporated is as much a political decision as a scientific one. But the question "forests for whom and for what?" (Clawson 1975) can perhaps never be answered once and for all, nor will the answer be the same for all forests everywhere. It must be revisited periodically as societal needs and conditions change, and we come to a more complete knowledge of what is needed to sustain the regenerative capacity of forest ecosystems to meet current and anticipated needs.

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Appendix 1: Montreal Process on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests [2]

The "Montreal Process" deals with criteria and indicators for sustainable forest management in temperate and boreal forests in 12 countries outside Europe. The 12 participating countries have agreed on a set of 7 non-legally binding criteria and 67 indicators for sustainable forest management for national implementation. Participating countries have agreed to review and consider possible elements for criteria and indicators at the forest management unit level.

Initiated: February1995; Santiago, Chile

Member Countries(12): Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russian Federation, Uruguay and USA.

Web address: http://www.mpci.org

Criteria and Indicators

Criterion 1: Conservation of biological diversity
Biological diversity includes the elements of the diversity of ecosystems, the diversity between species, and genetic diversity in species.

Indicators of ecosystem diversity:

1.1 Extent of area by forest type relative to total forest area-(a)[3]
1.2 Extent of area by forest type and by age class or successional stage-(b);
1.3 Extent of area by forest type in protected area categories as defined by IUCN[4] or other classification systems-(a);
1.4 Extent of areas by forest type in protected areas defined by age class or successional stage-(b);
1.5 Fragmentation of forest types-(b).

Indicators of species diversity:

[2] Source: Castañeda, F., Palmberg-Lerche, C., and Vuorinen, P. 2001.Criteria and Indicators for Sustainable Forest Management: A Compendium. Working Paper FM/5. Rome: UN Food and Agriculture Organization. Also available at: http://www.fao.org/DOCREP/004/AC135E/ac135e08.htm.

[3] The "a" depicts an indicator for which the Process assesses that data is most readily available; and a "b" for which data is not readily available.

[4] IUCN categories: I. Strict protection, II. Ecosystem conservation and tourism, III. Conservation of natural features, IV. Conservation through active management, V. Landscape/Seascape conservation and recreation, VI. Sustainable use of natural ecosystems.

1.6 The number of forest dependent species-(b);
1.7 The status (threatened, rare, vulnerable, endangered, or extinct) of forest dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment-(a).

Indicators of genetic diversity:

1.8 Number of forest dependent species that occupy a small portion of their former range-(b);
1.9 Population levels of representative species from diverse habitats monitored across their range-(b).

Criterion 2: Maintenance of productive capacity of forest ecosystems

Indicators:

2.1 Area of forest land and net area of forest land available for timber production (a);
2.2 Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production-(a);
2.3 The area and growing stock of plantations of native and exotic species-(a);
2.4 Annual removal of wood products compared to the volume determined to be sustainable-(a);
2.5 Annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable-(b).

Criterion 3: Maintenance of forest ecosystem health and vitality

Indicators:

3.1 Area and percent of forest affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinization, and domestic animals-(b);
3.2 Area and percent of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, ozone) or ultraviolet B that may cause negative impacts on the forest ecosystem-(b);
3.3 Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)- (b).

Criterion 4: Conservation and maintenance of soil and water resources

This criterion encompasses the conservation of soil and water resources and the protective and productive functions of forests.

Indicators:

4.1 Area and percent of forest land with significant soil erosion-(b);
4.2 Area and percent of forest land managed primarily for protective functions, e.g. watersheds, flood protection, avalanche protection, riparian zones-(a);

4.3 Percent of stream kilometres in forested catchments in which stream flow and timing has significantly deviated from the historic range of variation-(b);
4.4 Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties-(b);
4.5 Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities-(b);
4.6 Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variance of biological diversity from the historic range of variability-(b);
4.7 Percent of water bodies in forest areas (e.g. stream kilometres, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change-(b);
4.8 Area and percent of forest land experiencing an accumulation of persistent toxic substances-(b).

Criterion 5: Maintenance of forest contribution to global carbon cycles

Indicators:

5.1 Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age class, and successional stages-(b);
5.2 Contribution of forest ecosystems to the total global carbon budget, including absorption and release of carbon (standing biomass, coarse woody debris, peat and soil carbon)-(a or b);
5.3 Contribution of forest products to the global carbon budget-(b).

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

Indicators of production and consumption:

6.1 Value and volume of wood and wood products production, including value added through downstream processing-(a);
6.2 Value and quantities of production of non-wood forest products-(b);
6.3 Supply and consumption of wood and wood products, including consumption per capita-(a);
6.4 Value of wood and non-wood products production as percentage of GDP-(a or b);
6.5 Degree of recycling of forest products-(a or b);
6.6 Supply and consumption/use of non-wood products-(a or b).

Indicators of recreation and tourism:

6.7 Area and percent of forest land managed for general recreation and tourism, in relation to the total area of forest land-(a or b);
6.8 Number and type of facilities available for general recreation and tourism, in relation to population and forest area-(a or b);
6.9 Number of visitor days attributed to recreation and tourism, in relation to population and forest area-(b).

Indicators of investment in the forest sector:

6.10 Value of investment, including investment in forest growing, forest health and management, planted forests, wood processing, recreation and tourism-(a);
6.11 Level of expenditure on research and development, and education-(b);
6.12 Extension and use of new and improved technologies-(b);
6.13 Rates of return on investment-(b).

Indicators of cultural, social and spiritual needs and values:

6.14 Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values-(a or b);
6.15 Non-consumptive use forest values (b).

Indicators of employment and community needs:

6.16 Direct and indirect employment in the forest sector and forest sector employment as a proportion of total employment-(a or b);
6.17 Average wage rates and injury rates in major employment categories within the forest sector-(a);
6.18 Viability and adaptability to changing economic conditions, of forest dependent communities, including indigenous communities-(b);
6.19 Area and percent of forest land used for subsistence purposes-(b).

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management.

Indicators:

Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:
7.1 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;
7.2 Provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors;
7.3 Provides opportunities for public participation in public policy and decision-making related to forests and public access to information;
7.4 Encourages best practice codes for forest management;
7.5 Provides for the management of forests to conserve special environmental, cultural, social and/or scientific values.

Indicators:

Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to:
7.6 Provide for public involvement activities and public education, awareness and extension programs, and make available forest-related information;

7.7 Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and coordination;
7.8 Develop and maintain human resource skills across relevant disciplines;
7.9 Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management;
7.10 Enforce laws, regulations and guidelines.

Indicators:

Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests through:
7.11 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;
7.12 Non-discriminatory trade policies for forest products.

Indicators:

Capacity to measure and monitor changes in the conservation and sustainable management of forests, including:
7.13 Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7;
7.14 Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information;
7.15 Compatibility with other countries in measuring, monitoring and reporting on indicators.

Indicators:

Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services, including:
7.16 Development of scientific understanding of forest ecosystem characteristics and functions;
7.17 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;
7.18 New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies;
7.19 Enhancement of ability to predict impacts of human intervention on forests;
7.20 Ability to predict impacts on forests of possible climate change.

Appendix 2: Principles And Criteria For Forest Management[5]

Introduction

It is widely accepted that forest resources and associated lands should be managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations. Furthermore, growing public awareness of forest destruction and degradation has led consumers to demand that their purchases of wood and other forest products will not contribute to this destruction but rather help to secure forest resources for the future. In response to these demands, certification and self-certification programs of wood products have proliferated in the marketplace.

The Forest Stewardship Council (FSC) is an international body which accredits certification organizations in order to guarantee the authenticity of their claims. In all cases the process of certification will be initiated voluntarily by forest owners and managers who request the services of a certification organization. The goal of the FSC is to promote environmentally responsible, socially beneficial and economically viable management of the world's forests, by establishing a worldwide standard of recognized and respected Principles of Forest Stewardship.

The FSC's Principles and Criteria (P&C) apply to all tropical, temperate and boreal forests, as addressed in Principle #9 and the accompanying glossary. Many of these P&C apply also to plantations and partially replanted forests. More detailed standards for these and other vegetation types may be prepared at national and local levels. The P&C are to be incorporated into the evaluation systems and standards of all certification organizations seeking accreditation by the FSC. While the P&C are mainly designed for forests managed for the production of wood products, they are also relevant, to varying degrees, to forests managed for non-timber products and other services. The P&C are a complete package to be considered as a whole, and their sequence does not represent an ordering of priority. This document shall be used in conjunction with the FSC's Statutes, Procedures for Accreditation and Guidelines for Certifiers.

FSC and FSC-accredited certification organizations will not insist on perfection in satisfying the P&C. However, major failures in any individual Principles will normally disqualify a candidate from certification, or will lead to decertification. These decisions will be taken by individual certifiers, and guided by the extent to which each Criterion is satisfied and by the importance and consequences of failures. Some flexibility will be allowed to cope with local circumstances.

The scale and intensity of forest management operations, the uniqueness of the affected resources, and the relative ecological fragility of the forest will be considered in all certification assessments. Differences and difficulties of interpretation of the P&C will be addressed in national and local forest stewardship standards. These standards are to be developed in each country or region involved, and will be evaluated for purposes of certification, by certifiers and other involved and affected parties on a case by case basis. If necessary, FSC dispute resolution mechanisms may also be called upon during the course of assessment.

More information and guidance about the certification and accreditation process is included in the FSC Statutes, Accreditation Procedures, and Guidelines for Certifiers.

[5] Source: Forest Stewardship Council of the US. Principles and Criteria for Forest Management. http://www.fscus.org/images/documents/FSC_Principles_Criteria.pdf

The FSC P&C should be used in conjunction with national and international laws and regulations. FSC intends to complement, not supplant other initiatives that support responsible forest management worldwide.

The FSC will conduct educational activities to increase public awareness of the importance of the following: 1) improving forest management; 2) incorporating the full costs of management and production into the price of forest products; 3) promoting the highest and best use of forest resources; 4) reducing damage and waste; and 5) avoiding over-consumption and over-harvesting. The FSC will also provide guidance to policy makers on these issues, including improving forest management legislation and policies.

PRINCIPLE #1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES
Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.
1.1 Forest management shall respect all national and local laws and administrative requirements.
1.2 All applicable and legally prescribed fees, royalties, taxes and other charges shall be paid.
1.3 In signatory countries, the provisions of all binding international agreements such as CITES, ILO Conventions, ITTA, and Convention on Biological Diversity, shall be respected.
1.4 Conflicts between laws, regulations and the FSC Principles and Criteria shall be evaluated for the purposes of certification, on a case by case basis, by the certifiers and the involved or affected parties.
1.5 Forest management areas should be protected from illegal harvesting, settlement and other unauthorized activities.
1.6 Forest managers shall demonstrate a long-term commitment to adhere to the FSC Principles and Criteria.

PRINCIPLE #2: TENURE AND USE RIGHTS AND RESPONSIBILITIES
Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.
2.1 Clear evidence of long-term forest use rights to the land (e.g. land title, customary rights, or lease agreements) shall be demonstrated.
2.2 Local communities with legal or customary tenure or use rights shall maintain control, to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies.
2.3 Appropriate mechanisms shall be employed to resolve disputes over tenure claims and use rights. The circumstances and status of any outstanding disputes will be explicitly considered in the certification evaluation. Disputes of substantial magnitude involving a significant number of interests will normally disqualify an operation from being certified.

PRINCIPLE #3: INDIGENOUS PEOPLES' RIGHTS
The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.
3.1 Indigenous peoples shall control forest management on their lands and territories unless they delegate control with free and informed consent to other agencies.
3.2 Forest management shall not threaten or diminish, either directly or indirectly, the resources or tenure rights of indigenous peoples.
3.3 Sites of special cultural, ecological, economic or religious significance to indigenous peoples shall be clearly identified in cooperation with such peoples, and recognized and protected by forest managers.
3.4 Indigenous peoples shall be compensated for the application of their traditional knowledge regarding the use of forest species or management systems in forest operations. This compensation shall be formally agreed upon with their free and informed consent before forest operations

commence.

PRINCIPLE #4: COMMUNITY RELATIONS AND WORKER'S RIGHTS
Forest management operations shall maintain or enhance the long-term social and economic well being of forest workers and local communities.
4.1 The communities within, or adjacent to, the forest management area should be given opportunities for employment, training, and other services.
4.2 Forest management should meet or exceed all applicable laws and/or regulations covering health and safety of employees and their families.
4.3 The rights of workers to organize and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labour Organisation (ILO).
4.4 Management planning and operations shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups directly affected by management operations.
4.5 Appropriate mechanisms shall be employed for resolving grievances and for providing fair compensation in the case of loss or damage affecting the legal or customary rights, property, resources, or livelihoods of local peoples. Measures shall be taken to avoid such loss or damage.

PRINCIPLE # 5: BENEFITS FROM THE FOREST
Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.
5.1 Forest management should strive toward economic viability, while taking into account the full environmental, social, and operational costs of production, and ensuring the investments necessary to maintain the ecological productivity of the forest.
5.2 Forest management and marketing operations should encourage the optimal use and local processing of the forest's diversity of products.
5.3 Forest management should minimize waste associated with harvesting and on-site processing operations and avoid damage to other forest resources.
5.4 Forest management should strive to strengthen and diversify the local economy, avoiding dependence on a single forest product.
5.5 Forest management operations shall recognize, maintain, and, where appropriate, enhance the value of forest services and resources such as watersheds and fisheries.
5.6 The rate of harvest of forest products shall not exceed levels which can be permanently sustained.

PRINCIPLE #6: ENVIRONMENTAL IMPACT
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.
6.1 Assessment of environmental impacts shall be completed -- appropriate to the scale, intensity of forest management and the uniqueness of the affected resources -- and adequately integrated into management systems. Assessments shall include landscape level considerations as well as the impacts of on-site processing facilities. Environmental impacts shall be assessed prior to commencement of site-disturbing operations.
6.2 Safeguards shall exist which protect rare, threatened and endangered species and their habitats (e.g., nesting and feeding areas). Conservation zones and protection areas shall be established, appropriate to the scale and intensity of forest management and the uniqueness of the affected resources. Inappropriate hunting, fishing, trapping and collecting shall be controlled.
6.3 Ecological functions and values shall be maintained intact, enhanced, or restored, including:
a) Forest regeneration and succession.
b) Genetic, species, and ecosystem diversity.
c) Natural cycles that affect the productivity of the forest ecosystem.
6.4 Representative samples of existing ecosystems within the landscape shall be protected in their

natural state and recorded on maps, appropriate to the scale and intensity of operations and the uniqueness of the affected resources.
6.5 Written guidelines shall be prepared and implemented to: control erosion; minimize forest damage during harvesting, road construction, and all other mechanical disturbances; and protect water resources.
6.6 Management systems shall promote the development and adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides. World Health Organization Type 1A and 1B and chlorinated hydrocarbon pesticides; pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use; as well as any pesticides banned by international agreement, shall be prohibited. If chemicals are used, proper equipment and training shall be provided to minimize health and environmental risks.
6.7 Chemicals, containers, liquid and solid non-organic wastes including fuel and oil shall be disposed of in an environmentally appropriate manner at off-site locations.
6.8 Use of biological control agents shall be documented, minimized, monitored and strictly controlled in accordance with national laws and internationally accepted scientific protocols. Use of genetically modified organisms shall be prohibited.
6.9 The use of exotic species shall be carefully controlled and actively monitored to avoid adverse ecological impacts.
6.10 Forest conversion to plantations or non-forest land uses shall not occur, except in circumstances where conversion:
a) entails a very limited portion of the forest management unit; and
b) does not occur on high conservation value forest areas; and
c) will enable clear, substantial, additional, secure long term conservation benefits across the forest
management unit.

PRINCIPLE #7: MANAGEMENT PLAN
A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated.
7.1 The management plan and supporting documents shall provide:
a) Management objectives.
b) Description of the forest resources to be managed, environmental limitations, land use and ownership status, socio-economic conditions, and a profile of adjacent lands.
c) Description of silvicultural and/or other management system, based on the ecology of the forest in question and information gathered through resource inventories.
d) Rationale for rate of annual harvest and species selection.
e) Provisions for monitoring of forest growth and dynamics.
f) Environmental safeguards based on environmental assessments.
g) Plans for the identification and protection of rare, threatened and endangered species.
h) Maps describing the forest resource base including protected areas, planned management activities and land ownership.
i) Description and justification of harvesting techniques and equipment to be used.
7.2 The management plan shall be periodically revised to incorporate the results of monitoring or new scientific and technical information, as well as to respond to changing environmental, social and economic circumstances.
7.3 Forest workers shall receive adequate training and supervision to ensure proper implementation of the management plan.
7.4 While respecting the confidentiality of information, forest managers shall make publicly available a summary of the primary elements of the management plan, including those listed in Criterion 7.1.

PRINCIPLE #8: MONITORING AND ASSESSMENT

Monitoring shall be conducted -- appropriate to the scale and intensity of forest management -- to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

8.1 The frequency and intensity of monitoring should be determined by the scale and intensity of forest management operations as well as the relative complexity and fragility of the affected environment. Monitoring procedures should be consistent and replicable over time to allow comparison of results and assessment of change.

8.2 Forest management should include the research and data collection needed to monitor, at a minimum, the following indicators:

a) Yield of all forest products harvested.

b) Growth rates, regeneration and condition of the forest.

c) Composition and observed changes in the flora and fauna.

d) Environmental and social impacts of harvesting and other operations.

e) Costs, productivity, and efficiency of forest management.

8.3 Documentation shall be provided by the forest manager to enable monitoring and certifying organizations to trace each forest product from its origin, a process known as the "chain of custody."

8.4 The results of monitoring shall be incorporated into the implementation and revision of the management plan.

8.5 While respecting the confidentiality of information, forest managers shall make publicly available a summary of the results of monitoring indicators, including those listed in Criterion 8.2.

PRINCIPLE # 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS

Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

9.1 Assessment to determine the presence of the attributes consistent with High Conservation Value Forests will be completed, appropriate to scale and intensity of forest management.

9.2 The consultative portion of the certification process must place emphasis on the identified conservation attributes, and options for the maintenance thereof.

9.3 The management plan shall include and implement specific measures that ensure the maintenance and/or enhancement of the applicable conservation attributes consistent with the precautionary approach. These measures shall be specifically included in the publicly available management plan summary.

9.4 Annual monitoring shall be conducted to assess the effectiveness of the measures employed to maintain or enhance the applicable conservation attributes.

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.

10.1 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.

10.2 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.
10.3 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.
10.4 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.
10.5 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.
10.6 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.
10.7 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.
10.8 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.
10.9 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.

Principles 1-9 were ratified by the FSC Founding Members and Board of Directors in September 1994. Principle 10 was ratified by the FSC Members and Board of Directors in February 1996. The revision of Principle 9 and the addition of Criteria 6.10 and 10.9 were ratified by the FSC Members and Board of Directors in January 1999.

GLOSSARY
Words in this document are used as defined in most standard English language dictionaries. The precise meaning and local interpretation of certain phrases (such as local communities) should be decided in the local context by forest managers and certifiers. In this document, the words below are understood as follows:

Biological diversity: The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. (see Convention on Biological Diversity, 1992)
Biological diversity values: The intrinsic, ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components. (see Convention on Biological Diversity, 1992)
Biological control agents: Living organisms used to eliminate or regulate the population of other living organisms.
Chain of custody: The channel through which products are distributed from their origin in the forest to their end-use.
Chemicals: The range of fertilizers, insecticides, fungicides, and hormones which are used in forest management.
Criterion (pl. Criteria): A means of judging whether or not a Principle (of Forest Management) has been fulfilled.
Customary rights: Rights which result from a long series of habitual or customary actions, constantly repeated, which have, by such repetition and by uninterrupted acquiescence, acquired the force of a law within a geographical or sociological unit.
Ecosystem: A community of all plants and animals and their physical environment, functioning together as an interdependent unit.
Endangered species: Any species which is in danger of extinction throughout all or a significant portion of its range.
Exotic species: An introduced species not native or endemic to the area in question.
Forest integrity: The composition, dynamics, functions and structural attributes of a natural forest.
Forest management/manager: The people responsible for the operational management of the forest resource and of the enterprise, as well as the management system and structure, and the planning and field operations.
Genetically modified organisms: Biological organisms which have been induced by various means to consist of genetic structural changes.
High Conservation Value Forest: High Conservation Value Forests are those that possess one or more of the following attributes:
a) forest areas containing globally, regionally or nationally significant:
-concentrations of biodiversity values (e.g. endemism, endangered species, refugia); and/or
-large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patters of distribution and abundance
b) forest areas that are in or contain rare, threatened or endangered ecosystems
c) forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)
d) forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health) and/or critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).
Indigenous lands and territories: The total environment of the lands, air, water, sea, sea-ice, flora and fauna, and other resources which indigenous peoples have traditionally owned or otherwise occupied or used. (Draft Declaration of the Rights of Indigenous Peoples: Part VI)
Indigenous peoples: The existing descendants of the peoples who inhabited the present territory of a country wholly or partially at the time when persons of a different culture or ethnic origin arrived there from other parts of the world, overcame them and, by conquest, settlement, or other means reduced them to a non-dominant or colonial situation; who today live more in conformity with their particular social, economic and cultural customs and traditions than with the institutions of the country of which they now form a part, under State structure which incorporates mainly the national, social and cultural characteristics of other segments of the population which are predominant." (Working definition

adopted by the UN Working Group on Indigenous Peoples).
Landscape: A geographical mosaic composed of interacting ecosystems resulting from the influence of geological, topographical, soil, climatic, biotic and human interactions in a given area.
Local laws: Includes all legal norms given by organisms of government whose jurisdiction is less than the national level, such as departmental, municipal and customary norms.
Long term: The time-scale of the forest owner or manager as manifested by the objectives of the management plan, the rate of harvesting, and the commitment to maintain permanent forest cover. The length of time involved will vary according to the context and ecological conditions, and will be a function of how long it takes a given ecosystem to recover its natural structure and composition following harvesting or disturbance, or to produce mature or primary conditions.
Native species: A species that occurs naturally in the region; endemic to the area.
Natural cycles: Nutrient and mineral cycling as a result of interactions between soils, water, plants, and animals in forest environments that affect the ecological productivity of a given site.
Natural forest: Forest areas where most of the principal characteristics and key elements of native ecosystems such as complexity, structure and diversity are present, as defined by FSC- approved national and regional standards of forest management.
Nontimber forest products: All forest products except timber, including other materials obtained from trees such as resins and leaves, as well as any other plant and animal products.
Other forest types: Forest areas that do not fit the criteria for plantation or natural forests and which are defined more specifically by FSC-approved national and regional standards of forest management.
Plantation: 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.
Principle: An essential rule or element; in the FSC's case, of forest management.
Silviculture: The art of producing and tending a forest by manipulating its establishment, composition and growth to best fulfill the objectives of the owner. This may, or may not, include timber production.
Succession: Progressive changes in species composition and forest community structure caused by natural processes (nonhuman) over time.
Tenure: Socially defined agreements held by individuals or groups, recognized by legal statutes or customary practice, regarding the "bundle of rights and duties" of ownership, holding, access and/or usage of a particular land unit or the associated resources there within (such as individual trees, plant species, water, minerals, etc).
Threatened species: Any species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Use Rights: Rights for the use of forest resources that can be defined by local custom, mutual agreements, or prescribed by other entities holding access rights. These rights may restrict the use of particular resources to specific levels of consumption or particular harvesting techniques.