



Chapter 3

Forest biological diversity

OVERVIEW

Biological diversity encompasses the variety of existing life forms, the ecological roles they perform and the genetic diversity they contain (FAO, 1989). In forests, biological diversity allows species to evolve and dynamically adapt to changing environmental conditions (including climate), to maintain the potential for tree breeding and improvement (to meet human needs for goods and services, and changing end-use requirements) and to support their ecosystem functions.

While timber production often dominated the way in which forests were managed in the twentieth century, new pressures in the twenty-first century demand a more balanced approach that provides multiple goods and services. Progress towards sustainable forest management is now considered consistent with the conservation of biological diversity.

Assessing, monitoring and reporting on biological diversity are important activities aimed at guiding sustainable forest management. Monitoring of biological diversity – and the changes caused by forestry and other practices – is important in assessing the effectiveness of management and the cumulative changes brought about by forest use. However, there are conceptual and practical difficulties in measuring it. These are not unique to biological diversity *per se*, but are general inventory problems for variables in which target parameters are complex and highly variable.

Assessments of biological diversity can be made at a range of different scales that require different methodologies. These scales include ecosystems, landscapes, species, populations, individuals and genes. Varying and complex interactions exist among all these levels.

Because biological diversity encompasses the complexity of all life forms, assessment and monitoring are only possible for specific aspects or particular, defined goals. There is no single, objective measure of biological diversity, only proxy measures appropriate for specific and, by necessity, restricted purposes. Species richness, for example, has a very wide natural variation from boreal to tropical forests.

For policy and monitoring purposes, it is the change in biological diversity that is important, which implies identifying the relevant indicators and then monitoring them over time. So far this has not been achieved for forest ecosystems on a wide scale (i.e. national or continental). Most local forest inventories are conducted to estimate forest area and harvestable volumes of wood and sometimes NWFPs, rather than to monitor biological diversity. There is an immediate need to categorize – and substantially improve the understanding of – biological diversity with a view to measuring trends, particularly on regional scales.

In recent years, the Global Forest Resources Assessment has increased its focus on forest biological diversity. For FRA 2000, data were compiled on the proportion of forests in protected areas. Relevant information was compiled at the landscape and species levels for FRA 2005, while some structural and compositional aspects were also addressed. At the ecosystem level, for FRA 2005 countries provided information on the area of forests and, more specifically, on the area of primary forests and on forests designated for the conservation of biological diversity (including protected areas). At the species level, for FRA 2005 FAO focused on the assessment of the number of both native and endangered forest tree species at the country level. In addition, country

reports included lists of the ten most common tree species (measured by their share of total growing stock), thus providing important information on the tree species composition of forests.

The variables measured for FRA 2010 with relevance to forest biological diversity include:

- area of primary forests;
- forest area designated primarily for conservation of biological diversity;
- area of forests in protected areas;
- tree species composition of forests.

Although the second and third variables above are similar, the area of forest designated for the conservation of biological diversity is not necessarily equivalent to the area of forest in protected areas. This is because some protected areas may be designated for reasons other than the conservation of biological diversity, such as the protection of soil and water resources, or cultural heritage. At the same time, forests may be designated and managed primarily for the conservation of biological diversity without forming part of a protected area network.

In addition to the variables related to forest biological diversity presented and analysed here, Chapter 2 provides information on trends in the characteristics of forests – including the extent of selected forest types; Chapter 4 contains information on woody invasive species; and Chapter 5 presents an analysis of the use of introduced species in planted forests.

A study on the state of the world's forest genetic resources is currently underway and, once completed, will help fill an important information gap (see Box 3.1).

KEY FINDINGS

Primary forests account for 36 percent of forest area – but have decreased by more than 40 million hectares since 2000

Globally, more than one-third of all forest is classified as primary forest. This is defined as forest of native species where there are no clearly visible indications of human activities and the ecological processes have not been significantly disturbed. Primary forests, in particular tropical moist forests, include some of the world's most species-rich, diverse terrestrial ecosystems. The area of primary forest decreased by about 0.4 percent annually over the last ten years, largely as a result of the reclassification of primary forest to 'other naturally regenerated forest' because of selective logging and other human interventions.

Twelve percent of the world's forests are designated primarily for the conservation of biological diversity

The area of forest where conservation of biological diversity is designated as the primary function has increased by more than 95 million hectares since 1990, of which the largest part (46 percent) was designated between 2000 and 2005. These forests now account for 12 percent of the total forest area or more than 460 million hectares. Most, but not all, of them are located inside protected areas.

Legally established protected areas cover an estimated 13 percent of the world's forests

National parks, game reserves, wilderness areas and legally established protected areas cover more than 10 percent of the total forest area in most countries and regions. The primary function of these forests may be the conservation of biological diversity, the protection of soil and water resources, or the conservation of cultural heritage. The area of forest within protected area systems has increased by 94 million hectares since 1990. Two-thirds of this increase has been since 2000.

Analysis of data on growing stock composition can provide proxy indicators of forest tree species richness and relative abundance

This is useful for qualitative assessment and monitoring of biological diversity. While the growing stock of the ten most common tree species represents more than 90 percent of the total growing stock in many countries in the temperate and boreal zone, it represents less than 20 percent of total growing stock in tropical countries with high species diversity. The availability and comparability of information remains poor, however.

KEY CONCLUSIONS

Data collected for FRA 2010 show a continued positive trend in efforts to conserve forest biological diversity, as measured by quantitative indicators such as the area of forest designated primarily for the conservation of biological diversity and the area of forest in protected areas, which are both steadily increasing. However, the area of primary forest continues to decline.

Although information on growing stock composition is a useful proxy indicator of species richness and abundance, other indicators need to be determined or tested for use in qualitative assessments, which are necessary to monitor forest biological diversity. The preparation of the first report on *The State of the World's Forest Genetic Resources* (see Box 3.1) should contribute to the definition of additional indicators for monitoring forest biological diversity and the effectiveness of conservation measures.

BOX 3.1

Reporting on the *State of the World's Forest Genetic Resources*

Genetic diversity provides the fundamental basis for the evolution of forest tree species and for their adaptation to change. Conserving forest genetic resources is therefore vital, as they are a unique and irreplaceable resource for the future.

Forest genetic resources management can be effective only if treated as an integral element of overall sustainable forest management. Conservation concerns should be integrated into broader national and local development programmes, such as national forest programmes, rural development plans and poverty reduction strategies, which promote cooperation among sectors.

However, there is no consolidated global picture on the status and trends of forest genetic resources, and estimates of the rate of genetic diversity loss are lacking. This limits the capacity of countries and the international community to integrate forest genetic resources management into overall cross-cutting policies. It is recognized that reliable general data on forest status and trends are of great importance for the efficient management of forest genetic resources. Forest-related information, however, largely refers to forest resources in general rather than to forest diversity and variation. The availability of specific information on the status and trends in forest genetic resources is currently woefully inadequate.

The Commission on Genetic Resources for Food and Agriculture of FAO acknowledged the urgency of conserving and sustainably utilizing forest genetic resources. With the support of the Committee on Forestry, the Commission requested that a *State of the World's Forest Genetic Resources* report be prepared and presented to the Commission in 2013. The preparation of such a report was welcomed by the ninth meeting of the Conference of the Parties to the CBD.

The *State of the World's Forest Genetic Resources* will be prepared through a country-driven approach based on country reports and thematic studies. The Global Forest Resources Assessment process will serve as a model, and the two processes will be linked.

AREA OF PRIMARY FORESTS

Introduction

Information on total forest area, forest characteristics and the change in these over time is presented in Chapter 2, Extent of Forest Resources. This section focuses on primary forests, which are defined in FRA 2010 as forests of native species, in which there are no clearly visible indications of human activity and the ecological processes have not been significantly disturbed.

Primary forests are often equated with high levels of biological diversity, but this is not always the case. In the boreal zones and the arid tropics, for example, they can be poor in terms of numbers of plant and animal species, while some modified natural forests and forests interspersed with agricultural areas may provide additional habitats and thus harbour more species. Nevertheless, the size of the area of primary forest is an important indicator of the state of forest ecosystems.

It should also be kept in mind that primary forests fulfil many essential functions other than the conservation of biological diversity, such as protection of soil and water resources, carbon sequestration and the provision of aesthetic, cultural and religious values.

Status

Of the 233 countries and areas reporting for FRA 2010, 200 countries, accounting for 94 percent of total forest area, reported on the area of primary forest. Globally, close to 1.4 billion hectares, were classified as primary forest, which represents over one-third (36 percent) of total forest area of the reporting countries. However, information was missing for many of the smaller islands and territories, as well as for countries such as Cameroon and the Democratic Republic of the Congo (two of the largest countries in the Congo Basin, the second largest expanse of tropical forest) and for the Bolivarian Republic of Venezuela, so the actual area is probably slightly higher. Several countries reported that they had insufficient information on the area of primary forests, so they included it in the category of other naturally regenerated forests. Others used

TABLE 3.1
Area of primary forest by region and subregion, 2010

Region/subregion	Information availability		Area of primary forest		Regional distribution
	Number of countries	% of total forest area	1 000 ha	%	%
Eastern and Southern Africa	23	100.0	6 430	2.4	0.5
Northern Africa	8	100.0	13 990	17.8	1.0
Western and Central Africa	23	46.9	27 527	17.9	2.0
Total Africa	54	74.2	47 947	9.6	3.5
East Asia	5	100.0	25 268	9.9	1.9
South and Southeast Asia	17	100.0	81 235	27.6	6.0
Western and Central Asia	23	96.9	3 201	7.6	0.2
Total Asia	45	99.8	109 705	18.6	8.1
Europe excl. Russian Federation	42	97.7	5 438	2.8	0.4
Total Europe	43	99.6	261 920	26.2	19.3
Caribbean	16	70.4	205	4.2	n.s.
Central America	7	100.0	4 482	23.0	0.3
North America	5	100.0	275 035	40.5	20.2
Total North and Central America	28	99.7	279 722	39.8	20.6
Total Oceania	17	99.7	35 493	18.6	2.6
Total South America	13	94.6	624 077	76.3	45.9
World	200	94.3	1 358 864	35.7	100.0

the current area of forests in national parks and other protected areas as a proxy value or provided an expert estimate of the percentage of natural forests that could be considered primary according to the FRA 2010 definition.

There is great variation in the distribution of primary forests. At the regional level, the largest expanse is found in South America (624 million hectares), followed by North and Central America, and Europe (almost all in the Russian Federation) (see Table 3.1). Limited areas are reported by some countries of the Caribbean, Europe (excluding the Russian Federation) and the arid zones of Eastern and Southern Africa, Northern Africa and Western and Central Asia. A relatively high proportion of forests in Central Africa, North and Central America and the Russian Federation have been classified as primary.

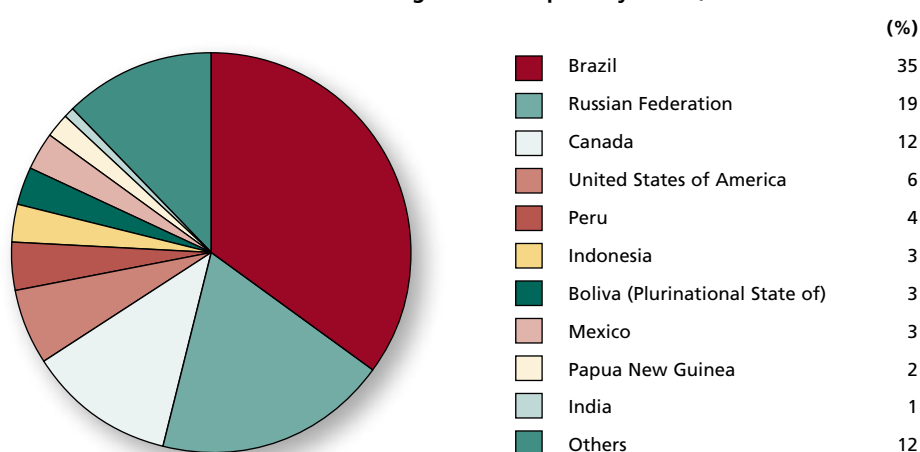
The ten countries with the largest areas of primary forest account for 88 percent of the total area of primary forest in the world (see Figure 3.1). However, as discussed above, information is missing from some of the large tropical countries, which might otherwise fall within the top ten countries. Primary forest makes up at least 50 percent of the total forest area in 19 countries, and seven countries have classified more than 75 percent of their forests as primary (Table 3.2 and Figure 3.2).

Of the 200 reporting countries and areas, 81 countries, mostly in Europe and the arid zones of Africa and Western Asia, as well as SIDS, reported that they have no primary forests left. In some cases, this may be due to a lack of data rather than a complete lack of primary forest, as for example in Finland.

Trends

A trend analysis was generated based on 198 countries accounting for 74 percent of the total forest area¹⁴. Of these, 184 countries provided data for all four years (1990, 2000, 2005 and 2010), including those reporting that they had no primary forest. Information was missing for eight countries for 1990 (Ecuador, Estonia, Guyana,

FIGURE 3.1
Ten countries with the largest area of primary forest, 2010

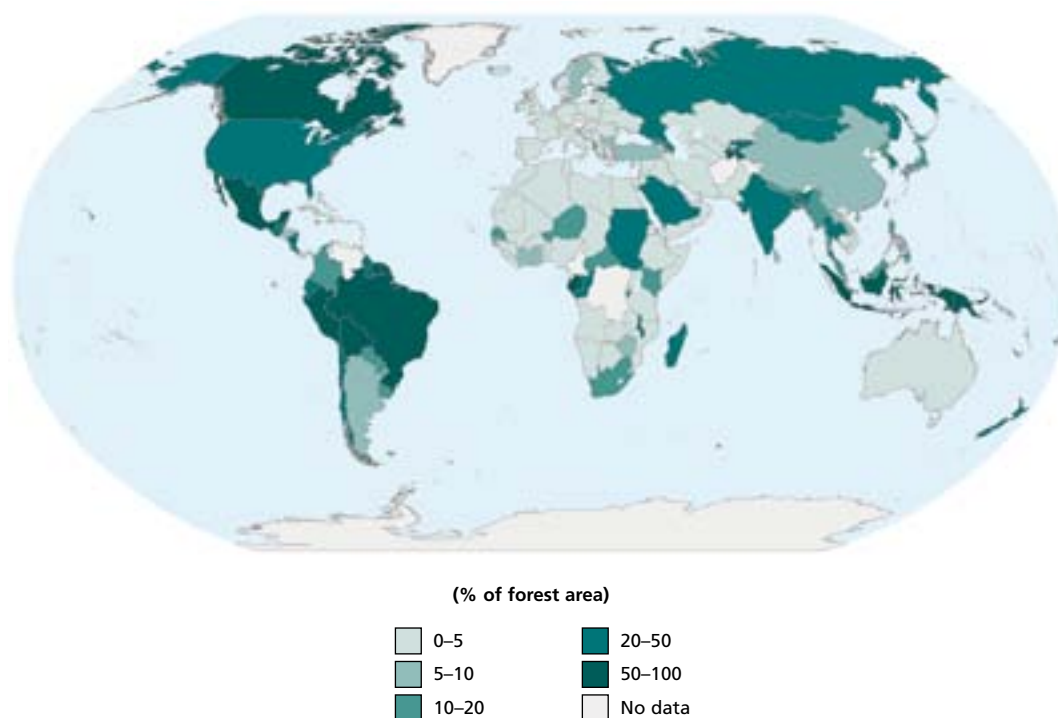


¹⁴ Although information was provided for all four reporting years, the Russian Federation was excluded from this analysis because there was a large difference in the reported change rate (from +1.6 million hectares per year in the 1990s to -0.5 million hectares per year in the period 2000–2005). This is the result of a modification to the classification system introduced in 1995 rather than actual changes in primary forest area.

TABLE 3.2
Ten countries with the highest percentage of primary forest, 2010

Country/area	Primary forest as % of total forest	Area of forest (1 000 ha)	Area of primary forest (1 000 ha)
Singapore	100	2	2
French Guiana	95	8 082	7 690
Suriname	95	14 758	14 001
Brazil	92	519 522	476 573
Papua New Guinea	91	28 726	26 210
Peru	89	67 992	60 178
Micronesia (Federated States of)	75	64	48
Tajikistan	72	410	297
Brunei Darussalam	69	380	263
Gabon	65	22 000	14 334

FIGURE 3.2
Primary forest as a percentage of total forest area by country, 2010



Indonesia, Portugal, Republic of Korea, Saint Vincent and the Grenadines, and Samoa), and for seven additional countries (Australia, French Polynesia, Honduras, Jordan, Lebanon, New Zealand and Nicaragua) data were missing for both 1990 and 2000. Estimates were made for these countries using the same trend reported for 2000–2005 and 2005–2010 respectively. One country (Niue) only provided an estimate for 2010 and was excluded from the analysis. While filling these gaps gives a better idea of the trend over time, it probably underestimates the actual loss of primary forest, especially for the 1990s.

At the global level the area of primary forest decreased by around 4.7 million hectares per year in the 1990s, and by 4.2 million hectares per year between 2000 and 2010. This loss, which equates to 0.4 percent of the area of primary forest annually

over the ten-year period, is largely due to the reclassification of primary forest to other categories of forest because of selective logging and other human interventions during this period. However, information is still insufficient to determine precisely what proportion of the decrease in primary forest is due to deforestation and what is due to a reclassification to one of the two other categories: 'other naturally regenerated forests' and 'planted forests'.

South America accounted for the largest proportion of the net loss, followed by Africa and Asia. The rate of loss is stable or decreasing in all regions except Oceania, where it is increasing (primarily as a result of a higher reported loss from Papua New Guinea for the period 2005–2010); and in Europe, and North and Central America which registered a net gain (Table 3.3).¹⁵

At the subregional level, the loss of primary forests in Eastern and Southern Africa has increased slightly, primarily due to an increased rate of loss reported by Madagascar. In Northern Africa a significant reduction in the rate of loss is reported by Sudan, while in Western and Central Africa, a slight decrease in the rate of loss reported by Gabon and Nigeria influence the subregional totals.

Overall, the rate of loss of primary forest decreased in East Asia. The Republic of Korea reported the largest loss in this subregion. In contrast, Japan is increasing its net gain (see below) and Mongolia reported a decrease in its net loss. In South and Southeast Asia, Indonesia reported the largest loss of primary forest, but did not provide an estimate for 1990; the annual net loss for the 1990s was therefore assumed to be the same as in 2000–2005 for the purpose of Table 3.3 and is likely to be an underestimate. Over the period 2000–2010, Indonesia reported a significant reduction in the average annual area lost in the five years 2005–2010, compared with 2000–2005.

TABLE 3.3
Trends in area of primary forest by region and subregion, 1990–2010

Region/subregion	Information availability		Area of primary forest (1 000 ha)			Annual change (1 000 ha)		Annual change rate (%)	
	Number of countries	% of total forest area	1990	2000	2010	1990–2000	2000–2010	1990–2000	2000–2010
Eastern and Southern Africa	23	100.0	7 594	7 024	6 430	-57	-59	-0.78	-0.88
Northern Africa	8	100.0	15 276	14 098	13 990	-118	-11	-0.80	-0.08
Western and Central Africa	23	46.9	37 737	32 540	27 527	-520	-501	-1.47	-1.66
Total Africa	54	74.2	60 607	53 662	47 947	-695	-572	-1.21	-1.12
East Asia	5	100.0	28 179	26 456	25 268	-172	-119	-0.63	-0.46
South and Southeast Asia	17	100.0	87 062	83 587	81 235	-348	-235	-0.41	-0.29
Western and Central Asia	23	96.9	2 924	3 083	3 201	16	12	0.53	0.38
Total Asia	45	99.8	118 166	113 127	109 705	-504	-342	-0.43	-0.31
Total Europe	42	19.1	5 183	5 360	5 438	18	8	0.34	0.14
Caribbean	16	70.4	207	206	205	n.s.	n.s.	-0.07	-0.02
Central America	7	100.0	5 766	5 226	4 482	-54	-74	-0.98	-1.52
North America	5	100.0	274 920	273 795	275 035	-113	124	-0.04	0.05
Total North and Central America	28	99.7	280 893	279 227	279 722	-167	50	-0.06	0.02
Total Oceania	16	99.7	41 416	39 191	35 493	-222	-370	-0.55	-0.99
Total South America	13	94.6	684 654	653 691	624 077	-3 096	-2 961	-0.46	-0.46
World	198	74.3	1 190 919	1 144 258	1 102 382	-4 666	-4 188	-0.40	-0.37

¹⁵ A gain in primary forest can occur when forest areas that were previously not classified as undisturbed are designated as areas in which no intervention should take place. With time, these areas evolve into forests that meet the definition of primary as used in the FRA process.

In Western and Central Asia, Turkey reported an increase in the area of primary forests – based on the area of forests in protected areas – while most other countries reported no primary forests, no data or no significant change.

In Europe (excluding the Russian Federation) an increase in the area of primary forest was reported by Bulgaria, Denmark, Lithuania, Poland and Slovenia, while Estonia and Latvia reported a slight decrease. All other countries reported no – or no significant – change.

In the Caribbean only the larger islands reported that they had areas of primary forest and there was no significant change in the total area. In Central America, Guatemala reported the largest area of primary forest and was the only country that reported a change in this area – with the loss in the last decade larger than in the 1990s. In North America, Mexico reported a decreasing rate of loss, while the United States of America reported an increasing rate of net gain of primary forest.

Australia did not report on the area of primary forest in 1990 and 2000, so for the purpose of Table 3.3, the change rate for the whole period was assumed to be the same as for 2005–2010. Papua New Guinea, which reported the largest area of primary forest in the region, also reported the largest loss of primary forest for the period, particularly in the last decade.

In South America, Brazil reported both the largest area and the largest loss; however, the rate of loss has decreased in the last decade from an average of 2.8 million hectares per year in the 1990s to 2.3 million hectares annually in 2005–2010. Peru and Bolivia also reported a significant loss of primary forests. This loss peaked in the period 2000–2005 in Peru and increased in Bolivia in the last decade compared with the 1990s.

The five countries reporting the largest decrease in primary forest over the last 20 years were Brazil, Gabon, Mexico, Papua New Guinea and Indonesia. A number of countries registered positive change rates in the area of primary forests, including several European countries, the United States of America and Japan. In most of these cases, countries have been setting aside natural forest areas in which no intervention should take place. With time, these areas evolve into forests in which there are no clearly visible indications of human activity and the ecological processes are not significantly disturbed, meeting the definition of primary forests used in FRA 2010. For example, Japan and some of the European countries classified all natural forests over a certain age or size, as well as all forests in inaccessible areas, as primary forests – in some cases only if no interventions had been conducted over a certain time period. The United States of America reported the largest net gain in primary forest of more than 200 000 ha per year, which was primarily the result of an increase in the area of forest in protected areas.

Conclusions

While globally more than one-third of total forest area is classified as primary forest, this area has decreased by more than 40 million hectares over the last ten years. Although there have been improvements in the availability of data on primary forests since the last global assessment, many countries still rely on proxies such as the area within national parks and other protected areas. Furthermore, information is still insufficient to determine what proportion of the decrease in primary forest is due to deforestation and what is due to a reclassification to one of the two other categories: ‘other naturally regenerated forests’ and ‘planted forests’.

FOREST AREA DESIGNATED FOR CONSERVATION OF BIOLOGICAL DIVERSITY

Introduction

The designation and management of land for conservation is a key part of ongoing global efforts to conserve biological diversity. The amount of land on which the conservation of biological diversity is the primary function is therefore an important

indicator of progress, and monitoring of this variable provides valuable information for conservation practitioners.

The forest area designated primarily for conservation of biological diversity is not necessarily equivalent to the area of forest in protected areas because some forests in protected areas may be designated for reasons other than the conservation of biological diversity, such as the conservation of soil and water resources or cultural heritage. Conversely, forest areas may be designated for the conservation of biodiversity without forming part of a protected area network or system.

Status

Of the 233 countries and areas reporting for FRA 2010, 205 countries and areas, representing 99.9 percent of the total forest area, provided information on forest area designated primarily for the conservation of biological diversity. The availability of information has improved compared with the last assessment (FRA 2005), when only 172 countries reported on this variable. This is particularly noticeable in Western and Central Africa, where all 24 countries provided data (compared with only 15 for FRA 2005). The availability of information for FRA 2010 was low only in the Caribbean.

These data show that, globally, 463 million hectares of forest, or 11.5 percent of the total forest area of the reporting countries, are designated for the conservation of biological diversity as the primary function (see Table 3.4 and Figure 3.3).

The largest area of forest designated for conservation of biological diversity is found in South America (116 million hectares), followed by North America and Africa. Central America and South and Southeast Asia have the highest percentage of forests designated primarily for conservation, while Europe (including the Russian Federation), and Western and Central Asia have the lowest.

Trends

Data for all four reporting years (1990, 2000, 2005 and 2010) was provided by 186 countries, representing 86.9 percent of the total forest area (see Table 3.5).

TABLE 3.4
Area of forest designated for conservation of biodiversity by region and subregion, 2010

Region/subregion	Information availability		Area designated for conservation of biodiversity	
	Number of countries	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	23	100.0	27 821	10.4
Northern Africa	7	99.1	12 769	16.3
Western and Central Africa	24	100.0	51 939	15.8
Total Africa	54	99.9	92 529	13.7
East Asia	5	100.0	14 889	5.8
South and Southeast Asia	17	100.0	60 846	20.7
Western and Central Asia	24	100.0	2 778	6.4
Total Asia	46	100.0	78 513	13.3
Europe excl. Russian Federation	45	100.0	19 578	10.0
Total Europe	46	100.0	37 150	3.7
Caribbean	12	53.8	717	19.2
Central America	7	100.0	9 203	47.2
North America	5	100.0	99 049	14.6
Total North and Central America	24	99.5	108 969	15.5
Total Oceania	21	99.8	30 640	16.0
Total South America	14	100.0	115 613	13.4
World	205	99.9	463 415	11.5

FIGURE 3.3
Proportion of forest area designated for conservation of biodiversity by country, 2010

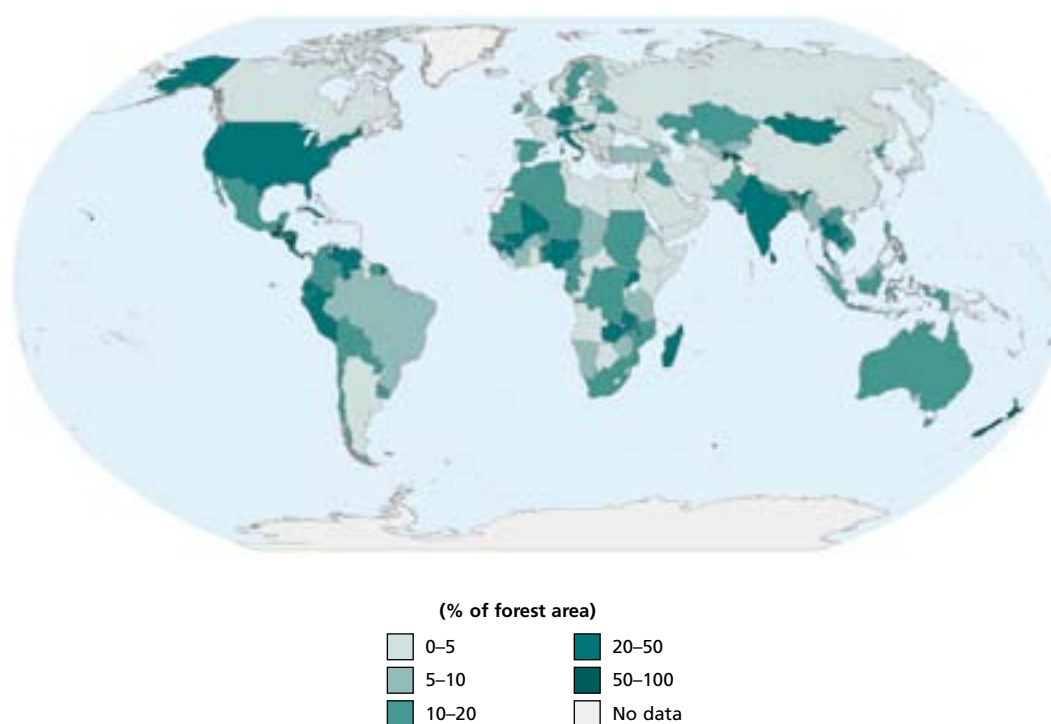
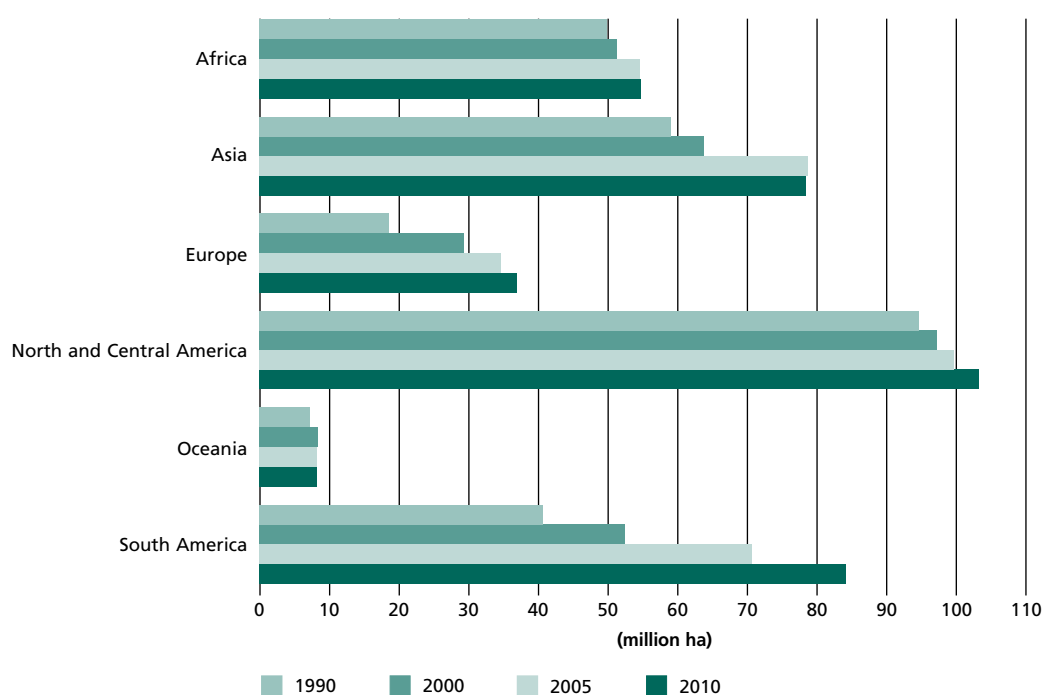


TABLE 3.5
Trends in area of forest designated for conservation of biodiversity by region and subregion, 1990–2010

Region/subregion	Information availability		Area of forest designated for conservation of biodiversity (1 000 ha)				Annual change (1 000 ha)		Annual change rate (%)	
	Number of countries	% of total forest area	1990	2000	2005	2010	1990–2000	2000–2010	1990–2000	2000–2010
Eastern and Southern Africa	21	80.9	14 467	15 539	17 176	17 064	107	153	0.72	0.94
Northern Africa	7	99.1	13 325	12 597	12 677	12 769	-73	17	-0.56	0.14
Western and Central Africa	22	52.5	22 135	23 215	24 791	25 039	108	182	0.48	0.76
Total Africa	50	69.2	49 927	51 351	54 644	54 873	142	352	0.28	0.67
East Asia	4	90.2	10 167	10 798	13 737	14 889	63	409	0.60	3.26
South and Southeast Asia	17	100.0	47 312	51 005	62 254	60 846	369	984	0.75	1.78
Western and Central Asia	23	99.7	1 710	2 095	2 775	2 775	39	68	2.05	2.85
Total Asia	44	95.8	59 188	63 898	78 766	78 510	471	1 461	0.77	2.08
Europe excl. Russian Federation	44	98.2	6 840	13 203	18 240	19 407	636	620	6.80	3.93
Total Europe	45	99.7	18 655	29 393	34 728	36 979	1 074	759	4.65	2.32
Caribbean	11	53.1	617	671	696	711	5	4	0.85	0.58
Central America	3	36.9	4 337	4 023	3 841	3 677	-31	-35	-0.75	-0.90
North America	5	100.0	89 811	92 619	95 316	99 049	281	643	0.31	0.67
Total North and Central America	19	97.8	94 765	97 314	99 853	103 437	255	612	0.27	0.61
Total Oceania	18	21.6	7 196	8 412	8 334	8 234	122	-18	1.57	-0.21
Total South America	10	85.1	40 683	52 548	70 804	84 222	1 187	3 167	2.59	4.83
World	186	86.9	270 413	302 916	347 129	366 255	3 250	6 334	1.14	1.92

FIGURE 3.4
Trends in area of forest designated for conservation of biodiversity by region, 1990–2010



The area of forest designated for the conservation of biological diversity has increased by more than 95 million hectares, or 30 percent, since 1990, of which the largest part was designated between 2000 and 2005. This trend is apparent in all regions and subregions except Northern Africa and Central America. The highest rates of increase are seen in South America (mainly due to recent conservation measures in Brazil) and Europe.

The period 2005–2010 shows a contrasting trend in some subregions however, with a decrease in South and Southeast Asia (mainly in Myanmar) and Eastern and Southern Africa, possibly correlated to the loss of forest area in these subregions. Figure 3.4 illustrates the evolution of the area of forest designated primarily for the conservation of biological diversity between 1990 and 2010 in different regions.

Conclusions

The area of forest where conservation of biological diversity is designated as the primary function has increased by more than 95 million hectares since 1990, of which the largest part (46 percent) was designated between 2000 and 2005. These forests now account for 12 percent of the total forest area or more than 460 million hectares.

AREA OF FOREST IN PROTECTED AREAS

Introduction

The legal designation of areas as national parks, wildlife reserves or other protected area categories has a long tradition and forests were included in some of the first of these. The World Database on Protected Areas (<http://www.wdpa.org/Default.aspx>) contains information on all nationally designated and internationally recognized protected areas. According to the latest information (WDPA, 2010), an estimated 12.9 percent of the global terrestrial area (excluding Antarctica) is located in protected areas.

As part of FRA 2010, countries were asked to provide information on the area of forest contained in protected areas systems. This is not an easy task where spatially explicit information is missing or outdated since not all protected areas are fully forested. However, most of the large, forest-rich countries did provide this information for all four reporting years. Where expert estimates or assumptions were necessary, these are clearly described in the individual country reports.

Status

Data on the area of forest in protected areas were provided by 135 countries, representing 91 percent of the total forest area. Information availability was relatively low in Western and Central Asia, the Caribbean, Central America and South America. The total area of forest in protected areas is 460 million hectares, representing 12.5 percent of the total forest area in reporting countries (Table 3.6 and Figure 3.5). Asia recorded the highest area of forest in protected areas (126 million hectares), followed by South America and Africa. Central America and South and Southeast Asia have the highest percentage of their forest area in protected areas, while Europe reported the lowest proportion of the forest area as protected area (4 percent). However, when excluding the vast forests of the Russian Federation, the percentage increases to 12.3 – similar to the world average.

A comparison of the percentage of forest in protected areas reported in FRA 2000 with the percentage of forest designated primarily for the conservation of biological diversity in FRA 2005, showed no significant difference. This observation led to the hypothesis that the similarity between the total figures for the two variables observed in FRA 2010 (460 million hectares in protected areas and 463 million hectares designated for conservation of biological diversity) would seem to indicate that countries were using the area of forest in protected areas as a proxy for the area of forest designated primarily for conservation of biological diversity.

TABLE 3.6
Area of forest in protected areas by region and subregion, 2010

Region/subregion	Information availability		Area of forest in protected areas	
	Number of countries	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	18	87.1	27 492	11.8
Northern Africa	5	98.5	13 986	18.0
Western and Central Africa	20	94.1	41 707	13.5
Total Africa	43	91.8	83 185	13.4
East Asia	4	97.6	43 752	17.6
South and Southeast Asia	11	88.5	80 303	30.8
Western and Central Asia	11	46.7	1 447	7.1
Total Asia	26	89.3	125 502	23.7
Europe excl. Russian Federation	35	93.4	22 475	12.3
Total Europe	36	98.7	40 047	4.0
Caribbean	9	50.4	779	22.3
Central America	4	60.7	6 501	54.9
North America	4	100.0	63 572	9.4
Total North and Central America	17	98.4	70 852	10.2
Total Oceania	7	99.1	30 640	16.2
Total South America	6	74.6	109 806	17.0
World	135	91.0	460 032	12.5

However, detailed comparison of the data showed that this was not systematically the case (see Tables 3.4 and 3.6). In some regions the reported area of forest in protected areas is slightly lower than the area of forest designated primarily for the conservation of biological diversity. In other regions, such as Asia (and in particular China, Indonesia, Malaysia and Thailand), the area of forest in protected areas is much higher than the area of forest designated for the conservation of biological diversity. This is an encouraging indication that some countries – and possibly a growing number – could make the distinction between the two variables. This would enhance the accuracy with which efforts to conserve biological diversity could be assessed.

Trends

A total of 109 countries (representing 78 percent of the total forest area) provided the full sequence of data on the area of forests in protected areas over time (see Table 3.7).

FIGURE 3.5
Percentage of forest area in protected areas by region, 2010

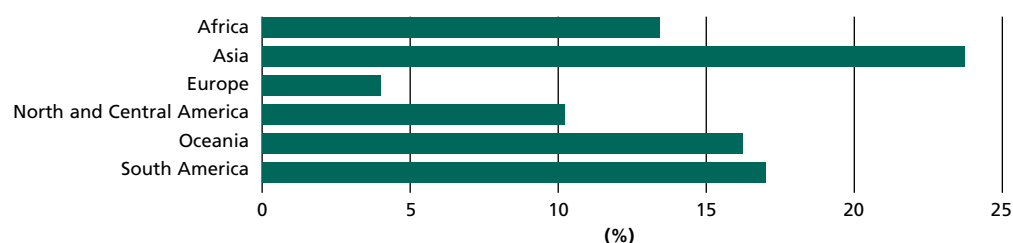


TABLE 3.7
Trends in area of forest in protected areas by region and subregion, 1990–2010

Region/subregion	Information availability		Area of forest in protected areas (1 000 ha)				Annual change (1 000 ha)		Annual change rate (%)	
	Number of countries	% of total forest area	1990	2000	2005	2010	1990–2000	2000–2010	1990–2000	2000–2010
Eastern and Southern Africa	17	86.6	24 786	25 863	27 524	27 437	108	157	0.43	0.59
Northern Africa	4	9.8	306	320	443	640	1	32	0.45	7.18
Western and Central Africa	18	47.0	20 330	21 748	22 206	25 401	142	365	0.68	1.56
Total Africa	39	58.4	45 421	47 931	50 173	53 478	251	555	0.54	1.10
East Asia	3	87.7	11 847	23 463	29 320	30 603	1 162	714	7.07	2.69
South and Southeast Asia	11	88.5	71 584	72 637	83 620	80 303	105	767	0.15	1.01
Western and Central Asia	8	38.0	306	559	799	781	25	22	6.23	3.39
Total Asia	22	84.5	83 737	96 660	113 739	111 687	1 292	1 503	1.45	1.46
Europe excl. Russian Federation	26	79.2	7 475	12 212	14 808	16 386	474	417	5.03	2.98
Total Europe	27	95.9	19 289	28 402	31 296	33 959	911	556	3.94	1.80
Caribbean	8	49.7	477	537	636	777	6	24	1.19	3.76
Central America	2	18.1	2 217	2 214	2 165	2 148	n.s.	-7	-0.01	-0.30
North America	4	100.0	47 356	50 135	56 338	63 572	278	1 344	0.57	2.40
Total North and Central America	14	97.2	50 050	52 886	59 139	66 497	284	1 361	0.55	2.32
Total Oceania	4	16.7	617	617	617	405	0	-21	0.00	-4.12
Total South America	3	65.4	67 368	70 384	83 190	94 693	302	2 431	0.44	3.01
World	109	77.9	266 482	296 879	338 155	360 718	3 040	6 384	1.09	1.97

This area increased steadily between 1990 and 2010, by more than 94 million hectares. While this is a general trend in all regions, poor availability of data for the full sequence does not permit a detailed assessment in those subregions showing a negative trend.

Conclusions

National parks, game reserves, wilderness areas and other legally established protected areas cover approximately 13 percent of the world's forest area and more than 10 percent of the total forest area in most countries and regions. The primary function of these forests may be the conservation of biological diversity, the protection of soil and water resources or the conservation of cultural heritage. The area of forest within protected area systems has increased by 94 million hectares since 1990. Two-thirds of this increase has been since 2000.

TREE SPECIES COMPOSITION

Introduction

Information on growing stock composition can be used as a proxy indicator of forest tree species richness and relative abundance. The percentage of growing stock represented by a given number of tree species is expected to be inversely correlated to tree species richness (and the number of tree species present in the area). Countries were requested to list the ten most common species in terms of growing stock and document their contribution to total growing stock for 1990, 2000 and 2005. Information was also obtained on the area of planted forests primarily composed of introduced species. The analysis of this data is found in Chapter 5.

To supplement this information, efforts are currently underway to solicit further details on the state of the world's forest genetic resources (see Box 3.1).

Status and trends

Information on the species represented in growing stock remains poor. For FRA 2010 only 79 countries (together representing 61 percent of the total forest area) provided data on the ten most common species (2005 data). The subregions with the highest response rates were East Asia, Europe, North America, Northern Africa and South and Southeast Asia (Table 3.8).

While the growing stock of the ten most common species represents more than 90 percent of the total growing stock in many countries in the temperate and boreal zone, it represents less than 20 percent of the total growing stock in tropical countries with high species diversity, such as the reporting countries from Western and Central Africa.

Data comparability is still an issue as indicated by the range of figures for each subregion (Table 3.8 and Figure 3.6). Some countries only have data on growing stock of commercial species with a merchantable diameter (e.g. Equatorial Guinea), others have data only for part of the country (e.g. Malaysia and United Republic of Tanzania) or have grouped some species (e.g. Guatemala and Poland). In addition, there is wide natural spread within some subregions – particularly when composed of both large, species-rich countries and small island states (e.g. Eastern and Southern Africa).

Comparison of the 1990 and 2005 data did not show significant changes in the relative ranking of the tree species, or in the share of growing stock occupied by the ten main species.

Conclusion

The analysis indicates that data on growing stock composition might provide reliable proxy indicators for tree species richness and relative abundance at a given time. This observation should be confirmed as comparable data become available from a larger number of countries.

TABLE 3.8
Growing stock of the ten most common species as a percentage of total growing stock by region and subregion, 2005

Region/subregion	Information availability		Growing stock of 10 most common species		
	Number of countries	% of total forest area	million m ³	% of total growing stock	
				Weighted average	Range
Eastern and Southern Africa	7	59.7	3 363	37	21–100
Northern Africa	2	95.3	476	41	31–90
Western and Central Africa	6	18.6	1661	18	10–89
Total Africa	15	43.8	5 500	28	10–100
East Asia	2	82.4	8 183	58	57–86
South and Southeast Asia	10	88.4	10 837	39	18–74
Western and Central Asia	9	51.3	2 354	99	82–100
Total Asia	21	83.2	21 374	48	18–100
Europe excl. Russian Federation	27	84.4	21 291	92	61–100
Total Europe	28	97.0	101 021	98	61–100
Caribbean	3	11.3	25	58	50–80
Central America	2	35.7	655	57	21–85
North America	2	90.3	42 116	55	43–70
Total North and Central America	7	88.0	42 795	55	21–85
Total Oceania	6	4.3	2 172	62	45–98
Total South America	2	10.1	4 046	55	49–65
World	79	61.0	176 908	69	10–100

FIGURE 3.6
Growing stock of the ten most common species as a percentage of total growing stock by country, 2005

