

U. S. DEPARTMENT OF AGRICULTURE

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PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

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Research Note

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DAMAGE TO WESTERN WASHINGTON FORESTS

FROM NOVEMBER 1955 COLD WAVE^{1/}

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The cold wave that occurred throughout the Pacific Northwest in mid-November 1955 caused serious damage to the forests of western Washington. Observations indicate that heavy mortality can be expected in 30- to 40-year-old stands in some areas. In addition, widespread damage was suffered by natural regeneration and young plantations, and by 1-0 stock in some forest nurseries.

Severity and Timing of Cold Wave

It is beyond the scope of this report to detail the meteorological aspects of the cold wave. However, weather records are cited to illustrate the general sequence of events. Data are from a weather station located at an elevation of 580 feet on the South Olympic Tree Farm in Grays Harbor County.

Cooperators participating in the survey were asked to rate damage as none, light, moderate, or heavy, based on observations of selected species. Extent of damage to major commercial species was noted.

^{1/} A survey sponsored by the Puget Sound Research Center Advisory Committee through its November Deep Freeze Subcommittee, consisting of J. W. Duffield, chairman, Mason Bruce, L. T. Webster (Don Lee Fraser, alternate), Stanley P. Gessel, and C. H. Willison, Jr.

October minimum temperatures were unusually mild; at no time during the month was a freezing temperature recorded. On November 1 and 2, temperatures of 32° F. were recorded, and on November 5, a temperature of 30° F. Starting on November 11, minimum and maximum temperatures were as follows:

	<u>November</u>	<u>Minimum</u>	<u>Maximum</u>
Dark and calm	11	30	38
Freezing or 30°	12	14	26
Light or more	13	12	29
Defoliated	14	7	26
	15	12	22
Leaves defoliated	16	19	29
Needles browned	17	20	29
	18	27	44
	19	33	42

1/ Where the three types of injury indicated more than one category.

The cold wave may be said to have broken between November 17 and 19. For several days during the period November 11 to 19, prevailing winds were from the east and northeast. On November 14, the date of lowest minimum temperature, relative humidity was 55 percent at 8 a.m. Weather records throughout western Washington followed a similar pattern during this period.

Survey Method

This survey report is based on questionnaires returned in early March 1956 by the Washington State Division of Forestry, four national forests, and members of the Industrial Forestry Association. By late April, it was evident that damage was greater in some areas than the March reports had indicated. Nevertheless, the committee that compiled the report feels that documentation of early effects of the freeze may be of value both for historical reasons and as a basis for further studies and surveys.

Cooperators participating in the survey were asked to rate damage as none, light, moderate, or heavy, based on observations of selected stands. Extent of damage to major coniferous species was rated according to percent of trees affected by three types of injury. Criteria used for rating damage were as follows:

Of particular importance is the fact that heavy mortality can be expected in 30- to 40-year-old stands in some sections of western Washington. Damage was generally greatest on south and southeast slopes in scattered stands and along edges of openings such as roads and cleared fields.

Type of injury	Extent of damage ^{1/}			
	None	Light	Moderate	Heavy
	----- Percent of trees damaged -----			
Totally killed	0	0	Less than 5	More than 5
Bark and cambium browning or 50 per-cent or more of crown defoliated or browned	0	Less than 5	5 to 25	More than 25
Leader defoliated or needles browned	0	Less than 25	25 to 50	More than 50

^{1/} Where the three types of injury indicated more than one damage rating, only the highest was reported.

Survey Findings

Main results of the survey are shown on the accompanying maps, which give the location and relative severity of damage to Douglas-fir, western hemlock, and western redcedar (Figs. 1 to 3). Evidence accumulated so far from both the maps and comments of observers suggest the following picture of the cold wave and its effects on principal conifers of western Washington.

Relatively high temperatures prevailing in October and early November failed to cold-condition trees and other vegetation. The temperature drop on November 11 was not only sudden but was also accompanied by high east and northeast winds followed by dry and sunny weather. Thus, trees with cell sap not yet concentrated, due to lack of normal autumnal cooling, were suddenly subjected to three injurious elements -- cold, high winds, and low atmospheric humidity. Injury to protoplasm was aggravated, particularly in open stands and on south slopes, by repeated freezing resulting from sunny days and clear, cold nights.

Extent of injury noted to cambium and phloem and observations of progressive defoliation suggest that heavy mortality can be expected in 30- to 40-year-old stands in some sections of western Washington. Damage was generally greatest on south and southeast slopes, in scattered stands and along edges of openings such as roads and cleared fields.

Among the five major conifers of western Washington, western hemlock was damaged most heavily, followed closely by western redcedar. Douglas-fir was apparently damaged somewhat less than its two common associates. Sitka spruce was not damaged seriously and injury to the true firs was very slight. For western hemlock, widespread reports of serious damage to cambium and phloem were received. With western redcedar, several observers noted that understory trees were damaged less than trees occurring in the main canopy or in exposed situations. In the case of Douglas-fir, the Olympic Peninsula area generally was least damaged and proximity to Puget Sound appeared to result in lighter-than-average injury. Young Douglas-fir that had been pruned or scarred for Christmas tree production appeared to be more seriously injured than untreated trees.

Among western Washington hardwoods, extensive killing of alder and Pacific madrone was reported. Several widely planted exotics, such as Monterey pine, redwood, and Port-Orford-cedar (except the blue variety allumi, which showed resistance), were killed outright or very heavily damaged. Among commercially important decorative evergreen shrubs, evergreen huckleberry was extensively killed and salal heavily damaged; particularly when unprotected by tree canopies.

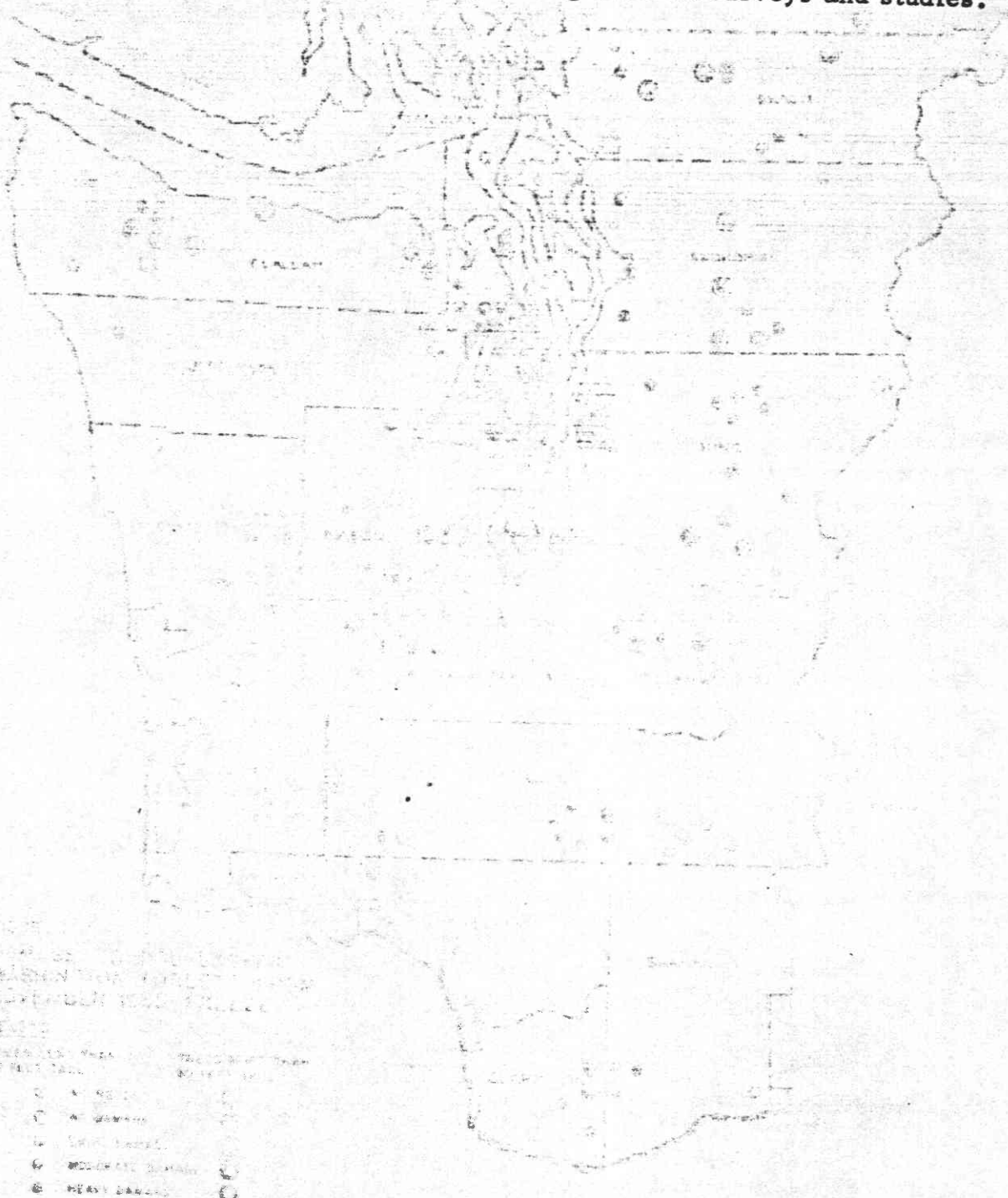
In addition to differences between species, observers noted a pronounced variation in the severity of injury from tree to tree, indicating that resistance to cold-wave damage is strongly inheritable.

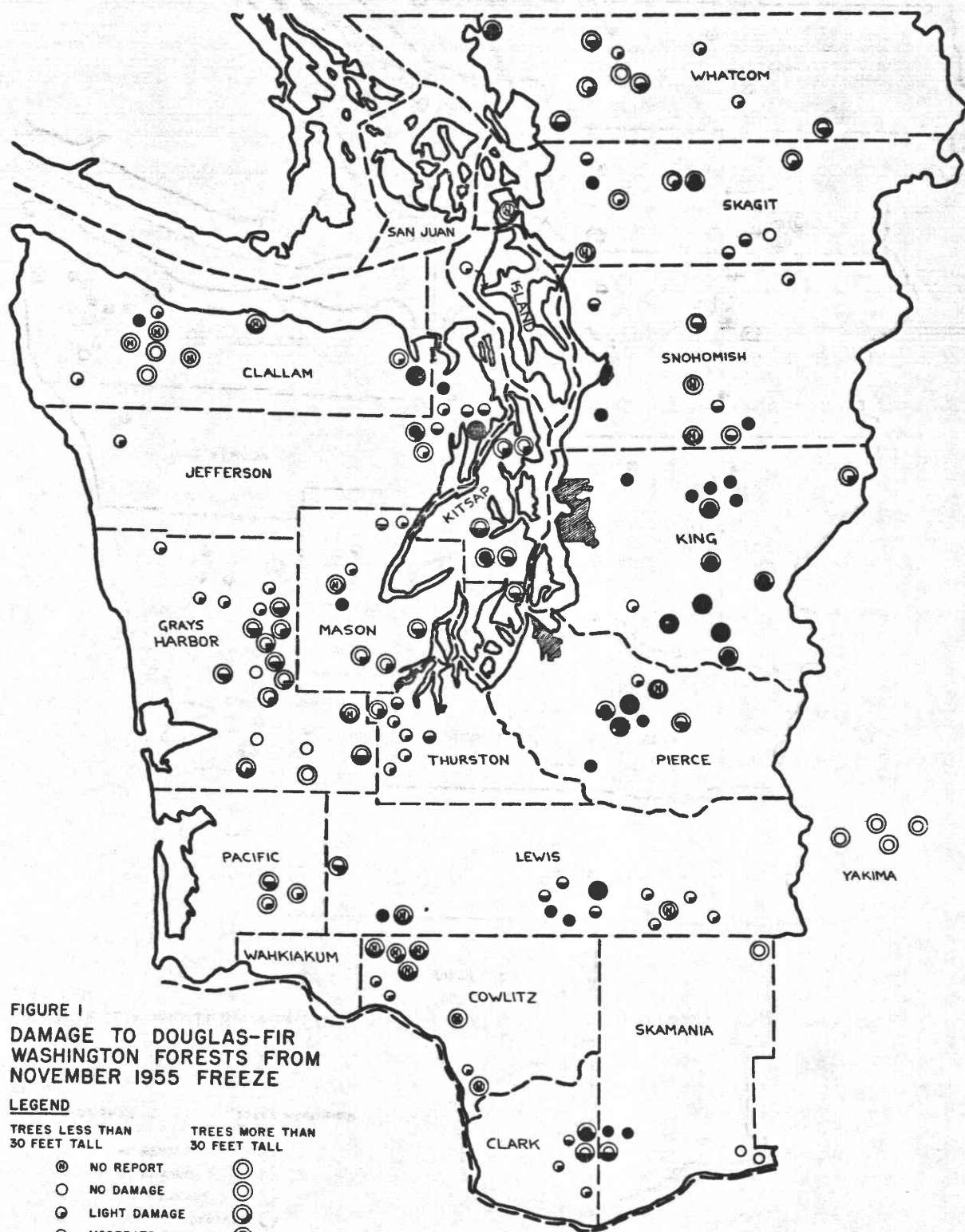
Damage to natural regeneration and young plantations was rather widespread. Also, serious damage occurred in those forest nurseries where snow cover was either lacking or blown off in the early hours of the cold wave. For all commercially planted species, except true firs, losses in 1-0 nursery stock were heavy and aggravated after the initial cold wave by abnormally severe frost heaving during the winter of 1955-56. Damage to 2-0 nursery stock was generally slight.

Implications

In some areas mortality is already heavy enough to increase fire hazard substantially. Moreover, stands containing damaged or dead trees large enough to attract bark beetles will need to be watched closely as trees weakened or killed by the cold wave provide a source of breeding material that could lead to epidemic populations. Some stands that were adequately stocked before November 1955 may be understocked now due to losses from the cold wave.

It is, of course, too early to even guess what the damage from the November cold wave will total in terms of either value of forest products lost or reduction in forest productivity. Nevertheless, the accompanying maps show certain patterns of damage distribution. It is hoped they will be helpful in planning detailed surveys and studies.





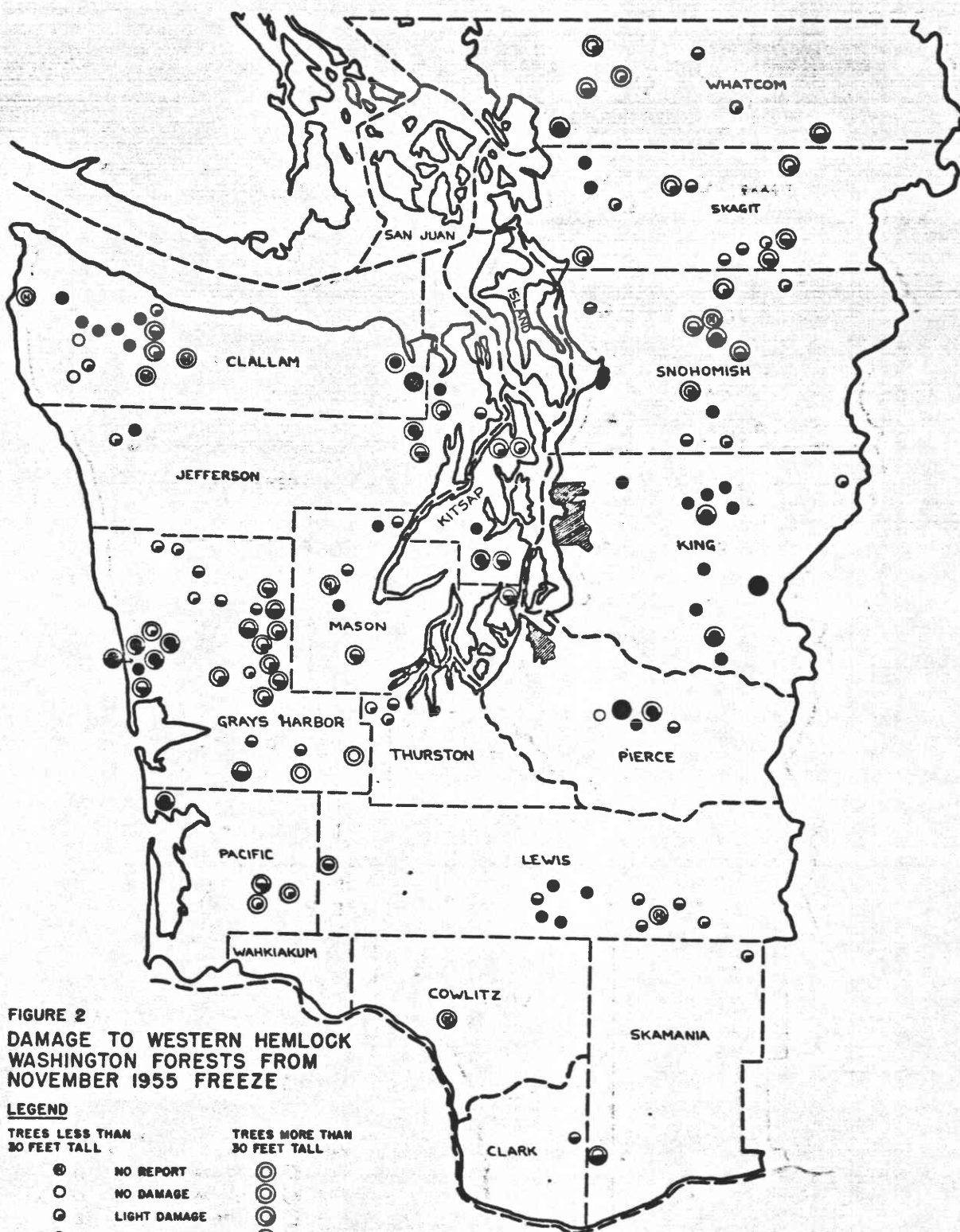


FIGURE 2
DAMAGE TO WESTERN HEMLOCK
WASHINGTON FORESTS FROM
NOVEMBER 1955 FREEZE

LEGEND

TREES LESS THAN
30 FEET TALL

- NO REPORT
- NO DAMAGE
- ◐ LIGHT DAMAGE
- ◑ MODERATE DAMAGE
- HEAVY DAMAGE

TREES MORE THAN
30 FEET TALL

- ◐ NO REPORT
- NO DAMAGE
- ◐ LIGHT DAMAGE
- ◑ MODERATE DAMAGE
- HEAVY DAMAGE

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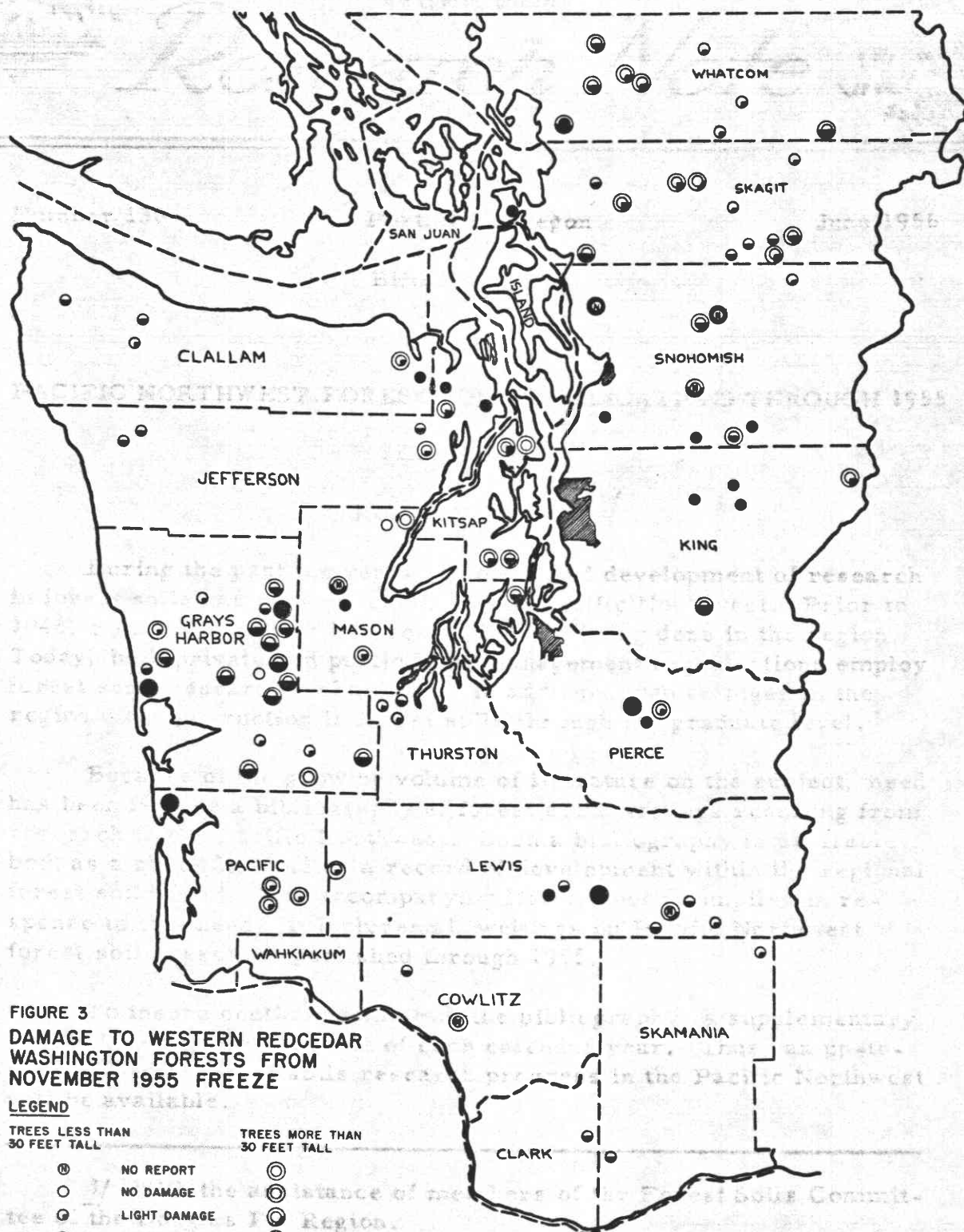


FIGURE 3
 DAMAGE TO WESTERN REDCEDAR
 WASHINGTON FORESTS FROM
 NOVEMBER 1955 FREEZE

LEGEND

TREES LESS THAN
 30 FEET TALL

- NO REPORT
- NO DAMAGE
- ◐ LIGHT DAMAGE
- ◑ MODERATE DAMAGE
- HEAVY DAMAGE

TREES MORE THAN
 30 FEET TALL

- NO REPORT
- NO DAMAGE
- ◐ LIGHT DAMAGE
- ◑ MODERATE DAMAGE
- HEAVY DAMAGE