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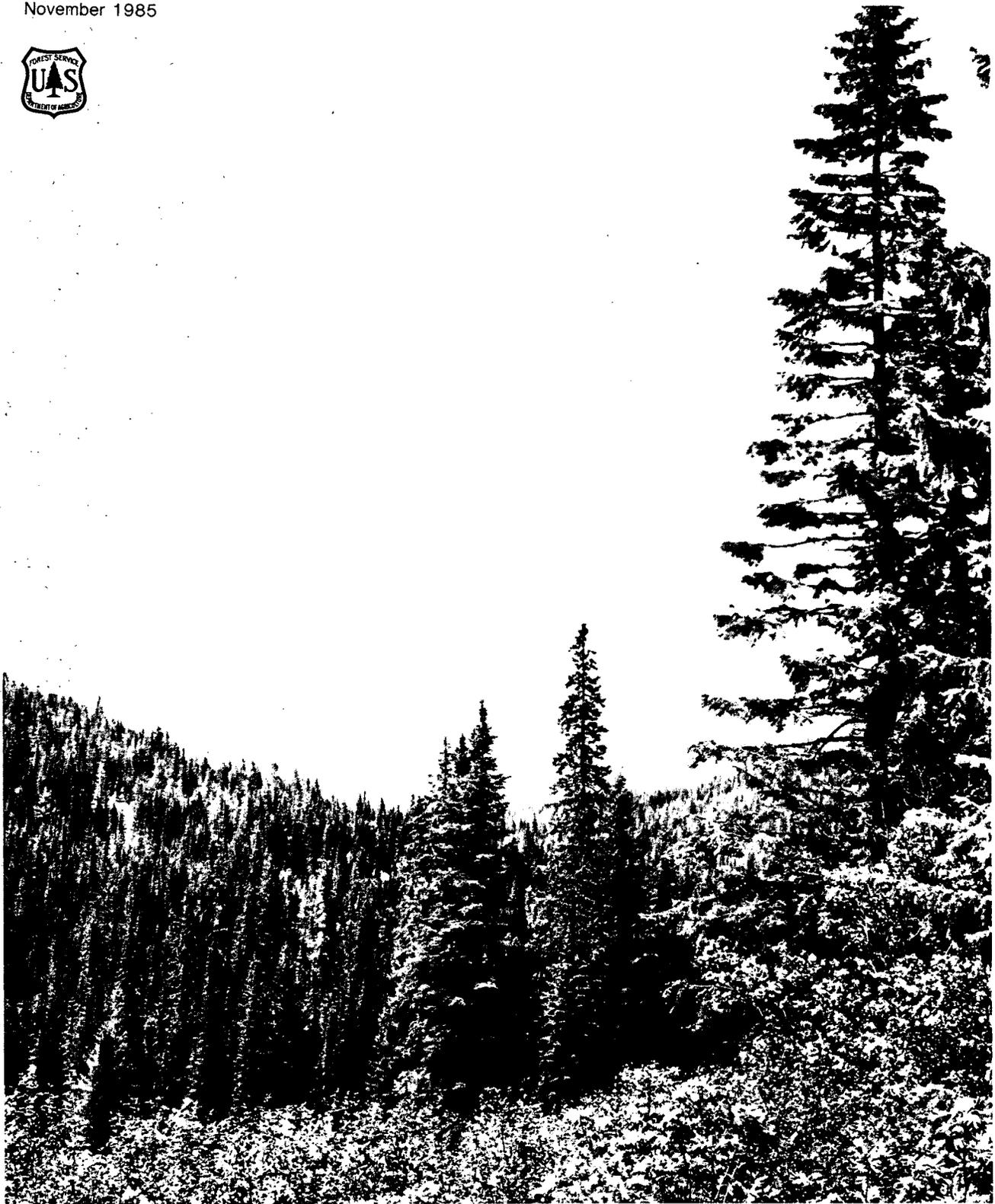
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Montana's Forests

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PREFACE

Forest Survey is a continuing nationwide undertaking conducted by the USDA Forest Service with the primary objective of providing an assessment of the renewable resources on the Nation's forest and range lands. This requires periodic State-by-State resource inventories. Originally, Forest Survey was authorized by the McSweeney-McNary Act of 1928. The current authorization is through the Renewable Resources Research Act of 1978.

The Intermountain Research Station with headquarters in Ogden, UT, administers the forest resource inventories for the Rocky Mountain States of Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Wyoming, western South Dakota, western Texas, and Oklahoma's Panhandle. These inventories provide information on the extent and condition of State and privately owned forest lands, volume of timber, and rates of timber growth and mortality. These data, when combined with similar information for Federal lands, provide a basis for forest policies and programs and for the orderly development and use of the resources.

ACKNOWLEDGMENTS

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RESEARCH SUMMARY

Presents highlights of the forest resources of Montana as of 1980. Describes the forest resources, their extent, condition, and location, and discusses levels of some nontimber use of forest lands. Includes statistical tables: area by land classes, ownership, growing stock and sawtimber volumes, growth, mortality, roundwood products output, utilization, and residues.

HIGHLIGHTS

Area

- Total land area in Montana is 93,048.4 thousand acres.
- Forests occupy 20,226 thousand acres.
- Area of commercial timberland is 13,571.3 thousand acres or 67 percent of the total forest land.
- Farmer and other private lands account for 3,048.9 thousand acres or 22 percent of the commercial timberland.
- National Forest lands account for 60 percent of commercial timberland.
- Forest industry has 1,601.3 thousand acres (12 percent), and other publics have 759.3 thousand acres (6 percent) of the commercial timberland.
- Douglas-fir is the predominant forest type, occupying slightly over a third of the commercial timberland.
- Douglas-fir, lodgepole pine, and ponderosa pine combined occupy 76 percent of the commercial timberland.
- These highlights do not include information on 2.9 million acres of Bureau of Land Management (BLM) land and 5.2 million acres of Indian land, a component of other private land.
- Of the commercial timberland, 40 percent is capable of producing at least 85 cubic feet of wood per acre per year.
- On the average, commercial timberland in Montana is currently producing 57 percent of its annual potential of 78 cubic feet per acre.
- Only 3 percent of the commercial timber on State and private land is old growth.
- Stands that are fully stocked with desirable trees occupy only about 20 percent of the commercial timberland on State and private land.

Inventory

- Including all ownerships, growing stock volume amounts to 26.2 billion cubic feet, and sawtimber volume totals 88.3 billion board feet (International).
- On State and private land, growing stock volume amounts to about 8 billion cubic feet, and sawtimber volume totals nearly 28 billion board feet (International).
- The most dominant single species—Douglas-fir—constitutes 35 percent of the cubic foot and 37 percent of the board foot volume on State and private land.
- Forest industry controls 42 percent of the growing stock and 45 percent of the sawtimber volumes on privately owned land.
- Of the sawtimber on commercial timberland, 60 percent is in trees less than 17 inches diameter at breast height.
- Net annual growth on commercial timberland in Montana was 490 million cubic feet in 1980.
- On private land in 1980, net annual growth totaled 142 million cubic feet or about a third of the total net growth of the State.
- Annual mortality of 107.6 million cubic feet in 1980 was about 18 percent of the gross annual growth in Montana.

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Montana's Forests

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INTRODUCTION

Although the forests were an integral part of Montana's settlement and early economic development, almost nothing was known about them until much later. Forest reserves had been established in the early 1900's and some National Forests proclaimed. Administration of Federal forest land was almost entirely a matter of maintenance, protection, surveying, and mapping.

In 1928 the McSweeney-McNary Act authorized and mandated a forest survey of forested lands in the United States. The first forest inventory of Montana began in 1934. Progress was slow. By the start of World War II only that part of the State west of the Continental Divide and four counties east of the Divide had been inventoried. Field work resumed in 1947 and the survey was completed in 1949.

The results of that survey were reported by Hutchison and Kemp (1952). The keen interest in the extent of the timber supply related to the expected postwar demands for timber products.

Between 1953 and 1958 the forests west of the Continental Divide were re-inventoried. But it was not until 1966 that the "east side" forests were looked at again. Pissot and Hanson (1963) reported on the "west side" forest inventory. The general concerns were the same—adequacy of timber supplies. There have been other reports and summaries of the various facets of Montana's forest economy, and all were concerned primarily with commercial output of wood products.

But in the early 1970's people began viewing Montana's forests as a complex of several resources having exceptional value in their own right. In 1975, Schweitzer and others updated a previous report and looked at the future economic prospects for the timber resource and industry. Also, they looked at the environmental aspects of both timber and nontimber use of the forests.

This current report presents the basic findings of the third forest inventory of State and privately owned lands in Montana. It contains basic data on forest area, timber volume, growth, and mortality statistics, and discusses some current situations and opportunities for increasing future timber supplies.

Comparing statistics from successive forest inventories is always tempting. Not particularly wise, but tempting. In this case, one has to realize more than 40 years have passed since the first inventory west of the Divide was completed. Changes in inventory techniques (sampling, design and intensity, measurement equipment) and changes in definitions and standards can lead such comparisons to some rather flimsy and unfounded conclusions.

But more importantly, at the time this report was prepared, there were no data for some 5.2 million acres of Indian lands (a component of "other private" owner groups) and about 2.9 million acres of Bureau of Land Management (BLM) lands, containing some 420 thousand acres of timberland in western Montana. However, data for the approximately 5.3 million acres of land

administered by BLM in eastern Montana, containing 67,600 acres of timberland, are included under the "other public" ownership groups.

The total area of Montana is 94.109 million acres, of which 93 million is land and 1.1 million water (table 1). In 1980 about 33.2 million acres (roughly 36 percent of the land area) was publicly owned.

Table 1.--Total land and water area in Montana by ownership class, 1980

Ownership class	Area
	<u>Thousand acres</u>
Land:	
National Forest	16,752.7
National Parks ¹	1,273.1
Other public:	
Bureau of Land Management	8,148.7
Miscellaneous Federal	1,319.0
State	5,563.3
County and municipal	114.8
Private:	
Forest industry ²	1,812.4
Farmer and other private	58,064.4
Total land area	<u>93,048.4</u>
Census water	<u>1,060.8</u>
Total land and water ³	<u>94,109.2</u>

¹Not included with miscellaneous Federal, a component of other public, for purposes of clarity.

²Forest industry is a component of private ownership, but because of its importance to the Montana timber supply situation, area and statistics for forest industry are shown separately in this and other tables dealing with owner groups in this report.

³U.S. Bureau of the Census, land and water area of the United States, 1980.

BRIEFLY HISTORICAL

When the Louisiana Purchase was consummated with France in 1803, few people knew much about the Northwest Territory. But fur trappers working for companies operating in Canada had filtered down and made deals with the Indians in the mid-1700's. Some trading posts had been set up at the mouth of the Columbia River.

In 1804 President Thomas Jefferson thought it a good idea to find the rumored waterway to the West Coast. If the waterway did exist, it would provide a great opportunity to expand trade, especially furs, and give the United States a better international image, which it needed.

Jefferson sent William Clark and Meriwether Lewis in search of the Northwest Passage. The details of their expedition are well documented. They did not find the great waterway, but they did make it to the mouth of the Columbia and over 2 years later were back in St. Louis. During their trek they spent

some 170 days in what is now Montana, documenting and mapping what they saw. As the Lewis and Clark journals were published, settlers began their own movement west—up the Missouri River from St. Louis or overland into the Northwest—to make a new life in the vastness of the “Big Sky.” The attraction was the green grass, farmland, abundant water, forests, and game.

As more settlers came, forts were built for protection from the Indians, and missions for protection from everything else. St. Mary’s Mission, established at Stevensville in 1841, was the first permanent white settlement in Montana.

By 1842 some Jesuit priests at the mission thought a sawmill would answer a need. They pounded flat the rim off a wagon wheel, cut teeth in it, and made a pit-saw setup.

The valleys in western Montana continued to accommodate the trickle of pilgrims from the East. The discovery of gold near Bannock in 1862 drew a big crowd. As the homesteaders followed the prospectors into Montana’s valleys, the need for lumber and structural timbers grew. By 1865 Montana had become a territory and the forests a prime resource for economic development, with both hand-powered and water-powered sawmills serving the communities’ and miners’ needs locally. Soon steam-driven mills were in place, and Montana’s forest products industry began.

THE FORESTS

Montana’s forests cover some 20.2 million acres, roughly 22 percent of the land area. Nearly 16 million acres are classed as productive timberland. The remainder is “other” forest land considered unproductive from the standpoint of growing and harvesting roundwood products usually associated with forest industries (table 2).

How Much Is There?

Over a fifth of the land area is forest.

Table 2.--Land area in Montana by land class, 1980

Land class	Total
	<u>Thousand acres</u>
Commercial timberland	13,571.3
Productive deferred	708.7
Productive reserved	1,561.7
Other forest land:	
Unproductive reserved	1,014.6
Unproductive nonreserved	3,369.7
Total forest land	20,226.0
Nonforest land	63,452.8
Total ¹	83,678.8

¹This report includes data for only 5.3 million acres of land (containing 67,600 acres of timberland) administered by BLM in eastern Montana. At the time this report was prepared there were no data available for the 2.9 million acres of BLM land (including 420,000 acres of timberland) in western Montana, or for any of the 5.2 million acres of Indian lands, a component of “other private” ownership category.

Some 2 million acres of public land is reserved from cutting.

Over 4 million acres of forest are unsuited for wood production.

Trends in Area

Early settlement and development exploited the timber resource.

The commercial timberland base is now 14 million acres.

About 2.3 million acres of productive timberland in public ownership is currently reserved from timber harvesting. Roughly 1.6 million acres have been set aside by administrative designation or through statutes. Much of the area is in the National Wilderness Preservation System. The remainder is in a "deferred" category; this means the areas are under study for possible inclusion into the wilderness system. (Definitions for other terms used in this report are in appendix I, "Terminology.")

The "other" forest land is considered unproductive either because of the tree species making up the stands or because of adverse site conditions that preclude any reasonable growth rate. In effect, you can't make a dollar trying to grow timber on it. That is not to say such land has no value for wildlife, grazing domestic livestock, watershed protection, or even some wood products.

Historical trends in forest area are difficult to track because of lack of good early historical data since Lewis and Clark trekked across Montana and back in the early 1800's. But we do know that the first non-Indian settlers cut trees and cleared land. Then the discovery of gold in the early 1860's created an almost instant demand for wood for the influx of miners, settlers, and attendant industries. Along with the forest land cleared for settlement, many forests were exploited for construction material, mine timbers, railroad ties, and charcoaling for ore reduction. Most areas cleared for these uses have reverted back to forest.

What has reduced is the area of productive forest land available for growing and harvesting industrial wood products—the "commercial timberland" base. In 1952 the estimated area of such land was about 16.7 million acres. It is currently estimated to be about 14.4 million acres (Green and Van Hooser 1983). A major reason for the decline—inclusion of publicly owned productive forest land into the Wilderness System or withdrawal in favor of uses that would preclude harvesting.

A more recent factor, and one that will continue into the future, is the subdivision of privately owned productive timberland into small parcels for home sites.

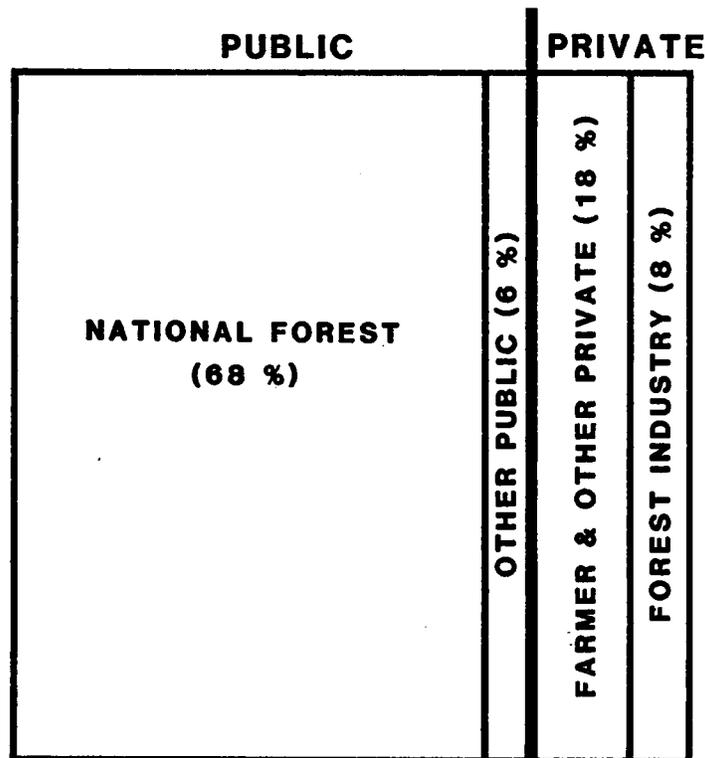
The future? It is doubtful the total area of forest land will change significantly. However, the allocation of forest land for various uses may change.

The Forest Owners

Three-fourths of the forest land is publicly owned . . .

Nearly three-fourths of Montana's forest land is publicly owned. Most of it is under the administration of Federal agencies. The Forest Service has the most. Its 13.8 million acres is 68 percent of the total and 93 percent of the publicly administered forest land.

Owner group	Area <i>Thousand acres</i>	Percent of total
Public		
Forest Service	13,817.2	68
Other public	1,053.4	6
Total	14,870.6	74
Private	5,355.4	26
Total	20,226.0	100



and most of it is on National Forests.

Farmers and other private owners have 70 per cent of the privately owned forest land.

Although the numbers change, the same general ownership pattern holds for the forest land classed as commercial timberland (table 3). Sixty-six percent is under public administration, mostly Federal.

Of the remainder under private ownerships (34 percent), over one-third is owned by forest industries, and almost two-thirds is owned by farmers or ranchers.

The significance of ownership of these lands lies in the rules and regulations governing their use and management. Private land owners can do almost anything they want on their own land. But all U.S. citizens, regardless of where they live, may have, if they choose, a say in how Montana's federally administered forests are used. Such public input to management planning affects the output of all resource uses of these important lands.

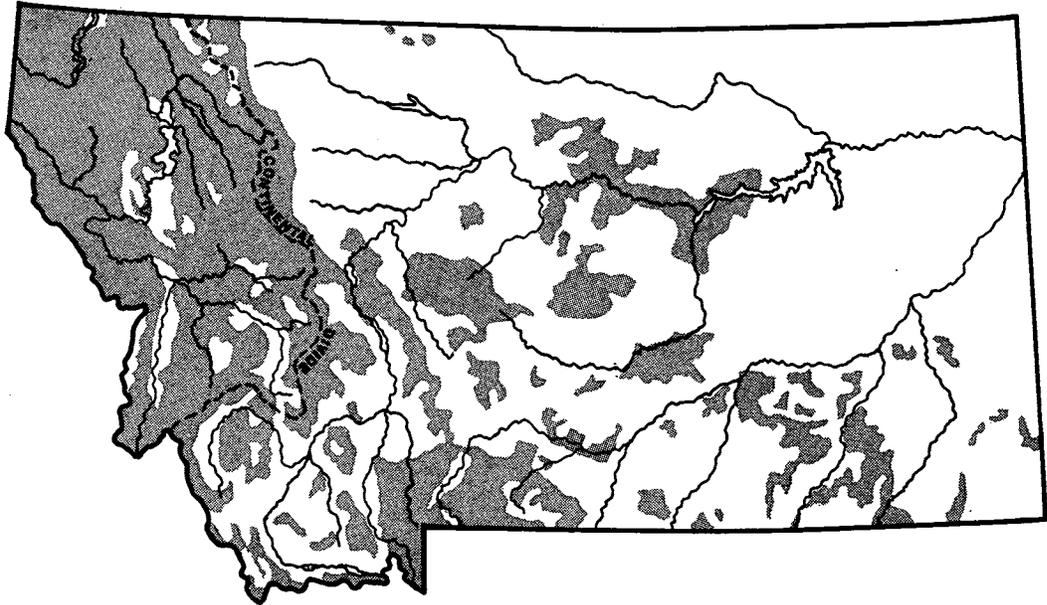
Table 3.--Area of forest land in Montana by major land class and ownership class, 1980

Land class	Ownership class				Total
	National Forest	Other public	Forest industry	Farmer and other private	
	----- Thousand acres -----				
Commercial timberland	8,161.8	759.3	1,601.3	3,048.9	13,571.3
Productive deferred	708.7	--	--	--	708.7
Productive reserved	1,439.9	112.8	1.8	7.2	1,561.7
Other forest land:					
Unproductive reserved	981.8	31.6	0.7	0.5	1,014.6
Unproductive nonreserved	2,525.0	149.7	12.2	682.8	3,369.7
Total forest land	13,817.2	1,053.4	1,616.0	3,739.4	20,226.0

Nature of the Forests

The forests consist of 27 species.

Montana forests contain 27 species of trees—17 conifers and 10 hardwoods (see appendix V for list). These species may grow singly in nearly pure stands or in combination with several other species. How and where they grow depends on such things as elevation, available moisture, and soil characteristics. As a general rule, where there are mountains there are forests. The larger, wide, low-elevation valleys generally are not forested except for hardwoods growing along the streams and rivers.



Western Montana is the most heavily forested region.

The most heavily forested part of Montana is west of the Continental Divide where the high mountain ranges trigger the release of large amounts of moisture from the westerly air flows coming from the Pacific Ocean (Arno 1979). There the nature of the forest changes quite noticeably over relatively short distances because the habitat conditions change rather rapidly with respect to elevation and moisture. East of the Divide the climate is much drier. Consequently, the forests are restricted to higher elevations, and so exist in scattered patches.

Forest ecosystems continually change.

Vegetation is the most recognizable feature of an ecosystem. And whatever vegetation exists at any place is a function of climate and landform (Bailey 1976; 1978). Ecosystems continue to change over long periods, progressing to a point where the system is in balance and the vegetation perpetuates itself without further change (climax vegetation). Some force from outside a climax state system, such as fire, a Mount St. Helens eruption, or human activity, that eliminates the existing vegetation, restarts the successional process of advancement toward the climax vegetation.

Habitat conditions dictate where species grow.

The major tree species grow over a range of habitat conditions, and most find some range of conditions in which they would become the climax vegetation type (fig. 1).

An inherent problem of describing the vegetation of any specific geographical area is classifying or categorizing into similar ecological units. Categories can be broad or specific depending on the needs of the user. It is through such categories that distinctions between one vegetational situation and another can be made.

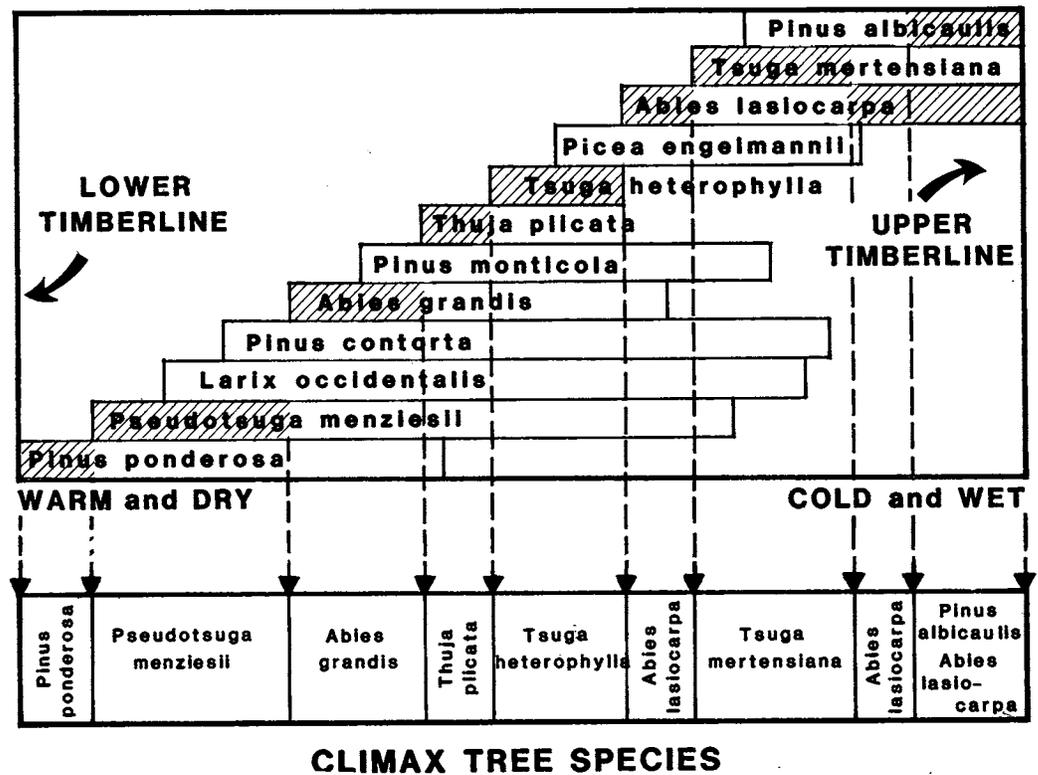


Figure 1.—Coniferous trees in Montana arranged vertically to show the usual order in which the species are encountered with increasing altitude. The horizontal bars designate upper and lower limits of the species relative to the climatic gradient. The shaded area indicates that portion of a species' altitudinal range in which it can maintain a self-reproducing population in the face of intense competition (modified from Daubenmire by Pfister 1976).

The five major forest zones in Montana ...

are made up of six major coniferous forest types.

Five major, and rather general, climax forest zones have been identified for Montana (fig. 2). In northwestern Montana the zone elevations are somewhat lower than those shown. In the southern and eastern parts of the State they would be somewhat higher.

Within the five forest zones in Montana, there are six major coniferous forest ecosystems of interest in terms of timber production: larch, lodgepole pine, ponderosa pine, Douglas-fir, white pine, and spruce-fir.

In the brief descriptions of the Montana forests that follow, the categories are at the "forest type" level. They are identified based on the dominant role of their namesake species within the ecosystem.

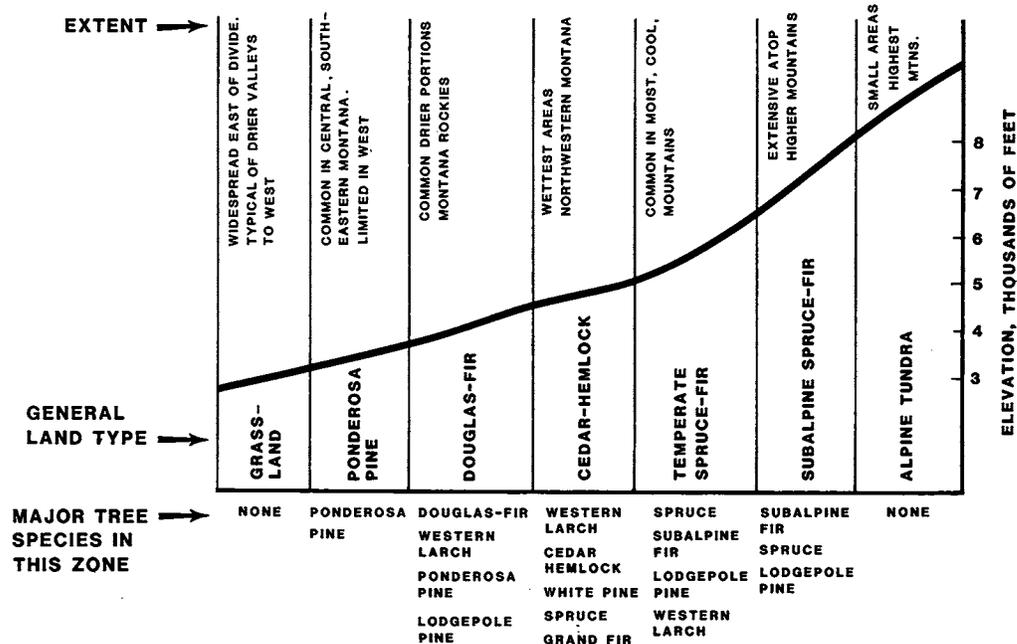


Figure 2.—Forest zones of Montana (Schwietzer and others 1975).

Nearly half the Nation's western larch is in Montana.

Western Larch.—A total of 637,000 acres, or 44 percent, of the western larch forest type in the United States, is in Montana. The larch type occurs almost totally west of the Continental Divide in Montana and is found in the Douglas-fir, cedar-hemlock, and temperate fir-spruce forest zones (fig. 2). Western larch (*Larix occidentalis* Nutt.) is a deciduous conifer and is a subclimax species often maintained by fire. Western larch is found on a wide range of sites, growing in association with ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) on dry, warm sites, and with grand fir (*Abies grandis* [Dougl. ex D. Don] Lindl.), western hemlock (*Tsuga heterophylla* [Raf.] Sarg.), and western white pine (*Pinus monticola* Dougl. ex D. Don) on more cool and moist sites. It grows at higher elevations with Engelmann spruce (*Picea engelmannii* Parry ex Engelm.) and subalpine fir (*Abies lasiocarpa* [Hook.] Nutt.). Western larch is one of the larger and better timber species in Montana, growing tall, straight, and clear.

Subalpine larch (*Larix lyallii* Parl.) is a rather rare tree seen up close by few people. It grows at high elevations in the subalpine fir-spruce zone, usually associated with subalpine fir and whitebark pine. It tends to be shorter and grow in a more scrubby form than western larch.

Lodgepole pine is one of the most abundant.

Lodgepole Pine.—Lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) has the widest range of any species in Montana and often consists of pure or nearly pure, dense stands at midelevations. Stands having thousands or tens of thousands of stems per acre are not uncommon. There are about 3.9 million acres of it in Montana, divided about equally east and west of the Continental Divide. Lodgepole pine is typically a seral species, frequently replaced through succession by other conifers such as Douglas-fir (*Pseudotsuga menziesii* var. *glauca* [Beissn.] Franco) and subalpine fir, and is found within several of the forest zones (fig. 2). In some cases, however, pure stands of lodgepole pine take on the appearance of a climax type, with little or no replacement by other species. This is especially true following fires in other ecosystems where it makes up a substantial portion of the stand and provides the major seed source for natural regeneration.



Much of the ponderosa pine occurs west of the Continental Divide.

Ponderosa Pine.—One of the most important timber trees in the United States and an important forest type in Montana is ponderosa pine. Of the 2.6 million acres of ponderosa pine in Montana, 85 percent occurs west of the Continental Divide and is a different variety (*P. ponderosa* Dougl. ex Laws. var. *ponderosa*) than that east of the Divide. In the east it is the shorter growth form, *P. ponderosa* var. *scopulorum* Engelm. In much of the eastern part of the State, ponderosa is the only upland tree species and occurs largely as islands in the plains. The ponderosa pine type in western Montana can be found in more or less pure stands on drier sites, or mixed with other species on sites with more moisture, principally in the Douglas-fir forest zone.



Douglas-fir is the number one timber species.

Douglas-fir.—This type occupies the area immediately above the ponderosa pine zone and below the cedar-hemlock zone. There are 4.9 million acres of this type in Montana, over half of which occur west of the Continental Divide. Few if any other important American tree species grow under more diverse climatic conditions. It can be found in pure stands as a climax species or in a codominant situation with grand fir, Engelmann spruce, subalpine fir, or western larch. In terms of timber production, it is number one in Montana.



Western white pine is found on some of the most productive land.

Western White Pine.—The western white pine type is centered in northern Idaho with some extension into the western edge of Montana. This seral type is located on midelevation sites, and usually contains a general mixture of western redcedar (*Thuja plicata* Donn ex D. Don), western hemlock, grand fir, Douglas-fir, and western larch, with ponderosa pine at lower elevations and Engelmann spruce at higher elevations. Western white pine and its associates occupy some of the most productive forest land in the State.

The fir-spruce type is found at higher elevations.

Fir-Spruce.—The fir-spruce forest type occupies about 1.2 million acres in Montana at higher elevations where temperatures are cool and moisture abundant. Grand fir, subalpine fir, and Engelmann spruce are the major species. Some of the more common associates in the Northern Rocky Mountains are larch, aspen (*Populus tremuloides* Michx.), lodgepole pine, and Douglas-fir. Mountain hemlock (*Tsuga mertensiana* [Bong.] Carr) is found in association with whitebark pine (*Pinus albicaulis* Engelm.), subalpine fir, and Engelmann spruce at higher altitudes, going to timberline.



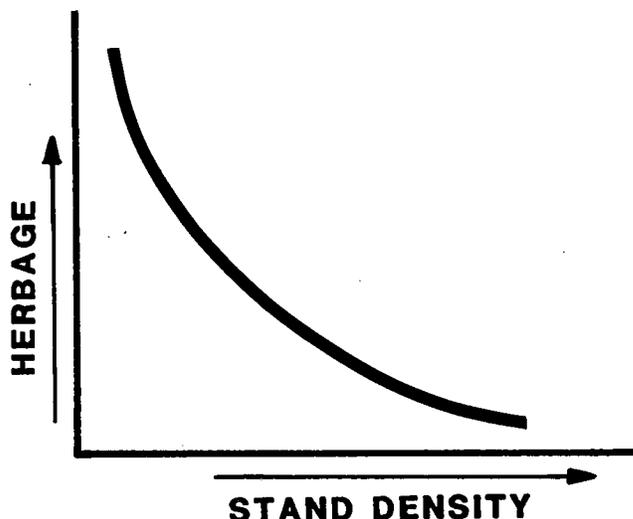
Hardwoods of the East and West meet in eastern Montana.

Hardwoods.—The hardwoods of the East and West meet in eastern Montana. Aspen and cottonwood (*Populus* L.), boxelder (*Acer negundo* L.), bur oak (*Quercus macrocarpa* Michx.), green ash (*Fraxinus pennsylvanica* Marsh.), willow (*Salix* L.), birch (*Betula* L.), and elm (*Ulmus* L.) are all native to the State. Only cottonwood occurs in sufficient volume to be important. Three-fourths of Montana's cottonwood is east of the Continental Divide. This type group occurs mostly as scattered patches and stringers along streams and rivers, with the largest quantities along major rivers such as the Milk and Yellowstone.



A Grazing Resource

As in other Rocky Mountain States, grazing has always been an important part of the forest scene in Montana. As the seasons change the grazing moves from low-elevation lands to higher ground and then back. The grazing done on forested land is centered on the openings in the forest and the more lightly stocked stands because that is where the forage is. As a general rule, the more dense the stand the less forage is available.



Available forage is related to stand characteristics and topography.

On a more practical note, topography and stand density can preclude grazing even if there is forage available.

Complete grazing statistics are rather difficult to come by. But grazing data for the National Forests for 1977 and 1981 give some indication of the level and recent trends in the activity:

	1977		1981	
	No. animals	AUM's ¹	No. animals	AUM's
Cattle	128,593	521,535	121,945	546,284
Horses and burros	14,039	11,176	17,393	13,746
Wild horses	—	115	—	29
Sheep and goats	37,822	19,380	37,901	21,998
Total	180,454	552,206	177,239	582,057

Recent trends show fewer animals grazing for longer periods.

These data indicate a substantial increase in animal unit month (AUM) use but a decrease in the number of animals grazed. The decrease in the number of cattle grazed was offset somewhat by the increase in horses.

Land development is impacting availability of forested range.

Just as with timber supplies, cattle grazing in the forest seems to be influenced by changes in forest use. For example, the development of forest land for summer houses or "ranchettes" displaces the opportunity for grazing cattle. In parts of Montana this has been happening for the past decade or longer. In areas such as the Bitterroot Valley, cattle are out but horses are acceptable.

Sheep, on the other hand, having somewhat different range requirements, have been grazed in about the same numbers but over a longer season.

¹An AUM (animal unit month) is the amount of forage required by a 1,000-pound cow or its equivalent in 1 month (Ford-Robertson 1971).

A Recreation Resource

Outdoor recreation is big business.

Montana ranked eighth in the nation for recreation on National Forests.

Outdoor recreation is a big part of the lives of many Montanans and a primary attraction for several million tourists annually. In 1980 nonresident tourists alone spent over \$250 million, most of which was recreation related (Oblinger-McCaleb Architects 1980). The center attractions for such recreation are the forest land and its streams and lakes.

The importance of a resource is usually gauged by some measure of its use. Unfortunately, recreation use of forest land is at best difficult to measure precisely. But reported estimates of such activities on the National Forests do give an indication of the extent and kind of activities people engage in.



In 1978 Montana's National Forests ranked eighth in the nation for recreational use with nearly 8.3 million recreation visitor days (RVD's). Not surprisingly, camping, hunting, and fishing were collectively the favored activities (table 4). Many of the RVD's were generated by nonresident tourists. By 1981 the total recreation on National Forests reached 9.5 million RVD's, with the largest increase in dispersed areas (USDA Forest Service 1981). Much of the backcountry recreation takes place in the 3.1 million acres of land in the National Wilderness Preservation System.

Table 4.--Summary of National Forest recreational use in Montana, 1978 (thousand recreation visitor days [RVD's])

Activity	RVD's	Total RVD's
Camping	1,704.0	
Fishing	732.7	3,147.1
Hunting	710.4	
Recreational travel	2,258.2	
Picnicking	337.9	2,733.8
Gathering forest products	137.7	
Boating	164.5	
Other water sports	100.5	265.0
Hiking and mountain climbing	379.2	
Horseback riding	229.3	608.5
Winter sports		486.6
Other ¹		<u>1,029.2</u>
Total		<u>8,270.2</u>

¹Other recreation activities include games and team sports, resort use, organization camp use, recreation residence use, nature study, viewing scenic areas, and visitor information services (exhibits, talks, and so forth).

Much of the attraction of Montana's forest is the abundance of wildlife. About 540 species of animals, birds, fish, reptiles, and amphibians rely on the forest land for their survival.

Probably the most well known—and most feared—is the grizzly bear. Jeremiah Johnson's legendary encounters notwithstanding, bare-handed combat with a "griz" in a wilderness area is not high on anyone's "wish-list" of outdoor recreation opportunities. The few grizzly bears that remain are found mostly in and around Glacier and Yellowstone National Parks but may be found in other remote areas. Their numbers are estimated to be roughly 1,000. In 1975 they were put on the "threatened species" list, requiring special land management considerations for their protection.

Montana's wildlife is an integral part of its recreation industry. No recent State-wide data are available, but in 1975 sportsmen spent approximately 5.2

Over 500 species of "critters" rely on Montana's forest.



Hunting game animals is a major recreational activity.

million visitor days hunting, fishing, or trapping. Assuming the average daily expenditure was \$20, over \$100 million was dropped by sportsmen into the State's economy that year. It is no doubt much greater today.

A convenient way to look at the main species is to categorize them:

Big game	Small game	Nongame
Mule deer	Native mountain grouse:	Mammals
White-tailed deer	Blue	Birds
Elk	Ruffed	Reptiles
Antelope	Spruce	Endangered
Others:	Native prairie	species:
Moose	grouse:	Bald eagle
Big horn sheep	Sage	Peregrine
Mountain goats	Sharptailed	falcon
Black bear	Introduced highland	Gray wolf
Grizzly bear	game birds:	Blackfooted
Cougar	Pheasant	ferret
Bison	Chukar	
	Hungarian partridge	
	Turkey	
	Migratory game birds:	
	Ducks	
	Geese	
	Other furbearers	

Populations fluctuate annually . . .

Populations of these species fluctuate from year to year depending on habitat conditions, severity of winter, hunting pressure and success, and so forth. No one knows how many animals of any species really exist in the State. And for most species there are both resident and migratory populations. However, some estimates indicate relative abundance of major big game species:

but deer are the most populous.

Mule and white-tailed deer	226,000
Elk	100,000
Big horn	3,000
Pronghorn	86,000
Bison	500
Black bear	
(on National Forests only)	15,000
Grizzly bear	± 1,000

A Timber Resource

Over 13 million acres of land are suitable for timber growing and harvesting.

Of the more than 20 million acres of forest land considered in this report, about 13.6 million were classed as commercial timberland in 1980:

	Million acres
Forest land	
Commercial timberland	13.6
Productive reserved	1.5
Deferred	.7
Unproductive	4.4
Total	20.2

Commercial timberland is that part of the forest land base from which current and future supplies of industrial wood can reliably be expected. But the "house" of commercial timberland has two masters—suitability and availability.

Suitability has to do with factors of productivity and the ability of the land to withstand the physical disturbance attendant to management and harvesting activities. Availability pertains to the relative importance of timber in relation to other forest uses and the difficulty of effecting management activities and harvest.

But some of the wood is not available for harvesting.

Wilderness and other nontimber uses have reduced the commercial timberland base.

About 40 percent of Montana's forest land can produce over 85 cubic feet per acre per year.

Douglas-fir and lodgepole pine make up nearly two-thirds of the forest.

Of the two factors, availability is the more fickle. Administrative or legislative decisions or both can make more or less forest land available for wood harvesting. Logging technology and elevated timber prices can make more wood available from forests that now are unavailable because of economic and environmental considerations. And then there is the perpetual question about the intentions of nonindustrial private owners. At what price will they harvest trees, if at all? Unfortunately, present timber inventories do not take into account all the factors affecting availability of the land for supplying timber or the availability for harvest of the wood that is grown.

Since 1970 the area classed as commercial timberland has dropped by 1.4 million acres. Nearly half of it was within areas added to the Wilderness Preservation System. Most of the remainder was reclassified as unproductive forest. And with Congress considering additional areas for wilderness, further reductions in the commercial timberland area may take place. However, much of the area still under study is in the high country and not of much importance for timber production.

Shifting ownerships and the resulting rarity of long-range plans make a guessing game of the availability of productive forests on nonindustrial privately owned land. The accelerated subdivision of forest land into summer house lots and "ranchettes" makes the availability of timber from these lands highly questionable. Increasing numbers of owners are holding the properties for purposes that exclude any major timber harvesting.

How Productive Is the Forest Land?—Montana has some of the most productive forest land in the Nation, particularly west of the Continental Divide. More than 40 percent of the forest land has the potential to produce over 85 cubic feet per acre per year:

Productivity class <i>Ft³/acre/year</i>	Thousands of Acres	Percent of total
20- 49	3,357.8	24.7
50- 84	4,702.0	34.6
85-119	4,032.2	29.7
120-164	1,426.1	10.5
165+	53.2	0.5
Total	13,571.3	100

The lands with the highest average biological potential productivity are on the National Forests and lands owned by forest industries:

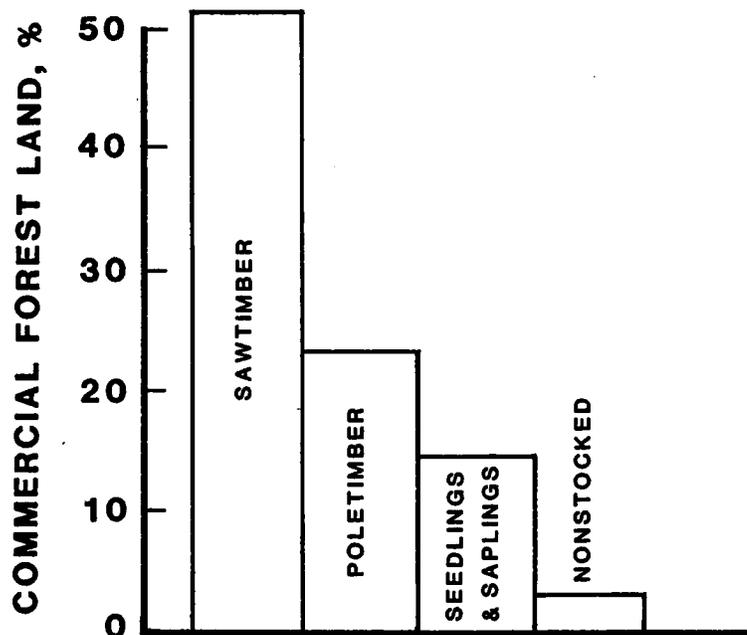
Owners group	Potential productivity <i>Ft³/acre/year</i>
National Forests	88.0
Forest industry	71.6
Other private	56.0
Other public	65.2
All owners	77.6

What Is It Like?—About 64 percent of Montana's commercial timberland is made up of two forest types: Douglas-fir at nearly 4.9 million acres and lodgepole pine at nearly 3.9 million acres. Tossing in the ponderosa pine and fir-spruce types brings the total to 93 percent of the timberland area.

And a bit of trivia: there are an estimated 2.6 billion lodgepole pine and 1.6 billion Douglas-fir growing stock trees out of a total 6.5 billion trees on commercial timberland (table 5).

Table 5.--Estimated number of growing stock trees on commercial timberland in Montana by species and diameter class, 1980

Species	Diameter class (inches at breast height)															
	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 22.9	23.0- 24.9	25.0- 26.9	27.0- 28.9		
	----- Thousand trees -----															
Douglas-fir	623,997	334,025	232,430	157,814	103,102	66,148	39,650	25,281	15,278	9,153	4,961	3,040	1,811	914		
Ponderosa pine	117,091	79,672	60,486	44,638	29,649	20,415	12,485	7,390	4,470	2,424	1,655	899	734	425		
Western white pine	6,373	1,980	2,718	2,164	1,414	1,159	917	417	295	305	133	139	61	51		
Lodgepole pine	783,092	716,553	540,392	316,640	138,231	52,875	19,650	5,944	1,790	634	146	77	13	11		
Whitebark-limber pine	49,697	27,720	31,101	23,109	15,014	8,897	4,383	2,084	1,042	532	242	76	78	19		
Western larch	74,644	61,852	50,848	30,079	17,071	10,285	6,967	4,774	3,375	2,488	1,829	1,413	882	531		
Grand fir	69,947	39,146	19,903	11,324	5,542	3,386	1,649	966	701	291	139	123	40	27		
Subalpine fir	408,942	168,212	106,299	55,709	27,881	13,570	6,290	3,360	1,330	665	386	168	50	12		
Engelmann spruce	155,540	62,634	47,688	25,278	17,605	12,474	8,253	5,236	3,263	2,049	1,445	713	504	198		
Western hemlock	21,291	12,159	8,010	6,845	2,746	1,811	1,047	846	467	262	212	193	103	67		
Western redcedar	61,227	19,014	10,806	5,241	2,678	2,112	1,229	763	393	401	195	153	160	137		
Other softwoods	189	--	25	--	--	53	--	--	--	--	--	--	--	--		
Total softwoods	2,372,030	1,522,967	1,110,706	678,841	360,933	193,185	102,520	57,061	32,404	19,204	11,343	6,994	4,436	2,392		
Aspen	20,528	10,411	9,602	5,915	3,544	1,420	379	70	42	33	8	7	1	8		
Cottonwood	3,962	1,211	1,890	1,410	1,099	1,205	1,254	850	702	637	557	247	155	157		
Other hardwoods	24,418	10,758	3,728	1,702	711	268	169	76	13	22	--	4	1	--		
Total hardwoods	48,908	22,380	15,220	9,027	5,354	2,893	1,802	996	757	692	565	258	157	165		
All species	2,420,938	1,545,347	1,125,926	687,868	366,287	196,078	104,322	58,057	33,161	19,896	11,908	7,252	4,593	2,557		



Over 60 percent of the forest is in sawtimber size stands . . .

and only about 2 percent is nonstocked.

Over 60 percent of the commercial timberland in Montana is occupied by sawtimber stands, somewhat less than in the other Rocky Mountain States, except Idaho (table 6). And only about 2 percent of the timberland is nonstocked. But a small percentage of a large number is a large number—in this case about 218,000 acres.

The distribution of poletimber and seedling-sapling stands among owner groups varies slightly. Stand size classes alone, however, do not offer any concrete management implications. They are merely descriptive. Tree size distribution within a stand is not indicated by stand size categories. Softwood sawtimber trees need only be 9.0 inches diameter at breast height (d.b.h.), and sawtimber stands need only have half the total stocking in sawtimber and poletimber trees with sawtimber at least equal to poletimber stocking. A wide range of tree diameter classes is common in many of the forest types.

Table 6.--Area of commercial timberland in Montana by stand-size class and ownership class, 1980

Stand-size class	Ownership class				
	National Forest	Other public	Forest industry	Farmer and other private	All ownerships
- - - - - Thousand acres - - - - -					
Sawtimber stands	4,995.2	485.1	966.3	1,833.1	8,279.7
Poletimber stands	2,165.2	135.0	253.7	557.0	3,110.9
Sapling and seedling stands	896.0	126.1	348.3	592.1	1,962.5
Nonstocked areas	105.4	13.1	33.0	66.7	218.2
Total	8,161.8	759.3	1,601.3	3,048.9	13,571.3

The total amount of wood, if put into a single log 50 feet in diameter, would run from Missoula to Miami.

How Much Wood?—In 1980 Montana's commercial timberland contained an estimated (and mind boggling) 26 billion cubic feet of wood in trees 5 inches d.b.h. and larger. All but 417,000 cubic feet are from softwood species (table 7). To comprehend a number of that size: if that volume were in one log 50 feet in diameter it would stretch from Missoula to Miami, about 2,500 miles. That volume represents nearly 30 percent of all the growing stock volume in the Rocky Mountain States (Green and Van Hooser 1983).

Table 7.--Net volume of timber on commercial timberland in Montana by class of timber, and softwoods and hardwoods, 1980

Class of timber	Softwoods	Hardwoods	All classes
- - - - - Million cubic feet - - - - -			
Sawtimber trees:			
Sawlog portion	16,093.2	205.5	16,298.7
Upper-stem portion	1,844.2	54.8	1,899.0
Total	17,937.4	260.3	18,197.7
Poletimber trees	7,811.3	157.0	7,968.3
All growing-stock trees	25,748.7	417.3	26,166.0
Sound cull trees	303.8	7.2	311.0
Rotten cull trees	223.5	6.3	229.8
Salvable dead trees	2,870.8	20.1	2,890.9
All timber	29,146.8	450.9	29,597.7

Only about 7.8 billion cubic feet are in trees less than 9 inches d.b.h. Nearly 18 billion cubic feet are in sawtimber-size trees. The remaining 3.4 billion are in cull (540 million cubic feet) and salvable dead trees (2.9 billion cubic feet).

Two species, lodgepole pine and Douglas-fir, make up over 60 percent of the volume (table 8), about in proportion to the areas occupied by the types. Adding ponderosa pine and western larch brings the total to 78 percent. About 60 percent of the volume is in trees less than 13 inches d.b.h.

Lodgepole pine and Douglas-fir make up 60 percent of the volume.

Table 8.--Net volume of growing stock and sawtimber on commercial timberland in Montana by ownership class and species, 1980

Species	Ownership				Total
	National Forest	Other public	Forest industry	Farmer and other private	
GROWING STOCK					
- - - Million cubic feet - - -					
Douglas-fir	4,623.6	412.4	1,003.7	1,407.7	7,447.4
Ponderosa pine	785.7	192.8	287.4	901.7	2,167.6
Western white pine	186.2	9.7	22.1	4.8	222.8
Lodgepole pine	6,660.6	280.9	641.4	787.5	8,370.4
Whitebark-limber pine	611.2	25.7	43.3	87.2	767.4
Western larch	1,503.8	138.6	394.8	141.5	2,178.7
Grand fir	306.7	23.9	101.0	19.7	451.3
Subalpine fir	1,330.0	61.0	101.5	95.4	1,587.9
Engelmann spruce	1,554.2	69.1	176.1	157.7	1,957.1
Western hemlock	293.7	0.5	13.4	7.0	314.6
Western redcedar	233.2	7.7	28.4	13.6	282.9
Other softwoods	0.6	--	--	--	0.6
Total softwoods	18,089.5	1,222.3	2,813.1	3,623.8	25,748.7
Aspen	20.3	12.4	8.4	106.5	147.6
Cottonwood	--	26.3	10.5	185.0	221.8
Other hardwoods	25.7	5.8	3.1	13.3	47.9
Total hardwoods	46.0	44.5	22.0	304.8	417.3
All species	18,135.5	1,266.8	2,835.1	3,928.6	26,166.0
SAWTIMBER					
- - - Million board feet, International 1/4-inch rule - - -					
Douglas-fir	17,035.4	1,615.4	3,924.1	4,911.8	27,486.7
Ponderosa pine	3,427.5	792.9	1,532.0	3,367.8	9,120.2
Western white pine	907.8	49.1	110.1	17.8	1,084.8
Lodgepole pine	15,094.1	634.3	1,098.3	1,842.2	18,668.9
Whitebark-limber pine	2,015.8	107.5	186.6	294.3	2,604.2
Western larch	6,533.5	740.4	2,024.7	533.4	9,832.0
Grand fir	1,212.3	88.7	387.2	65.9	1,754.1
Subalpine fir	4,205.0	156.9	248.7	198.1	4,808.7
Engelmann spruce	6,931.6	304.3	831.8	621.7	8,689.4
Western hemlock	1,337.1	1.1	41.2	22.1	1,401.5
Western redcedar	1,358.6	32.0	119.0	48.6	1,558.2
Other softwoods	2.3	--	--	--	2.3
Total softwoods	60,061.0	4,522.6	10,503.7	11,923.7	87,011.0
Aspen	28.5	18.6	12.5	163.4	223.0
Cottonwood	--	112.3	42.4	796.2	950.9
Other hardwoods	56.0	8.9	6.4	8.4	79.7
Total hardwoods	84.5	139.8	61.3	968.0	1,253.6
All species	60,145.5	4,662.4	10,565.0	12,891.7	88,264.6

Changes

The forest continually changes . . .

sometimes slowly . . .

and sometimes suddenly and drastically.

Net growth is a good indicator of forest condition.

In 1979 nearly a fifth of the growth was offset by mortality.

Current growth is less than half the potential.

Today's forest is a product of past events, whether natural or human caused. Even without human disturbance the natural progression of things will continue. Trees will sprout from seeds or roots, trees will grow, insects, disease, fire, and wind will take their toll, and some trees will live long enough to be killed by humans. And the next cycle begins.

Human use of the forest results in interruptions of the natural cycle by "rescheduling" the timing of two basic events—trees dying and trees beginning. In terms of growing a perpetual crop of trees for industrial wood products, the forest manager basically has only two tools, figuratively speaking: an ax and a planting bar. It is always assumed that any area harvested or destroyed will be regenerated by some means and in a timely fashion. And the trees killed by thinning or final harvest for products are categorized as "removals." This is to differentiate that volume used from the volume in trees dying from natural causes, which may or may not be used.

Growth.—Ordinarily the major factor of interest is growth. Annual growth per unit area is a good indicator of the nature and condition of the forest. But growth always must be looked at in relation to mortality. It is the net growth that is important.

In 1979 timberland in Montana grew about 598 million cubic feet (1,850 million board feet of sawtimber). But in that same year destructive agents of one kind or other killed 108 million cubic feet of growing stock and 360 million board feet of sawtimber, or about 18 percent of the growth. That leaves a net growth of about 490 million cubic feet and 1.5 billion board feet of sawtimber (table 9).

Table 9.--Net volume, net annual growth, and annual mortality of growing stock and sawtimber on commercial timberland in Montana by softwoods and hardwoods

Item	Softwoods	Hardwoods	Total
Net volume, 1980:			
Growing stock (million cubic feet)	25,748.7	417.3	26,166.0
Sawtimber ¹ (million board feet)	87,011.0	1,253.6	88,264.6
Net annual growth, 1979:			
Growing stock (thousand cubic feet)	480,474	9,840	490,314
Sawtimber ¹ (thousand board feet)	1,456,145	33,330	1,489,475
Annual mortality, 1979:			
Growing stock (thousand cubic feet)	105,391	2,208	107,599
Sawtimber ¹ (thousand board feet)	354,228	6,236	360,464

¹International ¼-inch rule.

For the total commercial timberland of 13.6 million acres the net growth is about 36 cubic feet per acre. This is less than half of the 78 cubic feet per acre the land is capable of producing.

Why the difference? Briefly, the condition of the timberland. "Condition" depends upon the amount of forest area nonstocked, overstocked, understocked, or stocked with inappropriate species, the amount of old growth, and the nature and size of the trees. These factors usually are described in terms of stocking levels, stand structure, and stand size.

One way to view the forest's condition combines stand stocking and the nature of the trees making up the stand into area condition classes (table 10). (See appendix I for definitions of area condition classes.) Table 10 exhibits data for State and private owner groups. Because National Forest and other public commercial timberland may be similar, percentages derived from table 10 should describe, in a relative way, the total Montana timberland condition.

Table 10.--Area of State and private commercial timberland in Montana by forest type and area condition class, 1980

Forest type	Area condition class										All classes
	10	20	30	40	50	60	70	80	90	Nonstocked	
----- Acres -----											
Douglas-fir	4,283	682	123,682	233,295	298,717	997,984	570,281	1,324	15,022	38,509	2,283,779
Western hemlock	--	--	3,806	--	--	4,258	--	--	--	--	8,064
Ponderosa pine	3,563	3,772	81,979	95,833	81,014	433,068	383,865	41,393	77,875	34,717	1,237,079
Western white pine	--	--	--	--	3,976	--	--	--	--	--	3,976
Lodgepole pine	6,988	52,590	11,200	157,991	310,745	135,090	69,652	--	1,639	16,340	762,235
Western larch	3,344	22,608	13,620	61,841	49,731	27,162	25,215	--	--	682	204,203
Western redcedar	--	--	--	7,160	14,325	7,007	4,407	--	--	--	32,899
Whitebark-limber pine	--	--	--	5,154	27,717	18,045	20,898	--	--	2,476	74,290
Grand fir	606	--	10,573	21,461	5,688	29,674	4,401	--	--	--	72,403
Subalpine fir-spruce	--	7,158	15,155	39,337	30,001	119,706	36,957	--	--	7,477	255,791
Engelmann spruce	--	2,909	14,961	6,243	22,910	42,130	14,377	--	820	--	104,350
Aspen	--	--	2,991	--	36,170	32,162	29,154	--	--	7,414	107,891
Cottonwood	--	--	--	1,591	11,825	33,511	90,787	--	35,732	3,975	177,421
Other hardwoods	--	4,210	--	--	--	1,424	--	--	--	840	6,474
All types	18,784	93,929	277,967	629,906	892,819	1,881,221	1,249,994	42,717	131,088	112,430	5,330,855

Old-growth stands, understocked and overstocked stands, and nonstocked areas contribute little to wood production.

Including old-growth and nonstocked areas, stands less than fully stocked with desirable trees occupy 81 percent of the commercial timberland. Of the nonstocked area, 65 percent is ponderosa pine and Douglas-fir types. These two types also make up 71 percent of the high risk old-growth stands. Not only is there too much at the extremes that contributes little to net annual growth, but future improvement in stocking in many stands is not possible because some growing space is occupied by rough and rotten trees and brush.

Nearly 108 million cubic feet of growing stock were lost to destructive agents in 1979.

Mortality.—Volume lost to insects, disease, fire, and other destructive agents in 1979 amounted to 107.6 million cubic feet of growing stock including 360.5 million board feet of sawtimber (table 11). This loss represents 19 percent of the sawtimber growth and 18 percent of the growing stock growth.

Insects, disease, and weather accounted for over half the loss.

Unknown causes of mortality resulted in 41.1 million cubic feet of lost growing stock volume (table 31 in appendix IV). Because numerous damaging agents often attack trees together or in succession, it is difficult to single out the real culprit. The top three identifiable agents—weather, insects, and disease—account for over 50 percent of the growing stock mortality. Within National Forest boundaries, mountain pine beetle and dwarf mistletoe were the primary insect and disease. In fact, they are the primary agents on all forest land.

Table 11.--Annual mortality of growing stock and sawtimber on commercial timberland in Montana by ownership class, and softwoods and hardwoods, 1979

Species group and ownership class	Growing stock	Sawtimber
	Thousand cubic feet	Thousand board feet ¹
Softwoods:		
National Forest	68,914	241,066
Other public	5,479	16,988
Forest industry	16,623	54,215
Farmer and other private	14,375	41,959
Total	105,391	354,228
Hardwoods:		
National Forest	49	--
Other public	256	725
Forest industry	35	162
Farmer and other private	1,868	5,349
Total	2,208	6,236
All species:		
National Forest	68,963	241,066
Other public	5,735	17,713
Forest industry	16,658	54,377
Farmer and other private	16,243	47,308
Total	107,599	360,464

¹International ¼-inch rule.

On State and private land over 38 million cubic feet of growing stock and 118.6 million board feet of sawtimber were lost (table 12).

Large-scale salvage operations of dead trees require large concentrations of trees, such as beetle-killed lodgepole pine stands. Otherwise, economics often dictate that salvage be coincidental to normal harvests.

But the total impact of destructive agents is not limited to mortality. Insects and diseases cause vigor loss, reducing growth, destroying seed crops, and limiting forests to less desirable trees. Often the quality and utility of the wood from these damaged trees is marginal and, therefore, impact the net volume available for products.

Reducing and controlling losses caused by destructive agents require cultural practices, chemical treatments, or both. Thinning stands and planting disease-resistant species are two practices to limit losses. Chemicals to control insects and disease are expensive and regulated by law, yet have been widely used. Continued research into the problems of destructive agents will provide needed answers.

Salvaging dead trees is sometimes feasible.

Controlling destructive agents is difficult and expensive.

Table 12.--Annual mortality of growing stock and sawtimber on State and private commercial timberland in Montana by ownership class and cause of death, 1979

Cause of death	Ownership			Total
	State	Forest industry	Farmer and other private	
GROWING STOCK				
----- Thousand cubic feet -----				
Insects	1,044	2,320	2,722	6,086
Disease	635	3,211	1,801	5,647
Fire	387	426	328	1,141
Animal	61	101	204	366
Weather	951	3,008	4,097	8,056
Suppression	81	404	296	781
Unknown	2,108	5,536	6,068	13,712
Logging	150	1,652	727	2,529
Total	5,417	16,658	16,243	38,318
SAWTIMBER				
Thousand board feet, International 1/4-inch rule				
Insects	3,478	7,407	9,526	20,411
Disease	2,357	14,263	5,850	22,470
Fire	679	615	795	2,089
Animal	278	541	659	1,478
Weather	3,445	13,931	13,073	30,449
Suppression	10	74	69	153
Unknown	6,522	14,845	16,639	38,006
Logging	224	2,701	697	3,622
Total	16,993	54,377	47,308	118,678

Nearly 300 million cubic feet were removed in 1976...

mostly for roundwood products.

Removals.—Removals can be (1) roundwood harvests of sawlogs, pulpwood, and poles, (2) residues from logging operations, and (3) precommercial thinning, other cultural operations, and shifts in land use such as land clearing for housing developments or setting aside areas for wilderness.

In 1976 removals for roundwood products totaled 246.3 million cubic feet of growing stock, including 1,460.1 million board feet of sawtimber (table 13).

Roundwood products are the bulk of removals from Montana's timberland, mainly in softwoods. National Forests supplied 43 percent of the total removals, with forest industry lands supplying 34 percent.

Total removals represent 1.1 percent of the growing stock inventory and 1.8 percent of the sawtimber inventory. For every cubic foot removed 2 cubic feet grew, and for every board foot removed 1.2 board feet grew. Therefore, gains were realized in the timber inventory volume.

Table 13.--Annual removals from growing stock and sawtimber on commercial timberland in Montana by source, 1976

Source	Growing stock	Sawtimber
	Thousand cubic feet	Thousand board feet ¹
Roundwood products:		
Sawlogs	187,046	1,124,889
Veneer logs	47,589	286,201
Other roundwood products:		
Pulpwood	2,677	13,065
Cedar products	929	4,292
Utility poles	544	2,514
Houselogs	3,777	17,451
Posts and poles	3,736	11,273
Total	11,663	49,045
Total roundwood products	246,298	1,460,135
Logging residues	39,368	121,100
Other removals	4,552	27,484
Total removals	290,218	1,608,719

¹International $\frac{1}{4}$ -inch rule.

Almost half the removals were Douglas-fir and lodgepole pine.

Four species—Douglas-fir, lodgepole pine, western larch, and ponderosa pine, in that order—made up 82 percent of the removals of growing stock (table 14). Over a fourth of the material removed in 1976 from Montana's timberland was Douglas-fir. Lodgepole pine removals were nearly as great.

About 70 percent of removals were sawlogs.

Total output of sawlogs accounted for 70 percent of the timber products, by far the most important single product from Montana's forests. Slightly more than 1.1 billion board feet of lumber was produced in 1976.

Over 39 million cubic feet of growing stock were left at logging sites. These logging residues amounted to 14 percent of the growing stock removals and 7 percent of the sawtimber removals. All of the material left behind were sections of growing stock trees.

Table 14.--Annual removals from growing stock and sawtimber on commercial timberland in Montana by species, 1976

Species	Growing stock	Sawtimber
	Thousand cubic feet	Thousand board feet ¹
Douglas-fir	75,814	425,564
Engelmann spruce	21,414	120,155
Lodgepole pine	62,709	339,948
Ponderosa pine	42,172	236,710
True firs	14,224	79,853
Western larch	55,402	310,939
Western hemlock	1,584	8,833
Western redcedar	4,899	25,403
Western white pine	7,398	41,352
Other	4,602	19,962
Total	290,218	1,608,719

¹International $\frac{1}{4}$ -inch rule.

A small percent of material removed is never used.

In 1976 four counties provided over 70 percent of the harvest.

Future removals will be made up of more but smaller trees.

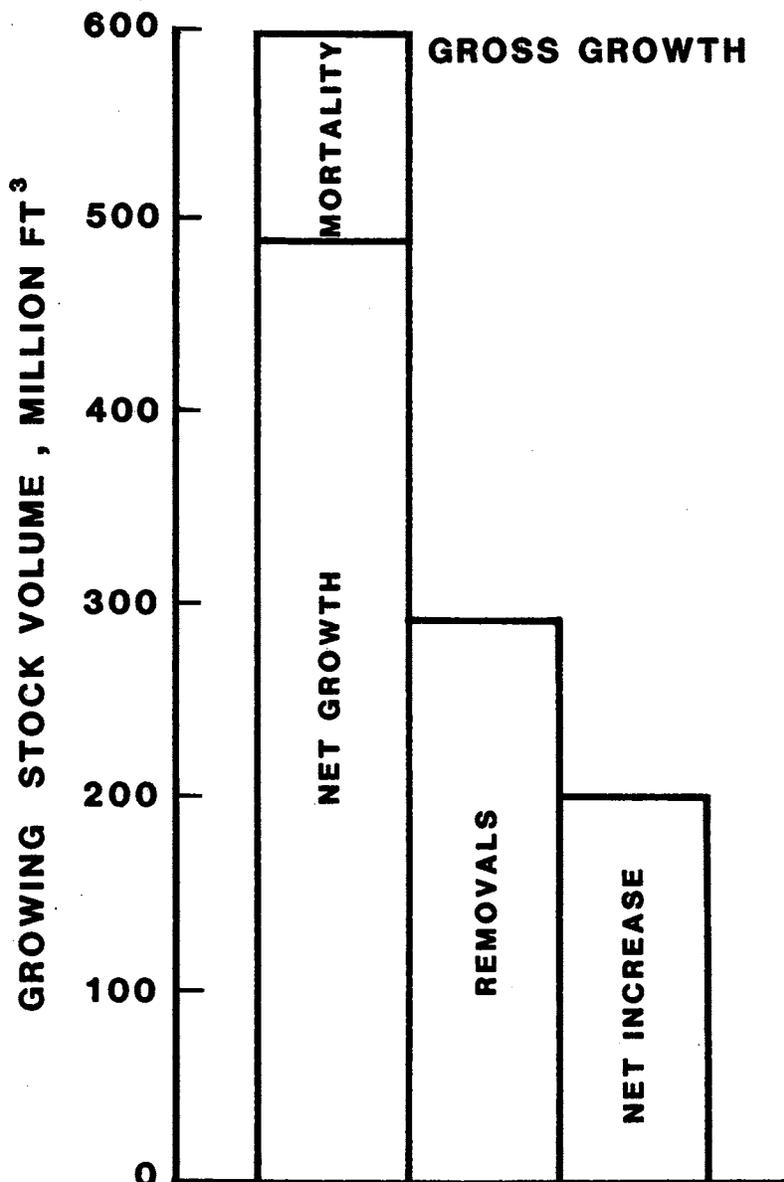
Gross growth less the mortality and the removals resulted in a net increase of 200 million cubic feet of growing stock volume.

Finally, a small percentage of total removals results in no industrial product. The standing inventory decrease from housing developments, wilderness areas, and thinnings represents less than 2 percent of the volume removed.

Of the growing stock removals, 70.4 percent came from the four major timber-producing counties, Lincoln, Flathead, Sanders, and Missoula. All have substantial areas in National Forests and industry ownership.

Maintaining the 1976 level of cubic foot output from these counties, and most of Montana, will require harvesting more and more acres each year in the future. Why? Because the growth rate generally will not produce as large a tree in the next hundred years as is presently being removed. Therefore, in the future smaller trees must be removed from more acres to total the same output.

What Does It Mean?—To summarize: In 1979 about 598 million cubic feet of wood was added to the estimated 26.2 billion cubic feet of growing stock volume on Montana's commercial timberland through tree growth. Put another way, the growing stock volume increased by about 2.3 percent. Unfortunately, about 107.6 million cubic feet of that growth (18 percent) was offset by mortality, leaving a net increase of only 490 million cubic feet.



Removals of 290.2 million cubic feet amounted to only about 1.1 percent of the total inventory volume but nearly 60 percent of the net growth. The net effect of all this was a net increase in the growing stock volume of some 200 million cubic feet over the entire State.

Despite the encouraging future of the timber resource, a situation developing in western Montana should be of concern.

But removal levels on private land in some western counties exceed volume and growth.

As previously stated, over 70 percent of the roundwood removals came from four counties in northwestern Montana (Lincoln, Flathead, Sanders, and Missoula). In these counties, the removals from lands owned by forest industry far exceeded growth. In Sanders and Missoula Counties removals from nonindustrial private owners also exceeded growth. While this need not necessarily be considered alarming in any one year, continuation of those harvest levels in relation to inventory volume could spell trouble for the future.

For example, in Lincoln County removals from industry lands amounted to about 4.3 percent of the growing stock and 6.1 percent of the sawtimber volume. In Sanders County removals were 5.3 percent of growing stock and 8.1 percent of the sawtimber volume.

Growing stock and sawtimber volumes on these lands could be gone in a few decades.

The implications are fairly clear: continuation of these levels of removals will eliminate the standing inventory volume on private lands in these counties in just a few decades.

Reducing removals to a "cut-equals-growth" level would necessarily mean a substantial reduction in deliveries to the mills from private lands. And assuming the total removal of 290 million cubic feet was necessary to meet the wood products demands from Montana's forests, alternate sources would be needed to make up the difference. That of course means public lands. How much more public timber will be available in the future is not known. Present demands on public forests and commitments for future generations make it questionable whether these lands can or will make up the entire difference.

A comprehensive assessment of future timber supplies is needed.

A comprehensive study is needed for taking a realistic look at alternative future harvest levels from all ownerships and the consequences to be expected from each in terms of economic impacts at the State and local levels, and at biological and environmental impacts on the forests and related resources.

ABOUT FOREST INDUSTRIES

Forest industries contribute substantially to Montana's economy.

Since the mid-1970's the number of active wood processing plants operating in Montana has changed almost weekly as flip flops in the economy affected the demand for lumber and plywood. In 1981 Montana's forest industries included 142 active sawmills, five plywood plants, a pulp and paper mill, two board plants (fiberboard and particleboard), and about 73 other plants producing miscellaneous products such as posts, poles, house logs, and cedar specialities (Keegan 1983) (table 15).

Table 15.--Active wood products plants in Montana, by county and type, 1976

County of location	Type of wood product plant						
	Lumber	Plywood	Particleboard and fiberboard	Pulp and paper	Posts and poles	House logs	Other products
Beaverhead	3	--	--	--	2	2	1
Broadwater	2	--	--	--	--	--	--
Cascade	1	--	--	--	--	--	--
Custer	1	--	--	--	--	--	--
Fergus	7	--	--	--	--	--	1
Flathead	18	2	1	--	8	2	1
Gallatin	5	--	--	--	4	1	1
Granite	1	--	--	--	2	--	--
Jefferson	--	--	--	--	3	--	--
Judith Basin	1	--	--	--	--	--	--
Lake	1	--	--	--	--	--	--
Lewis and Clark	2	--	--	--	3	1	--
Lincoln	16	1	--	--	--	--	6
Madison	4	--	--	--	2	--	--
Meagher	2	--	--	--	--	--	1
Mineral	3	--	--	--	1	1	2
Missoula	7	2	1	1	3	2	1
Musselshell	3	--	--	--	--	--	--
Park	5	--	--	--	3	--	--
Powell	1	--	--	--	1	--	--
Ravalli	5	--	--	--	4	7	2
Rosebud	1	--	--	--	--	--	--
Sanders	8	--	--	--	1	3	1
Silver Bow	1	--	--	--	--	--	--
Total	98	5	2	1	37	19	17

Source: University of Montana, Bureau of Business and Economic Research, Montana Forest Industries Data Collection System (Missoula, MT, 1979).

Sawmills

Lumber production has evolved from muscle power to water power to steam power to electric power.

Since early settlement, lumber production has been Montana's most important and most diverse forest industry. From the crude beginning with the pit saw at St. Mary's Mission, the industry followed the same progression as it had in the East. Water-powered, then steam-powered, then electric-power mills increased the capacity to produce lumber with both circular and gang saws.



Today, sawmills in Montana range in size from small family operations producing only a few thousand board feet of lumber per year, frequently on a demand basis, to fully automated mills with plant capacities exceeding 100 million board feet.

The trend is toward fewer but larger mills, mostly in western Montana.

Since World War II the trend has been toward fewer but larger mills, but even as late as 1956 there were 330 sawmills in Montana, most of them small. By 1966 small sawmills were producing only about 10 percent of the total lumber output. In 1981 the 28 largest sawmills in Montana produced about 93 percent of the lumber.

Nearly three-fourths of the sawmills active in 1981 were in western Montana. Fifty-four were in Flathead, Lincoln, Lake, and Sanders Counties. These mills and the 22 in Missoula, Ravalli, and Mineral Counties accounted for some 80 percent (843 million board feet) of the 1,071 million board feet of lumber produced that year.

Plywood Plants

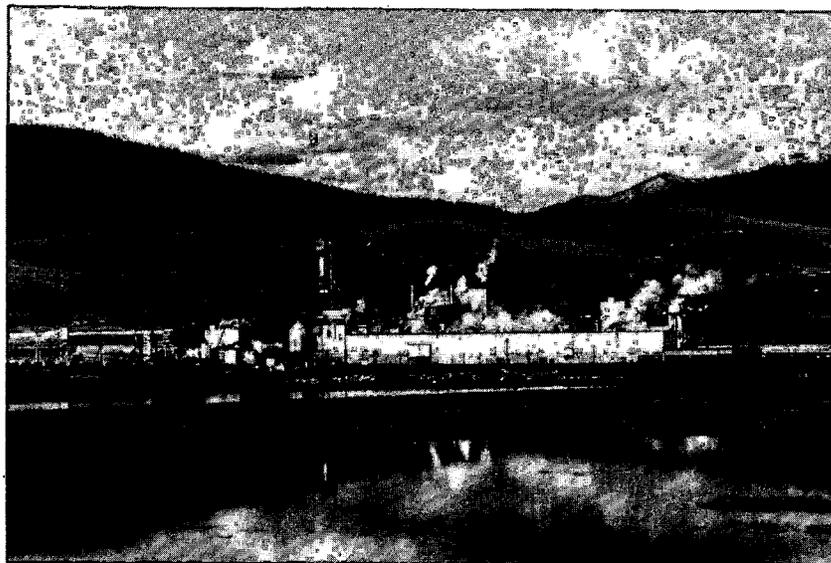
The four plywood plants increased production between 1973 and 1976.

Although Montana had only four plywood plants active in 1981, two in Flathead and one each in Missoula and Lincoln Counties, some "bragging rights" did exist. The Champion Bonner plant, completed in 1974, reportedly has the largest softwood lathe capacity of any plant in the world. The addition of this plant capacity helped send the production of plywood from around 420 million square feet in 1973 to 647 million square feet in 1976. Production in 1981, however, was down to 569 million square feet, as the plant in Missoula County was temporarily shut down.

Pulp, Paper, and Board Plants

The three pulp, paper, and board plants are not direct consumers of timber resources.

In 1981 the pulp, paper, and board industries were represented in Montana by three plants: a Kraft pulp and paper mill and a particleboard plant in Missoula County, and a fiberboard plant in Flathead County. They have no significant direct impact on roundwood supplies from the forests. Their major source of raw material is the manufacturing residues from plywood plants and sawmills.



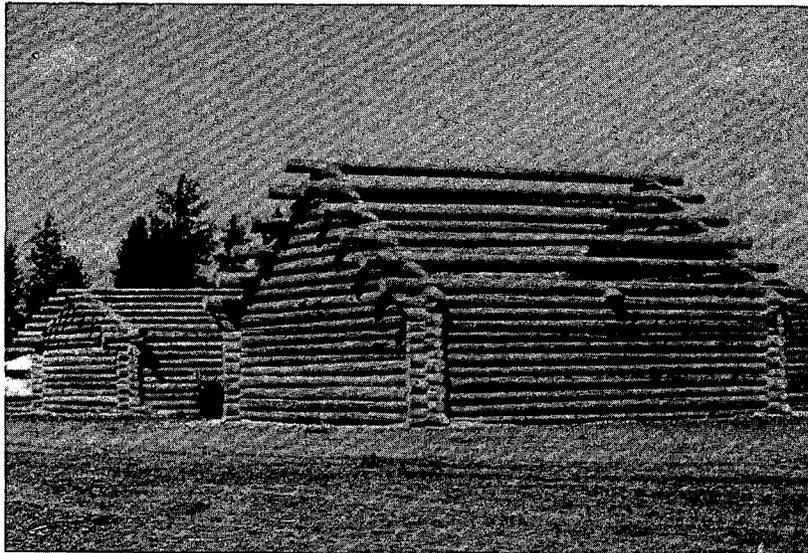
Their impact on the economy is twofold. In addition to the contribution to the economy generated by their operation, their use of waste products from other forest industries generates significant revenues for their suppliers. The sales value of products shipped from these plants in 1981 was about \$214 million.

Other Wood Products

The demand for house logs is increasing.

A number of small plants produce a variety of products such as posts, house logs, mine timbers, and so on. In 1976 output from these plants was valued in excess of \$33 million—not a big portion of the State's total economic activity but significant to local communities.

House Logs.—Houses built with logs are increasingly popular in Montana and neighboring States, particularly for second homes. Aside from their rustic appearance, they are well suited for the do-it-yourselfer who wants to be creative and save on construction costs.



In 1981 about 4 million linear feet of house logs valued at over \$7.7 million were turned out by 25 plants in the business.

Output of posts, poles, ...

Posts and Poles.—Plants producing these items numbered 37 in 1981. In addition to the roundwood products, some plants produced other products such as grape stakes. The total value of output from these plants was nearly \$5.5 million for the 4 million pieces produced.

and other products was worth nearly \$26 million in 1981.

Miscellaneous.—This catch-all group of plants turned out mine timbers, structural timbers, railroad ties, cedar specialty products such as shakes and shingles, and utility poles. In 1981 output of these products was valued at \$20.4 million.

Residues and Utilization

Residues are classed as coarse, fine, and bark.

Over half the volume in logs delivered to sawmills never makes it to the lumber yard. In fact, a substantial portion of the volume of any roundwood-derived wood product ends up on the floor awaiting disposal.

Residues come in several flavors: coarse (slabs, edgings, trimmings, and peeler cores), fine (planer shavings and sawdust), and bark. Coarse residues are chippable, although most of the peeler cores are cut into lumber, rendering only slabs and edgings to be disposed of.

Most mill residues are no longer burned except for fuel.

In 1981 nearly all residues were used.

Disposal of milling offal used to be rather routine: it was burned. The amount of smoke issuing from the teepee burners announced to observers how business was doing at the sawmill. This practice had two major features: it wasted resources and polluted the air.

Enter the pulp, paper, and board industry. It does not create residues but uses them as raw material. Some residues are still burned but as fuel in wood-fired boilers.

In 1981 nearly all residues were used:

Residue type	Estimated volume generated ² <i>Thousand bone-dry units</i>	Percent used
Coarse	817	99
Fine	427	93
Bark	321	89
	Total	95

By contrast, in 1969 less than two-thirds of generated residues were used.

Markets

The primary markets for Montana's wood products are the Midwest and Great Plains States.

The primary market area for wood products manufactured in Montana is the north-central region of the United States (the Midwest and Great Plains States). Over a third of the plywood and lumber ended up there in 1981. Much of the rest went to the Rocky Mountain and Pacific Coast States.

The primary market for posts and poles was Montana, with significant amounts going to the Pacific Coast. House logs, on the other hand, stayed largely in the Rocky Mountain and Pacific Coast area, although over a third of the production went to the north-central region. In fact, shipments of all wood products to that region in 1981 were about 35 percent of Montana's total production.

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²A bone-dry unit is 2,400 points, oven-dry weight.

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APPENDIX I: TERMINOLOGY

Acceptable trees—Growing stock trees meeting specified standards of size and quality, but not qualifying as desirable trees.

Area condition class—See stocking.

Bureau of Land Management land—Federal lands administered by the Bureau of Land Management, U.S. Department of the Interior.

Commercial forest land—See commercial timberland.

Commercial species—Tree species suitable for industrial wood products.

Commercial timberland—Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as commercial timberland have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently, inaccessible and inoperable areas are included.)

Cord—A pile of stacked wood containing 128 cubic feet within its outside surfaces. The standard dimensions are 4 by 4 by 8 feet.

Cropland—Land under cultivation within the past 24 months, including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, and land in soil improving crops, but excluding land cultivated in developing improved pasture.

Cull trees—Live trees of sawtimber and poletimber size that are unmerchantable for saw logs now or prospectively because of roughness, rot, or species (also see rotten trees and rough trees).

Deferred forest land—National Forest lands that meet productivity standards for commercial forest, but are under study for possible inclusion in the Wilderness System.

Desirable trees—Growing stock trees (1) having no serious defect in quality to limit present or prospective use for timber products; (2) of relatively high vigor; and (3) containing no pathogens that may result in death or serious deterioration before rotation age.

Diameter classes—A classification of trees based on diameter outside bark measured at breast height (4½ feet above the ground). D.b.h. is the common abbreviation for "diameter at breast height." When using 2-inch diameter classes, the 6-inch class, for example, includes trees 5.0 through 6.9 inches d.b.h. inclusive.

Ecosystem—A complete, interacting system of organisms considered together with their environment; for example, a marsh, a watershed, a lake, etc.

Establishment—An economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed.

Farmer and other private—All private ownerships except industry.

Farmer-owned lands—Lands owned by a person who operates a farm, either doing the work himself or directly supervising the work.

Forest industry lands—Lands owned by companies or individuals operating wood-processing plants.

Forest land—Land at least 10 percent stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. (Also see Commercial timberland, Productive-reserved forest land, and Other forest land.) Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with forest trees, and forest areas adjacent to urban and built-up

lands. Also included are pinyon-juniper and chaparral areas in the West, and afforested areas. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet in width.

Forest site productivity class—A classification of forest land in terms of potential cubic-foot volume growth per acre at culmination of mean annual increment in fully stocked natural stands.

Forest types—A classification of forest land based upon the tree species presently forming a plurality of stocking. For poletimber size trees and larger, stocking is determined from basal area occurrence and for trees less than 5.0 inches d.b.h. from number of trees.

Major western forest type groups:

Douglas-fir—Forests in which Douglas-fir comprises a plurality of the stocking. (Common associates include western hemlock, western redcedar, the true firs, redwood, ponderosa pine, and larch.)

Ponderosa pine—Forests in which ponderosa pine comprises a plurality of the stocking. (Common associates include Jeffrey pine, sugar pine, limber pine, Arizona pine, Apache pine, Chihuahua pine, Douglas-fir, incense cedar, and white fir.)

Lodgepole pine—Forests in which lodgepole pine comprises a plurality of the stocking. (Common associates are alpine fir, western white pine, Engelmann spruce, aspen, and larch.)

Fir-spruce—Forests in which true firs (*Abies* spp.), Engelmann spruce, or Colorado blue spruce, singly or combination, comprises a plurality of the

stocking. (Common associates are mountain hemlock and lodgepole pine.)

Aspen—Forests in which aspen comprises a plurality of the stocking.

Hardwoods—Forests in which red alder or other western hardwoods, singly or in combination, comprise a plurality of the stocking.

Pinyon-juniper—Forests in which pinyon pine and/or juniper comprise a plurality of the stocking.

Growing stock trees—Live sawtimber trees, poletimber trees, saplings, and seedlings meeting specified standards of quality or vigor; excludes cull trees.

Growing stock volume—Net volume in cubic feet of live sawtimber and poletimber trees from stump to a minimum 4-inch top (of central stem) outside bark or to the point where the central stem breaks into limbs.

Growth—See definition for "Net annual growth."

Hardwoods—Dicotyledonous trees, usually broad-leaved and deciduous.

Indian lands—Tribal lands held in fee by the Federal Government but administered for Indian tribal groups and Indian trust allotments.

Industrial wood—All commercial roundwood products except fuelwood.

Land area—Census definition: The area of dry land and land temporarily or partially covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres of area.

Forest Survey definition: Same as above except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Logging residues—The unused portions of pole timber and saw timber trees cut or killed by logging.

Mortality—The volume of sound wood in live trees that have died from natural causes during a specified period.

National Forest System land—Federal lands designated by Executive Order or statute as National Forests or purchase units, and other lands under the administration of the Forest Service including experimental areas and Bankhead-Jones Title III lands.

Net annual growth—The net increase in the volume of trees during a specified year. Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to its end, plus the net volume of trees reaching the minimum size class during the year, minus the volume of trees that died during the year, and minus the net volume of trees that became rough or rotten trees during the year.

Net volume in board feet—The gross board-foot volume of trees less deductions for rot or other defect affecting use for lumber.

Net volume in cubic feet—Gross volume in cubic feet less deductions for rot, roughness, and poor form. Volume is computed for the central stem from a 1-foot stump to a minimum 4.0-inch top diameter outside bark, or to the point where the central stem breaks into limbs.

Nonforest land—Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. (Note: Includes crop lands, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of

the Census as nonforest land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.)

Nonstocked areas—Commercial timberland less than 10 percent stocked with growing stock trees.

Other Federal land—Federal land other than lands administered by the Forest Service or the Bureau of Land Management.

Other forest land—Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

Other land—All land area other than forest and range lands.

Other private land—Privately owned land other than forest industry or farmer-owned.

Other public land—Publicly owned land other than National Forest System land.

Other removals—The net volume of growing stock trees removed from the inventory by cultural operations such as timber-stand improvement, by land clearing, and by changes in land use, such as a shift to wilderness.

Other species—Tree species of typical small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Ownership—The property under one owner, including all parcels of land in the United States.

Pasture—Land that is currently improved for grazing by cultivation, seeding, or irrigation.

Plant byproducts—Wood material from primary manufacturing plants (such as slabs, edgings, trimmings, miscuts, sawdust shavings, veneer cores and clippings, and pulp screenings) that are used for some products.

Poletimber stands—Stands at least 10 percent stocked with growing stock trees, of which half or more of the stocking is sawtimber and/or poletimber trees with poletimber stocking exceeding that of sawtimber. (See definition for Stocking.)

Poletimber trees—Live trees of commercial species at least 5.0 inches in diameter at breast height but smaller than sawtimber size, and of good form and vigor.

Potential growth—The average net annual growth per acre attainable in fully stocked natural stands at culmination of mean annual growth of dominant or codominant trees.

Primary manufacturing plants—Plants using roundwood products such as saw logs, pulpwood bolts, veneer logs, etc.

Productive-reserved forest land—Productive public forest land withdrawn from timber utilization through statute or administrative regulations.

Productivity class—A classification of forest land in terms of potential growth in cubic feet of fully stocked natural stands.

Rangeland—Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs, including land revegetated naturally or artificially that is managed like native vegetation. Rangeland includes natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows that are less than 10 percent stocked with forest trees of any size.

Removals—The net volume of growing-stock or sawtimber trees removed from the inventory by harvesting; cultural operations, such as timber stand improvement; land clearings; or changes in land use.

Residues:

Coarse residues—Plant residues suitable for chipping, such as slabs, edgings, and ends.

Fine residues—Plant residues not suitable for chipping, such as sawdust, shavings, and veneer clippings.

Logging residues—The unused portions of sawtimber and poletimber trees cut or killed by logging.

Plant residues—Wood materials from primary manufacturing plants that are not used for any product.

Urban residues—Wood materials from urban areas, such as newspapers, lumber and plywood from building demolition, and used packaging and shipping wood materials.

Rotten trees—Live trees of commercial species that do not contain a saw log now or prospectively, primarily because of rot (such as when rot accounts for more than 50 percent of the total cull volume).

Rough trees—(a) Live trees of commercial species that do not contain a saw log, now or prospectively, primarily because of roughness, poor form, splits, and cracks, and with less than one-third of the gross tree volume in sound material; and (b) all live trees of noncommercial species.

Roundwood equivalent—The volume of logs or other round products required to produce the lumber, plywood, woodpulp, paper, or other similar products.

Roundwood logs—Logs, bolts, or other round sections cut from trees.

Salvable dead trees—Standing or down dead trees that are considered currently or potentially merchantable by regional standards.

Saplings—Live trees of commercial species 1.0 inch to 5.0 inches d.b.h. and of good form and vigor.

Sapling and seedling stands—Stands at least 10 percent occupied with growing stock trees of which more than half of the stocking is saplings and/or seedlings.

Saw log—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, and with a minimum diameter inside bark for softwoods of 6 inches (8 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw log portion—That part of the bole of sawtimber trees between the stump and the saw log top.

Saw log top—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw log top is 7.0 inches diameter outside bark (d.o.b.) for softwoods, and 9.0 inches d.o.b. for hardwoods.

Sawtimber stands—Stands at least 10 percent occupied with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Sawtimber trees—Live trees of commercial species containing at least one 12-foot saw log or two noncontiguous 8-foot logs, and meeting regional specifications for freedom from defect. Softwood trees must be at least 9 inches d.b.h. and hardwood trees 11 inches d.b.h.

Sawtimber volume—Net volume of the saw log portion of live sawtimber trees in board feet.

Seedlings—Established live trees of commercial species less than 1.0 inch d.b.h. and of good form and vigor.

Softwoods—Monocotyledonous trees, usually evergreen, having needle or scalelike leaves.

Special interest areas—Areas described in the Environmental Policy Act of 1970 that include (1) cultural areas—historic or prehistoric sites and places of obvious future historical value, and (2) natural areas—outstanding ex-

amples of the Nation's geological and ecological features.

Standard error—An expression of the degree of confidence that can be placed on an estimated total or average obtained by statistical sampling methods. Sampling errors do not include technique errors that could occur in photo classification of areas, measurement of volume, or compilation of data.

Stand improvement—Measures such as thinning, pruning, release cutting, girdling, weeding, or poisoning of unwanted trees aimed at improving growing conditions for the remaining trees.

Stand-size classes—A classification of forest land based on the predominant size of timber present. See Poletimber stands, Sapling and seedling stands, and Sawtimber stands.

State, county, and municipal lands—Lands owned by States, counties, and local public agencies, or lands leased by these governmental units for more than 50 years.

Stocking—Stocking is an expression of the extent to which growing space is effectively utilized by present or potential growing stock trees of commercial species. "Percent of stocking" is synonymous with "percentage of growing space occupied" and means the ratio of actual stocking to full stocking for comparable sites and stands. Basal area is used as a basis for measuring stocking. Full utilization of the site is assumed to occur over a range of basal area. As an interim guide, 60 percent of the normal yield table values has been used to establish the lower limit of this range, which represents full-site occupancy. This is called 100 percent stocking. The upper limit of full stocking has been set at 132 percent. Sites with less than 100 percent stocking represent less than full-site occupancy. Overstocking is characterized by sites with 133 percent or more stocking.

“Stocking percentages” express current area occupancy in relation to specified standards for full stocking based on number, size, and spacing of trees considered necessary to fully utilize the forest land, and are summarized into the following area condition classes:

Class 10—Areas fully stocked (100 to 132 percent) with desirable trees and not overstocked (133 percent or more).

Class 20—Areas fully stocked with desirable trees, but overstocked with all live trees.

Class 30—Areas medium to fully stocked (60 to 99 percent) with desirable trees and with less than 30 percent of the area controlled by other trees and/or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.

Class 40—Areas medium to fully stocked with desirable trees and with 30 percent or more of the area controlled by other trees and/or conditions that ordinarily prevent occupancy by desirable trees.

Class 50—Areas poorly stocked (16.7 to 59 percent) with desirable trees, but fully stocked with growing stock trees.

Class 60—Areas poorly stocked with desirable trees, but with medium to full stocking of growing stock trees.

Class 70—Areas nonstocked (less than 16.7 percent) or poorly stocked with desirable trees, and poorly stocked with growing stock trees.

Class 80—Low-risk old-growth stands.

Class 90—High-risk old-growth stands.

Nonstocked—Areas less than 16.7 percent stocked with growing stock trees.

Upper-stem portion—That part of the main stem or fork of sawtimber trees above the saw log top to a minimum top diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Urban and other areas—Areas within the legal boundaries of cities and towns; suburban areas developed for residential, industrial, or recreational purposes; school yards; cemeteries; roads; railroads; airports; beaches; powerlines and other rights-of-way; or other nonforest land not included in any other specified land use class.

Water—Census definition: Streams, sloughs, estuaries, and canals more than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds more than 40 acres in area.

Forest Survey definition: Same as above except minimum width of streams, etc., is 120 feet, and minimum size of lakes, etc., is 1 acre.

Wilderness—An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value (from Wilderness Act 1964).

APPENDIX II: INVENTORY TECHNIQUES

The inventory was designed to provide reliable statistics primarily at the State and working circle levels. Procedures were as follows:

1. Initial area estimates were based on the classification of 620,227 sample points systematically placed on the latest aerial photographs available. The sample points were summarized and grouped into strata for subsequent field sampling. The photo points, adjusted to meet known land areas, were used to compute area expansion factors for the field stratum means.
2. Land classification and estimates of timber characteristics and volume were based on observations and measurements recorded at 3,857 ground sample locations. Sample trees were selected using a 10-point cluster, which includes fixed plots (1/300-acre) for trees less than 5 inches d.b.h. and variable plots (40-BAF) for trees 5 inches d.b.h. or larger.
3. Kemp's equations were used to compute volume and defect.
4. All photo and field data were sent to Ogden, UT, for editing and were punched onto cards and stored for machine computing, sorting, and tabulation. Final estimates were based on statistical summaries of the data.

APPENDIX III: RELIABILITY OF THE DATA

Individual cells within tables should be used with caution. Some are based on very small sample sizes, and so result in high sampling errors. The standard error percentages shown in tables 16 and 17 were calculated at the 67 percent confidence level.

Table 16.--Area of other public and private forest land excluding National Forest in Montana with percent standard error, 1980

Item	Softwoods		Hardwoods		All types	
	Acres	Percent standard error	Acres	Percent standard error	Acres	Percent standard error
Commercial timberland	5,110,355	±1.1	299,174	±8.7	5,409,529	±1.0
Productive reserved ¹	110,021		11,866		121,887	
Other forest land:						
Unproductive reserved ¹	28,562		4,209		32,771	
Unproductive nonreserved	737,431	±6.2	107,229	±15.8	844,660	±5.7

¹Reserved land areas are estimated from aerial photos without field verification; therefore, standard errors are not calculated.

Table 17.--Net volume, net annual growth, and annual mortality of growing stock and sawtimber on other public and private commercial timberland excluding National Forest in Montana with percent standard error

Item	Softwoods		Hardwoods		All types	
	Volume	Percent standard error	Volume	Percent standard error	Volume	Percent standard error
Net volume, 1980:						
Growing stock (M cubic feet)	7,659,213	±1.9	371,332	±11.2	8,030,545	±1.8
Sawtimber (M board feet)	26,949,954	±2.3	1,169,147	±13.8	28,119,101	±2.3
Net annual growth, 1979:						
Growing stock (M cubic feet)	160,528	±3.5	7,952	±15.1	168,480	±3.4
Sawtimber (M board feet)	605,740	±3.6	30,755	±21.6	636,495	±3.6
Annual mortality, 1979:						
Growing stock (M cubic feet)	36,477	±6.6	2,159	±28.0	38,636	±6.5
Sawtimber (M board feet)	113,162	±8.9	6,236	±42.7	119,398	±8.8

APPENDIX IV: FOREST SURVEY TABLES

Table 18.--Area of commercial timberland in Montana by forest type, stand-size class, and productivity class, 1980

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Douglas-fir:						
Sawtimber	0.6	437.6	1,134.8	1,381.5	590.1	3,544.6
Poletimber	--	33.4	127.8	319.5	173.8	654.5
Sapling and seedling	--	20.5	132.8	233.9	193.3	580.5
Nonstocked	--	1.4	38.9	26.3	27.3	93.9
Total	0.6	492.9	1,434.3	1,961.2	984.5	4,873.5
Western hemlock:						
Sawtimber	0.6	41.9	27.1	13.7	0.5	83.8
Poletimber	--	2.7	--	0.1	--	2.8
Sapling and seedling	--	4.3	2.6	--	--	6.9
Nonstocked	--	1.0	--	--	2.1	3.1
Total	0.6	49.9	29.7	13.8	2.6	96.6
Ponderosa pine:						
Sawtimber	1.4	49.1	161.0	271.3	617.9	1,100.7
Poletimber	--	9.8	5.0	45.6	111.9	172.3
Sapling and seedling	--	3.4	16.9	46.9	257.2	324.4
Nonstocked	--	--	6.1	9.8	23.8	39.7
Total	1.4	62.3	189.0	373.6	1,010.8	1,637.1
Western white pine:						
Sawtimber	1.9	6.7	23.8	0.4	--	32.8
Poletimber	--	4.6	0.2	--	0.1	4.9
Sapling and seedling	--	--	0.6	--	--	0.6
Nonstocked	--	--	--	--	--	--
Total	1.9	11.3	24.6	0.4	0.1	38.3
Lodgepole pine:						
Sawtimber	3.9	104.0	546.6	656.1	235.7	1,546.3
Poletimber	5.0	94.5	618.3	735.5	362.6	1,815.9
Sapling and seedling	--	41.4	81.6	182.2	159.5	464.7
Nonstocked	--	0.3	7.8	15.1	15.4	38.6
Total	8.9	240.2	1,254.3	1,588.9	773.2	3,865.5
Western larch:						
Sawtimber	26.9	179.9	117.8	75.3	4.8	404.7
Poletimber	2.4	33.3	59.6	10.7	--	106.0
Sapling and seedling	1.1	28.5	75.4	33.0	14.4	152.4
Nonstocked	--	6.2	3.2	0.6	--	10.0
Total	30.4	247.9	256.0	119.6	19.2	673.1
Western redcedar:						
Sawtimber	0.6	36.4	55.3	8.5	--	100.8
Poletimber	--	--	12.1	--	--	12.1
Sapling and seedling	--	2.4	7.1	--	--	9.5
Nonstocked	--	--	--	--	--	--
Total	0.6	38.8	74.5	8.5	--	122.4
Whitebark-limber pine:						
Sawtimber	--	--	7.7	35.3	83.5	126.5
Poletimber	--	--	--	--	33.4	33.4
Sapling and seedling	--	--	3.5	--	15.7	19.2
Nonstocked	--	--	--	--	2.5	2.5
Total	--	--	11.2	35.3	135.1	181.6

(con.)

Table 18. (Con.)

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Grand fir:						
Sawtimber	4.3	32.2	83.4	15.8	--	135.7
Poletimber	--	23.9	10.2	--	--	34.1
Sapling and seedling	--	4.8	30.5	4.5	--	39.8
Nonstocked	--	--	1.7	--	--	1.7
Total	4.3	60.9	125.8	20.3	--	211.3
Subalpine fir-spruce:						
Sawtimber	4.5	105.6	307.9	257.4	123.9	799.3
Poletimber	--	9.1	65.4	52.6	51.0	178.1
Sapling and seedling	--	11.4	104.6	94.4	50.3	260.7
Nonstocked	--	--	9.0	5.5	--	14.5
Total	4.5	126.1	486.9	409.9	225.2	1,252.6
Engelmann spruce:						
Sawtimber	--	50.1	102.1	51.0	18.1	221.3
Poletimber	--	7.9	6.1	17.4	0.8	32.2
Sapling and seedling	--	29.9	13.9	10.8	3.7	58.3
Nonstocked	--	--	2.1	--	--	2.1
Total	--	87.9	124.2	79.2	22.6	313.9
Other softwoods:						
Sawtimber	--	--	--	--	0.1	0.1
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	0.1	0.1
Aspen:						
Sawtimber	--	4.2	7.2	9.0	--	20.4
Poletimber	--	3.7	6.0	21.2	19.3	50.2
Sapling and seedling	--	--	1.3	7.7	23.0	32.0
Nonstocked	--	--	--	3.6	3.7	7.3
Total	--	7.9	14.5	41.5	46.0	109.9
Cottonwood:						
Sawtimber	--	--	7.2	38.0	111.0	156.2
Poletimber	--	--	--	3.5	9.8	13.3
Sapling and seedling	--	--	--	--	9.4	9.4
Nonstocked	--	--	--	--	4.0	4.0
Total	--	--	7.2	41.5	134.2	182.9
Other hardwoods:						
Sawtimber	--	--	--	3.1	3.4	6.5
Poletimber	--	--	--	1.1	--	1.1
Sapling and seedling	--	--	--	4.1	--	4.1
Nonstocked	--	--	--	--	0.8	0.8
Total	--	--	--	8.3	4.2	12.5
All types:						
Sawtimber	44.7	1,047.7	2,581.9	2,816.4	1,789.0	8,279.7
Poletimber	7.4	222.9	910.7	1,207.2	762.7	3,110.9
Sapling and seedling	1.1	146.6	470.8	617.5	726.5	1,962.5
Nonstocked	--	8.9	68.8	60.9	79.6	218.2
Total	53.2	1,426.1	4,032.2	4,702.0	3,357.8	13,571.3

Table 19.--Area of National Forest owned commercial timberland in Montana by forest type, stand-size class, and productivity class, 1980

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Douglas-fir:						
Sawtimber	0.6	378.7	917.1	531.0	206.0	2,033.4
Poletimber	--	29.9	109.6	139.5	29.2	308.2
Sapling and seedling	--	18.2	90.7	42.3	35.1	186.3
Nonstocked	--	1.4	38.9	12.5	2.4	55.2
Total	0.6	428.2	1,156.3	725.3	272.7	2,583.1
Western hemlock:						
Sawtimber	0.6	41.9	23.3	13.7	0.5	80.0
Poletimber	--	2.7	--	0.1	--	2.8
Sapling and seedling	--	--	2.6	--	--	2.6
Nonstocked	--	1.0	--	--	2.1	3.1
Total	0.6	45.6	25.9	13.8	2.6	88.5
Ponderosa pine:						
Sawtimber	--	31.0	74.7	56.8	106.8	269.3
Poletimber	--	5.4	1.0	27.7	8.9	43.0
Sapling and seedling	--	2.7	9.8	5.0	5.4	22.9
Nonstocked	--	--	0.7	1.8	2.3	4.8
Total	--	39.1	86.2	91.3	123.4	340.0
Western white pine:						
Sawtimber	1.9	6.7	23.8	0.4	--	32.8
Poletimber	--	0.6	0.2	--	0.1	0.9
Sapling and seedling	--	--	0.6	--	--	0.6
Nonstocked	--	--	--	--	--	--
Total	1.9	7.3	24.6	0.4	0.1	34.3
Lodgepole pine:						
Sawtimber	3.9	97.0	489.4	512.0	170.4	1,272.7
Poletimber	--	81.2	553.9	557.6	285.0	1,477.7
Sapling and seedling	--	33.9	64.7	141.0	87.9	327.5
Nonstocked	--	0.3	7.8	5.8	8.2	22.1
Total	3.9	212.4	1,115.8	1,216.4	551.5	3,100.0
Western larch:						
Sawtimber	22.6	170.2	65.2	11.5	0.7	270.2
Poletimber	2.4	33.3	57.4	--	--	93.1
Sapling and seedling	1.1	28.5	65.2	1.3	--	96.1
Nonstocked	--	6.2	3.2	--	--	9.4
Total	26.1	238.2	191.0	12.8	0.7	468.8
Western redcedar:						
Sawtimber	0.6	36.4	30.9	--	--	67.9
Poletimber	--	--	12.1	--	--	12.1
Sapling and seedling	--	2.4	7.1	--	--	9.5
Nonstocked	--	--	--	--	--	--
Total	0.6	38.8	50.1	--	--	89.5
Whitebark-limber pine:						
Sawtimber	--	--	7.7	21.8	45.3	74.8
Poletimber	--	--	--	--	27.5	27.5
Sapling and seedling	--	--	--	--	4.5	4.5
Nonstocked	--	--	--	--	--	--
Total	--	--	7.7	21.8	77.3	106.8

(con.)

Table 19. (Con.)

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- <u>Thousand acres</u> -----						
Grand fir:						
Sawtimber	--	29.4	49.5	--	--	78.9
Poletimber	--	23.9	8.8	--	--	32.7
Sapling and seedling	--	0.4	24.0	1.3	--	25.7
Nonstocked	--	--	1.7	--	--	1.7
Total	--	53.7	84.0	1.3	--	139.0
Subalpine fir-spruce:						
Sawtimber	4.5	91.7	278.2	175.6	113.3	663.3
Poletimber	--	9.1	57.6	35.9	47.1	149.7
Sapling and seedling	--	11.4	99.1	43.2	22.6	176.3
Nonstocked	--	--	5.4	1.6	--	7.0
Total	4.5	112.2	440.3	256.3	183.0	996.3
Engelmann spruce:						
Sawtimber	--	41.8	61.7	28.8	14.4	146.7
Poletimber	--	5.0	2.3	8.3	0.8	16.4
Sapling and seedling	--	29.9	11.1	3.0	--	44.0
Nonstocked	--	--	2.1	--	--	2.1
Total	--	76.7	77.2	40.1	15.2	209.2
Other softwoods:						
Sawtimber	--	--	--	--	0.1	0.1
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	0.1	0.1
Aspen:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Cottonwood:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Other hardwoods:						
Sawtimber	--	--	--	1.7	3.4	5.1
Poletimber	--	--	--	1.1	--	1.1
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	2.8	3.4	6.2
All types:						
Sawtimber	34.7	924.8	2,021.5	1,353.3	660.9	4,995.2
Poletimber	2.4	191.1	802.9	770.2	398.6	2,165.2
Sapling and seedling	1.1	127.4	374.9	237.1	155.5	896.0
Nonstocked	--	8.9	59.8	21.7	15.0	105.4
Total	38.2	1,252.2	3,259.1	2,382.3	1,230.0	8,161.8

Table 20.--Area of other publicly owned commercial timberland in Montana by forest type, stand-size class, and productivity class, 1980

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Douglas-fir:						
Sawtimber	--	12.4	45.0	111.6	43.4	212.4
Poletimber	--	1.0	3.5	23.0	18.0	45.5
Sapling and seedling	--	0.4	6.8	18.5	11.9	37.6
Nonstocked	--	--	--	2.3	3.2	5.5
Total	--	13.8	55.3	155.4	76.5	301.0
Western hemlock:						
Sawtimber	--	--	(1)	--	--	(1)
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	(1)	--	--	(1)
Ponderosa pine:						
Sawtimber	1.4	5.1	10.9	27.1	72.0	116.5
Poletimber	--	(1)	1.5	3.6	17.0	22.1
Sapling and seedling	--	(1)	1.8	4.6	31.5	37.9
Nonstocked	--	--	0.1	0.5	1.6	2.2
Total	1.4	5.1	14.3	35.8	122.1	178.7
Western white pine:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	0.1	--	--	--	0.1
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	0.1	--	--	--	0.1
Lodgepole pine:						
Sawtimber	--	--	12.3	22.1	12.8	47.2
Poletimber	0.8	1.1	11.0	28.4	7.3	48.6
Sapling and seedling	--	3.3	0.4	7.0	6.1	16.8
Nonstocked	--	--	--	1.3	0.4	1.7
Total	0.8	4.4	23.7	58.8	26.6	114.3
Western larch:						
Sawtimber	0.1	1.5	6.7	16.8	1.4	26.5
Poletimber	--	--	2.2	1.2	--	3.4
Sapling and seedling	--	--	3.3	2.8	1.8	7.9
Nonstocked	--	--	--	0.6	--	0.6
Total	0.1	1.5	12.2	21.4	3.2	38.4
Western redcedar:						
Sawtimber	--	--	0.4	1.4	--	1.8
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	0.4	1.4	--	1.8
Whitebark-limber pine:						
Sawtimber	--	--	--	2.0	5.8	7.8
Poletimber	--	--	--	--	0.8	0.8
Sapling and seedling	--	--	0.4	--	1.4	1.8
Nonstocked	--	--	--	--	1.4	1.4
Total	--	--	0.4	2.0	9.4	11.8

(con.)

Table 20. (Con.)

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Grand fir:						
Sawtimber	--	2.8	4.4	2.8	--	10.0
Poletimber	--	--	1.4	--	--	1.4
Sapling and seedling	--	--	2.1	1.0	--	3.1
Nonstocked	--	--	--	--	--	--
Total	--	2.8	7.9	3.8	--	14.5
Subalpine fir-spruce:						
Sawtimber	--	1.4	10.7	16.7	4.4	33.2
Poletimber	--	--	0.7	1.9	1.7	4.3
Sapling and seedling	--	--	2.8	8.5	4.0	15.3
Nonstocked	--	--	0.1	(¹)	--	0.1
Total	--	1.4	14.3	27.1	10.1	52.9
Engelmann spruce:						
Sawtimber	--	1.8	4.8	3.2	0.2	10.0
Poletimber	--	0.3	(¹)	0.9	--	1.2
Sapling and seedling	--	--	--	1.7	0.6	2.3
Nonstocked	--	--	--	--	--	--
Total	--	2.1	4.8	5.8	0.8	13.5
Other softwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Aspen:						
Sawtimber	--	0.1	0.3	1.0	--	1.4
Poletimber	--	--	0.7	3.6	2.1	6.4
Sapling and seedling	--	--	0.6	0.6	1.4	2.6
Nonstocked	--	--	--	0.6	0.5	1.1
Total	--	0.1	1.6	5.8	4.0	11.5
Cottonwood:						
Sawtimber	--	--	0.5	4.8	12.9	18.2
Poletimber	--	--	--	0.3	0.9	1.2
Sapling and seedling	--	--	--	--	0.8	0.8
Nonstocked	--	--	--	--	0.4	0.4
Total	--	--	0.5	5.1	15.0	20.6
Other hardwoods:						
Sawtimber	--	--	--	0.1	--	0.1
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	(¹)	--	(¹)
Nonstocked	--	--	--	--	0.1	0.1
Total	--	--	--	0.1	0.1	0.2
All types:						
Sawtimber	1.5	25.1	96.0	209.6	152.9	485.1
Poletimber	0.8	2.5	21.0	62.9	47.8	135.0
Sapling and seedling	--	3.7	18.2	44.7	59.5	126.1
Nonstocked	--	--	.2	5.3	7.6	13.1
Total	2.3	31.3	135.4	322.5	267.8	759.3

¹Less than 0.5 thousand acres.

Table 21.--Area of forest industry owned commercial timberland in Montana by forest type, stand-size class, and productivity class, 1980

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
- - - - - Thousand acres - - - - -						
Douglas-fir:						
Sawtimber	--	33.5	104.8	327.2	74.9	540.4
Poletimber	--	0.4	2.7	55.8	28.9	87.8
Sapling and seedling	--	0.9	11.9	79.2	50.9	142.9
Nonstocked	--	--	--	7.7	4.6	12.3
Total	--	34.8	119.4	469.9	159.3	783.4
Western hemlock:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	4.3	--	--	--	4.3
Nonstocked	--	--	--	--	--	--
Total	--	4.3	--	--	--	4.3
Ponderosa pine:						
Sawtimber	--	0.5	29.9	40.5	13.9	84.8
Poletimber	--	--	0.5	2.8	2.9	6.2
Sapling and seedling	--	0.1	2.7	22.6	10.1	35.5
Nonstocked	--	--	4.6	5.8	5.0	15.4
Total	--	0.6	37.7	71.7	31.9	141.9
Western white pine:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Lodgepole pine:						
Sawtimber	--	7.0	17.5	60.1	17.2	101.8
Poletimber	--	4.3	27.6	92.6	14.7	139.2
Sapling and seedling	--	--	2.8	23.5	35.4	61.7
Nonstocked	--	--	--	1.4	2.6	4.0
Total	--	11.3	47.9	177.6	69.9	306.7
Western larch:						
Sawtimber	--	4.3	29.6	33.3	2.7	69.9
Poletimber	--	--	--	2.7	--	2.7
Sapling and seedling	--	--	6.9	23.0	12.6	42.5
Nonstocked	--	--	--	--	--	--
Total	--	4.3	36.5	59.0	15.3	115.1
Western redcedar:						
Sawtimber	--	--	8.5	7.1	--	15.6
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	8.5	7.1	--	15.6
Whitebark-limber pine:						
Sawtimber	--	--	--	3.1	10.4	13.5
Poletimber	--	--	--	--	1.1	1.1
Sapling and seedling	--	--	--	(1)	1.7	1.7
Nonstocked	--	--	--	--	--	--
Total	--	--	--	3.1	13.2	16.3

(con.)

Table 21. (Con.)

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
- - - - - Thousand acres - - - - -						
Grand fir:						
Sawtimber	4.3	--	21.6	13.0	--	38.9
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	4.4	4.4	0.2	--	9.0
Nonstocked	--	--	--	--	--	--
Total	4.3	4.4	26.0	13.2	--	47.9
Subalpine fir-spruce:						
Sawtimber	--	12.5	15.1	27.7	3.8	59.1
Poletimber	--	--	7.1	4.8	0.4	12.3
Sapling and seedling	--	--	2.7	30.7	9.5	42.9
Nonstocked	--	--	--	1.3	--	1.3
Total	--	12.5	24.9	64.5	13.7	115.6
Engelmann spruce:						
Sawtimber	--	--	25.2	9.2	1.1	35.5
Poletimber	--	--	--	4.3	--	4.3
Sapling and seedling	--	--	2.8	0.4	0.9	4.1
Nonstocked	--	--	--	--	--	--
Total	--	--	28.0	13.9	2.0	43.9
Other softwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Aspen:						
Sawtimber	--	--	--	1.2	--	1.2
Poletimber	--	--	0.1	(¹)	(¹)	0.1
Sapling and seedling	--	--	0.1	1.0	2.5	3.6
Nonstocked	--	--	--	--	(¹)	--
Total	--	--	0.2	2.2	2.5	4.9
Cottonwood:						
Sawtimber	--	--	3.3	1.7	0.6	5.6
Poletimber	--	--	--	(¹)	(¹)	(¹)
Sapling and seedling	--	--	--	--	0.1	0.1
Nonstocked	--	--	--	--	--	--
Total	--	--	3.3	1.7	0.7	5.7
Other hardwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
All types:						
Sawtimber	4.3	57.8	255.5	524.1	124.6	966.3
Poletimber	--	4.7	38.0	163.0	48.0	253.7
Sapling and seedling	--	9.7	34.3	180.6	123.7	348.3
Nonstocked	--	--	4.6	16.2	12.2	33.0
Total	4.3	72.2	332.4	883.9	308.5	1,601.3

¹Less than 0.5 thousand acres.

Table 22.--Area of privately owned commercial timberland in Montana by forest type, stand-size class, and productivity class, 1980

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Douglas-fir:						
Sawtimber	--	13.0	67.9	411.7	265.8	758.4
Poletimber	--	2.1	12.0	101.2	97.7	213.0
Sapling and seedling	--	1.0	23.4	93.9	95.4	213.7
Nonstocked	--	--	--	3.8	17.1	20.9
Total	--	16.1	103.3	610.6	476.0	1,206.0
Western hemlock:						
Sawtimber	--	--	3.8	--	--	3.8
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	3.8	--	--	3.8
Ponderosa pine:						
Sawtimber	--	12.5	45.5	146.9	425.2	630.1
Poletimber	--	4.4	2.0	11.5	83.1	101.0
Sapling and seedling	--	0.6	2.6	14.7	210.2	228.1
Nonstocked	--	--	0.7	1.7	14.9	17.3
Total	--	17.5	50.8	174.8	733.4	976.5
Western white pine:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	3.9	--	--	--	3.9
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	3.9	--	--	--	3.9
Lodgepole pine:						
Sawtimber	--	--	27.4	61.9	35.3	124.6
Poletimber	4.2	7.9	25.8	56.9	55.6	150.4
Sapling and seedling	--	4.2	13.7	10.7	30.1	58.7
Nonstocked	--	--	--	6.6	4.2	10.8
Total	4.2	12.1	66.9	136.1	125.2	344.5
Western larch:						
Sawtimber	4.2	3.9	16.3	13.7	--	38.1
Poletimber	--	--	--	6.8	--	6.8
Sapling and seedling	--	--	--	5.9	--	5.9
Nonstocked	--	--	--	--	--	--
Total	4.2	3.9	16.3	26.4	--	50.8
Western redcedar:						
Sawtimber	--	--	15.5	--	--	15.5
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	15.5	--	--	15.5
Whitebark-limber pine:						
Sawtimber	--	--	--	8.4	22.0	30.4
Poletimber	--	--	--	--	4.0	4.0
Sapling and seedling	--	--	3.1	--	8.1	11.2
Nonstocked	--	--	--	--	1.1	1.1
Total	--	--	3.1	8.4	35.2	46.7

(con.)

Table 22. (Con.)

Forest type and stand-size class	Productivity class					Total acres
	165+	120-164	85-119	50-84	20-49	
----- Thousand acres -----						
Grand fir:						
Sawtimber	--	--	7.9	--	--	7.9
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	2.0	--	2.0
Nonstocked	--	--	--	--	--	--
Total	--	--	7.9	2.0	--	9.9
Subalpine fir-spruce:						
Sawtimber	--	--	3.9	37.4	2.4	43.7
Poletimber	--	--	--	10.0	1.8	11.8
Sapling and seedling	--	--	--	12.0	14.2	26.2
Nonstocked	--	--	3.5	2.6	--	6.1
Total	--	--	7.4	62.0	18.4	87.8
Engelmann spruce:						
Sawtimber	--	6.5	10.4	9.8	2.4	29.1
Poletimber	--	2.6	3.8	3.9	--	10.3
Sapling and seedling	--	--	--	5.7	2.2	7.9
Nonstocked	--	--	--	--	--	--
Total	--	9.1	14.2	19.4	4.6	47.3
Other softwoods:						
Sawtimber	--	--	--	--	--	--
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	--	--	--
Nonstocked	--	--	--	--	--	--
Total	--	--	--	--	--	--
Aspen:						
Sawtimber	--	4.1	6.9	6.8	--	17.8
Poletimber	--	3.7	5.2	17.6	17.2	43.7
Sapling and seedling	--	--	0.6	6.1	19.1	25.8
Nonstocked	--	--	--	3.0	3.2	6.2
Total	--	7.8	12.7	33.5	39.5	93.5
Cottonwood:						
Sawtimber	--	--	3.4	31.5	97.5	132.4
Poletimber	--	--	--	3.2	8.9	12.1
Sapling and seedling	--	--	--	--	8.5	8.5
Nonstocked	--	--	--	--	3.6	3.6
Total	--	--	3.4	34.7	118.5	156.6
Other hardwoods:						
Sawtimber	--	--	--	1.3	--	1.3
Poletimber	--	--	--	--	--	--
Sapling and seedling	--	--	--	4.1	--	4.1
Nonstocked	--	--	--	--	0.7	0.7
Total	--	--	--	5.4	0.7	6.1
All types:						
Sawtimber	4.2	40.0	208.9	729.4	850.6	1,833.1
Poletimber	4.2	24.6	48.8	211.1	268.3	557.0
Sapling and seedling	--	5.8	43.4	155.1	387.8	592.1
Nonstocked	--	--	4.2	17.7	44.8	66.7
Total	8.4	70.4	305.3	1,113.3	1,551.5	3,048.9

Table 23.--Area of productive deferred, productive reserved, and other forest land in Montana by land class, ownership class, and forest type, 1980

Land class	Forest type													All types		
	Douglas-fir	Western hemlock	Ponderosa pine	Western white pine	Lodgepole pine	Western larch	Western redcedar	Whitebark-limber pine	Grand fir	Subalpine fir-spruce	Engelmann spruce	Pinon-juniper	Other softwoods		Aspen	Cottonwood
Productive deferred area:	----- Thousand acres -----															
National Forest	167.7	3.0	17.3	1.8	318.9	31.2	0.7	42.0	2.0	94.6	24.6	--	--	4.3	--	708.7
Total	167.7	3.0	17.3	1.8	318.9	31.2	0.7	42.0	2.0	94.6	24.6	--	--	4.3	--	708.7
Productive reserved area:	----- Thousand acres -----															
National Forest	215.0	15.5	49.2	2.5	643.1	24.3	0.7	198.1	0.3	124.0	157.1	--	--	9.7	--	1,439.9
Other public	8.9	--	90.1	--	2.1	0.2	--	0.1	0.1	0.1	0.1	--	--	2.4	--	112.8
Forest industry	0.4	--	(1)	--	0.7	(1)	--	0.7	(1)	(1)	(1)	--	--	--	--	1.8
Farmer and other private	2.2	--	2.4	--	0.6	0.3	--	--	0.1	0.1	0.3	--	--	0.1	--	7.2
Total	226.5	15.5	141.7	2.5	646.5	24.8	0.7	198.8	0.5	124.2	157.5	--	--	12.2	9.0	1,561.7
Other forest land area:	----- Thousand acres -----															
Reserved:	----- Thousand acres -----															
National Forest	103.7	16.3	7.6	0.2	171.0	8.5	0.1	482.2	0.1	127.1	62.1	--	--	2.9	--	981.8
Other public	1.7	--	24.4	--	0.5	--	--	0.7	--	0.1	--	--	--	0.7	--	31.6
Forest industry	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.7
Farmer and other private	(1)	--	0.3	--	(1)	--	--	--	--	--	(1)	--	--	(1)	--	0.5
Total	105.4	16.3	32.3	0.2	171.5	8.5	0.1	482.9	0.1	127.3	62.1	--	--	3.6	3.4	1,014.6
Nonreserved:	----- Thousand acres -----															
National Forest	500.3	11.7	73.3	1.8	716.8	31.2	1.3	719.4	3.4	236.2	202.1	--	--	25.7	--	2,525.0
Other public	4.5	--	89.3	--	1.2	--	--	11.1	--	0.8	--	--	--	2.4	--	149.7
Forest industry	2.0	--	0.7	--	0.5	--	--	2.8	--	0.4	--	--	--	1.1	--	12.2
Farmer and other private	45.9	--	330.0	--	8.0	--	--	62.7	--	2.5	--	--	--	45.4	--	682.8
Total	552.7	11.7	493.3	1.8	726.5	31.2	1.3	796.0	3.4	239.9	202.1	88.3	86.8	74.6	19.4	3,369.7
Total other forest land:	----- Thousand acres -----															
National Forest	604.0	28.0	80.9	2.0	887.8	39.7	1.4	1,201.6	3.5	363.3	264.2	--	--	28.6	--	3,506.8
Other public	6.2	--	113.7	--	1.7	--	--	11.1	--	0.9	--	--	--	3.1	--	181.3
Forest industry	2.0	--	0.7	--	0.5	--	--	3.5	--	0.4	--	--	--	1.1	--	12.9
Farmer and other private	45.9	--	330.3	--	8.0	--	--	62.7	--	2.5	--	--	--	45.4	--	683.3
Total	658.1	28.0	525.6	2.0	898.0	39.7	1.4	1,278.9	3.5	367.2	264.2	88.3	87.6	78.2	22.8	4,384.3
Total all areas:	----- Thousand acres -----															
National Forest	986.7	46.5	147.4	6.3	1,849.8	95.2	2.8	1,441.7	5.8	581.9	445.9	--	--	42.6	--	5,655.4
Other public	15.1	--	203.8	--	3.8	0.2	--	11.1	0.1	1.0	0.1	--	--	5.5	13.7	294.1
Forest industry	2.4	--	0.7	--	1.2	(1)	--	4.2	(1)	0.4	(1)	--	--	1.1	--	14.7
Farmer and other private	48.1	--	332.7	--	8.6	0.3	--	62.7	0.1	2.7	0.3	--	--	45.5	18.1	690.5
Total	1,052.3	46.5	684.6	6.3	1,863.4	95.7	2.8	1,519.7	6.0	586.0	446.3	88.3	88.2	94.7	31.8	6,654.7

¹Less than 0.05 thousand acres.

Table 24.--Net volume of growing stock on commercial timberland in Montana by species and diameter class, 1980

Species	Diameter class (inches at breast height)														All classes
	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 22.9	23.0- 24.9	25.0- 26.9	27.0- 28.9	29.0+.		
	----- Million cubic feet -----														
Douglas-fir	546.7	904.8	1,044.7	1,048.6	919.0	801.8	636.0	480.6	332.6	241.6	174.8	104.6	211.6	7,447.4	
Ponderosa pine	93.6	188.2	241.3	277.4	255.9	217.1	180.2	136.2	124.0	84.8	91.4	65.3	212.2	2,167.6	
Western white pine	7.5	14.8	20.2	24.6	30.3	18.7	18.2	24.3	13.9	15.3	7.5	7.3	20.2	222.8	
Lodgepole pine	1,811.9	2,601.4	1,873.4	1,141.5	565.2	227.9	88.8	40.3	10.5	6.4	1.2	1.1	0.8	8,370.4	
Whitebark-limber pine	70.9	138.1	151.3	141.8	101.2	64.2	41.0	26.1	14.2	4.9	7.0	2.2	4.5	767.4	
Western larch	121.9	205.6	219.7	205.3	203.8	192.5	180.5	171.4	154.1	143.1	103.1	73.8	203.9	2,178.7	
Grand fir	45.2	77.1	71.9	68.0	50.1	42.3	39.0	20.9	11.6	12.3	4.6	4.2	4.1	451.3	
Subalpine fir	242.9	337.4	326.0	241.5	166.4	120.8	61.8	40.2	29.0	12.9	4.4	1.2	3.4	1,587.9	
Engelmann spruce	110.1	173.1	226.5	258.3	246.4	221.4	186.3	148.4	130.4	75.4	61.3	28.3	91.2	1,957.1	
Western hemlock	18.8	46.0	33.6	37.3	29.2	32.4	25.1	17.5	18.4	19.4	12.6	9.1	15.2	314.6	
Western redcedar	22.3	33.1	27.8	32.6	26.3	19.0	14.0	18.0	9.5	8.6	11.0	10.8	49.9	282.9	
Other softwoods	--	--	--	0.6	--	--	--	--	--	--	--	--	--	0.6	
Total softwoods	3,091.8	4,719.6	4,236.4	3,477.5	2,593.8	1,958.1	1,470.9	1,123.9	848.2	624.7	478.9	307.9	817.0	25,748.7	
Aspen	28.2	37.0	39.1	25.3	9.2	2.4	1.9	1.9	0.5	0.7	0.1	0.9	0.4	147.6	
Cottonwood	4.1	6.7	10.2	16.0	22.9	21.4	22.7	24.5	25.4	13.7	9.5	12.8	31.9	221.8	
Other hardwoods	11.2	11.2	9.3	5.2	5.5	2.7	0.4	1.2	--	0.3	0.2	--	0.7	47.9	
Total hardwoods	43.5	54.9	58.6	46.5	37.6	26.5	25.0	27.6	25.9	14.7	9.8	13.7	33.0	417.3	
All species	3,135.3	4,774.5	4,295.0	3,524.0	2,631.4	1,984.6	1,495.9	1,151.5	874.1	639.4	488.7	321.6	850.0	26,166.0	

Table 25.--Net volume of sawtimber on commercial timberland in Montana by species and diameter class, 1980

Species	Diameter class (inches at breast height)												All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+		
	----- Million board feet, International 1/4-inch rule -----												
Douglas-fir	3,436.5	4,570.0	4,231.1	3,876.2	3,186.0	2,456.6	1,729.4	1,279.3	944.3	576.6	1,200.7	27,486.7	
Ponderosa pine	639.9	1,111.8	1,228.7	1,117.1	972.9	753.9	692.0	482.8	503.1	362.8	1,255.2	9,120.2	
Western white pine	84.1	128.8	162.3	99.0	97.8	132.9	77.9	89.8	43.0	44.4	124.8	1,084.8	
Lodgepole pine	7,663.6	6,023.4	3,009.0	1,206.6	464.4	200.1	54.3	31.1	6.1	5.5	4.8	18,668.9	
Whitebark-limber pine	578.3	703.5	501.0	315.6	205.7	130.6	74.3	26.7	35.5	11.7	21.3	2,604.2	
Western larch	925.1	1,106.8	1,094.4	1,034.1	969.5	914.2	838.9	794.7	582.6	415.5	1,156.2	9,832.0	
Grand fir	284.1	358.1	276.3	240.7	225.9	124.5	65.7	85.9	29.9	28.2	34.8	1,754.1	
Subalpine fir	1,284.7	1,243.8	847.5	616.2	321.1	206.7	152.4	81.1	24.7	8.2	22.3	4,808.7	
Engelmann spruce	932.6	1,357.2	1,283.0	1,154.0	969.0	784.4	697.3	417.6	353.9	169.9	570.5	8,689.4	
Western hemlock	117.7	174.7	151.5	190.0	150.1	110.4	116.5	125.0	82.7	62.0	120.9	1,401.5	
Western redcedar	122.9	187.4	159.4	117.4	86.9	111.4	69.3	71.8	87.9	88.7	455.1	1,558.2	
Other softwoods	--	2.3	--	--	--	--	--	--	--	--	--	2.3	
Total softwoods	16,069.5	16,967.8	12,944.2	9,966.9	7,649.3	5,925.7	4,568.0	3,485.8	2,693.7	1,773.5	4,966.6	87,011.0	
Aspen	XXXX	130.8	49.2	12.1	9.5	9.0	2.2	3.5	0.3	4.2	2.2	223.0	
Cottonwood	XXXX	81.3	115.2	105.5	109.2	114.2	115.5	61.5	42.9	57.8	147.8	950.9	
Other hardwoods	XXXX	26.0	27.1	13.6	1.8	6.0	--	1.1	0.8	--	3.3	79.7	
Total hardwoods	XXXX	238.1	191.5	131.2	120.5	129.2	117.7	66.1	44.0	62.0	153.3	1,253.6	
All species	16,069.5	17,205.9	13,135.7	10,098.1	7,769.8	6,054.9	4,685.7	3,551.9	2,737.7	1,835.5	5,119.9	88,264.6	

Table 26.--Net annual growth of growing stock and sawtimber on commercial timberland in Montana by ownership class and species, 1979

Species	Ownership				Total
	National Forest	Other public	Forest industry	Farmer and other private	
GROWING STOCK					
- - - - - Thousand cubic feet - - - - -					
Douglas-fir	72,291	8,181	17,890	31,530	129,892
Ponderosa pine	14,638	4,237	4,209	20,445	43,529
Western white pine	3,685	155	526	368	4,734
Lodgepole pine	125,871	7,252	14,668	18,887	166,678
Whitebark-limber pine	6,440	186	458	1,284	8,368
Western larch	23,850	2,399	4,886	3,583	34,718
Grand fir	11,562	565	2,079	323	14,529
Subalpine fir	21,059	1,084	3,226	2,975	28,344
Engelmann spruce	25,876	1,076	2,124	3,696	32,772
Western hemlock	8,500	58	586	423	9,567
Western redcedar	6,160	166	657	346	7,329
Other softwoods	14	--	--	--	14
Total softwoods	319,946	25,359	51,309	83,860	480,474
Aspen	874	265	223	2,520	3,882
Cottonwood	--	482	188	3,263	3,933
Other hardwoods	1,014	373	84	554	2,025
Total hardwoods	1,888	1,120	495	6,337	9,840
All species	321,834	26,479	51,804	90,197	490,314
SAWTIMBER					
- - Thousand board feet, International 4-inch rule - -					
Douglas-fir	250,189	35,565	79,735	140,861	506,350
Ponderosa pine	66,504	19,947	25,315	95,301	207,067
Western white pine	17,822	700	2,728	654	21,904
Lodgepole pine	186,414	14,591	31,777	49,838	282,620
Whitebark-limber pine	19,232	669	1,537	5,158	26,596
Western larch	90,405	8,928	14,671	16,441	130,445
Grand fir	34,792	2,121	7,963	2,387	47,263
Subalpine fir	42,516	3,418	4,013	4,284	54,231
Engelmann spruce	91,841	4,286	10,825	13,434	120,386
Western hemlock	29,998	52	967	2,515	33,532
Western redcedar	20,633	709	1,360	2,990	25,692
Other softwoods	59	--	--	--	59
Total softwoods	850,405	90,986	180,891	333,863	1,456,145
Aspen	734	766	335	9,210	11,045
Cottonwood	--	2,141	379	16,796	19,316
Other hardwoods	1,841	807	100	221	2,969
Total hardwoods	2,575	3,714	814	26,227	33,330
All species	852,980	94,700	181,705	360,090	1,489,475

Table 27.--Net annual growth of growing stock on commercial timberland in Montana by species and diameter class, 1979

Species	Diameter class (inches at breast height)																All classes							
	5.0-6.9	7.0-8.9	9.0-10.9	10.9-11.9	11.0-12.9	12.9-13.9	13.0-14.9	14.9-15.9	15.0-16.9	16.9-17.9	17.0-18.9	18.9-19.9	19.0-20.9	20.9-21.9	21.0-22.9	22.9-23.9		23.0-24.9	24.9-25.9	25.0-26.9	26.9-28.9	28.9-29.0+		
	----- Thousand cubic feet -----																							
Douglas-fir	32,053	21,434	19,854	17,640	13,472	10,268	6,496	4,445	2,125	1,262	1,076	313	313	313	313	313	313	313	313	313	313	313	129,892	
Ponderosa pine	7,701	5,996	6,392	6,146	5,251	3,420	2,564	1,696	1,341	920	790	419	893	893	893	893	893	893	893	893	893	893	893	43,529
Western white pine	580	605	467	744	940	296	237	355	121	71	-51	122	247	247	247	247	247	247	247	247	247	247	247	4,734
Lodgepole pine	81,515	44,597	23,621	10,844	4,811	288	475	379	104	15	14	11	4	4	4	4	4	4	4	4	4	4	4	166,678
Whitebark-limber pine	2,374	1,708	1,576	990	711	516	306	66	12	31	40	11	27	27	27	27	27	27	27	27	27	27	27	8,368
Western larch	8,293	6,417	5,200	3,973	3,713	2,628	1,728	989	370	463	268	65	611	611	611	611	611	611	611	611	611	611	611	34,718
Grand fir	3,881	3,422	2,214	1,783	937	836	933	43	210	222	77	64	-93	-93	-93	-93	-93	-93	-93	-93	-93	-93	-93	14,529
Subalpine fir	13,242	7,226	2,449	2,706	1,626	1,029	134	-86	55	128	-11	8	-162	-162	-162	-162	-162	-162	-162	-162	-162	-162	-162	14,344
Engelmann spruce	7,077	4,754	4,744	4,134	3,576	2,958	1,893	1,207	844	625	355	114	491	491	491	491	491	491	491	491	491	491	491	32,772
Western hemlock	1,811	2,268	1,360	1,148	781	681	466	337	148	296	168	121	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18	9,567
Western redcedar	1,849	1,142	814	705	576	464	173	182	132	199	227	211	655	655	655	655	655	655	655	655	655	655	655	7,329
Other softwoods	2	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	
Total softwoods	160,378	99,569	68,691	50,825	36,394	23,384	15,405	9,613	5,462	4,232	2,953	1,459	2,109	2,109	2,109	2,109	2,109	2,109	2,109	2,109	2,109	2,109	2,109	480,474
Aspen	1,318	1,083	905	570	168	-24	23	-47	-60	-53	(1)	8	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	3,882
Cottonwood	287	398	326	400	369	488	382	430	328	227	159	229	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	3,933
Other hardwoods	837	453	340	169	142	51	6	13	--	2	1	--	11	11	11	11	11	11	11	11	11	11	11	2,025
Total hardwoods	2,442	1,934	1,571	1,139	679	515	411	396	268	176	160	237	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	9,840
All species	162,820	101,503	70,262	51,964	37,073	23,899	15,816	10,009	5,730	4,408	3,113	1,696	2,021	2,021	2,021	2,021	2,021	2,021	2,021	2,021	2,021	2,021	2,021	490,314

¹Less than 0.05 thousand cubic feet.

Table 28.--Net annual growth of sawtimber on commercial timberland in Montana by species and diameter class, 1979

Species	Diameter class (inches at breast height)														All classes
	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 22.9	23.0- 24.9	25.0- 26.9	27.0- 28.9	29.0+				
	----- Thousand board feet, International 1/4-inch rule -----														
Douglas-fir	191,278	100,780	73,148	56,991	35,883	23,699	12,203	7,653	6,450	1,515	-3,250	506,350			
Ponderosa pine	60,004	40,492	33,041	21,038	15,750	9,825	7,561	5,777	4,536	2,700	6,343	207,067			
Western white pine	3,266	4,612	5,431	1,769	1,351	2,115	854	323	-509	881	1,811	21,904			
Lodgepole pine	190,841	57,705	25,856	2,876	2,386	2,158	506	94	92	80	26	282,620			
Whitebark-limber pine	12,030	5,926	3,461	2,725	1,430	430	60	164	204	67	99	26,596			
Western larch	38,479	24,589	21,323	16,275	10,712	6,135	3,736	3,107	1,813	81	4,195	130,445			
Grand fir	20,249	11,226	5,418	3,800	4,131	99	911	1,078	421	329	-399	47,263			
Subalpine: fir	25,285	14,638	7,545	6,493	362	-2	244	686	-62	46	-1,004	54,231			
Engelmann spruce	33,352	19,951	18,703	15,465	9,963	6,576	5,865	4,223	2,652	600	3,036	120,386			
Western hemlock	9,734	6,187	4,178	3,178	2,655	2,282	1,138	2,152	1,247	881	-100	33,532			
Western redcedar	6,961	3,881	2,816	2,311	802	1,031	659	1,007	1,115	1,039	4,070	25,692			
Other softwoods	--	59	--	--	--	--	--	--	--	--	--	59			
Total softwoods	591,479	290,046	200,920	132,921	85,425	54,348	33,737	26,264	17,959	8,219	14,827	1,456,145			
Aspen	XXXX	10,990	857	-123	105	-241	-288	-249	1	34	-41	11,045			
Cottonwood	XXXX	8,342	1,722	2,154	1,583	1,707	1,326	986	726	1,085	-315	19,316			
Other hardwoods	XXXX	1,656	865	263	25	74	--	7	9	--	70	2,969			
Total hardwoods	XXXX	20,988	3,444	2,294	1,713	1,540	1,038	744	736	1,119	-286	33,330			
All species	591,479	311,034	204,364	135,215	87,138	55,888	34,775	27,008	18,695	9,338	14,541	1,489,475			

Table 29.--Annual mortality of growing stock on commercial timberland in Montana by species and diameter class, 1979

Species	Diameter class (inches at breast height)														All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+		
	----- Thousand cubic feet -----														
Douglas-fir	3,678	3,278	3,836	2,779	2,153	1,617	1,883	1,151	1,023	901	444	378	1,619	24,740	
Ponderosa pine	449	868	891	851	260	568	258	205	248	42	154	129	2,385	7,308	
Western white pine	153	163	302	118	78	144	124	105	73	161	101	--	--	1,522	
Lodgepole pine	8,402	11,761	7,872	5,413	2,605	2,006	423	27	--	45	--	--	--	38,554	
Whitebark-limber pine	491	591	255	542	316	80	43	108	69	4	30	--	2	2,531	
Western larch	971	599	693	846	281	479	625	707	651	465	310	260	540	7,427	
Grand fir	102	256	538	468	561	301	36	381	--	--	--	--	150	2,793	
Subalpine fir	1,912	2,498	3,390	1,988	1,436	1,057	606	506	194	--	48	--	172	13,807	
Engelmann spruce	548	480	443	883	711	451	577	632	435	58	205	130	251	5,804	
Western hemlock	46	--	--	20	--	4	1	4	80	--	--	--	205	360	
Western redcedar	4	61	--	161	69	53	91	106	--	--	--	--	--	545	
Other softwoods	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Total softwoods	16,756	20,555	18,220	14,069	8,470	6,760	4,667	3,932	2,773	1,676	1,292	897	5,324	105,391	
Aspen	387	145	142	--	--	58	--	66	63	58	--	--	16	935	
Cottonwood	21	42	161	116	227	--	10	77	125	12	--	--	482	1,273	
Other hardwoods	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Total hardwoods	408	187	303	116	227	58	10	143	188	70	--	--	498	2,208	
All species	17,164	20,742	18,523	14,185	8,697	6,818	4,677	4,075	2,961	1,746	1,292	897	5,822	107,599	

Table 30.--Annual mortality of sawtimber on commercial timberland in Montana by species and diameter class, 1979

Species	Diameter class (inches at breast height)												All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+		
	----- Thousand board feet, International 1/4-inch rule -----												
Douglas-fir	11,850	12,787	10,555	8,518	10,302	6,483	6,031	5,222	2,627	2,448	10,011		86,834
Ponderosa pine	2,517	3,671	1,363	2,990	1,436	1,141	1,431	251	917	793	17,199		33,709
Western white pine	937	657	425	832	755	668	406	989	752	--	--		6,421
Lodgepole pine	32,809	32,101	15,119	11,574	2,288	143	--	248	--	--	--		94,282
Whitebark-limber pine	1,077	3,077	1,713	468	238	639	403	23	203	--	8		7,849
Western larch	2,959	4,701	1,670	2,809	3,657	4,102	3,800	2,962	1,969	1,835	3,404		33,868
Grand fir	2,227	2,597	3,099	1,718	180	1,872	--	--	--	--	691		12,384
Subalpine fir	13,838	10,860	7,962	5,858	3,757	2,295	1,132	--	274	--	1,073		47,049
Engelmann spruce	2,284	4,999	4,079	2,555	3,339	3,569	2,436	358	1,287	867	1,509		27,282
Western hemlock	1	87	--	20	3	21	573	--	--	--	1,151		1,856
Western redcedar	--	1,005	348	262	559	520	--	--	--	--	--		2,694
Other softwoods	--	--	--	--	--	--	--	--	--	--	--		--
Total softwoods	70,499	76,542	46,333	37,604	26,514	21,453	16,212	10,053	8,029	5,943	35,046		354,228
Aspen	XXXXX	--	--	295	--	322	304	273	--	--	73		1,267
Cottonwood	XXXXX	602	1,141	--	48	359	560	53	--	--	2,206		4,969
Other hardwoods	XXXXX	--	--	--	--	--	--	--	--	--	--		--
Total hardwoods	XXXXX	602	1,141	295	48	681	864	326	--	--	2,279		6,236
All species	70,499	77,144	47,474	37,899	26,562	22,134	17,076	10,379	8,029	5,943	37,325		360,464

Table 31.--Annual mortality of growing stock and sawtimber on commercial timberland in Montana by cause of death and species, 1979

Species	Cause of Death								Total
	Insects	Disease	Fire	Animal	Weather	Suppression	Logging	Unknown	
GROWING STOCK									
----- Thousand cubic feet -----									
Douglas-fir	3,134	3,575	1,370	82	6,543	720	3,243	6,073	24,740
Ponderosa pine	3,258	286	243	47	1,261	65	148	2,000	7,308
Western white pine	--	1,024	--	--	--	--	132	366	1,522
Lodgepole pine	6,532	2,141	895	601	6,599	1,402	878	19,506	38,554
Whitebark-limber pine	--	325	--	--	683	--	--	1,523	2,531
Western larch	1,228	1,895	312	--	2,026	--	158	1,808	7,427
Grand fir	144	1,845	--	--	223	--	132	449	2,793
Subalpine fir	1,977	3,650	205	--	1,853	--	--	6,122	13,807
Engelmann spruce	299	162	--	--	2,778	--	1,361	1,204	5,804
Western hemlock	--	--	--	--	--	--	--	360	360
Western redcedar	--	219	--	--	--	--	--	326	545
Total softwoods	16,572	15,122	3,025	730	21,966	2,187	6,052	39,737	105,391
Aspen	--	119	--	9	146	31	--	630	935
Cottonwood	--	350	32	125	65	--	14	687	1,273
Total hardwoods	--	469	32	134	211	31	14	1,317	2,208
All species	16,572	15,591	3,057	864	22,177	2,218	6,066	41,054	107,599
SAWTIMBER									
----- Thousand board feet, International 1/4-inch rule -----									
Douglas-fir	10,129	11,971	1,580	535	32,681	428	3,806	25,704	86,834
Ponderosa pine	18,710	1,402	1,440	95	1,989	--	415	9,658	33,709
Western white pine	--	3,410	--	--	--	--	817	2,194	6,421
Lodgepole pine	20,213	5,682	702	2,601	18,545	--	1,427	45,112	94,282
Whitebark-limber pine	--	1,844	--	--	3,340	--	--	2,665	7,849
Western larch	5,464	10,691	1,737	--	9,813	--	--	6,163	33,868
Grand fir	--	9,007	--	--	839	--	683	1,855	12,384
Subalpine fir	6,108	19,704	--	--	6,748	--	--	14,489	47,049
Engelmann spruce	1,303	979	--	--	16,253	--	2,451	6,296	27,282
Western hemlock	--	--	--	--	--	--	--	1,856	1,856
Western redcedar	--	1,097	--	--	--	--	--	1,597	2,694
Total softwoods	61,927	65,787	5,459	3,231	90,208	428	9,599	117,589	354,228
Aspen	--	322	--	--	377	--	--	568	1,267
Cottonwood	--	1,602	150	560	307	--	--	2,350	4,969
Total hardwoods	--	1,924	150	560	684	--	--	2,918	6,236
All species	61,927	67,711	5,609	3,791	90,892	428	9,599	120,507	360,464

Table 32.--Number of cull and salvable dead trees on State and private commercial timberland in Montana by ownership class, and softwoods and hardwoods, 1980

Ownership class and species group	Cull trees			Salvable dead trees	All dead trees
	Sound	Rotten	Total		
----- Thousand trees -----					
State:					
Softwoods	2,574	1,259	3,833	10,392	14,225
Hardwoods	76	108	184	467	651
Total	2,650	1,367	4,017	10,859	14,876
Forest industry:					
Softwoods	4,718	2,527	7,245	24,109	31,354
Hardwoods	148	115	263	42	305
Total	4,866	2,642	7,508	24,151	31,659
Farmer and other private:					
Softwoods	19,247	2,570	21,817	36,649	58,466
Hardwoods	1,376	1,390	2,766	3,518	6,284
Total	20,623	3,960	24,583	40,167	64,750
Total:					
Softwoods	26,539	6,356	32,895	71,150	104,045
Hardwoods	1,600	1,613	3,213	4,027	7,240
Total	28,139	7,969	36,108	75,177	111,285

Table 33.--Net volume of growing stock on State and private commercial timberland in Montana by ownership class, forest type, and stand-size class, 1980

Ownership class	Forest type	Stand-size class				All classes
		Sawtimber	Poletimber	Sapling/seedling	Nonstocked	
----- Thousand cubic feet -----						
State:	Douglas-fir	407,572	59,399	22,486	529	489,986
	Western hemlock	--	--	--	--	--
	Ponderosa pine	104,176	9,005	10,292	395	123,868
	Western white pine	--	37	--	--	37
	Lodgepole pine	129,237	126,232	12,363	41	267,873
	Western larch	76,662	7,256	4,226	156	88,300
	Western redcedar	6,906	--	--	--	6,906
	Whitebark-limber pine	14,168	487	391	95	15,141
	Grand fir	30,025	1,211	1,277	--	32,513
	Subalpine fir-spruce	93,232	6,831	4,843	54	104,960
	Engelmann spruce	37,241	2,272	581	--	40,094
	Aspen	1,898	5,546	1,357	31	8,832
	Cottonwood	16,666	673	306	32	17,677
	Other hardwoods	144	--	5	15	164
	All types	917,927	218,949	58,127	1,348	1,196,351
Forest industry:	Douglas-fir	1,046,663	120,436	71,312	791	1,239,202
	Western hemlock	--	--	--	--	--
	Ponderosa pine	135,640	5,385	12,836	3,552	157,413
	Western white pine	--	--	--	--	--
	Lodgepole pine	265,448	384,842	24,859	274	675,423
	Western larch	179,024	5,414	23,179	--	207,617
	Western redcedar	68,364	--	--	--	68,364
	Whitebark-limber pine	38,636	702	200	--	39,538
	Grand fir	97,776	--	3,227	--	101,003
	Subalpine fir-spruce	178,226	24,626	14,273	316	217,441
	Engelmann spruce	106,834	7,940	509	--	115,283
	Aspen	378	145	1,079	4	1,606
	Cottonwood	12,147	13	35	--	12,195
	Other hardwoods	--	--	--	--	--
	All types	2,129,136	549,503	151,509	4,937	2,835,085
Farmer and other private:	Douglas-fir	1,235,469	266,605	86,365	1,272	1,589,711
	Western hemlock	5,768	--	--	--	5,768
	Ponderosa pine	678,983	78,586	99,218	2,061	858,848
	Western white pine	--	4,045	--	--	4,045
	Lodgepole pine	307,699	369,748	37,961	605	716,013
	Western larch	112,943	11,522	3,874	--	128,339
	Western redcedar	23,449	--	--	--	23,449
	Whitebark-limber pine	60,292	2,394	2,135	139	64,960
	Grand fir	12,999	--	461	--	13,460
	Subalpine fir-spruce	118,314	21,369	9,645	2,635	151,963
	Engelmann spruce	68,296	23,091	4,386	--	95,773
	Aspen	32,480	59,642	11,315	224	103,661
	Cottonwood	157,801	7,577	3,162	279	168,819
	Other hardwoods	2,020	--	1,701	138	3,859
	All types	2,816,513	844,579	260,223	7,353	3,928,668
Total:	Douglas-fir	2,689,704	446,440	180,163	2,592	3,318,899
	Western hemlock	5,768	--	--	--	5,768
	Ponderosa pine	918,799	92,976	122,346	6,008	1,140,129
	Western white pine	--	4,082	--	--	4,082
	Lodgepole pine	702,384	880,822	75,183	920	1,659,309
	Western larch	368,629	24,192	31,279	156	424,256
	Western redcedar	98,719	--	--	--	98,719
	Whitebark-limber pine	113,096	3,583	2,726	234	119,639
	Grand fir	140,800	1,211	4,965	--	146,976
	Subalpine fir-spruce	389,772	52,826	28,761	3,005	474,364
	Engelmann spruce	212,371	33,303	5,476	--	251,150
	Aspen	34,756	65,333	13,751	259	114,099
	Cottonwood	186,614	8,263	3,503	311	198,691
	Other hardwoods	2,164	--	1,706	153	4,023
	All types	5,863,576	1,613,031	469,859	13,638	7,960,104

Table 34.--Net volume of sawtimber on State and private commercial timberland in Montana by ownership class, forest type, and stand-size class, 1980

Ownership class	Forest type	Stand-size class				All classes
		Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	
--- Thousand board feet International 4-inch rule ---						
State:	Douglas-fir	1,752,884	100,744	84,851	2,078	1,940,557
	Western hemlock	--	--	--	--	--
	Ponderosa pine	439,899	18,153	35,736	2,100	495,888
	Western white pine	--	91	--	--	91
	Lodgepole pine	464,856	166,773	20,603	125	652,357
	Western larch	375,516	14,509	11,899	967	402,891
	Western redcedar	33,392	--	--	--	33,392
	Whitebark-limber pine	48,831	753	158	286	50,028
	Grand fir	128,805	2,302	5,826	--	136,933
	Subalpine fir-spruce	412,972	9,938	17,264	290	440,464
	Engelmann spruce	177,752	5,109	2,231	--	185,092
	Aspen	7,137	6,639	2,499	162	16,437
	Cottonwood	72,386	1,618	849	122	74,975
	Other hardwoods	448	--	6	59	513
	All types	3,914,878	326,629	181,922	6,189	4,429,618
Forest industry:	Douglas-fir	4,541,592	211,950	263,578	4,319	5,021,439
	Western hemlock	--	--	--	--	--
	Ponderosa pine	649,716	5,516	68,857	19,019	743,108
	Western white pine	--	--	--	--	--
	Lodgepole pine	922,119	450,895	44,841	836	1,418,691
	Western larch	840,241	7,877	105,317	--	953,435
	Western redcedar	313,918	--	--	--	313,918
	Whitebark-limber pine	163,076	1,072	360	--	164,508
	Grand fir	443,083	--	13,425	--	456,508
	Subalpine fir-spruce	801,747	54,711	45,558	1,264	903,280
	Engelmann spruce	511,865	16,893	1,260	--	530,018
	Aspen	1,614	269	5,464	17	7,364
	Cottonwood	52,619	33	63	--	52,715
	Other hardwoods	--	--	--	--	--
	All types	9,241,590	749,216	548,723	25,455	10,564,984
Farmer and other private:	Douglas-fir	4,803,155	437,030	252,069	5,595	5,497,849
	Western hemlock	21,885	--	--	--	21,885
	Ponderosa pine	2,605,945	136,782	356,249	10,582	3,109,558
	Western white pine	--	9,914	--	--	9,914
	Lodgepole pine	1,108,364	492,171	22,427	1,843	1,624,805
	Western larch	446,187	21,070	4,835	--	472,092
	Western redcedar	77,539	--	--	--	77,539
	Whitebark-limber pine	217,086	4,216	1,703	403	223,408
	Grand fir	32,229	--	730	--	32,959
	Subalpine fir-spruce	442,969	43,127	27,854	13,358	527,308
	Engelmann spruce	276,928	46,402	17,583	--	340,913
	Aspen	120,964	76,693	21,519	1,172	220,348
	Cottonwood	696,800	18,614	7,908	1,094	724,416
	Other hardwoods	6,310	--	1,896	533	8,739
	All types	10,856,361	1,286,019	714,773	34,580	12,891,733
Total:	Douglas-fir	11,097,631	749,724	600,498	11,992	12,459,845
	Western hemlock	21,885	--	--	--	21,885
	Ponderosa pine	3,695,560	160,451	460,842	31,701	4,348,554
	Western white pine	--	10,005	--	--	10,005
	Lodgepole pine	2,495,339	1,109,839	87,871	2,804	3,695,853
	Western larch	1,661,944	43,456	122,051	967	1,828,418
	Western redcedar	424,849	--	--	--	424,849
	Whitebark-limber pine	428,993	6,041	2,221	689	437,944
	Grand fir	604,117	2,302	19,981	--	626,400
	Subalpine fir-spruce	1,657,688	107,776	90,676	14,912	1,871,052
	Engelmann spruce	966,545	68,404	21,074	--	1,056,023
	Aspen	129,715	83,601	29,482	1,351	244,149
	Cottonwood	821,805	20,265	8,820	1,216	852,106
	Other hardwoods	6,758	--	1,902	592	9,252
	All types	24,012,829	2,361,864	1,445,418	66,224	27,886,335

Table 35.--Net volume of timber on State and private commercial timberland in Montana by class of timber, and softwoods and hardwoods, 1980

Class of timber	Softwoods	Hardwoods	All classes
- - - - - <u>Thousand cubic feet</u> - - - - -			
Sawtimber trees:			
Sawlog portion	4,690,340	188,003	4,878,343
Upper-stem portion	631,053	48,826	679,879
Total	5,321,393	236,829	5,558,222
Poletimber trees	2,276,115	125,767	2,401,882
All growing-stock trees	7,597,508	362,596	7,960,104
Sound cull trees	83,249	4,973	88,222
Rotten cull trees	30,487	3,470	33,957
Salvable dead trees	423,715	18,637	442,352
All timber	8,134,959	389,676	8,524,635

Table 36.--Net volume of growing stock on State and private commercial timberland in Montana by forest type and species, 1980

Forest type	Species									
	Douglas-fir	Ponderosa pine	Western white pine	Lodgepole pine	Whitebark-limber pine	Western larch	Grand fir	Subalpine fir	Engelmann spruce	Thousand cubic feet
Douglas-fir	2,429,069	279,305	1,829	262,704	19,380	210,968	35,242	17,776	41,606	
Western hemlock	329	--	--	691	--	348	409	389	438	
Ponderosa pine	89,467	1,018,705	807	12,357	1,576	11,540	554	255	581	
Western white pine	--	--	1,491	--	--	--	--	--	--	
Lodgepole pine	114,552	14,966	1,768	1,289,265	10,124	116,127	10,514	46,127	30,537	
Western larch	76,660	18,012	3,840	44,986	--	236,302	12,689	8,021	11,791	
Western redcedar	7,878	927	4,450	1,128	--	17,473	17,388	879	4,270	
Whitebark-limber pine	5,332	64	--	3,238	81,936	--	--	16,601	11,607	
Grand fir	27,882	1,839	16,055	6,077	--	13,398	59,287	2,832	6,680	
Subalpine fir-spruce	39,652	--	5,917	48,680	40,043	36,101	1,014	153,993	145,794	
Engelmann spruce	14,626	1,118	1,086	22,888	2,277	31,079	7,391	10,094	143,791	
Aspen	7,544	4,777	840	7,448	--	--	--	--	1,935	
Cottonwood	339	1,890	--	--	--	1,199	--	201	2,685	
Other hardwoods	--	--	--	1,211	--	--	--	--	--	
All types	2,813,330	1,341,603	36,592	1,702,164	155,336	674,535	144,488	257,168	401,715	

Table 36. (Con.)

Forest type	Species						Total hardwoods	All species
	Western hemlock	Western redcedar	Total softwoods	Aspen	Cottonwood	Other hardwoods		
Douglas-fir	1,283	1,446	3,300,608	10,700	4,936	2,655	18,291	3,318,899
Western hemlock	3,164	--	5,768	--	--	--	--	5,768
Ponderosa pine	--	--	1,135,035	3,126	1,968	--	5,094	1,140,129
Western white pine	--	--	2,298	--	--	1,784	1,784	4,082
Lodgepole pine	321	2,366	1,636,667	18,175	3,814	653	22,642	1,659,309
Western larch	1,987	2,743	417,031	--	1,426	5,799	7,225	424,256
Western redcedar	8,566	33,909	96,868	495	1,224	132	1,851	98,719
Whitebark-limber pine	861	--	119,639	--	--	--	--	119,639
Grand fir	4,695	4,587	143,332	--	1,746	1,898	3,644	146,976
Subalpine fir-spruce	--	1,644	472,838	393	1,133	--	1,526	474,364
Engelmann spruce	--	2,525	236,875	2,593	7,705	3,977	14,275	251,150
Aspen	--	--	22,544	86,806	4,749	--	91,555	114,099
Cottonwood	--	480	6,794	2,008	186,979	2,910	191,897	198,691
Other hardwoods	--	--	1,211	259	253	2,300	2,812	4,023
All types	20,877	49,700	7,597,508	124,555	215,933	22,108	362,596	7,960,104

(con.)

Table 37.--Net volume of sawtimber on State and private commercial timberland in Montana by forest type and species, 1980

Forest type	Species									
	Douglas-fir	Ponderosa pine	Western white pine	Lodgepole pine	White-bark timber pine	Western larch	Grand fir	Subalpine fir	Engelmann spruce	
	-- Thousand board feet, International 1/4-inch rule									
Douglas-fir	8,946,813	1,380,292	9,028	699,730	50,781	1,018,010	122,264	42,251	150,469	
Western hemlock	1,576	--	--	1,021	--	2,068	2,111	2,067	2,390	
Ponderosa pine	297,036	3,929,640	--	41,923	3,148	57,635	2,930	--	2,087	
Western white pine	--	--	4,442	5,563	--	--	--	--	--	
Lodgepole pine	393,249	79,767	2,816	2,387,363	36,925	520,867	27,090	82,711	120,532	
Western larch	294,598	106,614	20,040	128,430	--	1,158,449	38,490	17,348	41,331	
Western redcedar	35,767	4,943	25,028	--	--	85,132	78,643	4,063	21,265	
Whitebark-limber pine	23,053	333	--	8,344	319,956	--	--	33,481	50,951	
Grand fir	128,181	11,345	75,346	15,038	--	76,709	234,427	5,614	28,990	
Subalpine fir-spruce	183,560	--	32,622	173,617	169,687	197,532	2,908	386,834	709,115	
Engelmann spruce	70,845	6,656	6,148	71,302	4,264	174,270	32,664	27,803	605,413	
Aspen	36,201	26,648	1,486	25,381	--	--	--	--	7,507	
Cottonwood	982	10,923	--	--	--	6,667	--	--	12,806	
Other hardwoods	--	--	--	1,902	--	--	--	--	--	
All types	10,411,861	5,557,161	176,956	3,559,614	584,761	3,297,339	541,527	602,172	1,752,856	

(con.)

Table 37. (Con.)

Forest type	Species						Total hardwoods	All species
	Western hemlock	Western redcedar	Total softwoods	Aspen	Cottonwood	Other hardwoods		
	-- Thousand board feet, International 1/4-inch rule							
Douglas-fir	4,841	4,086	12,428,565	9,211	20,338	1,731	31,280	12,459,845
Western hemlock	10,652	--	21,885	--	--	--	--	21,885
Ponderosa pine	--	--	4,334,399	5,766	8,389	--	14,155	4,348,554
Western white pine	--	--	10,005	--	--	--	--	10,005
Lodgepole pine	4,984	5,506	3,656,826	28,345	10,682	--	39,027	3,695,853
Western larch	19,015	10,156	1,820,440	--	7,122	856	7,978	1,828,418
Western redcedar	1,826	142,042	415,898	2,622	5,640	689	8,951	424,849
Whitebark-limber pine	22,934	17,092	437,944	--	--	--	--	437,944
Grand fir	--	7,917	615,676	--	6,319	4,405	10,724	626,400
Subalpine fir-spruce	--	10,918	1,863,792	1,934	5,326	--	7,260	1,871,052
Engelmann spruce	--	--	1,010,283	12,886	30,774	2,080	45,740	1,056,023
Aspen	--	--	97,223	125,148	21,778	--	146,926	244,149
Cottonwood	--	1,850	33,228	3,914	807,420	7,544	818,878	852,106
Other hardwoods	--	--	1,902	--	1,052	6,298	7,350	9,252
All types	64,252	199,567	26,748,066	189,826	924,840	23,603	1,138,269	27,886,335

Table 38.--Net volume of growing stock and sawtimber on State and private commercial timberland in Montana by ownership class and species, 1980

Species	Ownership			Total
	State	Forest industry	Farmer and other private	
GROWING STOCK				
Thousand cubic feet				
Douglas-fir	401,911	1,003,705	1,407,714	2,813,330
Ponderosa pine	152,504	287,367	901,732	1,341,603
Western white pine	9,673	22,137	4,782	36,592
Lodgepole pine	273,291	641,421	787,452	1,702,164
Whitebark-limber pine	24,799	43,350	87,187	155,336
Western larch	138,204	394,773	141,558	674,535
Grand fir	23,800	101,006	19,682	144,488
Subalpine fir	60,267	101,492	95,409	257,168
Engelmann spruce	67,952	176,102	157,661	401,715
Western hemlock	459	13,346	7,072	20,877
Western redcedar	7,683	28,409	13,608	49,700
Total softwoods	1,160,543	2,813,108	3,623,857	7,597,508
Aspen	9,610	8,406	106,539	124,555
Cottonwood	20,434	10,528	184,971	215,933
Other hardwoods	5,764	3,043	13,301	22,108
Total hardwoods	35,808	21,977	304,811	362,596
All species	1,196,351	2,835,085	3,928,668	7,960,104
SAWTIMBER				
Thousand board feet, International 4-inch rule				
Douglas-fir	1,576,033	3,924,044	4,911,784	10,411,861
Ponderosa pine	657,311	1,532,091	3,367,759	5,557,161
Western white pine	49,033	110,092	17,831	176,956
Lodgepole pine	619,148	1,098,331	1,842,135	3,559,614
Whitebark-limber pine	103,872	186,583	294,306	584,761
Western larch	739,204	2,024,756	533,379	3,297,339
Grand fir	88,391	387,222	65,914	541,527
Subalpine fir	155,328	248,715	198,129	602,172
Engelmann spruce	299,397	831,743	621,716	1,752,856
Western hemlock	1,030	41,169	22,053	64,252
Western redcedar	31,932	118,995	48,640	199,567
Total softwoods	4,320,679	10,503,741	11,923,646	26,748,066
Aspen	13,952	12,501	163,373	189,826
Cottonwood	86,182	42,397	796,261	924,840
Other hardwoods	8,805	6,345	8,453	23,603
Total hardwoods	108,939	61,243	968,087	1,138,269
All species	4,429,618	10,564,984	12,891,733	27,886,335

Table 39.--Net annual growth of growing stock and sawtimber on State and private commercial timberland in Montana by ownership class and species, 1979

Species	Ownership			Total
	State	Forest industry	Farmer and other private	
GROWING STOCK				
Thousand cubic feet				
Douglas-fir	8,002	17,890	31,530	57,422
Ponderosa pine	3,113	4,209	20,445	27,767
Western white pine	154	526	368	1,048
Lodgepole pine	7,046	14,668	18,887	40,601
Whitebark-limber pine	171	458	1,284	1,913
Western larch	2,390	4,886	3,583	10,859
Grand fir	562	2,079	323	2,964
Subalpine fir	1,064	3,226	2,975	7,265
Engelmann spruce	1,057	2,124	3,696	6,877
Western hemlock	56	586	423	1,065
Western redcedar	165	657	346	1,168
Total softwoods	23,780	51,309	83,860	158,949
Aspen	238	223	2,520	2,981
Cottonwoods	396	188	3,263	3,847
Other hardwoods	370	84	554	1,008
Total hardwoods	1,004	495	6,337	7,836
All species	24,784	51,804	90,197	166,785
Sawtimber				
Thousand board feet, International 4-inch rule				
Douglas-fir	34,554	79,735	140,861	255,150
Ponderosa pine	15,676	25,315	95,301	136,292
Western white pine	697	2,728	654	4,079
Lodgepole pine	14,367	31,777	49,838	95,982
Whitebark-limber pine	627	1,537	5,158	7,322
Western larch	8,881	14,671	16,441	39,993
Grand fir	2,104	7,963	2,387	12,454
Subalpine fir	3,394	4,013	4,284	11,691
Engelmann spruce	4,190	10,825	13,434	28,449
Western hemlock	41	967	2,515	3,523
Western redcedar	708	1,360	2,990	5,058
Total softwoods	85,239	180,891	333,863	599,993
Aspen	688	335	9,210	10,233
Cottonwood	1,627	379	16,796	18,802
Other hardwoods	805	100	221	1,126
Total hardwoods	3,120	814	26,227	30,161
All species	88,359	181,705	360,090	630,154

Table 40.--Annual mortality of growing stock and sawtimber on State and private commercial timberland in Montana by ownership class and species, 1979

Species	Ownership			Total
	State	Forest industry	Farmer and other private	
GROWING STOCK				
Thousand cubic feet				
Douglas-fir	1,399	4,869	3,935	10,203
Ponderosa pine	636	754	2,715	4,105
Western white pine	30	158	136	324
Lodgepole pine	1,623	5,118	4,731	11,472
Whitebark-limber pine	164	--	153	317
Western larch	182	1,652	379	2,213
Grand fir	174	1,275	428	1,877
Subalpine fir	643	1,286	830	2,759
Engelmann spruce	377	1,442	974	2,793
Western hemlock	--	--	--	--
Western redcedar	9	69	94	172
Total softwoods	5,237	16,623	14,375	36,235
Aspen	74	2	780	856
Cottonwoods	106	33	1,088	1,227
Other hardwoods	--	--	--	--
Total hardwoods	180	35	1,868	2,083
All species	5,417	16,658	16,243	38,318
SAWTIMBER				
Thousand board feet, International $\frac{1}{4}$ -inch rule				
Douglas-fir	4,557	16,670	10,040	31,267
Ponderosa pine	2,312	3,864	8,209	14,385
Western white pine	166	659	416	1,241
Lodgepole pine	3,691	8,458	13,514	25,663
Whitebark-limber pine	675	--	292	967
Western larch	706	9,655	480	10,841
Grand fir	733	5,952	1,552	8,237
Subalpine fir	1,873	3,697	1,841	7,411
Engelmann spruce	1,698	4,912	5,151	11,761
Western hemlock	--	--	--	--
Western redcedar	43	348	464	855
Total softwoods	16,454	54,215	41,959	112,628
Aspen	134	--	1,130	1,264
Cottonwood	405	162	4,219	4,786
Other hardwoods	--	--	--	--
Total hardwoods	539	162	5,349	6,050
All species	16,993	54,377	47,308	118,678

APPENDIX V: TREE SPECIES NATIVE TO MONTANA

Coniferous

Grand fir	<i>Abies grandis</i>
Subalpine fir	<i>A. lasiocarpa</i>
Utah juniper	<i>Juniperous osteosperma</i>
Rocky Mountain juniper	<i>J. scopulorum</i>
Subalpine larch	<i>Larix lyallii</i>
Western larch	<i>L. occidentalis</i>
Engelmann spruce	<i>Picea engelmannii</i>
White spruce	<i>P. glauca</i>
Whitebark pine	<i>Pinus albicaulis</i>
Lodgepole pine	<i>P. contorta</i> var. <i>latifolia</i>
Limber pine	<i>P. flexilis</i>
Western white pine	<i>P. monticola</i>
Ponderosa pine	<i>P. ponderosa</i>
	<i>P. ponderosa</i> var. <i>scopulorum</i>
Douglas-fir	<i>Pseudotsuga menziesii</i> var. <i>glauca</i>
Western redcedar	<i>Thuja plicata</i>
Western hemlock	<i>Tsuga heterophylla</i>
Mountain hemlock	<i>T. mertensiana</i>

Deciduous

Boxelder	<i>Acer negundo</i>
Paper birch	<i>Betula papyrifera</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Balsam poplar	<i>Populus balsamifera</i>
Eastern cottonwood	<i>P. deltoides</i>
Black cottonwood	<i>P. trichocarpa</i>
Quaking aspen	<i>P. tremuloides</i>
Cascara buckthorn	<i>Rhamnus purshiana</i>
Peachleaf willow	<i>Salix amygdaloides</i>
American elm	<i>Ulmus americana</i>

Green, Alan W.; O'Brien, Renee A.; Schaefer, James C. Montana's forests.
Resource Bulletin INT-38. Ogden, UT: U.S. Department of Agriculture, Forest
Service, Intermountain Research Station; 1985. 70 p.

Presents highlights of the forest resources of Montana as of 1980. Describes
the forest resources, their extent, condition, and location, and discusses levels
of some nontimber use of forest lands. Includes statistical tables: area by land
classes, ownership, growing stock and sawtimber volumes, growth, mortality,
roundwood products output, utilization, and residues.

KEYWORDS: commercial timberland, forest inventory, timber volume, timber
mortality, timber removals

The Intermountain Research Station, headquartered in Ogden, Utah, is one of eight Forest Service Research stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

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