UNITED STATES
2003 Report on Sustainable Forests

DATA REPORT

Criterion 2

MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

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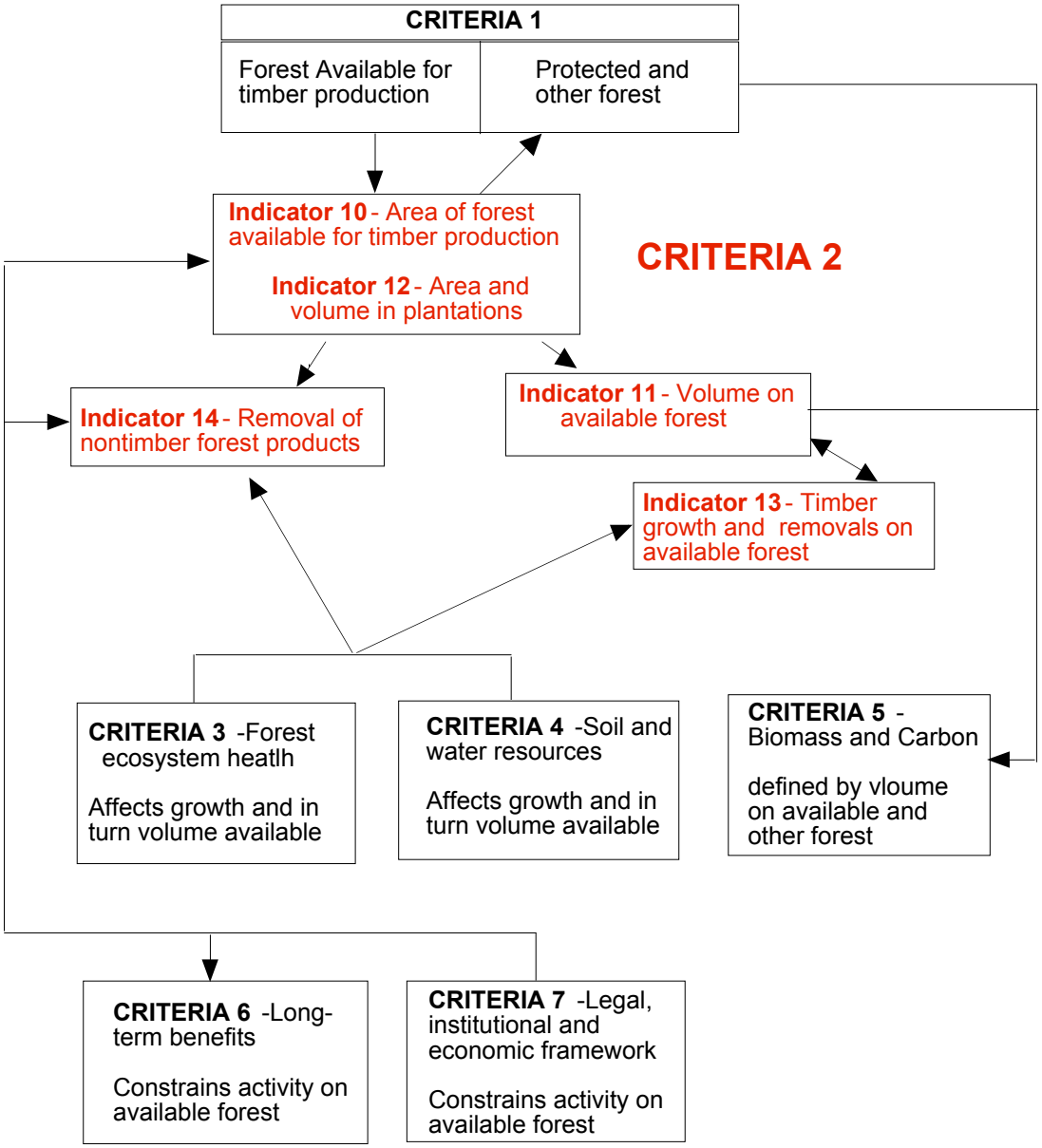
Criteria and Indicator interactions for CRITERIA 2- Maintenance of productive capacity of forests



MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

Caveats for analysis of data for forest land available for timber production
Indicators 10 through 13 provide information fundamental to calculating the timber productive capacity based upon how much forest is potentially available for timber production. Knowledge of the availability as well as the capability of forest land to provide desired goods and services is a critical indicator of the balance of forest ecosystems relative to potential end uses. The multitemporal nature of the management objectives and planning guidelines for the Nation's diverse forest owners, however, make it difficult to summarize the area of forest available for timber production as a single value at a single point in time, much less consistently over time. Within the context of this report, forest available for timber production will be defined as forest land not precluded by law or regulation from commercial harvesting of trees or "timber land" as it is defined in national reports (Smith et al., 2002). In practice, the area available for timber production at any given time will always be a value less than total timber land. The amount of the area adjustment required to determine the actual availability of timber land will depend on the ownership mix and the management constraints in place at the time of analysis. This adjustment will affect all other indicators in this criterion as well. Supporting tables for these criteria are provided in Appendix A, Forest Resources of the United States, 2002. Major reporting regions for this report are shown in Figure 10-1 below.

Figure 10-1. Major reporting regions for Criterion 2

Indicator 10. Area of forest land and net area of forest land available for timber production

What is the indicator and why is it important?

This indicator provides information fundamental to calculating the timber productive capacity of existing forests and shows how much forest is potentially available for timber production, compared with total forest area. The difference between total area and net area demonstrates that some forests are not going to be harvested for a variety of reasons.

Available data used for this indicator are from the USDA Forest Service Forest Inventory and Analysis Program for forest land available for timber management reported in Forest Resources of the United States (2002 Draft RPA tables, http://www.fia.fs.fed.us).

Refer to APPENDIX Tables 10-24.

What the data shows

Total forest area available for timber management by broad management class provides an aggregate view of the management/capability status of the Nation's forests. Natural/seminatural timber lands provide high annual biomass productive potential and are generally not precluded from management activities that include harvesting. Plantation timber lands are intensively managed, have a high annual biomass productive potential, and are generally managed primarily for timber production. The combination of 'reserved' and 'other' forest land includes areas that are either precluded by legislation from commercial harvesting activity or are comprised of forests with low annual biomass productive potential. The latter includes areas such as low density/slow growing pinyon-juniper in the Rocky Mountain Region and the slow growing mixed spruce and birch forests of interior Alaska.

Forest land, totaling 749 million acres, in the United States is nearly equally distributed between East and West, with 384 million acres in the East (North and South Regions) and 365 million acres in the West (Rocky Mountain, Pacific Coast, and Alaska Regions). Timber lands, including natural/seminatural stands and plantations comprise the largest category of forest (Figure 10-2) with 504 million acres nationally; 361 million acres (72 percent) of this total is in the East and 143 million acres in the West. Plantations currently comprise 9 percent (47 million acres) of all U.S. timber land and the area is increasing. Plantation forests are most common in the South where 38 million acres (81 percent) of all such forests in the United States occur. Plantation forests are discussed in more detail in Indicator 12.

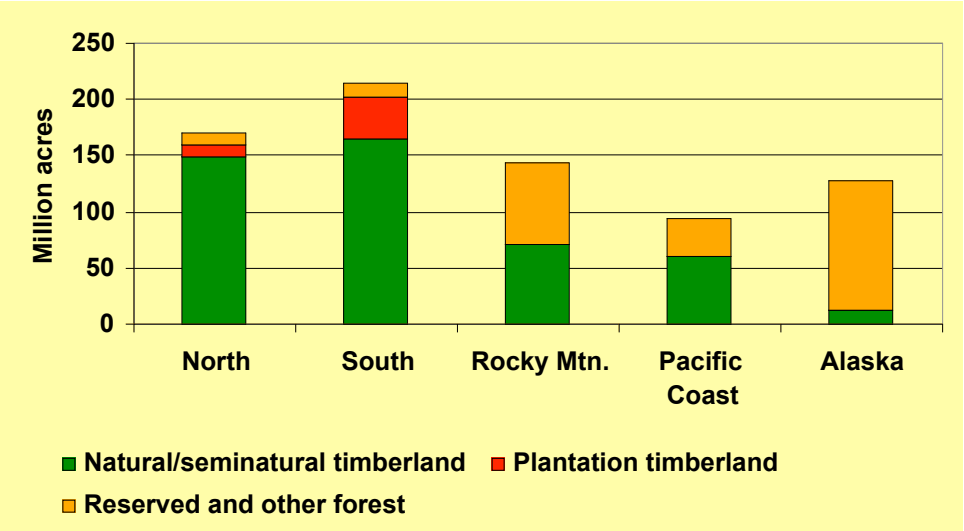


Figure 10-2. Area of forest land in the United States by region and class of forest

The total area forest land available for timber management in the United States has been stable over the past 50 years with an overall loss of 1 percent (Table 10-1). The decline has generally been the result of reclassification of these lands for other uses such as reserved forest, particularly in Alaska.

Table 10-1. Timber land area in the United States by region, 1953, 1977, 2002

Inventory date	Total	North	South	Rocky Mtn	Pacific Coast	Alaska
			(Million acres)			
1953	509	154	205	67	63	20
1977	492	153	200	60	59	20
2002	504	159	203	71	60	12
Change 1953–2002	**-1%**	**3%**	**-1%**	**6%**	**-5%**	**-42%**

As demand for fiber production has increased, intensively managed plantations aimed at high productivity fiber production from fewer acres than required by natural stands have also increased. At the same time environmental concerns have increased the need for reserved forest areas aimed at ensuring the conservation of biological diversity. Determining how to best manage the Nation's forests is closely linked to the potential for different types of management activity.

Ownership, while not accounted for in the indicators, is a factor that will play a key role in management activity. Public agencies generally manage their lands within the frame of an overall plan that considers the management for all resources. These plans generally have in them some notion or intention to manage resources in a sustainable fashion and frequently take into account current management activity on surrounding private lands. On private forest lands, according to Birch (1996), about 5 percent of owners nationwide had prepared written management plans that covered 39 percent of the total private forest land area. Some plans on private lands may include consideration of sustainable outputs; others may be based solely on financial considerations.

Public ownerships also have the benefit of very long-term single-owner tenure. Because the tenure is secured on public lands, citizens expect that public forest managers accept a proportionally higher responsibility for biodiversity conservation than private forest managers.

Given recent public land policy shifts toward reducing the amount of timber harvested from public lands due to a fully balanced multiple-use mandate, increasing pressure is placed on private forests in the United States and imports to meet the Nation's timber needs. Private timber lands account for 356 million acres, about 71 percent, of all forest available for timber management in the United States (Table 10-2). And, private forests currently account for 89 percent of the Nation's timber production, compared to 86 percent in 1952 (see Indicator 13).

The notion of sustainability of forest available for timber production is linked to the demand for these forests for other uses. And, it should be noted, the existence of forest plans does not necessarily guarantee that forest available for timber production is sustainable—this depends in part on plan objectives, the skill of planners, and the realization of assumptions necessary in the plan.

Given these caveats, if demand for wood remains at current levels or higher and competing uses for forest land reduce the acres available for timber management, a shift to fewer, more productive forests is a logical alternative. Increases in the area of highly productive plantation forests are one possible solution. The largest change will likely be in the South where increased emphasis on conifer plantations, particularly the potential planting of marginal farmlands to pine, is expected (Alig et al., 2002).

The South will likely continue its dominance as the Nation's wood basket well into the future as wood supplies from the Pacific Coast continue to decline in response to demand for other forest uses. Another possible solution to meet higher demand for wood might be to develop methods to increase productivity of natural forests through more intensive management or fertilization. Both of these alternatives are controversial for environmental interests, and transparent, multistakeholder decisionmaking processes will be needed to arrive at future public policies that are well accepted by all forest stakeholder groups.

Table 10-2. Timberland area in the United States, by management class and region, 2002.

Type of land	All regions	North	South	Rocky Mtn.	Pacific Coast	Alaska
			(Million acres)			
Natural/seminatural timberland						
Public	*142*	*29*	*19*	*50*	*34*	*9*
Private	*315*	*120*	*146*	*20*	*26*	*3*
Total	**457**	**150**	**165**	**71**	**60**	**12**
Plantation timberland						
Public	*5*	*3*	*2*	*0*	*0*	*0*
Private	*41*	*6*	*35*	*0*	*0*	*0*
Total	**47**	**9**	**38**	**0**	**0**	**0**
All timberland						
Public	*147*	*33*	*21*	*50*	*34*	*9*
Private	*356*	*126*	*181*	*20*	*26*	*3*
Total	**504**	**159**	**203**	**71**	**60**	**12**
Reserved and other forest	**245**	**11**	**12**	**74**	**34**	**115**
Total forest land	**749**	**170**	**225**	**145**	**94**	**127**
Nonforest land	**1,519**	**244**	**320**	**598**	**115**	**243**
Total, all land	**2,268**	**413**	**534**	**742**	**208**	**370**
Percent of timberland by owner group						
Public	29%	21%	10%	71%	57%	77%
Private	71%	79%	90%	29%	43%	23%

Literature cited

Birch, Thomas W. 1996. Private forest-land owners of the United States. 1994. Resour. Bull. NE-134. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station. 183 p.

Smith, W.B.; Vissage, J.S.; Darr, D.R.; Sheffield, R.M. 2001. Forest Statistics of the United States, 1997. Gen. Tech. Rep. NC-219. St. Paul, MN: USDA Forest Service. 191p.

USDA Forest Service. 1958. Timber resource for America's future. Forest Resource Report No. 14. Washington, DC: USDA Forest Service. 713 p.

Smith, W.B.; Miles, P.M.; Vissage, J.S.; Sheffield, R.M. [In press] Forest Statistics of the United States, 2002. Gen. Tech. Rep., St. Paul, MN: USDA Forest Service.

Indicator 11. Total growing stock of both merchantable and nonmerchantable tree species on forest land available for timber production

What is the indicator and why is it important?

Growing stock is a fundamental element in determining the productive capacity of the area identified as forest available for timber production. Knowledge of growing stock of the various species that make up the forest and how it changes over time is central to considerations of a sustainable supply of wood for products and the sustainability of the ecosystems that provide them.

Available data used for this indicator are from the USDA Forest Service Forest Inventory and Analysis Program for forest land available for timber management reported in Forest Resources of the United States (2002 Draft RPA tables, http://www.fia.fs.fed.us).

Refer to APPENDIX Tables 25-33

What the data shows

The Nation's timber lands contain over 800 species of trees. Variability in the condition of the size and quality of these trees has considerable bearing on their value in wood products. Generally speaking, about 94 percent of all live tree volume on timber land in the United States is considered to be growing stock or wood capable of being used for commercial products (Table 11-1). The remaining 6 percent are trees of poor form, small stature, or otherwise unsuited for wood products. Given the minor influence of nonmerchantable volume relative to total live volume of timber on forests available for timber production, the remainder of the discussion for this indicator will focus on merchantable or growing stock volume.

Table 11-1. Proportion of merchantable and nonmerchantable volume on U.S. timber land, 1953 and 2002

Region	1953			2002		
	Merch-antable volume	Nonmer-chantable volume	Percent merch-antable	Merch-antable volume	Nonmer-chantable volume	Percent merch-antable
	billion ft³		*percent*	*billion ft³*		*percent*
North	111	16	87%	218	20	91%
South	114	24	83%	268	26	91%
Rocky Mountain	60	3	95%	132	4	97%
Pacific Coast	213	6	97%	207	3	99%
Alaska	18	5	78%	32	1	97%
U.S. Total	**516**	**54**	**91%**	**856**	**54**	**94%**

With the relatively stable base of forest land available for timber production or timber land (Indicator 10) and a historic pattern of growth exceeding removals (Indicator 13), the volume of growing stock in the United States has been rising steadily for more than 50 years. The current 856 billion feet of growing stock is 39 percent higher than the volume in 1953.

The Nation's conifer growing stock volume totals 492 billion cubic feet or 57 percent of all growing stock. Conifer growing stock volume is concentrated in the West. The Pacific Coast alone accounts for 37 percent of all conifer growing stock, despite its relatively small timber land base. The West contains most of the United States' remaining forests of old-growth forests; these stands have high per acre volumes than early and middle succession stands. Many of the young forests on the Pacific Coast also have high per acre volumes due to the high productivity of much of the timber land and of the larger natural morphology of native species there (e.g., redwood, Douglas fir, Western red cedar and true firs are naturally larger than most eastern species). Most of the remainder of conifer timber is evenly distributed between the South and the Rocky Mountains; the North has only 10 percent of the Nation's total conifer timber volume

Broadleaf species, at 364 billion cubic feet, account for 43 percent of all growing stock timber volume in the United States. Fully 90 percent of all broadleaf timber volume is in the Eastern United States, almost evenly distributed between the North and the South. Most of the remaining 10 percent is on the Pacific Coast.

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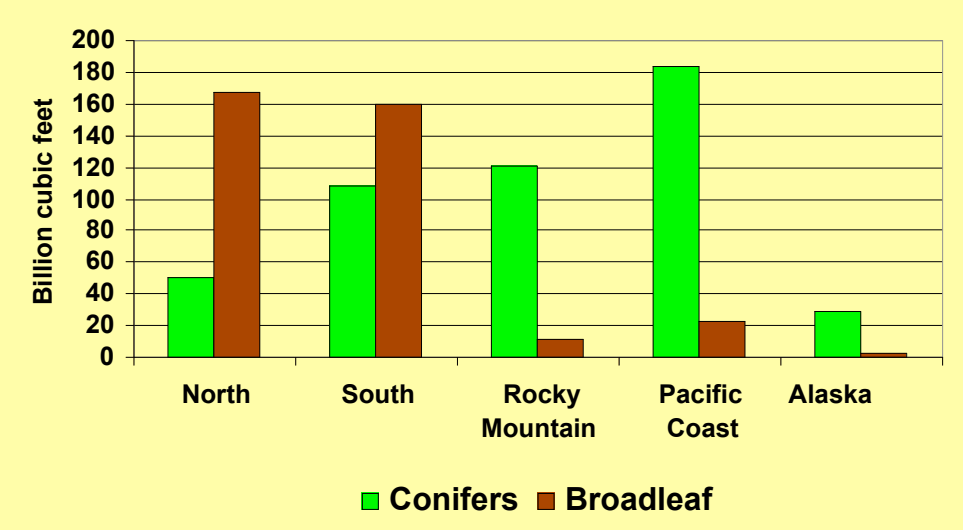
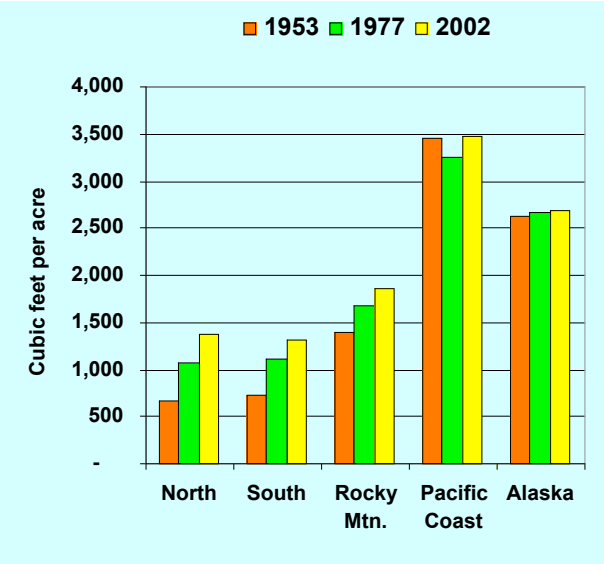


Figure 11-2. Distribution of conifer and broadleaf growing stock in the United States by region

Trends

Overall, growing stock volume per acre (Figure 11-3) has been rising in all regions of the country for the past 50 years. The exception being the Pacific Coast where harvesting of large timber and losses of high volume timber lands to reserves in the 1970s and 1980s resulted in declines. Recent reductions in harvest in this region have reversed this trend.

Total growing stock volume for both conifers and broadleaves have been rising for the past 50 years in every region of the country (Figure 11-4) with the exception of the Pacific Coast as mentioned above and in Alaska for similar reasons. Overall, conifer volumes have risen 14 percent since 1953 and broadleaf volume has risen 98 percent. The smaller increase for conifers primarily due to harvesting. The sharp increase in broadleaf species comes as a result of continued maturation of second and third growth forests of the North and South continue to mature and experience relatively lighter commercial demand. Recent data indicates that this situation is changing (Indicator 13).



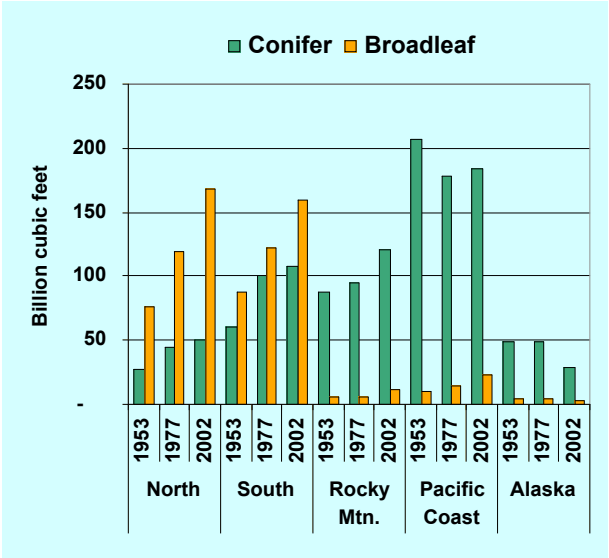


Figure 11-3. Growing stock volume per acre on timber land by region , 1953–2002

Figure 11-4. Growing stock volume on timber land by region and species group, 1953–2002

As mentioned in other indicators in this criterion, ownership has a direct bearing on management policy and access to available timber. Timber volumes are distributed unevenly among owners because of many factors, among them history of use, land productivity, and degree of management.. National forests, which account for only 19 percent of the Nation's timber land, have 30 percent of all timber volume, and 46 percent of all conifer timber volume (Table 11-2). The national forests still have a considerable area in large diameter conifer stands with high per-acre volumes, but little broadleaf volume relative to the other owner groups.

Table 11-2. Volume of growing stock in the United States, by ownership and species group, 2002

Ownership	All species	Species group	
		Conifer	Broadleaf
	(Billion cubic feet)		
National Forest	260	228	32
Other public	91	52	39
Forest industry	99	66	33
Other private	406	146	260
Total	856	492	364

As public policy responds to increasing demand for uses of public forest land for recreation, wildlife habitat, and biodiversity conservation, the area and corresponding volume of timber available for harvest from these lands will decline. Currently public timber lands contain 42 percent of all growing stock on forest available for timber production and 57 percent of all conifer growing stock. Limitations on the harvest of this resource will put significant strain on private forests even if improved technologies allow a shift to broadleaf species, since these species are located predominantly on private timber lands. Per acre volume on private lands is still increasing, but has slowed in response to increasing demand caused by the shifts in harvesting policies on public lands. The full impact of recent policy shifts is still not clear but the level of participation by stakeholder groups in both the public and private sector is encouraging.

From an analyst's perspective, perhaps the current need is better spatial analysis tools to allow the necessary in-depth analyses of management activities and their impacts for all forest ownerships.

Additional detailed discussion timber volume by species

Conifer Timber Volume

The Nation's conifer growing stock volume totals 492 billion cubic feet or 58 percent of all growing stock (Table 11-3). Conifer growing stock volume is concentrated in the West. The Pacific Coast alone accounts for 44 percent of all conifer growing stock, despite its relatively small timber land base. The West contains most of the United States' remaining forests of old growth; these stands have high per acre volumes. Many of the young forests on the Pacific Coast also have high per acre volumes due to the high productivity of much of the timber land. Most of the remainder of conifer timber is evenly distributed between the South and the Rocky Mountains; the North has only 10 percent of the Nation's total conifer timber volume.

Douglas-fir is the most abundant conifer species; it totals 107 billion cubic feet or 22 percent of all conifer timber volume in the United States (Table 11-3). And, 61 percent of all Douglas-fir volume is in Oregon and Washington.

Other important western conifer species in order of volume abundance are True firs (49 billion cubic feet); ponderosa and Jeffrey pine (39 billion cubic feet); Sitka and other spruces (33 billion cubic feet); western hemlock (32 billion cubic feet); and lodgepole pine (29 billion cubic feet). The location of volume concentrations of these species follows closely the distribution of the namesake forest types discussed earlier.

Eastern conifer species are found primarily in the South, an area that has become a focal point for new forest industrial investment in recent years. This shift in the level of timber harvest and industrial development between the Pacific Coast and the South has resulted in part from the declining supplies of large old timber on private lands on the Pacific Coast along with increased demands for other nontimber uses of public forest lands. Eastern conifers account for nearly one-third of the Nation's conifer timber; Southern pines alone account for 20 percent.

Loblolly and shortleaf pines total 73 billion cubic feet or 47 percent of all conifer volume in the East. Other important Eastern conifers are: longleaf and slash pines (16 billion cubic feet); red and white pines, located in the Northeast and North Central region (18 billion cubic feet); spruce and balsam fir, located in the North (14 billion cubic feet); and other yellow pines (11 billion cubic feet).

Broadleaf Timber Volume

Broadleaf species account for 44 percent of all growing stock timber volume in the United States (Table 11-3). Fully 87 percent of all broadleaf timber volume is in the Eastern United States, almost evenly distributed between the North and the South. Most of the remaining 10 percent is on the Pacific Coast.

The broadleaf species of the East are numerous, and their unique characteristics warrant tracking many of them as separately identifiable species. The oaks total 112 billion cubic feet. The higher economic value select species, which include select white and red oaks, hard maple, yellow birch, sweet gum, yellow poplar, ash, black walnut, and black cherry, total 143 billion cubic feet or 44 percent of all broadleaf growing stock in the United States. Although there is an apparent abundance of select species, much of the volume is in relatively small trees, which limits their usefulness for many products where clear, wide surfaces are important. In the East, 51 percent of all broadleaf timber volume is in trees less than 13 inches in diameter.

The volume of western broadleaf species is small relative to the vast conifer resources in the West, or the broadleaf resources in the East. But locally, western broadleaf species are important, and their use is growing as conifers become more limited in supply. Red alder, with an inventory of 8 billion cubic feet, has risen for nearly three decades but has declined due to increased use in recent years. It is located almost entirely in the western

third of Oregon and Washington. The aspens in Colorado and other States in the Rocky Mountains are becoming increasingly popular with tourists in the fall when the aspen foliage changes to a fluorescent gold against the backdrop of mountains and emerald green conifer forests**.**

Ownership of Timber Volume

The pattern of ownership of timber land area is not a good indication of distribution of timber volumes among the same owner groups. Because of many factors, among them; history of use, land productivity, and degree of management, timber volumes are distributed unevenly among owners. National forests, which account for only 20 percent of the Nation's timber land, have 30 percent of all timber volume, and 46 percent of all conifer timber volume (Table 11-2). The national forests still have a considerable area in old conifer stands with high per-acre volumes, but little broadleaf volume relative to the other owner groups.

Other Public Owners—States, Federal agencies other than the Forest Service, counties, and municipalities—account for about 11 percent of all timber, 57 percent of which is conifers. The broadleaf volume in this owner group is concentrated in the North; the conifer volume is mostly in the West.

Forest industries account for about 12 percent of all timber volume in the United States, and 13 percent of all conifer volume. This group of timber land owners accounts for a small part of total timber land and timber volume in most regions, but is locally important in many States and areas. In all areas having industry timber, it is important beyond its relative abundance, because industry owners hold and manage timber for harvest. Inventory turnover—the rate of harvest and replacement of timber inventories—is higher on forest industry land than on other ownerships.

Other private timber lands account for 47 percent of all growing stock volume in the United States, a proportion less than the timber land area share of this owner group might indicate, but nevertheless a large and important resource. This owner group controls 30 percent of all conifer timber, and 71 percent of all broadleaf timber. Both conifer and broadleaf timber volume in this owner group are concentrated in the Eastern United States, conifers in Northeast, Southeast, and South Central regions; broadleaf species are abundant in this ownership throughout the East.

Table 11-3. Volume and proportion of growing stock in the United States, by species, 2002.

Species	Volume	Proportion	Species	Volume	Proportion
	(Billion cubic feet)	*(Percent)*		*(Billion cubic feet)*	*(Percent)*
			Western species:		
Loblolly-shortleaf pine	73	9	Douglas -fir	114	13
White and red pine	18	2	True fir	49	6
Longleaf-slash pine	16	2	Ponderosa and Jeffrey pine	39	5
Spruce-fir	14	2	Sitka and other spruces	33	4
Other yellow pines	11	1	Western hemlock	32	4
Other conifers	9	1	Lodgepole pine	29	3
Eastern hemlock	9	1	Western redcedar	9	1
Cypress	7	1	Other conifers	16	2
Jack pine	2	0	Western broadleaves	51	6
Total	**158**	**18**	**Total**	**371**	**43**
Eastern hardwoods:			**Total, all species**	**856**	**100**
Other red and white oaks	60	7			
Select red and white oaks	52	6			
Soft maple	33	4			
Yellow poplar	23	3			
Hard maple	22	3			
Hickory	19	2			
Sweetgum	18	2			
Cottonwood and aspen	16	2			
Ash	14	2			
Black Cherry	7	1			
Yellow birch	4	0			
Black walnut	2	0			
Other broadleaves	56	7			
Total	**328**	**38**			

Literature cited

Birch, Thomas W. 1996. Private forest-land owners of the United States. 1994. Resour. Bull. NE-134. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station. 183 p.

Smith, W.B.; Vissage, J.S.; Darr, D.R.; Sheffield, R.M. 2001. Forest Statistics of the United States, 1997. Gen. Tech. Rep. NC-219. St. Paul, MN: USDA Forest Service. 191p.

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Indicator 12. The area and growing stock of plantations of native and exotic species

What is the indicator and why is it important?

This indicator is a measure of the degree to which forest plantations are being established in response to increasing demand for forest products as well as competing nontimber uses for forest land. The provision of forest products from intensively managed plantations can enhance the potential range and quantity of goods and services available from the forest.

Available data used for this indicator is from the USDA Forest Service Cooperative Forestry Program tree planting statistics and the Forest Inventory and Analysis Program for forest land available for timber management reported in Forest Resources of the United States (2002 Draft RPA tables, http://www.fia.fs.fed.us).

While there are true plantations in the West such as those found in the South, acreages are small (estimated at less than 10 percent of all plantations) and most planting is stocking augmentation. It should be noted, however, as stands are augmented, it is generally done with a single species thus favoring that species in the future development of the forest.

Refer to APPENDIX Tables 8 and 34

What the data shows

Forest planting began in earnest in the United States with the passage of the Clarke-McNary Act (PL 68-270, 43 Stat. 653). The first trees were distributed under this Act in 1926 and organized planting efforts became widespread. Since 1926, planting and plantations have risen steadily in the United States and by 2001 was taking place on over 2 million acres per year throughout the Nation. Two types of planting can be identified; traditional plantations of intensively managed trees where other native tree species are actively suppressed, and planting to augment stocking of naturally regenerating forests. The latter, predominantly in the West, seeks to improve stocking of desired native species and to improve the capacity of the forest to produce timber products.

In the West, planting estimates were compiled by the Forest Service from planting records. These records indicate an estimated 13.6 million acres of planted forests in the West (Table 12-1); about 70 percent of which are in the Pacific Coast Region. Tree planting in the West is predominantly for augmentation of natural regeneration. Douglas-fir and ponderosa pine are the dominant species planted in this region. Because it is often difficult to visually distinguish natural from planted forests after a decade or so in the West, traditional inventories have not recorded stand origin data and thus make it difficult to provide consistent data on the status of planted areas. FIA field inventories are being modified to better identify intensively managed plantations in the West, but the augmented stands will remain difficult to identify and monitor.

In contrast to many other countries, virtually all tree planting in the United States is of native species. There are about a dozen introduced or exotic species planted in the United States, predominantly Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestrus*), Swiss stone pine (*Pinus pinea*), and Austrian pine (*Pinus nigra*), according to recent nursery data (TBFRA, 2001). The acreage of these exotic forest plantings is less than 1 percent of all planting in the United States annually.

Table 12-1. Area of forest planting in the West

Forest type	*Area planted*	*Percent of area*
	Thousand acres	
Douglas-fir	7,402	54%
Ponderosa pine	2,328	17%
Western white pine	45	0%
Fir-spruce	1,216	9%
Hemlock-Sitka spruce	194	1%
Larch	859	6%
Lodgepole pine	988	7%
Other conifers	195	1%
Western broadleaves	397	3%
Total	**13,626**	**100%**

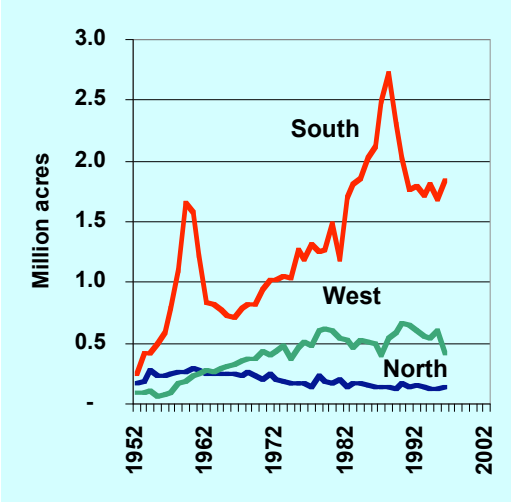

Figure 12-1. Area of tree planting in the United States by major geographic region, 1952–2001

Occasionally, as shown in the graphic, tree planting programs can provide substantial incentive to establish forest plantations for a variety of reasons. The Soil Bank Program, initiated in 1956 to stabilize highly erodible soils, spawned thousands of acres of plantations in the South. Again, during the late 1980s and early 1990s nearly 3 million acres of nonforest (agricultural) land was planted to forest in the South under the Conservation Reserve Program. While most of these plantations were established on private land, public funding and management incentives were used to put them into place. Additionally, forest industries frequently lease private forest land or offer management assistance to private landowners to establish or maintain plantations to assure future wood supplies for their operations. These planting programs and assistance have also helped offset losses of forest area to urbanization and development.

The remainder of this indicator discussion will focus on plantation timber land in the North and South, which generally use silvicultural practices that suppress existing vegetation, either fully or partially, at the time of planting and/or during stand rotation to improve yields and shorten rotations.

Plantation timber land and totaled 42 million acres (8 percent of all timber land) in the United States in 2002, and was predominately comprised of conifer species (Table 12-2). Most plantations are in the South, which has 38 million acres or about 90 percent of all plantations. And 75 percent of all plantations in the United States are composed of longleaf, slash, loblolly, or shortleaf pine in the South. Plantation acreage continues to rise in the United States, particularly in the South where they currently make up 19 percent of all timber lands. Growing stock volume on plantation timber land totaled 30 billion cubic feet in 2002 or 12 percent of total growing stock in the combined North and South regions and 4 percent of all growing stock in the United States.

Table 12-2. Area of plantations in the East, 2002

Forest type	Area planted	Percent of area
	Thousand acres	
NORTH		
White-red-jack pine	2,663	6.4%
Spruce-fir	460	1.1%
Loblolly-shortleaf pine	273	0.7%
Other forest types	928	2.2%
Total	4,326	10.3%
SOUTH		
White-red-jack pine	98	0.2%
Longleaf-slash pine	7,683	18.3%
Loblolly-shortleaf pine	23,928	57.1%
Other forest types	5,777	13.8%
Total	37,602	89.7%
Total plantations	41,927	100%

Plantations make up a substantial component of only a few forest type groups across the country. In the South, the loblolly-shortleaf pine group has the greatest acreage classed as plantations at 24 million acres or 64 percent of southern plantations. The longleaf-slash pine group, predominantly in the South, also contain a relatively high proportion of plantation area with nearly 8 million acres. In the North region, white-red-jack pine plantations are the most common species planted with 2.6 million acres.

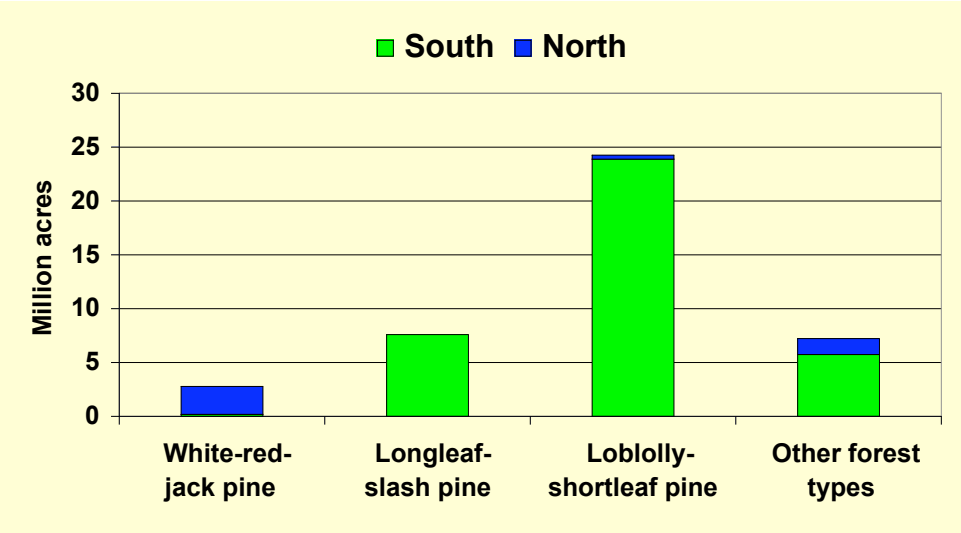

Figure 12-2. Area of timber land plantations in the North and South, 2002

While most plantations are conifers, broadleaves have been planted as well. Broadleaf plantations in the United States have tended to be experimental such as hybrid poplar (*Populus* spp.*)* in the Lake States area of the North region, and short rotation fiber plantations of species such as sycamore (*Platinus* spp.*)*. High value species such as black walnut (*Juglans nigra*) and oaks (*Quercus spp.)* also represent a small area of planted forest in the United States overall, broadleaves account for less than 1 percent of all forests planted annually.

Plantations are considered to be one of the best alternatives for maintaining timber supplies in the face of shrinking areas of forest available for timber production due to competing uses. The creation and management of additional intensively managed plantations should be considered carefully with respect to Criterion 1 (biodiversity conservation) and its indicators. The provision of forest products from intensively managed plantations may affect biodiversity and demands for other products and services from native or natural forests.

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Indicator 13. Annual removal of wood products compared to the volume determined to be sustainable

What is the indicator and why is it important?

This indicator compares net growth with wood harvest (removals) for products on timber land which is a frequently used method of assessing whether or not wood harvesting is reducing the total volume of trees on forest available for timber production. Growth is the net annual increase in the volume of growing stock between inventories after accounting for effects of mortality, but before accounting for the effects of harvest. Removals are the measure of average annual volume of living trees harvested between inventories. Timber land is the subset of forest land on which some level of harvesting is potentially allowed. So long as growth (net of mortality) exceeds removals then the volume of trees on timber land is considered sustainable.

Available data used for this indicator are from the USDA Forest Service Forest Inventory and Analysis Program for growth and removals on timber land reported in Forest Resources of the United States (2002 Draft RPA tables, http://www.fia.fs.fed.us).

Refer to APPENDIX Tables 12-19 and 37-38

What the data shows

The Montreal Process assumes that forest management plans can identify sustainable volume of timber harvest. This is not the case for all U.S. forest lands. When Federal and some other public agencies produce wood products, production is generally planned within the frame of an overall plan that considers the management for all resources. These plans generally have in them some notion or intention to manage resources in a sustainable fashion. For timber, this would, at a minimum, include the objective that timber harvests should be attainable through management that would also sustain the forest ecosystem.

According to Birch (1996), 5.3 percent of private landowners nationwide have prepared written management plans, and they cover 39 percent of the total private forest land area. Some plans on private lands include consideration of sustainable outputs; others are based solely on financial considerations. On private lands, the concept of sustainable outputs may be dependent on price and other workings of the market place. For example, from a forest owner's financial point of view, higher wood prices may lead to more intensive management, which would in turn increase the level of economically sustainable output of wood products. In 1996, 11 percent of the Nation's timber output was produced on public lands and 89 percent on private lands.

The reader is advised to review the "Caveat" section preceding Indicator 10 regarding availability for forest land for timber production. Growth and removals comparisons provide a coarse-filter measure that approximates the notion of sustainable production from a volumetric standpoint.

Growth has exceeded removals on U.S. timber lands for several decades (Figure 13-1), while the area of timber land has remained relatively stable. The result has been a substantial increase in the volume of growing stock on U.S. timber lands. In the 2002, growth continued to exceed removals for both publicly and privately owned timber lands in the East (North and South regions) and West (Rocky Mountain, Pacific Coast, and Alaska regions). Trends in growth on timber land since 1952 are attributable to several factors. In general, positive growth trends reflect regrowth and maturation of forests on lands that had been harvested prior to 1952. Investments in fire protection, landowner education, and silviculture are also reflected in growth trends. Changes in harvest patterns in the 1990s resulted in growth and removals shifts by ownership and region.

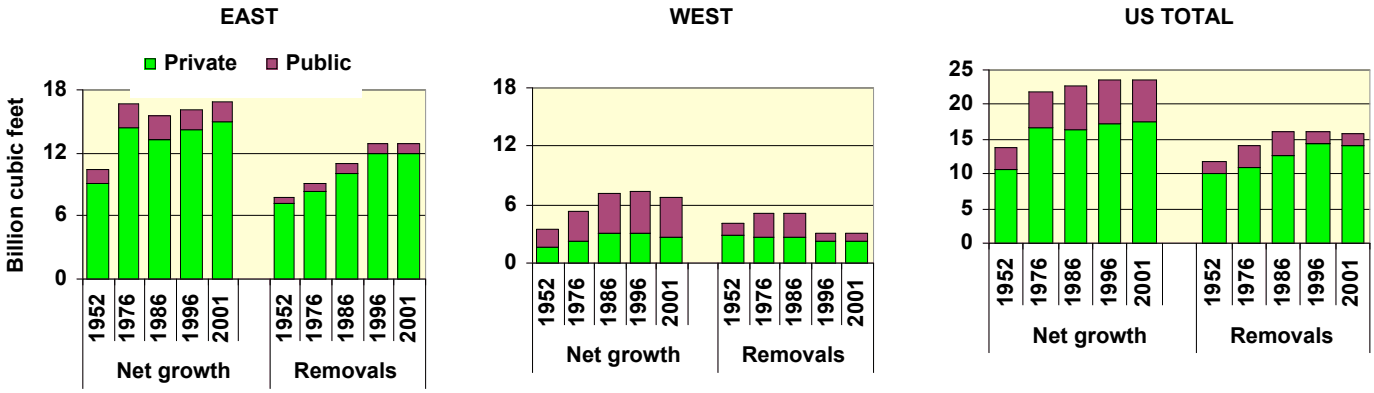

Figure 13-1. Historic growth and removals of growing stock by owner group in the United States

Historically, most harvesting occurred on private timber lands in the East and recent data shows a further shift of removals from public timber land in the West to private timber land in the East. Thus, growth has been exceeding removals by a wider margin in the West while the gap has been decreasing in the East. Currently total removals are 76 percent of growth in the East and 45 percent of growth in the West.

The current situation indicates that growth is exceeding removals for conifers and broadleaves in all regions of the country except the South. The southern forests have born the brunt of declining harvests in the West in recent years and currently removals exceed growth by a small amount in that region.

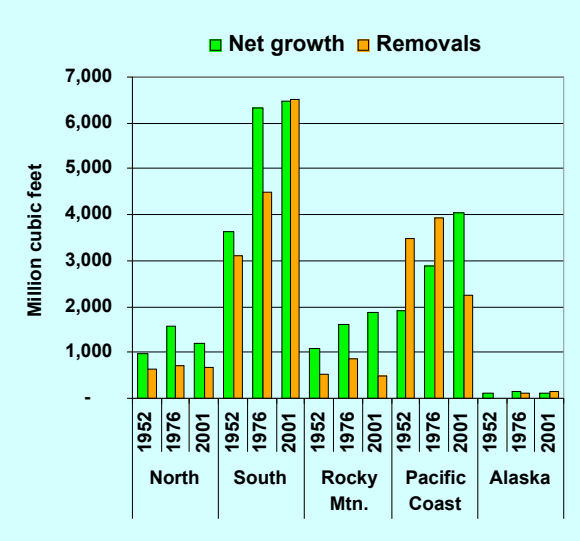

Figure 13-2. Net growth and removals of conifers in the United States, 1952–2001

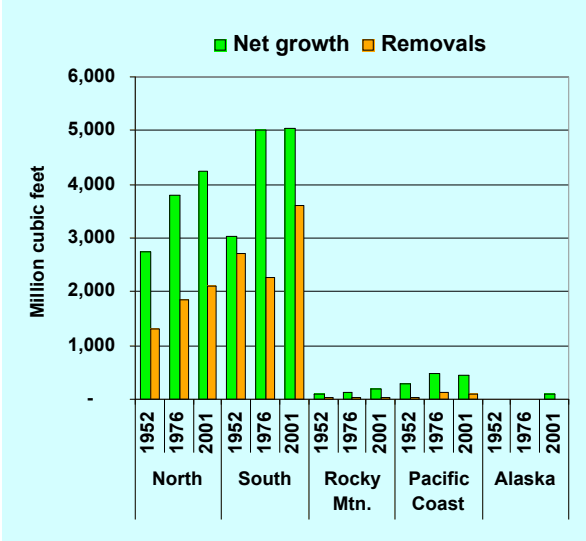

Figure 13-3. Net growth and removals of broadleaves in the United States, 1952–2001

While this situation is significant, major planting of conifer plantations in the South in the late 1980s and early 1990s are rapidly becoming of commercial size and are expected to offset this temporary imbalance. Nearly 3 million acres of new plantations were established as part of the Conservation Reserve Program during that period. Current growth measures in the South do not reflect anticipated growth on these plantations which will reach merchantable size over the next decade (see indicator 12).

Is there a way to measure sustainable levels of growth? Based on site productivity data measured during field inventories, an estimate can be made of the productive potential of U.S. forests and how they relate to the current situation. This measure provides and estimate of the productive capacity of forests based on maximum growth at the culmination of mean annual increment. That is, if the overall objective of management was to maximize fiber production and stands were harvested at this point, what would the productivity of the forest be? Figure 13-4 shows the relationship between estimated potential growth, current growth and the current level of removals.

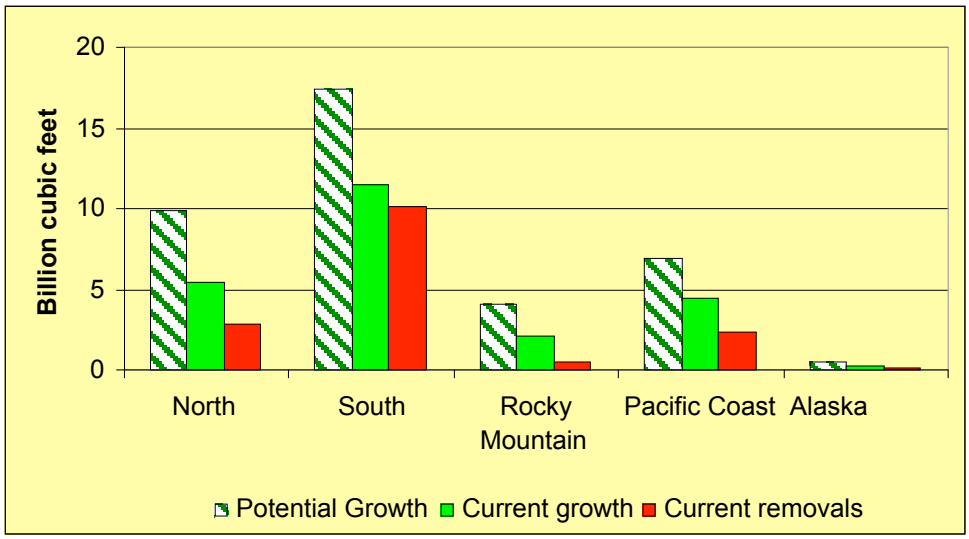

Figure 13-4. Potential and current growth and removals on timber land by region, 2001

Overall, U.S. forests are growing at 23.7 billion cubic feet per year with a potential of 38.7 billion cubic feet. The South and Pacific Coast have both achieved about two-thirds of their estimated potential. The North and Rocky Mountain regions are at about half. Clearly there is capacity to sustain present levels of timber harvest.

There are many reasons why these potentials may not be achieved. The main reason is that the diverse objectives of the managers of these lands may not have fiber maximization as primary objective. However, the existence of forest plans does not necessarily guarantee that annual removals of wood products are sustainable—this would depend in part on plan objectives, the skill of planners, and the realization of assumptions necessary in the plan. Thus, even if there were to be a plan for all forest land in the United States, this would not guarantee balance.

Given the coarse scale of this analysis, if growth on timber land compared with removals is acceptable as a measure of sustainable removal of wood products, then removals of wood products in the United States are currently sustainable. For certain it indicates that we are not consuming our base of growing stock volume that continues to increase. This measure, however, conveys no information about quality, biodiversity, other attributes of ecology, or management objectives and should be considered in conjunction with other indicators to monitor the sustainability of a specific species or resource characteristic and should be evaluated in conjunction with other measures in other criterion as part of an analysis of overall objectives for forest ecosystem sustainability.

Impact of forest ownership

Surveys of public ownerships may provide some information about removals relative to sustainable volume. However, the political economy for determining this volume has changed in the last two decades and plans may be out of date. Many forest industry ownerships have specified objectives and have the capability to determine sustainable

levels of timber harvest. A survey of these ownerships might provide the desired information. Birch (1996) found that about 5 percent of private forest land owners had timber production as the primary goal, but no information was requested regarding removals and sustainable volume. In addition, ownership objectives can change quickly as owner needs change.

An alternative to surveys of private lands is to do modeling of the behavior of forest land owners regarding timber removals and forest inventories on this land. Models could be based on past behavior of forest land owners. No agency has the responsibility for determination of sustainable volumes of wood removals. The Forest Service has long had the capability to do modeling of markets for timber products and their interactions with the timber resource base. These models can be used to determine whether growth exceeds harvest for the two private ownerships of forest industry and other private.

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Indicator 14. Annual removal of nontimber forest products compared to the level determined to be sustainable

This indicator compares actual removal of nontimber products against the level of removal permitted by forest management plans as a measure of the forest's ability to maintain its productive capacity over time. Posts and poles, pilings and firewood, are excluded from this indicator and may be found in Indicator 13 (wood fiber).

Refer to APPENDIX Tables 39-40

Nontimber forest products (NTFPs) include many plants, lichens, and fungi from forests, including understory species used in floral markets, for seasonal greenery, wild foods, medicinals, plant extracts, and transplants. Game animals in U.S. forests are an important source of food to many people. Plants and animals with a long tradition of use provide people with an identity that contrasts with trends toward mass production and uniformity. Harvesters, biologists, and the general public have expressed concerns about the commercial harvest of NTFPs, particularly those for which little formal biological information exists. Domestication for many extractive products may mean improved conservation of the natural resources by reducing pressure on stocks. Domestication of many native species in the United States has been quite successful, such as cranberries (*Vaccinium* spp.) and pecans (*Carya illinoensis*), both grown agriculturally on a large scale. Domestication of other species, such as ginseng (*Panax quinquefolius*) and goldenseal (*Hydrastis canadensis*) has been successful, but prices for wild product is still high enough to keep pressure on the wild resource.

National legislation does not explicitly state that nontimber forest products will be addressed in forest planning. However, among 32 eastern forest plans examined by Chamberlain and others (2002), seven addressed NTFPs to some extent. No national forest plan devoted more than 1 percent of its text to NTFPs.

Information about game animal and fur-bearer populations and harvest is collected by State and Federal agencies, but national information is not generally available for all species. Information about the variety of plants, lichen, and fungi being harvested, in what quantities, and the impact of harvest on sustainability is not well researched. Existing information is not well integrated across disciplines. There have been estimates, based on surveys or other means, of the scope of various segments of the NTFP industry, particularly in the Pacific Northwest. Permits and contracts for nontimber forest products are sold by the U.S. Department of the Interior, Bureau of Land Management (Table 39) and by the USDA Forest Service (Table 40). The Bureau of Land Management data does not extend further east than the intermountain region (Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico) because they have very little land holdings in the Midwest, East, or South. However, the permit sales data does give an excellent indication of demand for many of these resources.

We will discuss NTFP by several categories: 1) medicinals; 2) food and forage species; 3) floral and horticultural species; 4) resins and oils; 5) arts and crafts; 6) secondary wood products such as posts and poles; and 7) game animals and fur bearers. Tables 1 and 2 will be referred to throughout the discussions.

1. Medicinals

The popular use of medicinal plants has experienced an expansion in the past 20 years exceeding that of any other nontimber native flora. The awareness and consumption of medicinal plants by Americans has revived markets for plants that had wide use in the nineteenth century, such as goldenseal; expanded markets for plants with formerly small markets, such as osha (*Ligusticum porteri*); and encouraged the development of new markets for species with little or no past history of use, such as Chamisso arnica (*Arnica chamissonis*). Interest in medicinal plants is evidenced by the sales of permits for native species such as bay leaves (wax-myrtle, *Myrica* spp.), cascara bark (*Rhamnus purshiana* DC), elderberries (*Sambucus* spp. L), and prince's pine (*Chimaphila* spp.) by the Bureau of Land Management in the Pacific Northwest (Table 39). The Forest Service sells permits for herbs (Table 40) but does not list species. Both agencies allow collection of small amounts of medicinals for personal use, with and without permits, depending on the species and the location.

Medicinal herbal products and plants have been and are big business in the United States, and demand for them has prompted protective measures. Many major herbal products important historically in the United States are mentioned in legislative laws in many States, including American ginseng, goldenseal, cascara, St. Johnswort (*Hypericum perforatum*), and Sitka valerian (*Valeriana sitchensis* Bong.) (Alexander and others 2002). Some are concerned that the increasing demand will increase pressure on harvesters to supply large volumes to brokers (von Hagen and Fight 1999). Others see opportunities for value-added processing by independent entrepreneurs (Mater 1994). One of the critically endangered species within its small range in the United States is peyote (*Lophophora wiiliamsii*), a native cactus with psychoactive properties used in religious ceremonies of the Native American Church. Some species used in flower essences are rare, threatened, or endangered, federally or in the States where people produce flower essences. The California pitcher plant (*Darlingtonia californica*) and Humbolt's lily (*Lilium humboldtii*) are both protected species used for flower essences. Actual impacts from flower essence production on native species are difficult to monitor or assess. Consumer awareness of choices and impacts has critical implications for sustainability, product purity issues, equity and social issues, and many other concerns. Species used in the industry differ considerably in their cultural and geographic origins, current areas of production, their current availability, and the product forms in which they arrive at the marketplace (Alexander and others 2002).

2. Food and forage species

Foods from native species provide a very small share of the food species consumed by Americans, but are often culturally significant. Wild foods are becoming increasingly popular in restaurants. The most popular native fruits in the United States are species of berry genera also found in Europe, for example, *Ribes*, *Rubus*, and *Vaccinium*. Although information on domestic wild berry trade is not generally available, several species are harvested for domestic use, including huckleberries (*Vaccinium* spp.) and blackberries (*Rubus* spp.). Huckleberries and blueberries are the most frequently harvested wild berries in forest landscapes, important to indigenous people and to other local communities, for personal consumption, as gifts, and for sale. Other foods harvested from U.S. forests include black walnuts (*Juglans* spp.), wild rice (*Zizania aquatica*), ramps (*Allium* spp.), and various ferns, tubers, and roots. A number of fungal species are harvested on U.S. forest lands; Table 39 includes specific species data for Bureau of Land Management lands, and illustrates the harvest of chanterelles (*Cantharellus* spp.), morels (*Morchella* spp.), and American matsutake (*Tricholoma magnivelare*). Pinyon pine (*Pinus* spp.) nuts are harvested in the intermountain region. Permits for nuts and seed, mushrooms, fungi, and fruit and berries were issued by the Bureau of Land Management (Table 39) and the Forest Service (Table 40).

Most categories in the United States Harmonized Tariff Code (HTC) system identifiable to species or to species groups refer to food. Of all the native fruit products explicitly named in the HTC codes, blueberries (*Vaccinium* spp.) have the largest number of classifications. Wild blueberry exports have a long tradition, particularly wild blueberries harvested in the northeastern United States. Forest lands in the Northeastern United States are often managed specifically for blueberry production (Chaney 1990). Regionally harvested foods that have been domesticated, and are now primarily cultivated, include cranberries (primarily *Vaccinium macrocarpon*), maple sugar and maple syrup (primarily *Acer saccharum*), and pecans. All are consumed domestically and exported. Since 1992, the value of maple product exports has exceeded $3 million annually. Most pecan production comes from cultivars grown in orchards. Export quantities climbed from 1.5 thousand to 8 thousand metric tons between 1989 and 1998. Small amounts of pinyon pine nuts (mostly *Pinus edulis* and *P. monophylla*) are exported, although most of the market is domestic. The flavor of pinyon pine nuts has international renown dating from the time of Spanish exploration, however, crops are unpredictable and labor costs are comparatively high in contrast to the major competitor nation, China. Traditional cultural uses by Southwest and California native peoples have the highest priority for use on Federal lands. Vanilla (*Vanilla planifolia*) is native to Florida and Puerto Rico. Domestic production is difficult to detect in U.S. export data (Alexander and others 2002).

Edible wild-growing mushrooms have wide and growing popularity, both in the United States and as exports. The most widely harvested wild edible mushrooms grow in forests, and include porcini (mostly king bolete, *Boletus edulis*), chanterelles, hedgehog mushroom (*Hydnum repandum*), Oregon white truffles (*Tuber gibbosum*), morels, American matsutake, and lobster mushrooms (*Hypomyces lactiflorum*). The biological aspects of commercial mushroom production have been explored by several studies (e.g., Norvell 1995; Pilz and others 1999). So far the conclusion is that yields fluctuate so widely that it is difficult to generalize, but estimates of productivity may be used to make local site-specific assessments of long-term productivity (Alexander and others, in press).

Forage grass species are particularly important to Federal and private land management in California and the Pacific Northwest, Rocky Mountain, and Southwest regions where grazing in or near forest environments is a major land use activity and where native range restoration is a goal. The Bureau of Land Management sells permits for feed and forage, allowing the harvest of hay for forage use or for other uses, such as seed collection (Table 39). The Forest Service sells permits for grass (Table 40). Common native grass species provide valuable forage for domesticated animals and wildlife species, and are used for range reclamation and restoration. Some species, such as buffalo grass (*Buchloe dactyloides*), are used as turf and lawn grasses. Native legumes are also commercially available, including milkvetches (*Astragalus* spp.), bundleflowers (*Desmanthus* spp.), and purple prairie clover (*Petalostemon purpureus*). Mesquite (*Prosopis* spp.) is important forage for animals in Texas and the Southwest. California is the second most important region evolutionarily for clover (*Trifolium* spp.) species diversity (Zohary and Heller 1984) after the Mediterranean Basin. Native clover species are very important in landscape restoration. Some commercial grass forage species such as Indian ricegrass (*Achnantherum hymenoides*) are traditional staple crops of Native Americans. Programs for seeding lands with native forage accomplish two important elements of Federal trust responsibilities to recognized Indian tribes: restoring ecosystems with traditional food species and providing high-quality forage for native game species such as buffalo and pronghorn antelope (Alexander and others 2002).

3. Floral and horticultural species

Native plants used for decorating homes and workplaces are as diverse as the decorative forms invented. Native plants from forests are used for Christmas trees, holiday greenery, accent materials, and fresh and preserved materials in floral designs.

Climate conditions provide the major divisions for availability of Christmas trees in various regions of the United States. True firs (*Abies* spp.), spruces (*Picea* spp.), pines (*Pinus* spp.), and Douglas-fir (*Pseudotsuga menziesii*) are the major Christmas trees in all regions except in California, the Southeast, and Florida. In California, redwood (*Sequoia sempervirens*) and giant sequoia (*Sequoiadendron*

giganteum) are major Christmas tree species. In the Southeast and Florida, Fraser fir (*Abies fraseri*) is probably the most important Christmas tree regionally. Also popular are white pine (*Pinus strobes*) and Norway spruce (*Picea abies*). Tradition and cultural use also influences Christmas tree use. Eastern red cedar is common as a Christmas tree only as far north as Virginia although the species ranges on the Atlantic seaboard north to southern Maine. People in interior Alaska are accustomed to harvesting black and white spruces (*Picea mariana* and *P. glauca*) for personal use from public lands without charge or regulation. In the Southwest, juniper Christmas trees cut on rangelands helped to reduce woodland encroachment. In the West, Midwest, and Northeast, public land managers also permit individuals to cut trees for personal use with no or minimal charge (Alexander and others 2002). Christmas tree harvest is a significant activity on public lands, and many species are harvested (Tables 1 and 2).

A tremendous variety of native plant, lichen, and moss species supply commercial foliage, stems, branches, fruits, and other vegetation for use in the winter holiday season and in the year-round floral industry. The harvest and use of native species has a strongly regional character, particularly for the species that people wildcraft. Species availability and use can change rapidly with changes in taste and with the introduction of new items to the marketplace.

Florida, the Southeast, and the Pacific Northwest are the major centers for the fresh floral industry, with many native nonconifer evergreen species available nearly year-round. The importance of public lands for many of these products can been seen by the variety, value, and number of permits sold by the Bureau of Land Management (Table 39) and Forest Service (Table 40) for transplants, limbs and boughs, foliage, cones, moss, and cacti. American, Dutch, and German firms are present in Florida and California. Firms in Florida ship foliage products from both the Pacific Northwest and the Southeast to European markets. Pacific Northwest firms ship agriculturally grown or wildcrafted foliage species from the region. California, Florida, Minnesota, Oregon, Pennsylvania, and Texas are major centers for the dried foliage industry in the United States. This market supplies mainly domestic consumers as export markets emphasize fresh materials. Salal (*Gualtheria shallon*), beargrass (*Xerophyllum tenax*), and iron fern (*Rumohra adiantiformis*), all in the fresh foliage market, are widely available in the United States as preserved materials. The NTFP industry has been in existence in the Pacific Northwest since the early 1900s, and in the East and South for much longer. The industry will likely remain an important component of regional economies for years to come, although individual product markets will increase or decrease from year to year depending on changing market conditions and resource availability (Alexander and others 2002).

Since 1992, the value of moss and lichen exports has been increasing steadily. Most of the increase has been taking place in customs districts in the Pacific Northwest and New York. Although at least $13 million worth of moss and lichen was exported from the Pacific Northwest in 1998, the amount of biomass cannot be

estimated from the HTC data (Alexander and others 2002). Permits for moss and bryophytes from Bureau of Land Management lands in Oregon and Washington included tree moss, sheet moss (moss that can be lifted from surfaces in large sheets), and lichens; harvesters bought permits for a total of 133,647 pounds in 2000 (Table 39). The Forest Service also sold permits for moss (Table 40).

4. Resins and oils

This section synthesizes current information on plant and lichen species native to the United States and its territories used as fragrances and flavors. Products derived from native plant species fall into several broad categories. Industrial chemists use aromatic plant compounds in air fresheners, bath products, diffusers, hair- and skin-care products, inhalants, massage oils, and perfumes. Food flavorists also use many of these same essential oils to flavor foods or to impart a combination of fragrance or flavor to pharmaceuticals. A few species native to the United States have a long tradition of commercial industrial uses as fragrances and have international markets: eastern arborvitae (*Thuja occidentalis*) and eastern red cedar, for example. Other species such as wintergreen (*Gaultheria procumbens*) and sassafras (*Sassafras albidum*), although native to North America, are increasingly grown commercially in other countries, in particular China and Vietnam. Many other species native to the United States and its territories are no longer produced commercially because costs of labor and production are prohibitive to commercialization (Bauer and others 1997). Certain common species such as balsam fir (*Abies balsamea*) are still wildcrafted in the Northeast and the North Central States. A partial list of species native to the United States used for essential oil production in North America includes balsam fir, sweet birch (*Betula lenta*), alligator juniper (*Juniperus deppeana*), eastern red cedar, Labrador-tea (*Ledum groenlandicum*), black spruce, eastern white pine (*Pinus strobes*), goldenrod (*Solidago canadensis*), northern white-cedar (*Thuja occidentalis*), and eastern hemlock (*Tsuga canadensis*). The range of species currently used in the perfume industry is narrow, particularly when only North American species are considered. By contrast, resins and oils are important NTFPs in the United States. Moerman (1998) provides a comprehensive summary of native plant species used as fragrances and incense that have subsistence and cultural importance. Conservation of many of these species is important for land managers and landowners, especially in areas that comprise ceded lands or customary use lands as defined in treaties between the U.S. Government and sovereign Indian tribes.

5. Arts and crafts

The use of nontimber forest products in arts and crafts is an integral part of innumerable traditions in the United States. From Native American use of bark, feathers, fur, willow and branches in baskets, masks, traditional and ceremonial dress, to dollmaking and baskets in the Appalachians, to furniture, birdhouses, bowls and other well-known and admired Shaker products, the plants and animals used are as varied as the products created. Many sources have documented the use of nontimber forest products in arts and crafts (e.g., Emery 1998; de Geus 1995).

The demand for permits for cones, burls, hobby wood, small alder sticks and bark from public lands (Tables 1 and 2) attest to the popularity of many craft and hobby activities. An internet search yields innumerable sites for basket weaving, basket making supplies, crafts, and cane chairs, to name a few products. Although many of the plant materials used in arts and crafts come from India and the Philippines, there are products in the United States that are unequalled anywhere else in the world, such as the pine cones from sugar pine (*Pinus lambertiana*) and western white pine (*Pinus monticola*). The arts and crafts markets have experienced great increases in demand. As many of the products are created in rural communities and are bartered or sold without records, information about these markets has not been summarized. In addition, the diversity of products makes these markets difficult to track as a group. It should be acknowledged, however, that these are significant products that contribute in important ways to household economies and have important meaning across U.S. cultures (Alexander 2002).

6. Secondary wood products

The demand for most types of wood products is covered in other Indicators. However, Table 39 gives a glimpse into the demand for many types of wood products that are not always obvious when data are summed for all types of wood and fuel use. Fuel wood is a significant resource gathered from public lands. Permits for fuel wood sold by the Bureau of Land Management are important in all western States that have Bureau of Land Management lands, from Alaska to New Mexico. Poles are another significant category, from small poles to house logs. Many people rely of public lands as a source of fuel wood, and many small businesses survive on the harvest and sale of posts and poles. The Forest Service is also an important source of fuel wood, posts, and poles in many communities.

7. Game animals and fur bearers

Ecosystems in the United States support some of the most diverse temperate forests, warm deserts, and shallow-water wetlands found in the world (Ricketts and others 1999). The composition and configuration of wildlife habitat is fundamentally affected by land use activities. Changes in land use affect changes in wildlife populations and harvests. Land use changes most likely to significantly affect wildlife populations and harvests include the increase in urban and built-up land, the retirement of cropland acreage into the Cropland Reserve Program, changes in forest successional stages, the extensive loss of grassland habitats, and the continued loss of wetland habitats. Based on these changes, Flather and others (1999) expect increase in species that tolerate intensive land use activities, increases in species associated with agricultural habitats, decreases in species associated with grasslands and early successional stages of forest habitats (especially in the north), and general declines in species dependent on wetlands.

Following Flather and others (1999), this discussion will address game animals and fur bearers by major species categories, including: big game, small game, migratory game birds, and furbearers.

Big game: Big game are primarily large mammal species taken for sport or subsistence. Wild turkeys (*Meleagris gallopavo*) are included in this category. Wildlife conservation has focused on these species and many are now highlighted as wildlife management successes. Nationally, estimates of big game populations have increased substantially since 1975, including wild turkeys, deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and black bear (*Ursus americana*). Exceptions to the pattern include deer in the West, wild turkey in the Rocky Mountains, and pronghorn (*Antelocapra americana*) in the South. Some of these population numbers are, however, difficult to interpret (Flather and others 1999). Big game contribute significantly to rural economies through recreational harvests, but overabundant populations of some species can carry significant economic and ecological costs.

Over the past 20 years, harvests of common big game species have tended to parallel population trends. The harvest rate has varied from about 10 percent for black bear to nearly 20 percent for elk. Nearly 90 percent of deer harvested came from the North and South regions. Harvest rates are lower than population growth for elk in the Pacific Coast region, for bear in the Rocky Mountains, and for pronghorn in the South. This divergence between harvest and population growth may be due to public sentiment about harvest of some species, reduced access to private lands, or reduced participation in hunting activities. These factors may also affect the ability of wildlife managers to control excessive populations of game animals in certain areas (Flather and others 1999).

Since 1955, trends in wildlife-oriented recreation activities have been monitored by the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Participation in big game hunting has increased in every survey period since 1955. Both the number of hunters and the time devoted to hunting has increased. More days are spent hunting big game than any other category of hunting (Flather and others 1999).

Small game: The number of small game hunters has declined at a nearly constant rate since the mid-1970s. Based on data from States that can provide both population and harvest data for small game, about 15 to 20 percent of the small game population is harvested each year, ranging from a low of about 3 percent for hare (*Lepus* spp.) to a high of 31 percent for ring-necked pheasant (*Phasianus colchicus*). Few States can provide both population and harvest estimates, so the relation between harvest and population trends is difficult to estimate. Flather and others (1999) provide extensive detail on specific species.

Migratory game birds: From 1975 to 1996, there was a steady decline in the number of migratory bird hunters. The most recent survey indicates participation in migratory bird hunting may be increasing. “Migratory game birds” refers to a collection of species that include waterfowl and webless migratory species, such as

American woodcock (*Scolopax minor*) and mourning dove (*Zenaida macroura*). Conservation and management is the responsibility of Federal agencies. The primary objective of treaties the United States has with Canada, Mexico, Japan, and the Soviet Union is the protection and conservation of migratory birds. Harvesting in a manner consistent with conservation is a secondary objective. The history of monitoring migratory birds in North America has resulted in the most extensive and reliable estimates of population and harvest in the world (Nichols and others 1995). Population and harvest trends are published annually by the U.S. Fish and Wildlife Service. Flather and others (1999) again provide extensive detail on specific species.

Furbearers: The national trend in fur harvests has declined from a peak of 20 million pelts in 1980 to a low of 3 million pelts in 1991. Since 1991 there has been a modest increase in fur harvest, reaching 6 million pelts in 1995. Muskrat (*Ondatra zibethicus*) and raccoon (*Procyon lotor*) are the two most commonly harvested species. Although furs harvested by trapping remain an important source of pelts, most pelts are produced by fur farms that primarily raise mink (*Mustela vison*) and fox (various spp.). From 1987 to 1990, trapped mink dropped from 8 percent of the total harvest to about 4 percent. To sell into Europe, the fur industry must continuously demonstrate compliance with the humane trapping standards adopted by the European Economic Community. State populations of most furbearers (beaver (*Castor canadensis*), raccoon, muskrat, coyote (*Canis latrans*), bobcat (*Lynx rufus*)/lynx (*L. canadensis*), and red fox (*Vulpes vulpes*)/gray fox (*Urocyon cinereoargenteus*)) were estimated to be at or above carrying capacity. Several species have the capacity to cause significant economic damage (e.g., beaver, coyote) or can be a public health concern (e.g., raccoon) when populations exceed carrying capacity. Few States report furbearer populations below carrying capacity. Many biologists project populations to continue to increase unless there are disease outbreaks, due to improving habitat conditions and low fur prices (Flather and others 1999).

Annual or periodic harvest of NTFPs is largely undocumented, particularly on private forest lands, although it is understood that such activity has impacted forest ecosystems. And, in general, the meaning of productive capacity for nontimber forest products is unclear and species sensitivity to management and harvest is largely unknown.

Current approaches include analysis and summaries of Bureau of Land Management permit data, industry surveys, Forest Service Timber Sale Accounting System cut and sold reports, Harmonized Tariff Code data, State and Federal game harvest information and biological population function estimates, and other data sources and analysis at regional or local levels. Although for some industries, locations, and specific species these analyses may be comprehensive, that majority are incomplete and do not fully represent the range of products. Prominent data gaps include personal use and removals from private lands.

HR2466 Sec. 339, part of the fiscal year 2000 appropriations budget, is titled "Pilot Program of Charges and Fees for Harvest of Forest Botanical Products." The law defines botanical products as florals, mushrooms, and the like removed from Federal forests (excluding wood products), defines "fair market value," and requires that permit fees be based on a determination of "fair market value" and sustainable harvest levels. This law is having a considerable impact on the development of appraisal methods and on commercial nontimber forest product harvesting on Federal lands. Proposed Codified Federal Regulations (CFRs) for HR2466 Sec. 339 will be published in the Federal Register in spring 2002.

Options need to be developed to address what data gaps exist and how to remedy them. Clearance surveys required prior to on-the-ground implementation of projects could be expanded to include NTFP species. Stakeholder involvement should be sought to reduce data collection costs and share ownership in results.

Given that management plans are inadequate for determining sustainability and given the lack of information on annual removal, CTC 4 recommended:

- Compiling existing life history information on NTFPs and providing easy access for potential users.
- Developing life history information for those NTFPs without such data and focusing on high priority species first.
- Choosing several key NTFPs based on ecological sensitivity or economic/social importance and developing pilot studies to measure both biologically and socially sustainable levels of harvest using the concepts of population biology, social science, economics, and ecology. One goal of the studies would be to address protocol transfer and use for other NTFPs. The pilots would seek to examine sustainability at regional levels and develop ways to summarize them at the national level. Some studies like these are underway; one example is an effort to develop collaborative management and profit sharing in Washington with an agreement between the landowner and an organized group of harvesters. Another is an ongoing study of salal ecology and response to harvest in Washington.
- Changing Forest Inventory and Analysis (FIA) data collection based on current studies.
- Developing protocols for determining sustainability for many NTFP species for groups of related species, life forms, or products.

Problems related to scientific, socials/political, economic, and institutional concerns.

General Scientific:

- Need to determine how to answer questions at the regional level since sustainability is both culturally and biophysical dependent.
- Need to recognize vulnerability and viability of particular NTFPs – both socially and biologically.
- Need to determine national level of harvest and sustainable level for products.

- Need to regularly collected data on harvest amount (commercial, personal use, cultural and traditional use).
- Need a protocol for determining sustainability.
- NTFP species cover every phylum; thus it is hard to make generalizations about suggested inventory and monitoring protocols, regional or national harvest suggestions, land management to optimize production of all species, and so on.
- Need to create unit measures of variability (e.g., weight, volume, counts, etc).
- Need a method to measure annual variation in production of NTFPs.

Social/Political:

- NTFPs are a large contributor to household economies and income, for which almost no data are collected.
- Recognize the vulnerability and viability of particular NTFPs – both socially and biologically.
- Access issues and harvest tenure rights have been getting more attention lately; these issues need further exploration.

Economic:

- Funds are needed for data collection and pilot studies and for consolidating NTFP data for all U.S. forests into a national database.
- Significant data gaps need to be filled for adequate measurement of this indicator.
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Institutional:

- Historically, NTFPs have not been a very high administrative priority of Federal/State agencies. Recent Federal law (HR2466 Sec. 339) means more attention will be focused on Federal public lands.
- Fiduciary trust responsibility for tribes. The Federal Government has trust (fiduciary; i.e., regulated by statute, legislation, legal precedent, or treaty) responsibilities to Native Americans that include the provision of access and rights to NTFPs.

Despite the lack of national quantified information across all categories of nontimber forest products, removal of nontimber forest products from forest ecosystems is a significant and very important activity for many Americans, for recreational, commercial, subsistence, and cultural uses. There is a pressing need to recognize the vulnerability and also the viability of particular nontimber forest products, both socially and biologically. It is important to recognize that the significant gaps for this indicator will take large amounts of time, effort, and dollars to fill.

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APPENDIX A

UNITED STATES
2003 Report on Sustainable Forests

CHAPTER 2

DATA TABLES

Criterion 2

MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

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September 2002