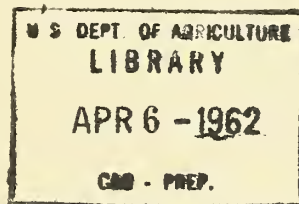
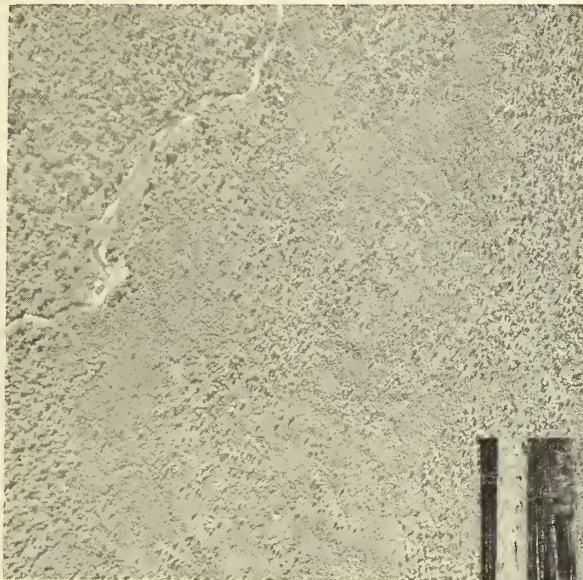


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Guide to
Two-story Forest Type
Mapping
in the Douglas-fir subregion



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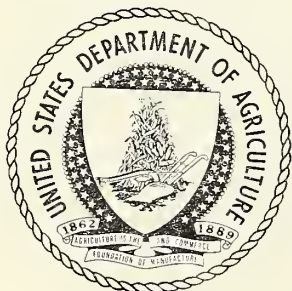
JANUARY 1962

PREFACE

These guides were developed by David A. Bernstein during the course of his work on the Survey Techniques Research project, a group effort within the U. S. Forest Service by Region 6 and the Pacific Northwest Forest and Range Experiment Station for the purpose of conducting research and administrative studies. The objective is to improve the effectiveness of forest measurement and sampling procedures, specifically in Forest Survey, forest inventories, and pest surveys.

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A handwritten signature in cursive script that reads "J. Herbert Stone".

J. HERBERT STONE
Regional Forester

A handwritten signature in cursive script that reads "R. W. Cowlin".

R. W. COWLIN
Director

GUIDES TO TWO-STORY FOREST TYPE MAPPING

IN THE DOUGLAS-FIR SUBREGION

INTRODUCTION

The current trend in forest type mapping in the Douglas-fir subregion is to use two-story designations where appropriate rather than single-story. The single-story system treats each type as if it were of uniform composition and fails to distinguish truly uniform stands from those which are highly variable. Two-story type maps give a better picture of the true composition of the stand and help the forest manager in making decisions on prelogging, partial cutting, thinning, and other intensive management practices.

Type mapping, whether single-story or two-story, is a subjective process which depends on the experience and judgment of the mapper. While type definitions are specific, many forest stands are heterogeneous mixtures that are difficult to classify even with intensive field inspection. Many type boundaries are actually zones where types blend together.

Because type mapping is a subjective process, it is difficult to describe and define conditions and to secure uniformity of application by words alone. Visual aids help convey these ideas to the mapper. Since most type mapping is based on aerial photos supplemented by field checking, stereograms are a reliable visual aid. This guide presents descriptions and stereograms of some of the major two-story types of the Douglas-fir subregion to aid mappers in making and forest managers in understanding two-story type maps.

The guide is divided into two parts: a discussion of the major two-story types and a collection of pairs of stereograms accompanied by descriptions of their occurrence and photo identification. Each pair contains a vertical view showing a two-story type on an aerial photo and a matching ground view looking into the stand. Many of the variations in two-story conditions are not illustrated. However, the material furnished by this guide provides examples from which mappers can construct more detailed guides to their own areas.

TYPE SYMBOLS

A standard type-symbol system created by the U. S. Forest Service and several other major landowners is used on the photographic examples. Forest type symbols consist of three parts-- species, size class, and density of stocking.

Species

The species symbol is determined by the predominant species or groups of species in the stand, for example:

D	Douglas-fir	WF	white fir
H	hemlock	P	ponderosa pine
FM	true fir-mountain hemlock	SP	sugar pine
HD	hardwoods	LP	lodgepole pine

Secondary species are indicated in lowercase letters after the main type symbol if they comprise at least 20 percent of the stand. In the case of the FM and HD types, the main type symbol does not indicate the specific key species, and so it is necessary to list all recognized species in order to indicate composition and order of importance, for example:

FM a	silver fir
srf	Shasta red fir
HD to	tanoak
ch	chinkapin
ra	red alder

Size Class

Size-class symbols are based on tree diameters:

<u>Symbol</u>	<u>Stand-size class</u>	<u>Description</u>
1	Seedlings and saplings	0 - 4.9 inches d. b. h.
2	Poles	5.0-10.9 inches d. b. h.
3	Small sawtimber	11.0-20.9 inches d. b. h.
4	Large sawtimber	21+ inches d. b. h.
5	Old-growth Douglas-fir sawtimber	21+ inches d. b. h., usually over 180 years old

The preceding size-class definitions are useful in describing even-aged stands or two-story stands of two distinct age classes. However, when a heterogeneous mixture of tree heights indicates the stand is uneven aged, the symbol "U" is used in conjunction with the symbol for the predominate size class. A hemlock, large-sawtimber, uneven-aged stand is H4U. At least three size classes must be present in an uneven-aged stand (figs. 7 and 8).

Stocking

On aerial photos, density of stocking is expressed as the percentage of crown closure. When seedling and sapling stand-size class is not visible on aerial photos, density of stocking is determined from stocked-quadrat counts of number of trees.

<u>Symbol</u>	<u>Percent of full crown closure</u>	<u>Description</u>
-	10 to 39	Poorly stocked
=	40 to 69	Medium stocked
≡	70 to 100	Well stocked

GENERAL GUIDES TO TWO-STORY TYPING

There are some general rules guiding the application of these symbols in two-story type mapping. Each story is considered separately and has a complete set of species, size, and density symbols. These symbols are divided by a horizontal line; for example, poorly stocked, Douglas-fir large-sawtimber stand over well-stocked, hemlock pole stand is shown as $\frac{D4-}{H2\equiv}$.

Generally, when mapping two-story stands, the understory and overstory should be two size classes apart for recognizable contrast on aerial photos. An exception is a situation where there are pronounced differences, such as a 12-inch d. b. h., small-sawtimber understory and a 40-inch d. b. h., large-sawtimber overstory (4/3) (fig. 14), or where there is a marked species contrast (fig. 12).

Normally, the total density of the two stories will not exceed 100 percent. For instance, faulty typing may result in a medium-stocked stand (at least 40-percent density) over a well-stocked stand (at least 70-percent density). This combination would be unlikely because the total density would be 110 percent. On the other hand, a

poorly stocked stand over a well-stocked stand such as in the above example, $\frac{D4}{H2}$, is possible because the overstory may have 20-percent density and the understory 80-percent density for a total density of 100 percent.

TWO-STORY TYPES

Old-Growth Douglas-fir Overstory

An old-growth Douglas-fir overstory over an understory of small sawtimber, poles, or reproduction of various species is one of the most easily identified and widespread of the two-story conditions. This combination often occurs as a scattered overstory over a dense understory. The overstory may be a residual mature stand among a young stand established after logging or fire. Two-story stands also develop when mature stands "break up," and the holes fill with young growth.

The species of the understory is often hard to name. Knowledge of species distribution and the characteristics of the local area is an aid in identification. Douglas-fir understories can be found anywhere throughout the Douglas-fir range, but are generally located at the lower and medium elevations on the west slopes of the Cascades from central Washington to California and in southwest Oregon (fig. 1). Often, however, species other than Douglas-fir predominate in the understory. Hemlock is a common understory component at elevations of 1,000 to 3,000 feet on the west slope of the Cascades and in the Coast Ranges, from the Canadian border to central Oregon. Hemlock understories are rare in southern Oregon. Species separation of hemlock and Douglas-fir in the small size classes is very difficult on photos (figs. 1 and 2). At the higher elevations in the Cascades from northern Washington to southern Oregon, the true fir-mountain hemlock understory predominates. This type is easily recognized when silver fir, with its characteristic dark tone, is a major component (fig. 3).

White fir and grand fir sometimes replace hemlock (fig. 4) and the true fir-mountain hemlock type as an understory toward the east side of the Cascades from central Washington and southward. White and grand fir are also found through southern Oregon. White fir has no definite photo recognition features that distinguish it from Douglas-fir and hemlock. Acquaintance with its local distribution gives a clue in its identification.

Old-growth with understories of pole or small-sawtimber-- hardwood mixtures of tanoak, madrone, and chinkapin is often found in southwest Oregon (fig. 5).

The use of the two-story designation in old growth is inappropriate when the understory is in the larger diameter classes or when the old-growth canopy occupies a great majority of the crown closure. For instance, there is no apparent advantage in recognizing a $\frac{D5}{D4}$ or a $\frac{D5}{H4}$ stand because most old-growth stands have minor amounts of other large sawtimber and other size classes in them, anyway. In addition, $\frac{5}{4}$ stands are hard to recognize on aerial photos (fig. 6).

Often an old-growth stand with a substantial mixture of hemlock and true firs develops a distinctive uneven-age appearance. There are certain management advantages in recognizing this uneven-age type (called D5U) as distinct from a simple D5 type. For instance, there is probably less total volume than in a pure stand. Proposed logging plans might include a provision for prelogging not anticipated otherwise. Figure 7 shows a typical D5U mixture of Douglas-fir, hemlock, and silver fir. The D5U type sometimes merges with the $\frac{D5}{FM3}$ type. In the two-story type, the overstory is usually more scattered.

Large-Sawtimber Douglas-fir Overstory

In general, the distribution of D4 two-story types is the same as the D5 types. However, they are not typed such as commonly as the old-growth two-story stands. One reason for this is that only two of the three possible combinations are practical. The $\frac{4}{3}$ combination, although recognizable on the ground, is virtually impossible to distinguish from the air (fig. 9).

D4 occurs in partially closed canopies (fig. 11) and as a scattered overstory. The scattered overstory is a remnant of past logging or fires and is sometimes hard to distinguish from D5 in similar conditions.

A closed canopy of D4 may give little indication from the air of a substantial understory of poles or reproduction (fig. 10). Practically all stands, even those with a completely closed canopy, have

some sort of an understory of tolerant species. However, such stands cannot be classified as two-storied because they cannot be recognized as such on the photos.

D4 with hardwood understory occurs in southern Oregon and in coastal areas. In southwest Oregon, the hardwoods are a mixture of tanoak, madrone, and others. From central Oregon northward, the hardwood understory is almost always red alder (fig. 12).

The uneven-age type D4U (fig. 8) is seen in most forests but is most common in the southern Oregon forests.

Large-Sawtimber Ponderosa Pine Overstory

Although usually regarded as an east-side species, ponderosa pine also appears in the Douglas-fir subregion. Two-story stands consist of a scattered overstory with the understory usually white fir or Douglas-fir rather than ponderosa pine. Pine will appear near the crest of the Cascades as a transition type (fig. 13) and sometimes as pockets well within the Douglas-fir type (fig. 14). It is quite common in southern Oregon, where it appears as an overstory over conifers, hardwoods, or a mixture of the two (fig. 15). In many areas, sugar pine is a companion overstory species (fig. 16). The two pines cannot always be differentiated on photos. They differ from Douglas-fir in that they have a lighter tone and a puffy appearance.

MISCELLANEOUS TYPES

The preceding are the most common two-story types in the Douglas-fir subregion. There are many variations, some of them limited in distribution but still worth recognizing. Two-story hemlock stands occur in the forests of central and northern Washington and in the coastal forests. However, they are not nearly as common as the Douglas-fir two-story types (fig. 17). An example of a type with limited distribution is Shasta red fir over lodgepole pine (fig. 18).

The true fir-mountain hemlock type is sometimes divided into two-story stands. The mature stand characteristically appears uneven aged so an FM4U designation would be superfluous.

Illustrations of these and other types are found on the following pages.

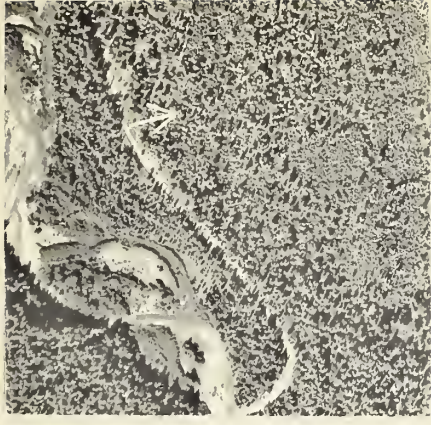
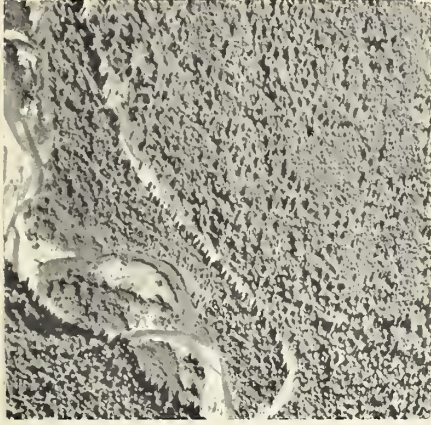
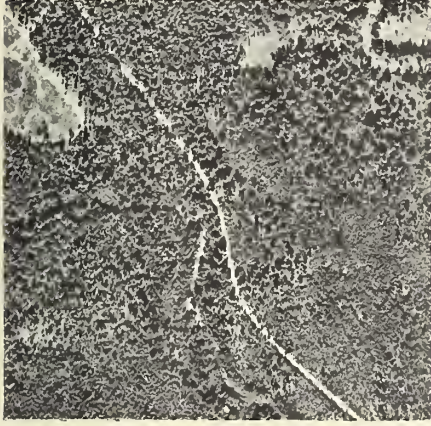
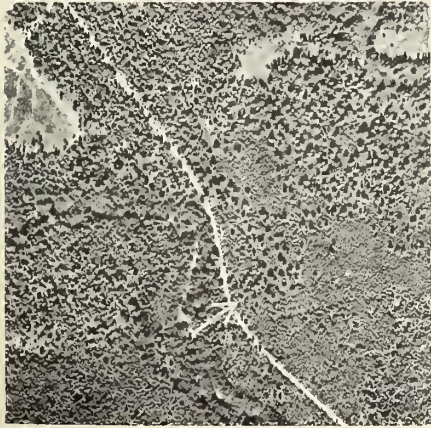


Figure 1. $\frac{D5-}{D1E}$ Old-growth Douglas-fir over Douglas-fir seedlings and saplings.
 Gifford Pinchot National Forest, Wash.
 Elevation: 2,500 ft.

Scattered stands of old growth over a dense stand of Douglas-fir reproduction are common in the subregion. In this illustration the two-story type occupies only a small area and merges into a single-story D5 type at the lower right-hand corner. Old growth can be recognized by its unusual height and the large diameter and occasionally ragged appearance of the individual crown.

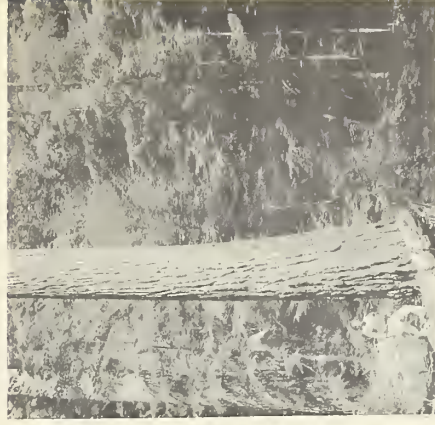
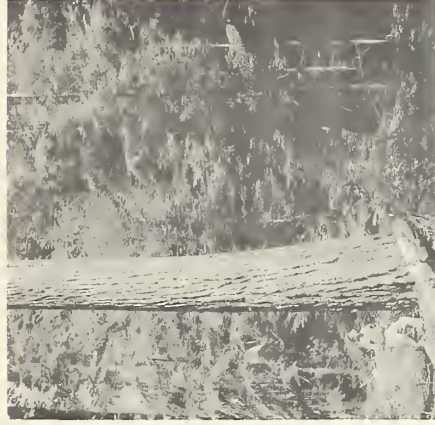
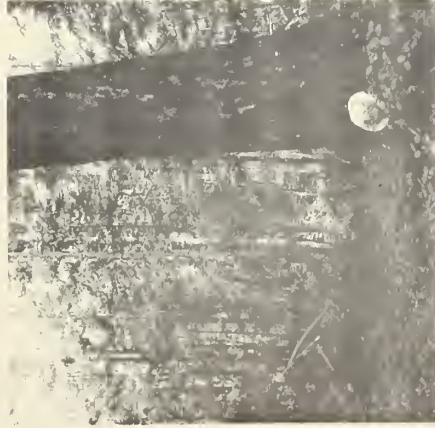


Figure 2. $\frac{D5-}{HZE}$ Old-growth Douglas-fir over hemlock poles.
 Gifford Pinchot National Forest, Wash.
 Elevation: 1,300 ft.

Scale: 1:14,000
 Site: Lower west slope

Another example of scattered old growth, but with a dense understory of hemlock poles. In this case the two-story type covers a fairly extensive area. There are no practical photo recognition features that would separate young hemlock stands from Douglas-fir (fig. 1). The difference in texture between the two young stands is probably due to size-class differences.



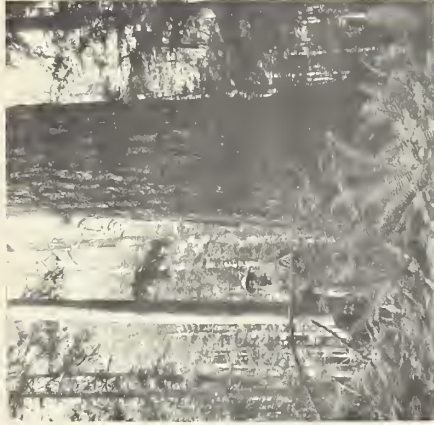
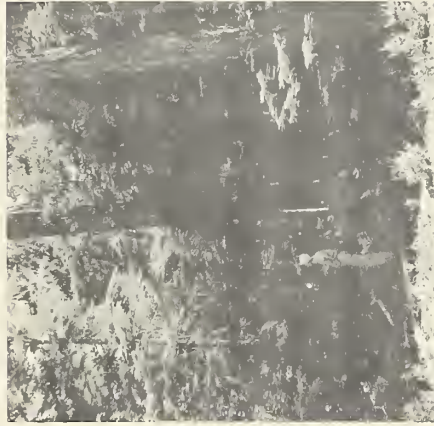
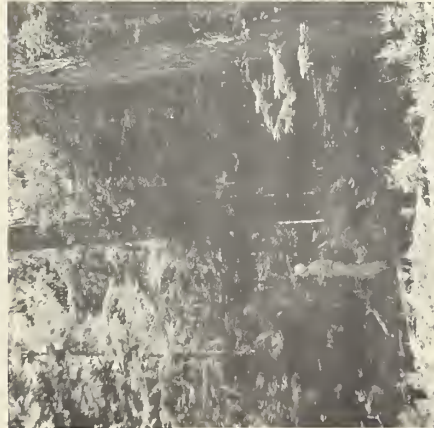
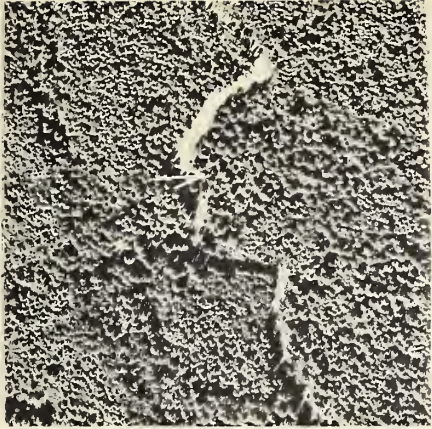
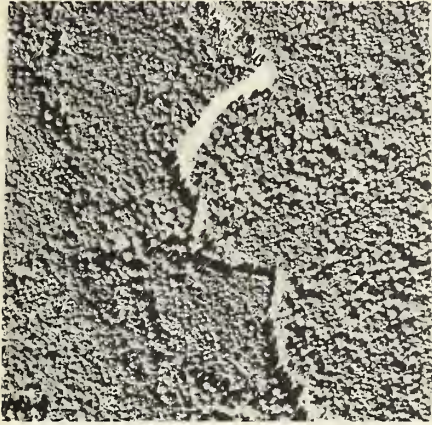
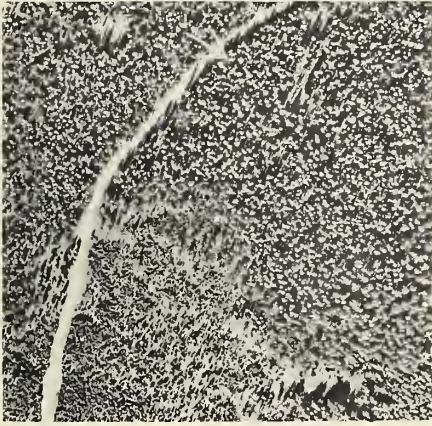
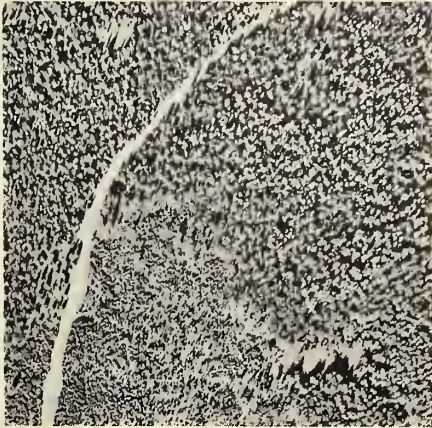


Figure 3. --- $\frac{D5=}{FM2= a, h}$ Old-growth Douglas-fir over silver fir and hemlock poles.
 Mount Hood National Forest, Oreg.
 Elevation: 3,300 ft.

This is a common two-story type at the higher elevations in the Cascades. Note that the overstory is denser than in figures 1 and 2. Conditions like this occur when the old Douglas-fir stand starts to break up and the holes are filled by the more tolerant species. Silver fir gives the understorey a dark tone. Also, the individual crowns are more discernible than in hemlock or Douglas-fir stands.

Figure 4. --- $\frac{D5=}{H3=}$ Old-growth Douglas-fir over hemlock small sawtimber.
 Siuslaw National Forest, Oreg.
 Elevation: 1,000 ft.

This stand still shows up as two-storied even when the understorey is in the small-sawtimber size class. There is a considerable height difference between the two stories. The understorey crowns are now getting to a size where an attempt at species identification can be made. Hemlock crowns have a star-shaped appearance on aerial photos. They have also been described as "pagodalike."

Scale: 1:12,000
 Site: Lower south slope

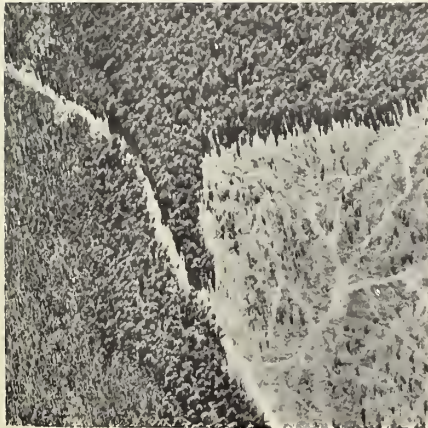
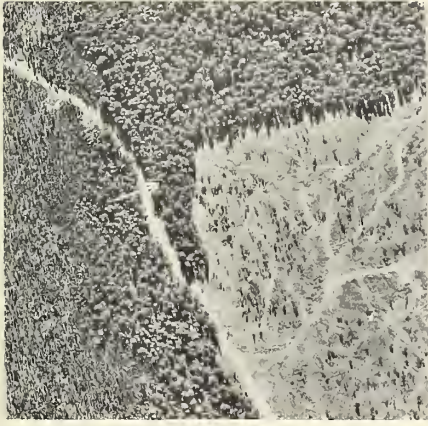
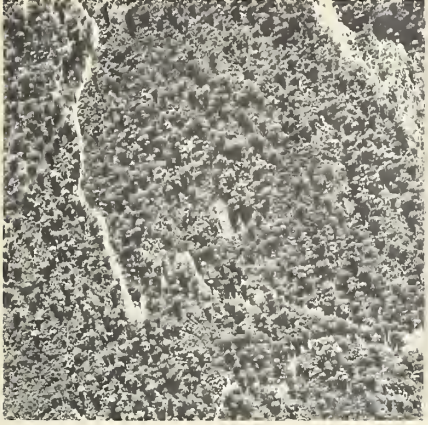
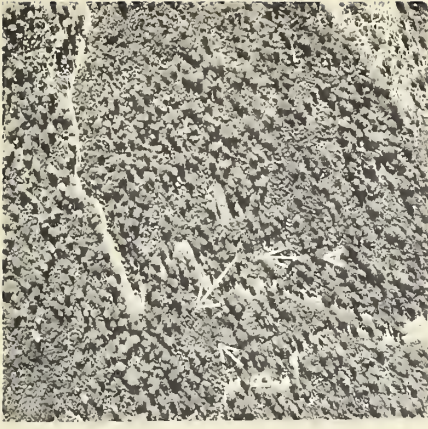


Figure 6. --D5= Old-growth Douglas-fir.

Umpqua National Forest, Oreg.
Elevation: 4,000 ft.

Scale: 1:12,000
Site: East slope

This old-growth stand has a substantial amount of large sawtimber Douglas-fir in it. Under very intensive type mapping practices this might be called D4.

However, this kind of fine distinction should be avoided.

Figure 5. ---D5-
HD2= to, d

Siskiyou National Forest, Oreg.
Elevation: 2,500 ft.

Scale: 1:12,000
Site: Middle south slope

Invasion of hardwood species in the understory of old-growth Douglas-fir stands is often found in southern Oregon. Hardwood poles (A) can be differentiated from conifers (B) by their lighter tone and larger, more rounded crowns.



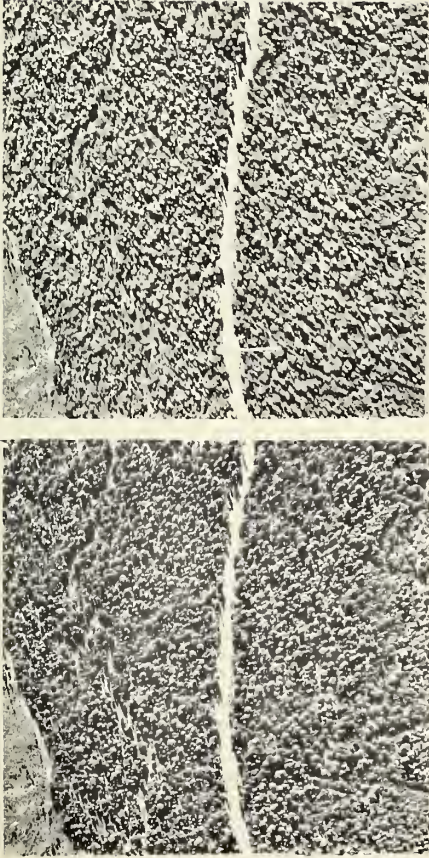


Figure 7. --D5E U Old-growth Douglas-fir (uneven-aged).

Gifford Pinchot National Forest, Wash.
Elevation: 3,000 ft.

Scale: 1:12,000
Site: Level

A mixture of old-growth Douglas-fir, large-sawtimber hemlock, and small-sawtimber and pole-size silver fir often produces a ragged appearance on the aerial photo. Compare this to the uniform appearance of the canopy in figure 6. There is too great a variety of tree sizes to sort the stand into two definite stories.

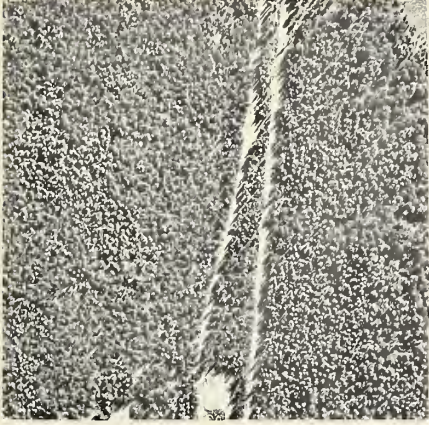


Figure 8. --D4E h U Douglas-fir large sawtimber (uneven-aged).

Mount Hood National Forest, Oreg.
Elevation: 4,000 ft.

Scale: 1:12,000
Site: East slope

This uneven-aged stand is a mixture of several different size classes of Douglas-fir and hemlock with no understory size class clearly predominating. There are no old-growth trees present here. Note smaller crowns and lower tree heights than in figure 7.



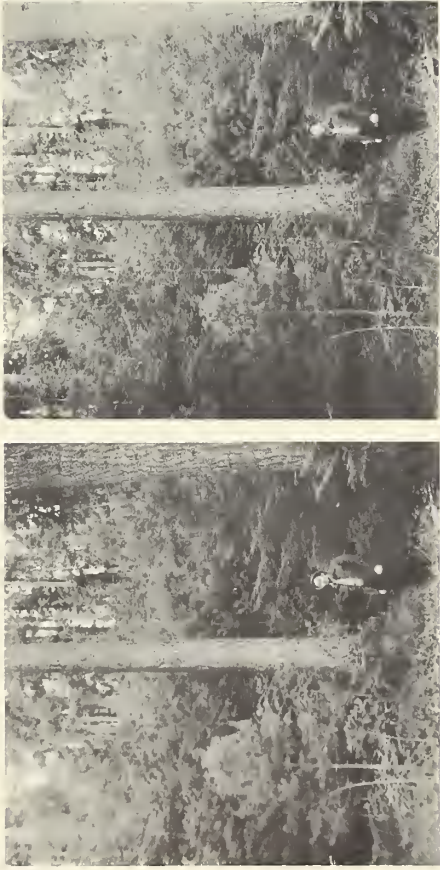
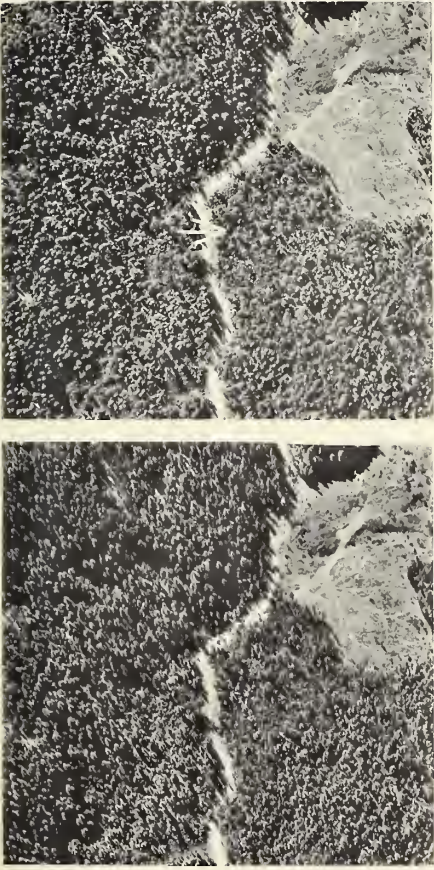


Figure 11. -- $\frac{D4 = sp}{D1 = sp, h}$ Douglas-fir and sugar pine large sawtimber over Douglas-fir, sugar pine, and hemlock saplings.
 Umpqua National Forest, Oreg.
 Scale: 1:14,000
 Site: Lower east slope
 Elevation: 2,000 ft.

Both the overstory and understorey are a mixture of Douglas-fir and sugar pine. In such mixtures, sugar pine can sometimes be distinguished from Douglas-fir by its lighter tone and extended middle branches (also see fig. 16). This species separation is not possible in the understorey.

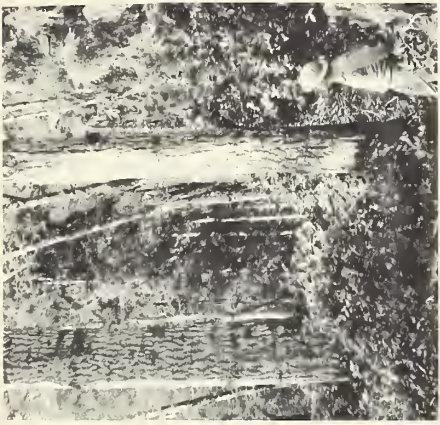
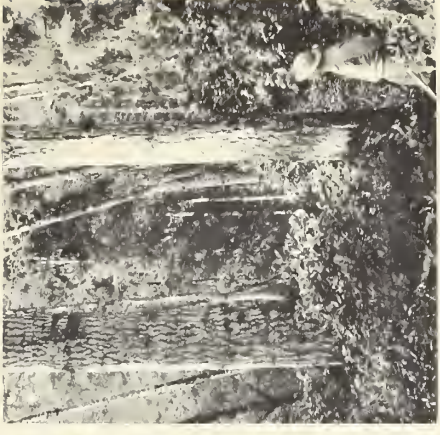


Figure 12. -- $\frac{D4 = HD3E ra}{HD3E ra}$ Douglas-fir large sawtimber over red alder small sawtimber.
 Siuslaw National Forest, Oreg.
 Scale: 1:13,000
 Site: West slope
 Elevation: 500 ft.

Douglas-fir--red alder combinations occur throughout the red alder range in coastal areas. Pure red alder stands often occupy sites that have been deformed through fire or logging. The red alder type can be recognized by the relatively even crown canopy, light tone, and "woolly" texture.





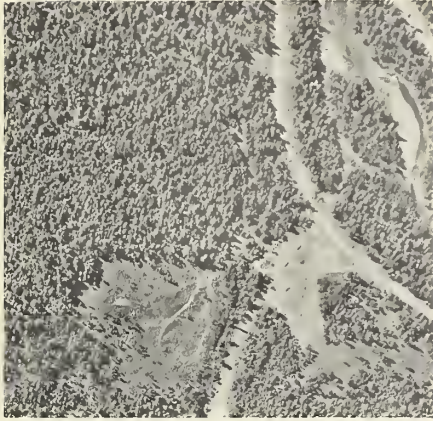


Figure 13. --- $\frac{P4-}{WF2}$

Ponderosa pine large sawtimber over white fir poles.
Mount Hood National Forest, Oreg.
Elevation: 3,300 ft.

Scale: 1:12,000
Site: Level

Here is an example of a two-story type near the crest of the Cascades where the ponderosa pine and Douglas-fir types merge. Ponderosa pine can be distinguished from Douglas-fir by its lighter tone and ball-shaped crown. The white fir understory can only be positively identified by ground inspection.

Figure 14. --- $\frac{P4-d}{D3}$

Ponderosa pine and Douglas-fir large sawtimber over Douglas-fir small sawtimber.
Willamette National Forest, Oreg.
Elevation: 2,200 ft.

Scale: 1:13,000
Site: Lower slope

Such areas of a ponderosa pine overstory in the Douglas-fir subregion are rare outside of southern Oregon. As illustrated here, the overstory large sawtimber is of large diameter for its class (36 to 40 inches) and the understory small sawtimber is of small diameter for its class (12 inches). In this case, it is possible to have a two-story stand even though they are one size class removed.



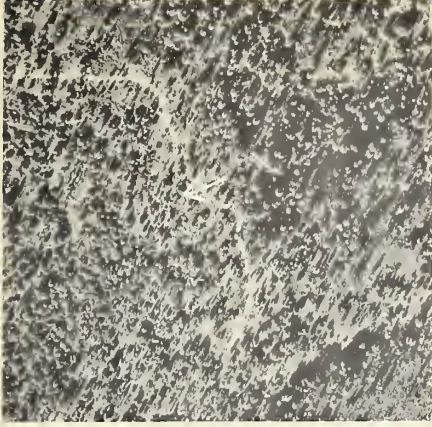
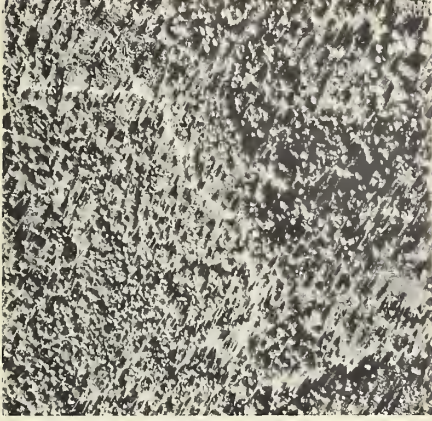
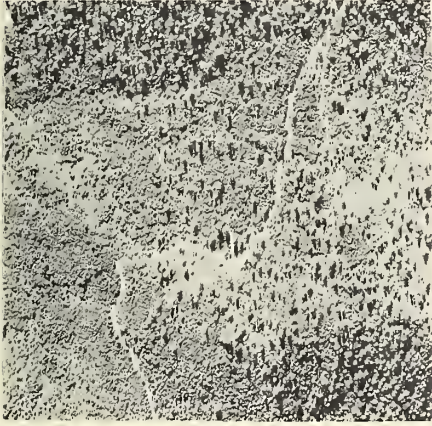
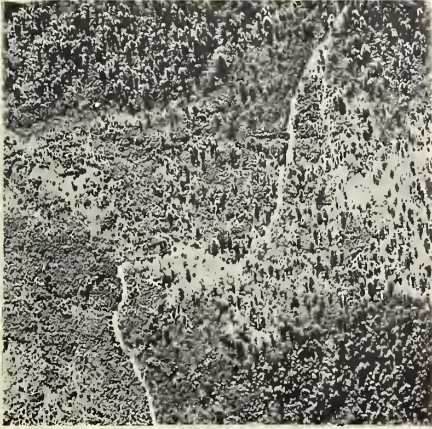


Figure 15. --- P4-
D1 ≡ Ponderosa pine large sawtimber over Douglas-fir saplings.
Rogue River National Forest, Oreg.
Elevation: 3,600 ft.
Scale: 1:13,000
Site: Middle south slope

Almost pure stands of ponderosa pine overstory cover extensive areas on dry exposures in southern Oregon. However, pine is almost always a minor component of the understory. In this illustration, the understory is predominately Douglas-fir. This understory does not differ greatly in appearance from Douglas-fir understories elsewhere in the region (figs. 1 and 13).

Figure 16. --- SP4- d
WF2 = d, ch Sugar pine large sawtimber over white fir, Douglas-fir, and chinkapin poles.
Siskiyou National Forest, Oreg.
Elevation: 4,000 ft.
Scale: 1:11,000
Site: Upper west slope

Sugar pine occurs in single trees and small groups but never in pure stands. Its usual companions in the southern Oregon mountains are ponderosa pine and Douglas-fir. Ponderosa and sugar pine can sometimes be told apart by the distinctive branching pattern of the sugar pine (fig. 11). Understories in this type are usually a mixture of conifers and hardwoods (fig. 5).



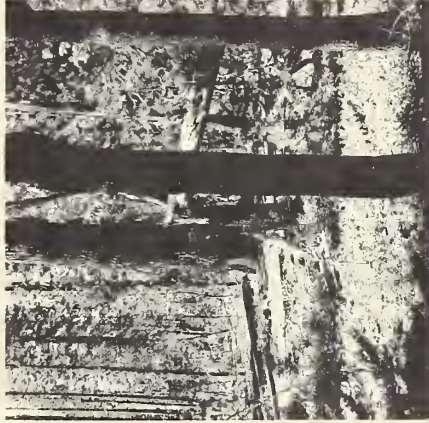
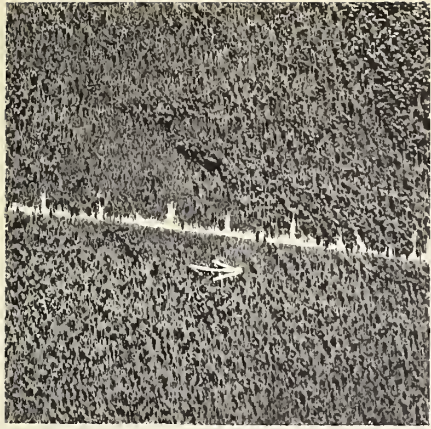
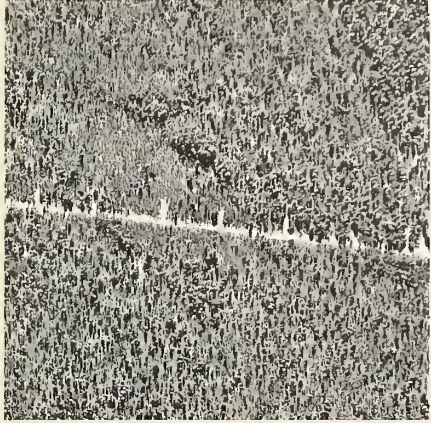
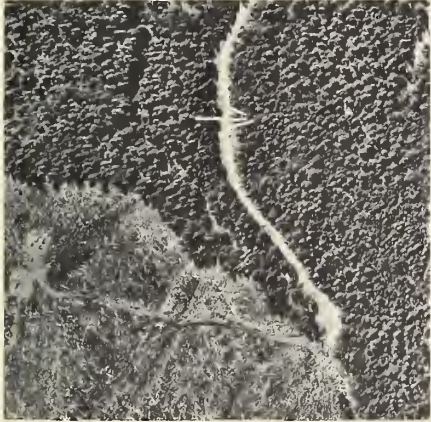
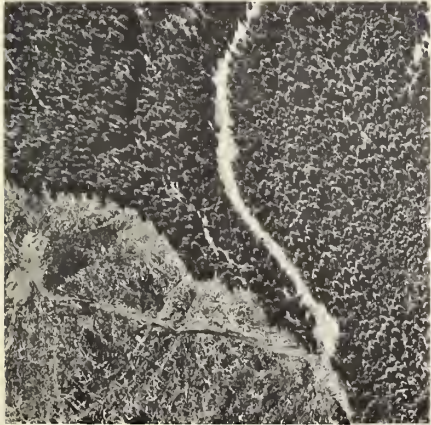


Figure 17. --- $\frac{H4=d}{H2=}$ Hemlock and Douglas-fir large sawtimber over hemlock poles.
 Snoqualmie National Forest, Wash. Scale: 1:12,000
 Elevation: 2,000 ft. Site: Lower east slope

In the northern Cascades and on the Olympic Peninsula, hemlock is often the predominant species and two-story stands are composed of this species. Hemlock over a silver fir understory is another common type in this area.

Figure 18. --- $\frac{FM4=srf}{LP2=}$ Shasta red fir large sawtimber over lodgepole pine poles.
 Umpqua National Forest, Oreg. Scale: 1:12,000
 Elevation: 4,600 ft. Site: Level

Combinations of minor species of the region form two-story types such as shown here.



