LAKE STATES TREE SEED COLLECTION ZONES

JUNE, 1957

Prepared by:

LAKE STATES TREE
IMPROVEMENT COMMITTEE

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FOREST TREE SEED COLLECTION ZONES FOR THE LAKE STATES

PREPARED BY THE SUBCOMMITTEE ON FOREST TREE SEED COLLECTION ZONES,
LAKE STATES FOREST TREE IMPROVEMENT COMMITTEE

PUBLISHED BY THE FORESTRY DIVISION, MICHIGAN DEPARTMENT OF CONSERVATION

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PREFACE

The growing knowledge of variation within forest tree species points more and more to the importance of knowing the source of seed we use in reforestation. The need is becoming more urgent with the increasing demand for forest planting stock. We are happy, therefore, to further the work of the Lake States Forest Tree Improvement Committee by publishing this report.

G. S. McIntire, Chief
Division of Forestry
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FOREWORD

One of the initial tasks assigned the Lake States Forest Tree Improvement Committee at its inception in April 1953 was that it "take steps to foster forest tree seed certification in the three Lake States." Because an estimated 90 percent of the forest tree seed collected in this region is obtained by or for public agencies or for industrial agencies which grow their own stock, there seemed to be little immediate compulsion for certification laws. The Committee decided, therefore, to develop a basis for seed collection zones as a first step. This could lead to meaningful certification as to origin. Accordingly, a sub-committee on seed collection zones developed this report. Although all members of the subcommittee participated in planning and reviewing it, the report was prepared by Paul O. Rudolf of the Lake States Forest Experiment Station.

F. J. Hodge, Chairman
Subcommittee on Forest Tree Seed Collection Zo
Lake States Forest Tree Improvement Committee

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FOREST TREE SEED COLLECTION ZONES
FOR THE LAKE STATES [1/]

WHY SEED COLLECTION ZONES ARE IMPORTANT

Forest tree species which grow over a wide range of conditions probably have developed races. There is experimental proof for such development for some 25 North American species and observational evidence for several more. In some instances the races are easily distinguished, differing in such morphological features as length or color of the leaves, bud shape or color, or bark characteristics. More often, however, the differences are primarily physiological; they may involve resistance to drought, insects, and diseases or adaptability to certain site conditions. Such differences are not visible and usually show up only when stock of two or more races is planted in the same place.

Trees grown from local seed usually are best adapted to conditions in that locality. Introduced races sometimes are superior to local races, but more often the reverse is true. In either event it is important to know whether or not the seed for any plantation originated under conditions comparable to or different from those of the planting site. For this reason it is important to establish homogeneous seed collection zones and to designate as to origin each lot of seed used in reforestation.

1/ Prepared by Paul O. Rudolf for the Subcommittee on Forest Tree Seed Collection Zones, Lake States Forest Tree Improvement Committee; F. J. Hodge, Michigan Conservation Department (Chairman); B. L. Berklund, Nekoosa-Edwards Paper Co., W. H. Brener, Wisconsin Conservation Department; J. W. Macon, Consolidated Water Power and Paper Co.; Paul O. Rudolf, Lake States Forest Experiment Station; and T. Schantz-Hansen, University of Minnesota.

ZONES PREVIOUSLY USED OR PROPOSED

Forest tree seed collection zones, in a broad sense, have been used in the Lake States for more than 30 years. State nurseries generally have used seed from their own states, except when exotic species were grown. Sometimes they have specified sections of the state from which the seed originated. The U. S. Forest Service has identified its seed collections by the national forest of origin.

Based on studies of seedling cold resistance and on intensive observations of the parent stands in the field, C. G. Bates, in 1929, proposed 8 seed collection centers for red pine in the Lake States (1, 2).[2/] In 1931, Rudolf modified these centers into contiguous zones (fig. 1) characterized by definite but overlapping climatic characteristics (table 1) (3). These zones were used to analyze the results of red pine seed source studies.

In 1939, the U. S. Department of Agriculture developed the following seed policy: (1) To use only seed of known locality of origin, and nursery stock grown from such seed; (2) To require from the vendor adequate evidence verifying place and year of origin for all lots of seed or nursery stock purchased ....; (3) To require an accurate record of the origin of all lots of seed and nursery stock used in forest, shelterbelt, and erosion-control planting ....; (4) To use local seed from natural stands wherever available unless it has been demonstrated that seed from another specific source produces desirable plants for the locality and uses involved. Local seed means seed from an area subject to similar climatic influences and may usually be considered as that collected within 100 miles of the planting site and differing from it in elevation by less than 1,000 feet. (5) When local seed is not available, to use seed from a region having as nearly as possible the same length of growing season, the same mean temperature of

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2/Underlined numbers in parentheses refer to references cited at end of this report.

the growing season, the same frequencies of summer droughts, the same latitude, and other similar environment so far as possible. (6) To continue experimentation with indigenous and exotic species, races, and clones to determine their possible usefulness, and to delimit as early as practicable climatic zones within which seed or planting stock of species and their strains may be safely used for forest, shelterbelt, and erosion control. (7) To urge that states, counties, cities, corporations, other organizations, and individuals producing and planting trees for forest, shelterbelt, and erosion-control purposes, the expense of which is borne wholly or in part by the Federal Government, adhere to the policy here outlined. This policy provides a basis for certifying seeds as to origin.

Deficiencies of Previous Collection Zones

The seed collection zones previously suggested for the Lake States were not based primarily upon climatic factors, and display considerable overlapping of such features. Time may show that they provide valid divisions for certain species, but for the present it will be desirable to recognize zones based on meaningful readily available climatic data. As knowledge of species behavior accumulates it should be possible to develop seed collection zones more applicable to individual species. Until that time, however, it will be desirable to use uniform zones for all species. It is the purpose of this subcommittee to develop such uniform zones.

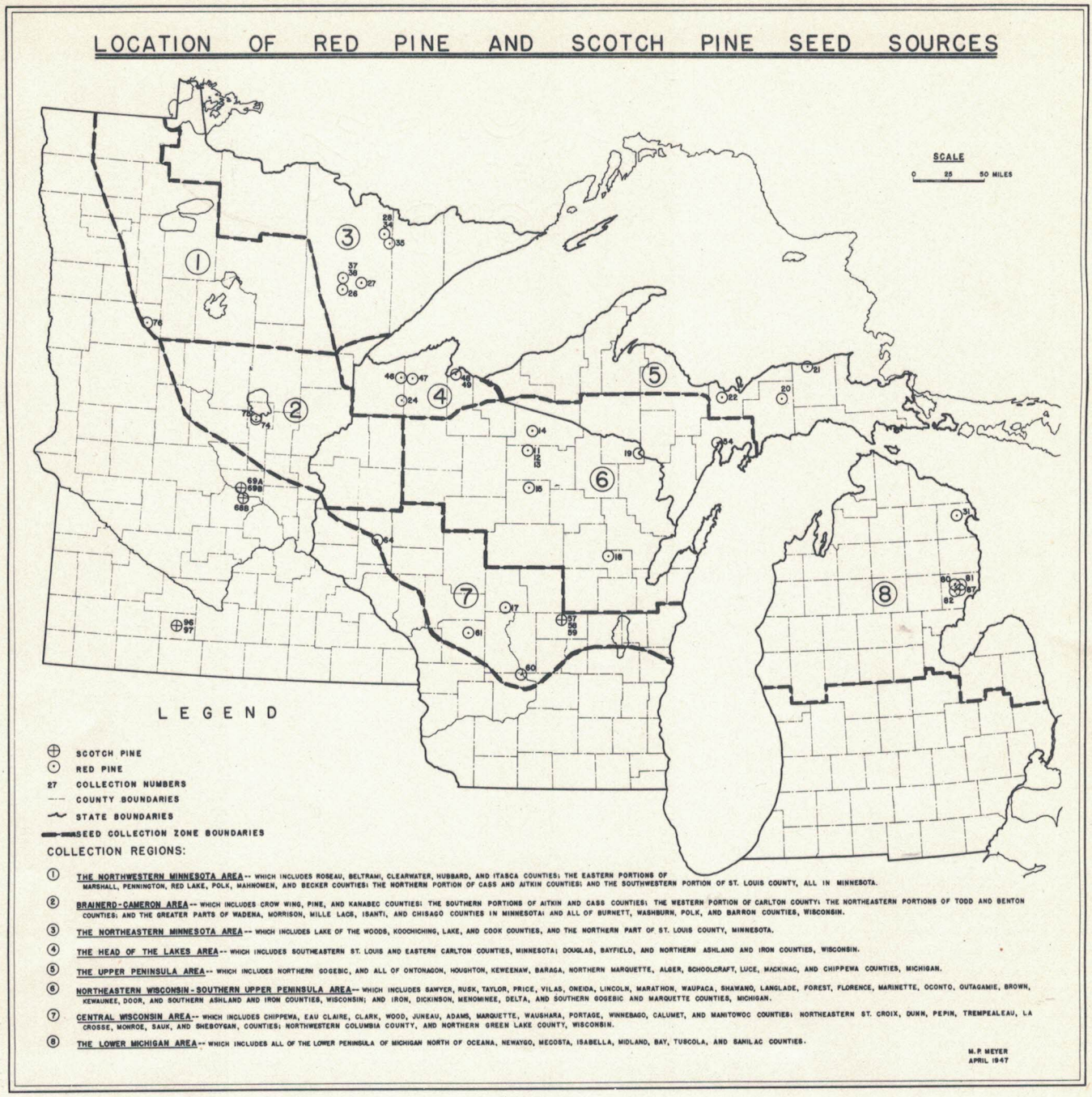

Figure 1.--Forest tree seed collection zones based on seedling response of red pine, developed by Bates and Rudolf.

Table 1.--Characteristics of red pine seed collection zones

Zone	Temperature ranges		Length of growing season
	Mean January	Mean July	
	Degrees F.	Degrees F.	Days
1. Northwestern Minnesota	0- 6	66-68	100-130
2. Brainerd-Cameron area	4- 8	66-70	110-130
3. Northeastern Minnesota	2-14	60-66	110-140
4. Head of the Lakes	6-12	64-66	120-140
5. Northern Upper Peninsula	12-16	60-66	80-140
6. Northeastern Wisconsin-Southern Upper Peninsula	10-18	60-68	80-150
7. Central Wisconsin	12-18	68-70	130-170
8. Lower Michigan	18-24	66-70	90-150

In 1939, H. L. Shirley then of the Lake States Station, proposed a series of seed collection zones combining a greater number of factors (table 2). These zones also have some overlapping characteristics. So far they have not been used in practice.

Table 2. --Seed collection zones proposed by Shirley

No.	Territory	Original forest type	Climatic factors		
			Annual precipitation	Length of growing season	Mean temperature of growing season
			Inches	Days	Degrees F.
1	Keweenaw Peninsula, eastern tip of Upper Peninsula and northern fringe of Lower Peninsula, Michigan	Spruce-fir and northern hardwood.	25-30	140	60-64
2	Lower Peninsula of Michigan north of Saginaw Bay	Northern hardwood, pine	25-30	120-140	62-66
3	Lower Michigan south of Saginaw Bay	Oak-hickory, northern and central hardwoods.	30	140-160	66-70
4	Upper Peninsula of Michigan and northern Wis.	Northern hardwoods.	30	80-120	60-64
5	North central Wisconsin	Northern hardwoods and pine.	30	120-140	64-66
6	Southeastern Minn. and southern Wis.	Oak-hickory, northern hardwood, and pine.	25-35	140-160	66-70
7	Northeastern Minnesota	Spruce-fir	20-25	110-120	60-62
8	Head of the Lakes	Spruce-fir.	25	120-140	60-62
9	North central Minnesota	Pine, spruce-fir, and poor northern hardwoods.	23	120-130	62-64
10	South central Minnesota	Pine, oak, and hardwoods	25	130-140	64-66

THE PROPOSED NEW ZONES

An initial attempt to develop seed collection zones on a simple basis involv the use of mean July temperatures. Using an interval of 4° F. three zones were outlined: (1) less than 66°, (2) 66° to 70°, and (3) above 70°.

These zones, however, were rather broad and included quite a range of growin conditions, so a more comprehensive basis was sought. A unit of measure clearly showing the accumulation of warm temperatures seemed most desirable. It was decided, therefore, to use a summation of normal average daily temperatures per year above 50° F. The choice of 50° was governed by the fact that most of the physiological activity in many temperate zone plants occurs above that temperatur

The annual sums of normal average daily temperatures of 50° F. or above, cal "growth degrees," 3/ were computed for all Lake States localities for which the U. S. Weather Bureau reports normal temperatures. These values were entered on a map and from them zone lines were drawn for each 1,000 "growth degrees" (which roughly approximates an interval of 2° F. during the period in which average dail temperatures are 50° F. or above). For the region, this provided 7 zones (the nu bered zones in fig. 2), two of them of very limited extent.

To test whether or not these zones had any significance we used data for red pine from 119 Lake States seed sources which had been planted by the Lake States

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3/ In searching for a suitable term both "degree days" and "day degrees" were considered and discarded. The former has been used frequently by the Weather Bureau and heating engineers in a special sense; it is commonly understood to mean the "sum of the amounts by which the normal temperature of each day cooler than 65° F. is less than 65°." The latter, "day degree," has been used in agriculture to mean "one degree Fahrenheit above or below 42° F. for a period of 24 hours or its equivalent." To avoid confusion a new term seemed desirable. We have, therefore, used "growth degree" in this paper, as defined above.

Forest Experiment Station on the Superior National Forest in 1933. Twenty years after planting, values for approximate volume in cubic feet per 100 trees planted (thus combining the effects of survival, height growth, and diameter growth) show reasonably good agreement with the zonation as follows: 7,000 to 8,000 "growth degrees," 26.9; 8,000 to 9,000 "growth degrees," 35.6 (the home locality occurs here); 9,000 to 10,000 "growth degrees," 28.1; 10,000 to 11,000 "growth degrees," 19.3; and 11,000 to 12,000 "growth degrees," 10.4.

However, there was a distinct trend for volumes within a zone to decrease with distance away from the home locality. This led to a search for a significan modifying factor. Annual and growing-season precipitations were tried but found unsatisfactory. Average January temperatures, as representing severity of the winters in the localities of seed origin, showed a marked relationship to the average volume per 100 trees planted of the 119 red pine seed sources as follows: 0° to 4° F., 50.5 cubic feet; 4° to 8° F., 41.5 cubic feet (the home locality is this belt); 8° to 12° F., 36.6 cubic feet; 12° to 16° F., 26.0 cubic feet; 16° to 20° F., 19.2 cubic feet; and 20° to 24° F., 10.6 cubic feet.

A map (fig. 2) was then prepared showing zones based on intervals of 1,000 "growth degrees"over 50° F. and 4° F. intervals of mean January temperature. Combined, these two factors produce 28 zones in the Lake States. 4/ By states th number of zones is 15 for Minnesota, 15 for Wisconsin, and 13 for Michigan. Disregarding those which occur to a limited degree only, there are 10 for Minneso and 8 each for Wisconsin and Michigan.

To simplify delineation of the zones, boundaries were generalized to coincid with county lines (fig. 3). At the present stage of knowledge and practice such

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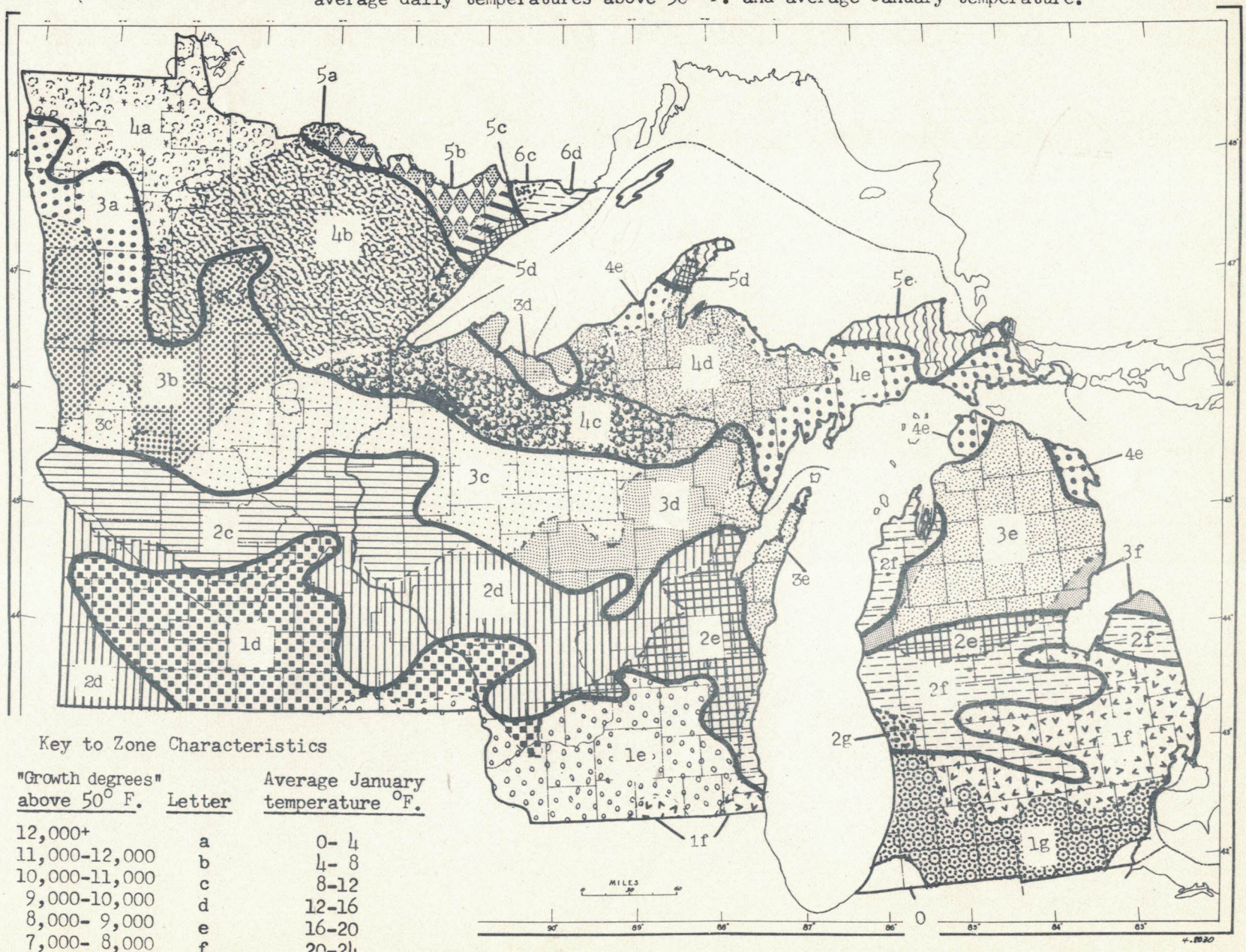
4/ One reviewer suggested numbering the zones consecutively from 1 to 28. To preserve the identity of similar zones in different states, however, the combination of numbers (for "growth degrees") and letters (for January compensation) was retained.

Figure 2.--Proposed forest tree seed collection zones based on the average annual accumulation of normal average daily temperatures above 50° F. and average January temperature.

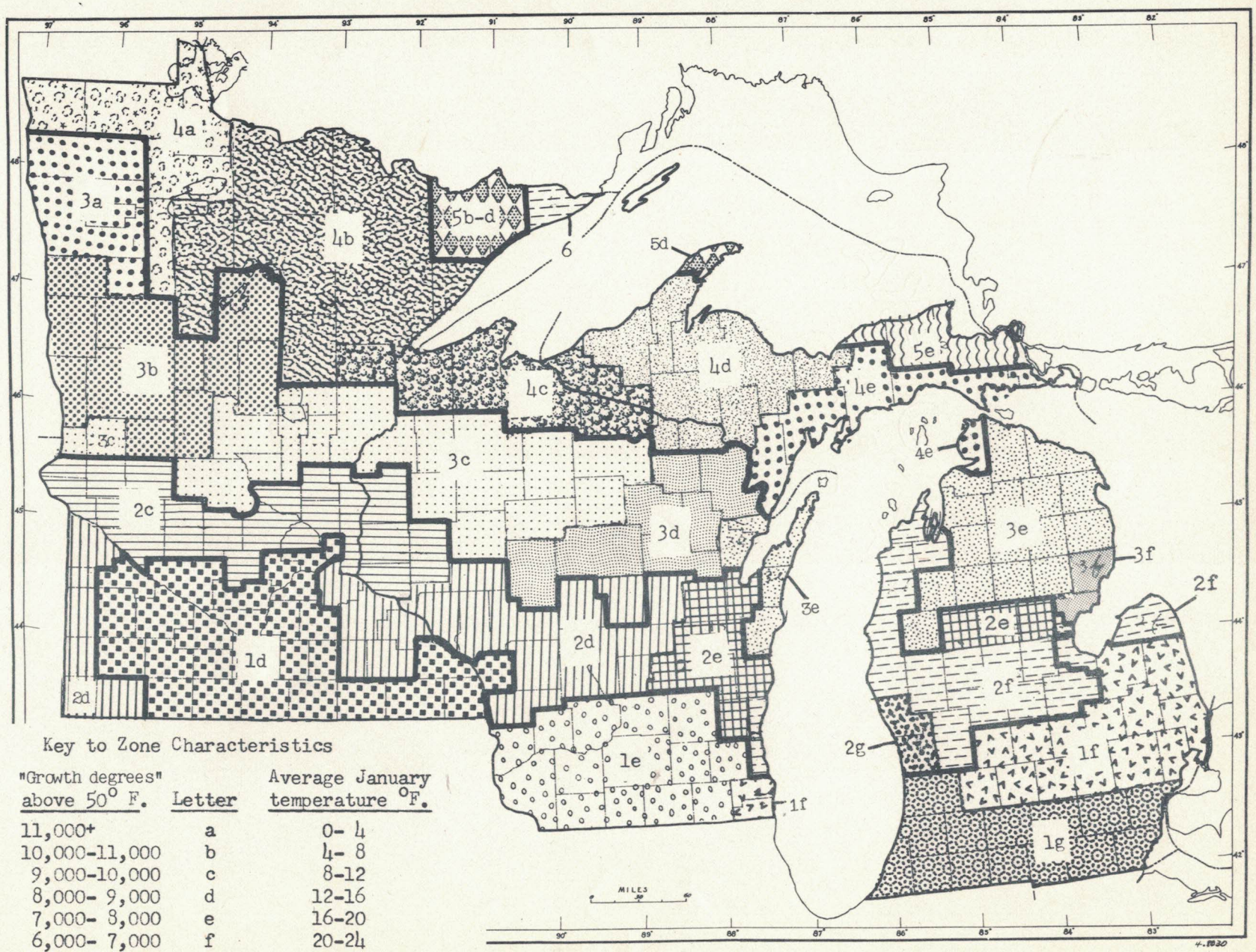


Key to Zone Characteristics

No.	"Growth degrees" above 50° F.	Letter	Average January temperature °F.
0	12,000+	a	0- 4
1	11,000-12,000	b	4- 8
2	10,000-11,000	c	8-12
3	9,000-10,000	d	12-16
4	8,000- 9,000	e	16-20
5	7,000- 8,000	f	20-24

Figure 2.--Proposed forest tree seed collection zones based on the average annual accumulation of normal average daily temperatures above 50° F. and average January temperature.

Figure 3.--Proposed seed collection zones generalized by county lines.



Key to Zone Characteristics

No.	"Growth degrees" above 50° F.	Letter	Average January temperature °F.
1	11,000+	a	0- 4
2	10,000-11,000	b	4- 8
3	9,000-10,000	c	8-12
4	8,000- 9,000	d	12-16
5	7,000- 8,000	e	16-20
6	6,000- 7,000	f	20-24

Figure 3.--Proposed seed collection zones generalized by county lines.

generalizations should cause no serious loss in significance of the zones, and will simplify zone designation and administration of collections based upon the zones.

PUTTING THE ZONES TO USE

To be effective the zones will have to be used by all agencies collecting and using forest tree seed within the region. However, there has been some objection that the proposed zones are too numerous. Fortunately, some practical concessions can be made.

For use within a state the "growth degrees" zones may be sufficient for many purposes. This would provide 6 zones for Minnesota, 5 for Michigan, and 4 for Wisconsin--the numbered zones on figure 3. It would be desirable to designate collections by both number and letter zones ("growth degrees" and January temperature), but the letters could often be ignored for use within a state. For interchange of seed between states, however, the lettered subdivisions of the numbered zones should be included. Recently the Wisconsin Conservation Department has initiated a program of seed "verification" for red pine. This program recognizes three seed collection zones based on the "growth degree" zones proposed in this report.

WHAT SHOULD COME NEXT?

The use of the seed collection zones will provide a basis for certifying forest tree seed in the Lake States as to origin. That is an important part, but only a part, of seed certification. A complete job requires also certification as to quality. Such a procedure is a necessary basis for setting a reliable price or value for seed. It requires seed testing, not now generally available for forest tree seeds. However, the establishment of workable seed collection zones is a necessary first step in seed certification.

If forest tree seeds are to be tested for quality in the Lake States, laboratories will have to be provided. The present state seed laboratories are equipped only for the relatively simple job of testing agricultural seeds. Either they will have to obtain different equipment and adapt some different procedures or special laboratories will have to be developed.

If the tree seed trade is to be governed by law the proper legal machinery will have to be set up. Currently an effort is being made to develop a uniform seed law to cover the handling of agricultural seeds. Possibly this proposed law can be amended or amplified to cover forest tree seeds also. It would then provide a model which states could adopt whenever they are prepared to do so. An attempt now is being made by foresters to provide for this modification.

SUMMARY

Most forest tree species probably have developed races many of which differ from one another physiologically rather than morphologically. Often, but not always, the local races are better adapted to the localities of their origin than are other races. For this reason it is important to establish homogeneous seed collection zones and to designate as to origin each lot of seed used in reforesta

Previously forest tree seed collections usually have been designated only as to state of origin or, on the national forests, as to forest of origin. In 1929 Bates proposed 8 seed collection zones based on response of red pine seedlings. They were modified by Rudolf in 1931. In 1939 Shirley proposed a series of zones combining a number of factors. In that year also the U. S. Department of Agricul adopted a seed policy stressing use of local or well adapted seed for forestry an related purposes.

All these previously proposed zones, however, display considerable overlappi of climatic features. There is proposed here, therefore, a series of zones based on two temperature factors: (1) a summation of normal average daily temperatures per year above 50° F., "growth degrees" and (2) mean January temperatures. The development of red pine trees of 119 seed sources 20 years after planting showed good relationships to these zones.

The use of seed collection zones will facilitate certification of forest tre seeds as to origin. To certify them also as to quality will require seed testing not now generally available for forest tree seeds. Certification as to origin, however, is a necessary first step in this process. This report provides a basis for that first step.

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This publication was issued for the Lake States Forest Tree Improvement Committee by the Michigan Department of Conservation, Forestry Division. The following publications have been issued previously for the Committee:

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1956. Lake States Forest Exp. Sta., Sta. Paper 40, 32 pp., illus. (Processed)