

AN ABSTRACT OF THE THESIS OF

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Title THE FREQUENCY OF OCCURRENCE OF CORTICOLOUS  
LICHENS ON QUERCUS GARRYANA IN THE WILLAMETTE  
VALLEY

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This study was made to present any evidence as to differences in the frequency of occurrence of corticolous lichens from east to west in the Willamette Valley on a bark substrate of Quercus Garryana.

Twenty-four species of lichens were observed to be present within the grid area of the 100 trees used in the study, i. e., ten trees in each of ten stands of White Oak. At the western base of the Cascades the total number of species present was 15. This number diminished to a total of three species at the eastern base of the Coast Range.

Only two lichens, Arthopyrenia punctiformis and Pertusaria multipuncta, occurred throughout the ten stands in some frequency. Among the stands nine species of lichens were found in one stand out of ten. Variations in the frequency of occurrence were found to exist among the other 14 species, and in many cases not necessarily

in direct relationship to their habitats. This was especially true of Lobaria pulmonaria which occurred most frequently in stand IV, but in stand I, which was environmentally similar in all respects to stand IV, it did not occur at all.

Certain species of corticolous lichens have a greater tendency to appear on the north or south side of the trunk, while others appear in approximately equal frequency on the north or south sides of the trunks.

The grid method, applied to determine the frequency of occurrence, was successful for all three forms of lichens: crustose, fruticose and foliose. This made possible a quantitative approach to the study of lichen relationships.

The corticolous lichens studied do occur at different frequencies from east to west. In addition, the number of species and kinds of species are different.

THE FREQUENCY OF OCCURRENCE OF CORTICOLOUS  
LICHENS ON QUERCUS GARRYANA IN THE  
WILLAMETTE VALLEY

by

ROBERT HOWARD SAXTON

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THE FREQUENCY OF OCCURRENCE OF CORTICOLOUS  
LICHENS ON QUERCUS GARRYANA IN THE  
WILLAMETTE VALLEY

INTRODUCTION

It has been observed that corticolous species of lichens occurring on the trunks of Quercus Garryana (White Oak) appear in different frequencies and numbers of species from east to west, and that there is a common group of lichens occurring in all areas along this east-west distribution. This study was undertaken to determine by quantitative methods the differences existing in the area under consideration.

This study is an attempt to determine the frequency of occurrence of the species of lichens growing on the trunks of Quercus Garryana using data obtained from adequate sampling of ten stands of White Oak along the 44th parallel or a few miles north or south of this parallel. The areas involved are selected stands of Quercus Garryana from its most westerly appearance at the eastern base of the Coast Range to its most easterly appearance at the western base of the Cascade Range along the 44th parallel.

The two primary objectives of this study are: (1) to determine the frequency of occurrence of an individual lichen species in each of ten stands on the trunks at breast height; (2) to determine whether or not there is a difference in the total number of species and kinds of species occurring on Quercus Garryana from west to

east along the 44th parallel in its normal habitat.

Determination of lichens were based upon Fink (1935), Hale (1950) and Howard (1950). Specimens from the collection of Professor Frank Sipe, emeritus, University of Oregon herbarium, were constantly referred to as an added check to proper identification.

## METHODOLOGY

### The Selection of Oak Stands

The selection of mature stands of White Oak was based primarily on their proximity to accessible roads. Moreover, the stands were so selected from other stands as to be at intervals of different exposures and distribution along this area of study. These were all mature stands of Oaks; maturity of the stand being based on an arbitrary minimum tree circumference of approximately one foot (12 inches) for all Oaks in the stand.

Ten stands were selected and assigned numbers beginning with stand number one (I) on the extreme western limit of Quercus Garryana to number ten (X) on the extreme eastern limit. The precise location of each stand is indicated in Table I.

TABLE I Location of stands

| Stand no. | Township | Range | Section | Quadrangle name       |
|-----------|----------|-------|---------|-----------------------|
| I         | 17 S     | 7 W   | 22      | Blachly, Oregon       |
| II        | 18 S     | 5 W   | 19      | Crow, Oregon          |
| III       | 18 S     | 5 W   | 19      | Crow, Oregon          |
| IV        | 17 S     | 5 W   | 34      | Elmira, Oregon        |
| V         | 18 S     | 3 W   | 18      | Eugene, Oregon        |
| VI        | 18 S     | 3 W   | 10      | Eugene, Oregon        |
| VII       | 18 S     | 3 W   | 14      | Cottage Grove, Oregon |
| VIII      | 18 S     | 2 W   | 14      | Marcola, Oregon       |
| IX        | 18 S     | 1 W   | 33      | Lowell, Oregon        |
| X         | 19 S     | 1 W   | 11      | Lowell, Oregon        |

No stand is more than 5.5 miles from the 44th parallel. The north and south boundaries were purposely extended because of accessibility to stands of Quercus Garryana and because of the greater selection of stands, i. e. to increase the variation in habitats from west to east. For clarity, it will be assumed that all stands are located on the 44th parallel. If each stand is transferred vertically to this parallel, the distance between stands is as indicated in Table II.

TABLE II Distance between stands

| Stand no. | Distance between stands (miles) |
|-----------|---------------------------------|
| I         | 3                               |
| II        | 0.1                             |
| III       | 3                               |
| IV        | 8.9                             |
| V         | 3                               |
| VI        | 1.1                             |
| VII       | 6                               |
| VIII      | 3.7                             |
| IX        | 2.4                             |
| X         |                                 |

It will be noted that the distance between stands II and III is considerably shorter than between any two other stands. This

shortness of distance is justified on the basis that two different exposures are involved; stand II being of a southern exposure (Plates 7 and 8) and stand III being of a western exposure (Plates 9, 10, and 11).

Three stands, I (Plates 3, 4, 5 and 6), IV (Plates 12, 13 and 14), and V (Plates 15, 16 and 17) were very moist, while all other stands were relatively dry on the same day of observation. In addition, the maturity and density of Oaks in these stands is nearly identical. Stands I and IV occur on level ground, while stand V is found on a 10° slope of northern exposure. As indicated in Table II, the distance from stand I to stand IV is six miles and from stand I to stand V 15 miles, yet stand characteristics are similar. The seven remaining stands occur on dry, sloping ground with similar density and maturity of Oaks.

#### The Selection of Oaks Within Stands

Ten White Oaks were selected in each stand by determining true north bearings and then establishing an east-west azimuth. The selection of ten Oaks in line with east-west bearings eliminates many of the Oaks very close to these bearings; the result being that less than ten Oaks are present in line unless the stand is particularly large or dense. Therefore, the Oaks closest to the east-west bearings were selected beginning eastwardly and selecting westwardly

until ten trees were obtained. If, for example, 11 Oaks were found in line, the Oak toward the east of any two closest Oaks along the east-west bearing was eliminated. No dead Oaks were included in this study.

By selecting ten trees, each tree has a frequency value of 10%. The reason for selecting a straight east-west azimuth was to include one tree on each edge of the stand and thereby obtain a true sampling of the corticolous lichens within the entire stand. The relative density of each stand was noted using Acocks scale (18, p. 27-28).

#### Selection of Area on Tree to be Sampled

Only corticolous lichens appearing on the trunks of the mature White Oaks are considered in this study. For convenience, and because it is commonly used, the area of the trunk at breast height (approximately 1.5 meters from the ground) was used for this study. It was considered necessary to obtain a sampling on the north and south sides of the trees because of the extreme difference of exposure on those two sides. Using an orientation by a compass, the trunk was divided into north and south sides, and a sample taken on each of those sides.

#### Determination of Sampling Method

Since it was desired to obtain frequency values for the lichens

observed, some adaptation of a quadrat method was considered appropriate for this study. It is assumed that if the individual quadrats are of an appropriate size, an adequate sampling of the species present may be obtained. Also, by merely counting the presence of a species within each quadrat, and if the number of samples is large enough, reasonably accurate values for frequency of occurrence may be obtained by direct conversion of the values obtained to percentage values. This method cannot show patterns of individuals present, but can show their relative abundance.

Lichens present a problem in the use of a quadrat method because of their gross variations in size. Therefore, a quadrat size which is reasonably accurate for all species of lichens is difficult to obtain.

An appropriate grid size has been defined as a grid that allows a frequency of 63% to 86% for the most frequent species (14). After some trial and error to determine a grid size for this study it was discovered that a grid five quadrats wide by 20 quadrats long, each quadrat  $12.5 \text{ mm}^2$ , came closest to the most appropriate quadrat size based on Hyder's studies. However, the selection of an appropriate grid size for greatest accuracy is in itself a distinct individual problem and should be considered as a possible problem at a later date.

The total grid size used in this study was  $1,250 \text{ mm}^2$ . A



rectangular quadrat was used because it gave a better indication of presence of species, especially where the trunks of the Oaks were narrow in diameter. The grid was made from sturdy "chicken" wire cut to the appropriate size and the periphery of the area used was painted so as to assure accuracy in counting. Plates 1 and 2 show the grid placed over the bark and lichens; a species of lichen is being counted for its frequency of occurrence by determining its presence in each quadrat.

The grid was applied to each trunk twice; one count was recorded for each lichen present on the south side, and one count was recorded for each lichen present on the north side. Any White Oak trunk of less than 12 inches in circumference was not considered as sampling material because of the possibility of the immaturity of the bark, and because some lichens may not have had an opportunity to establish themselves on the immature bark.

The arrangement of the quadrat with 100 sub-quadrats applied on each side of the Oak trunk gives a total of 200 possible counts per species of lichen per tree. In one stand there were 2,000 possible counts per species of lichen. Ten stands of ten selected Oaks each gives a total of 100 Oaks sampled and 20,000 possible counts per species of lichen.

## RESULTS

Tables III and IV indicate the presence of 24 species of corticolous lichens differing in their frequency of occurrence in the Willamette Valley from east to west.

The data is graphically represented in Figures 1 through 8. Figures 1 and 2 show the percent occurrence of eight species found generally throughout the ten stands. These species show the average percentage for the north and south sides of the trunks. Figures 3 through 8 show the percent occurrence on north and south sides for six different species.

Table IV shows that two lichens were present in two stands with a frequency of occurrence of .1% or less. These two lichens were Blastenia atosanguinea (stands IV and IX, .1% in both stands), and Xanthoria polycarpa (stands IX and X, .05% in both stands).

Graphis scripta occurred in stands VII and IX and with a frequency of occurrence of 4.6% and 23%, respectively.

Eight lichens were present in one stand out of ten and with a frequency of occurrence of .7% or less: Calicium hyperellum (stand VI, .2%); Parmelia olivacia (stand X, .6%); Peltigera scutata (stand VIII, .2%); Nephroma helveticum (stand VIII, .3%); Evernia prunastri (stand IX, .7%); Lecanora pacifica (stand IX, 2.6%); Parmelia sulcata (stand III, .3%); Ramalina dilacerata (stand X, .2%). An unknown lichen species was present in stand IX at a frequency of occurrence of 7.5%.

Table III North and South frequency of occurrence

| Species Crustose                 |   | Frequency of occurrence as % in quadrat in stands |      |      |      |      |      |      |      |      |      |
|----------------------------------|---|---|------|------|------|------|------|------|------|------|------|
|                                  |   | I   | II   | III  | IV   | V    | VI   | VII  | VIII | IX   | X    |
| <u>Arthopyrenia punctiformis</u> | N | 18.9  | 4.5  | 1.6  | 4.3  | .3   | .9   | 5.3  | .7   | 4.5  | 1.9  |
|                                  | S | 40.9  | 2.9  | 3.2  | 1.0  | 4.9  | --   | 10.8 | 1.5  | 4.1  | 8.1  |
| <u>Buellia disciformis</u>       | N | .5  |      | 1.2  | 2.0  | 2.1  | 2.7  | --   | 23.5 | 3.3  | 21.7 |
|                                  | S | --  |      | .7   | .5   | 3.3  | 5.6  | 4.2  | 42.0 | 25.5 | 38.1 |
| <u>Pertusaria multipuncta</u>    | N | 5.4   | 9.8  | 27.6 | 27.5 | 3.3  | 28.9 | 16.7 | 12.1 | .8   | 6.7  |
|                                  | S | 1.9   | --   | 1.1  | 3.3  | 23.3 | --   | .4   | .7   | 2.8  | --   |
| <u>Pertusaria amara</u>          | N |   | .2   | --   | .9   | --   | 1.5  | .7   | 4.4  | --   | 4.1  |
|                                  | S |   | 1.0  | .9   | 4.5  | 3.2  | 14.1 | 9.3  | 20.4 | 3.8  | 2.3  |
| <u>Ochrolechia tartarea</u>      | N |   |      | .1   | 2.3  |      | .6   | --   |      | --   | 1.3  |
|                                  | S |   |      | --   | 5.0  |      | .1   | .9   |      | .3   | --   |
| <u>Caloplaca citrina</u>         | N |   | .3   |      |      | --   | 2.5  | 15.1 | --   |      | .4   |
|                                  | S |   | --   |      |      | 1.7  | .8   | .1   | .4   |      | .1   |
| <u>Blastenia atosanguinea</u>    | N |   |      |      | --   |      |      |      |      | --   |      |
|                                  | S |   |      |      | .2   |      |      |      |      | .2   |      |
| <u>Calicium hyperellum</u>       | N |   |      |      |      |      | .4   |      |      |      |      |
|                                  | S |   |      |      |      |      | --   |      |      |      |      |
| <u>Graphis scripta</u>           | N |   |      |      |      |      |      | 9.3  |      | 29.1 |      |
|                                  | S |   |      |      |      |      |      | --   |      | 16.9 |      |
| <u>Lecanora subfusca</u>         | N |   |      |      |      | .1   | 3.0  | 1.1  | .2   |      | 6.1  |
|                                  | S |   |      |      |      | 2.0  | 2.7  | --   | --   |      | 2.3  |
| <u>Lecanora pacifica</u>         | N |   |      |      |      |      |      |      |      | --   |      |
|                                  | S |   |      |      |      |      |      |      |      | 5.3  |      |
| Unknown                          | N |   |      |      |      |      |      |      |      | 1.0  |      |
|                                  | S |   |      |      |      |      |      |      |      | 14.1 |      |
| <u>Physcia leucoleiptes</u>      | N |   | --   | --   | --   | 1.5  | 8.3  | 2.7  | --   | --   | 1.0  |
|                                  | S |   | 2.5  | 1.3  | 1.3  | .5   | 32.4 | 16.3 | 5.2  | 7.1  | 4.6  |
| <u>Xanthoria polycarpa</u>       | N |   |      |      |      |      |      |      |      | --   | --   |
|                                  | S |   |      |      |      |      |      |      |      | .1   | .1   |
| Species Fruticose and Foliose    |   | Frequency of occurrence in stand                  |      |      |      |      |      |      |      |      |      |
|                                  |   | I   | II   | III  | IV   | V    | VI   | VII  | VIII | IX   | X    |
| <u>Ramalina farinacea</u>        | N |   | 13.5 | 6.4  | 3.1  | .9   | 14.6 | 12.1 | 2.7  | 2.1  | 5.8  |
|                                  | S |   | 14.  | --   | 2.8  | 3.7  | 5.1  | 11.9 | 12.8 | 5.7  | 5.9  |
| <u>Ramalina dilacerata</u>       | N |   |      |      |      |      |      |      |      |      | .5   |
|                                  | S |   |      |      |      |      |      |      |      |      | --   |
| <u>Parmelia saxatilis</u>        | N |   |      |      | 2.6  | .1   | .3   | --   | --   |      | 8.2  |
|                                  | S |   |      |      | --   | --   | --   | .4   | .2   |      | .9   |
| <u>Parmelia sulcata</u>          | N |   |      |      |      |      | --   |      |      |      |      |
|                                  | S |   |      |      |      |      | .7   |      |      |      |      |
| <u>Parmelia olivacea</u>         | N |   |      |      |      |      |      |      |      |      | .6   |
|                                  | S |   |      |      |      |      |      |      |      |      | .6   |
| <u>Peltigera scutata</u>         | N |   |      |      |      |      |      |      | .5   |      |      |
|                                  | S |   |      |      |      |      |      |      | --   |      |      |
| <u>Nephroma helveticum</u>       | N |   |      |      |      |      |      |      | .7   |      |      |
|                                  | S |   |      |      |      |      |      |      | --   |      |      |
| <u>Evernia prunastri</u>         | N |   |      |      |      |      |      |      |      | --   |      |
|                                  | S |   |      |      |      |      |      |      |      | 1.5  |      |
| <u>Sticta fuliginosa</u>         | N |   |      |      |      | 1.3  | .9   | --   | .6   |      | 1.2  |
|                                  | S |   |      |      |      | .1   | 1.9  | 9.4  | --   |      | 1.2  |
| <u>Lobaria pulmonaria</u>        | N |   | --   | .4   | 19.2 | 4.2  | --   | 1.3  | 9.9  |      | 18.6 |
|                                  | S |   | 6.1  | .9   | 54.4 | 3.2  | .4   | 5.4  | 5.0  |      | 4.5  |

Table IV Total frequency of occurrence

| Spp                              | Total frequency of occurrence in each stand expressed as a percent |     |      |      |      |      |      |      |      |      |
|----------------------------------|--|-----|------|------|------|------|------|------|------|------|
|                                  | I  | II  | III  | IV   | V    | VI   | VII  | VIII | IX   | X    |
| <u>Arthopyrenia punctiformis</u> | 29.9   | 3.7 | 2.4  | 2.6  | 2.6  | .4   | 8.0  | 1.1  | 4.3  | 5.0  |
| <u>Buellia disciformis</u>       | .2   | --  | .95  | 1.2  | 2.7  | 4.1  | 2.1  | 32.7 | 14.4 | 29.9 |
| <u>Pertusaria multipuncta</u>    | 3.6  | 4.9 | 14.3 | 13.7 | 13.3 | 14.4 | 8.5  | 6.4  | 1.8  | 3.8  |
| <u>Pertusaria amara</u>          | --   | .6  | .4   | 2.7  | 1.6  | 7.8  | 5.   | 12.4 | 1.9  | 3.2  |
| <u>Ochrolechia tartarea</u>      | --   | --  | .05  | 3.6  | --   | .3   | .4   | --   | .1   | .6   |
| <u>Caloplaca citrina</u>         | --   | .1  | --   | --   | .8   | 1.6  | 7.6  | .2   | --   | .2   |
| <u>Blastenia atrosanguinea</u>   | --   | --  | --   | .1   | --   | --   | --   | --   | .1   | --   |
| <u>Calicium hyperellum</u>       | --   | --  | --   | --   | --   | .2   | --   | --   | --   | --   |
| <u>Graphis scripta</u>           | --   | --  | --   | --   | --   | --   | 4.6  | --   | 23.  | --   |
| <u>Lecanora subfusca</u>         | --   | --  | --   | --   | 1.0  | 2.8  | .5   | .1   | --   | 4.2  |
| <u>Lecanora pacifica</u>         | --   | --  | --   | --   | --   | --   | --   | --   | 2.6  | --   |
| Unknown                          | --   | --  | --   | --   | --   | --   | --   | --   | 7.5  | --   |
| <u>Physcia leucoleiptes</u>      | --   | 1.7 | 6.5  | 6.5  | 1.0  | 20.3 | 9.5  | 2.6  | 3.5  | 2.8  |
| <u>Xanthoria polycarpa</u>       | --   | --  | --   | --   | --   | --   | --   | --   | .05  | .05  |
| <u>Ramalina farinacea</u>        | --   | 7.4 | 3.2  | 2.9  | 2.3  | 9.8  | 12.0 | 7.7  | 3.9  | 5.8  |
| <u>Ramalina dilacerata</u>       | --   | --  | --   | --   | --   | --   | --   | --   | --   | .2   |
| <u>Parmelia saxatilis</u>        | --   | --  | --   | 1.3  | .05  | .15  | .2   | .1   | --   | 4.5  |
| <u>Parmelia sulcata</u>          | --   | --  | --   | --   | --   | .3   | --   | --   | --   | --   |
| <u>Parmelia olivacea</u>         | --   | --  | --   | --   | --   | --   | --   | --   | --   | .6   |
| <u>Peltigera scutata</u>         | --   | --  | --   | --   | --   | --   | --   | .2   | --   | --   |
| <u>Nephroma helveticum</u>       | --   | --  | --   | --   | --   | --   | --   | .3   | --   | --   |
| <u>Evernia prunastri</u>         | --   | --  | --   | --   | --   | --   | --   | --   | .7   | --   |
| <u>Sticta fuliginosa</u>         | --   | --  | --   | --   | .7   | 1.4  | 4.7  | .3   | --   | 1.2  |
| <u>Lobaria pulmonaria</u>        | --   | 3.0 | .6   | 36.8 | 3.7  | .2   | 3.8  | 7.4  | --   | 11.5 |

Five lichens have a frequency of occurrence that varies from .05% to 7.6% and are shown in Table IV to be present in three to six stands out of ten: Ochrolechia tartarea, Caloplaca citrina, Lecanora subfusca, Parmelia saxatilis, and Sticta fuliginosa.

Five lichens present in seven to nine stands out of ten and with a frequency of occurrence that varies from 32.7% to .2% are Buellia disciformis, Pertusaria amara, Physcia leucoleiptes, Ramalina farinacea, and Lobaria pulmonaria.

Only two lichens occurred throughout all ten stands, and the frequency of occurrence ranges from 29.9% to .4%. These were Arthopyrenia punctiformis and Pertusaria multipuncta.

The species Arthopyrenia punctiformis had its highest frequency of occurrence of 29.9% in stand I; its next highest was 8% in stand VII, and it occurred in all other stands at lower frequencies.

Table III and Figures 3 to 8 indicate that the frequency of occurrence of corticolous lichens differs on the same tree trunk at breast height (1.5 meters) when the northern exposure is compared to the southern exposure. Species found only on the north side and their frequencies of occurrence are: Ramalina dilacerata, .5%; Peltigera scutata, .5%; Nephroma helveticum, .7%; Calicium hyperellum, .4%. Species found only on the south side and their frequencies of occurrence are: Blastenia atosanguinea, .2%; Xanthoria polycarpa, .1%; Parmelia sulcata, .7%; Evernia prunastri, 1.5%; and Lecanora

pacifica, 5.3%. All other species of lichens observed occur with varying frequencies of occurrence on both northern and southern exposures.

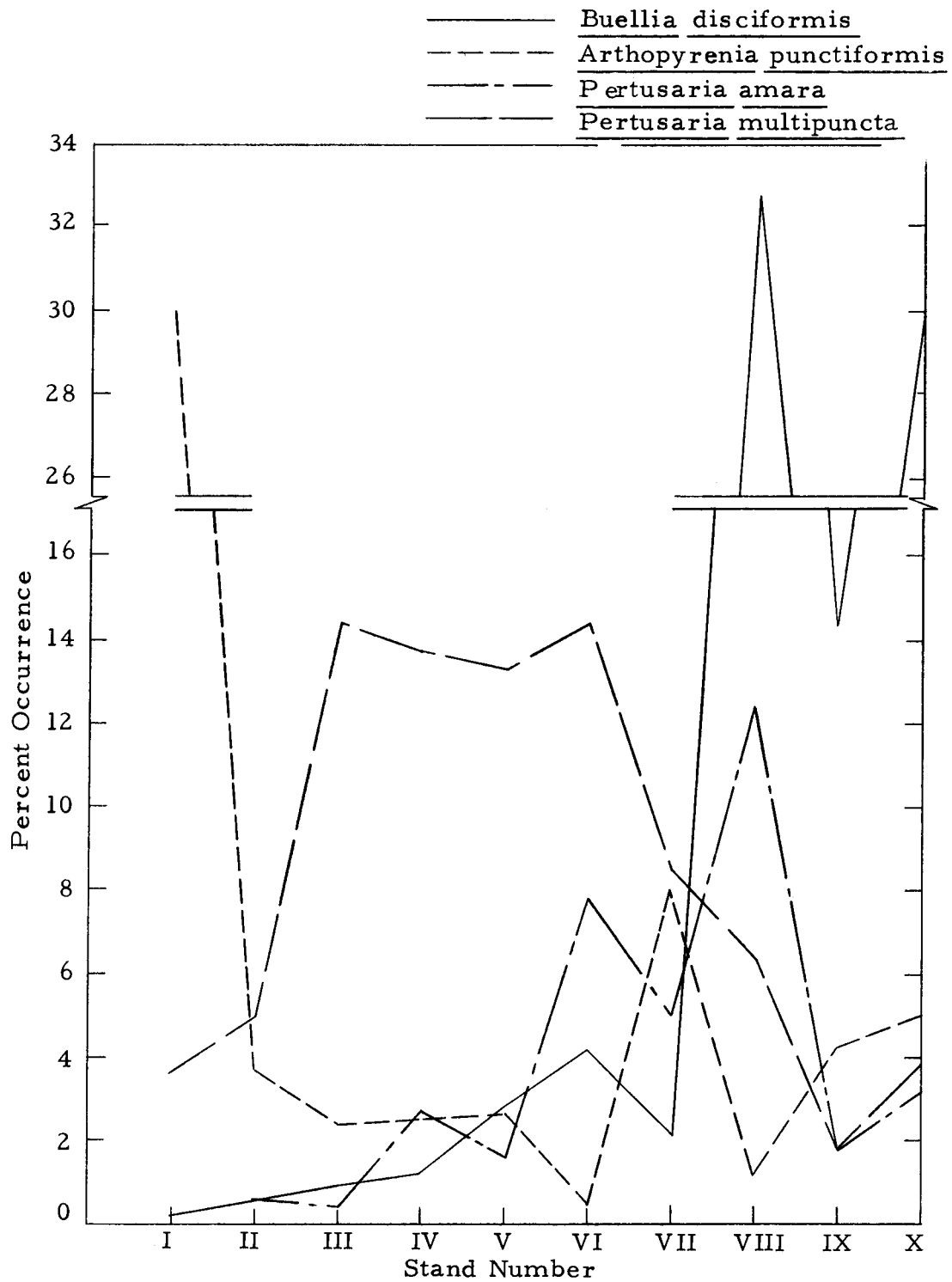


Figure 1. The percent occurrence of four crustose lichens found generally throughout the ten stands.

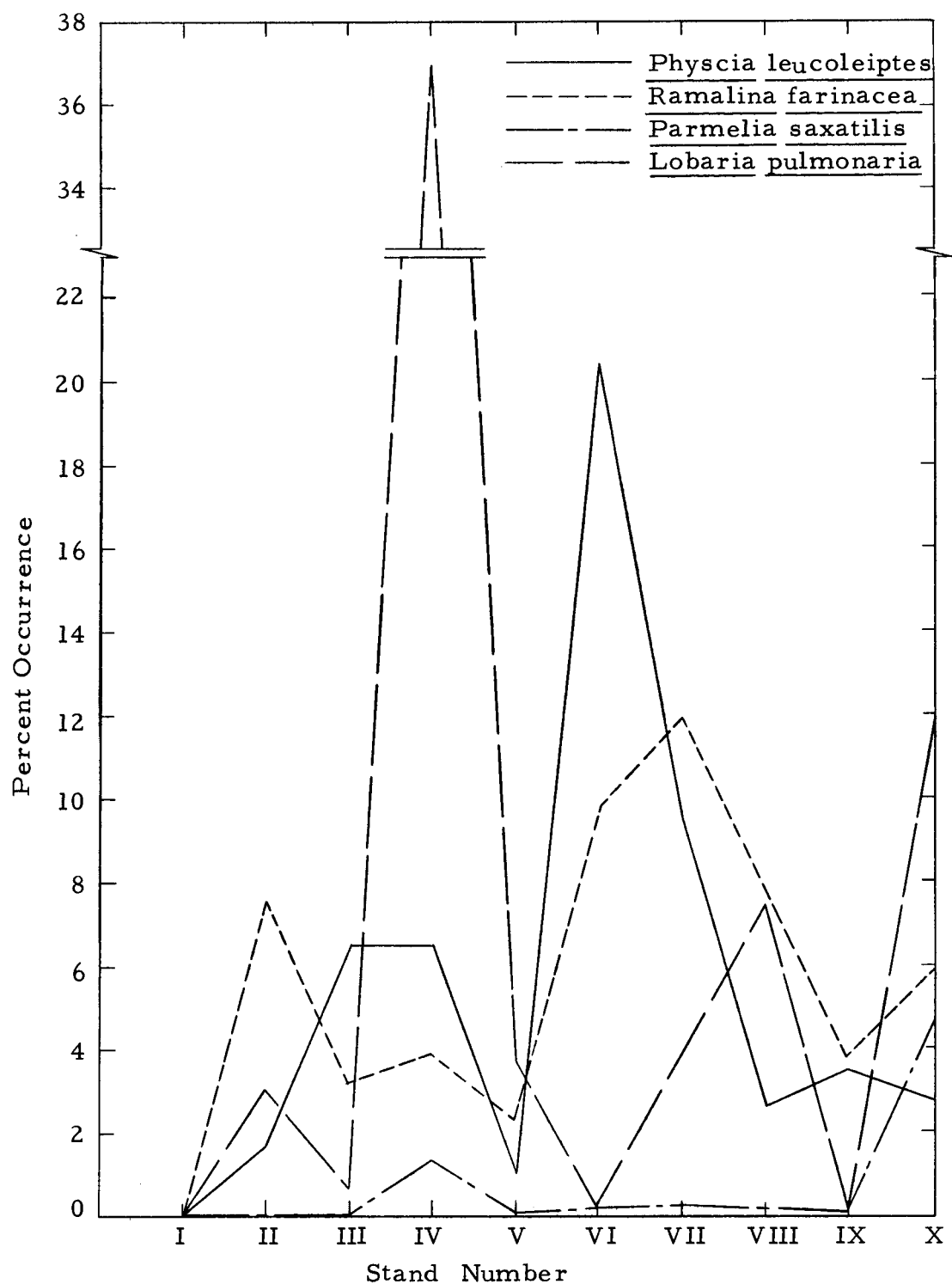


Figure 2. The percent occurrence of three foliose and one fruticose species of lichens found generally throughout the ten stands.



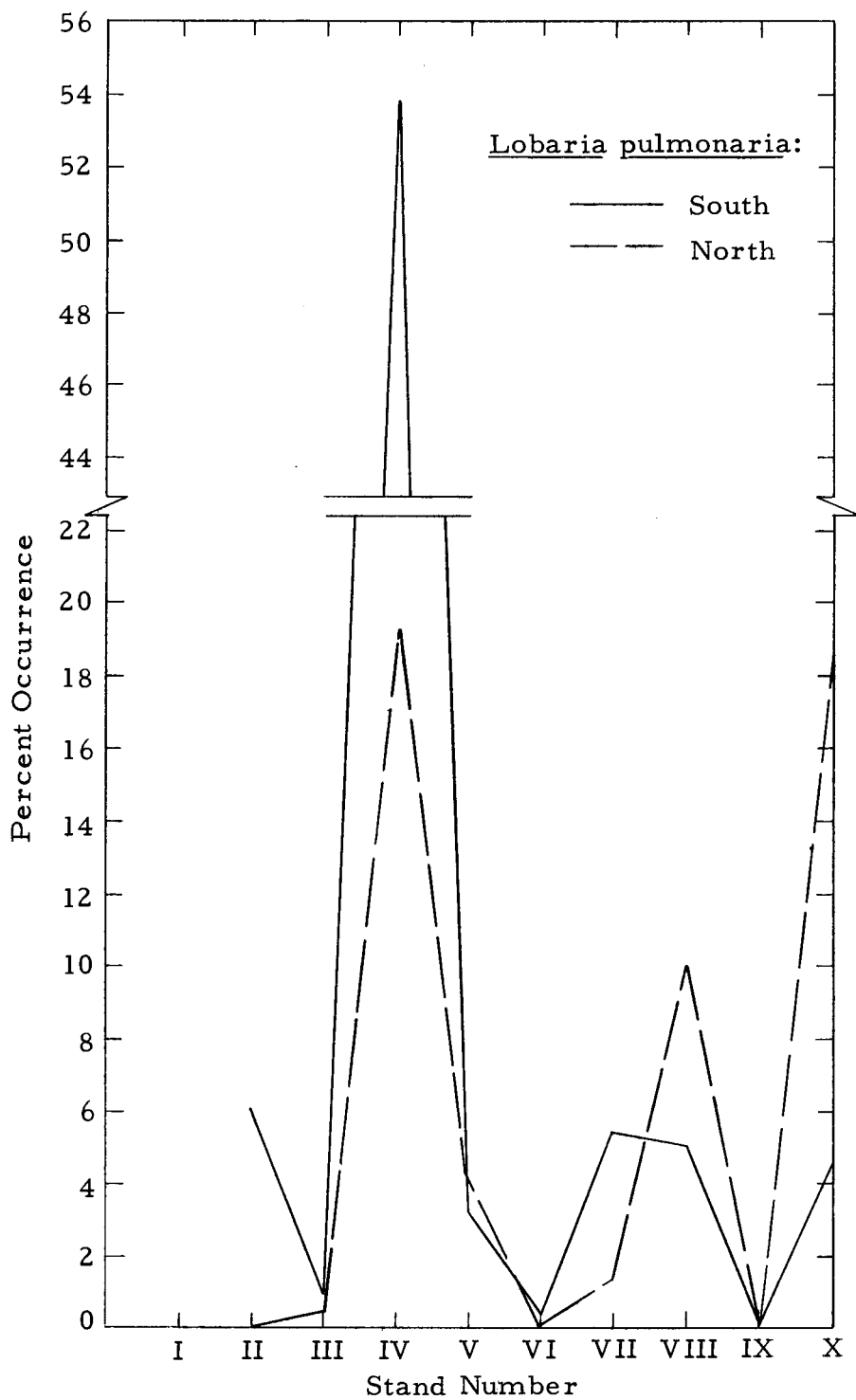


Figure 3. The percent occurrence of Lobaria pulmonaria on the north and south sides of the trunks of Quercus Garryana throughout the ten stands.

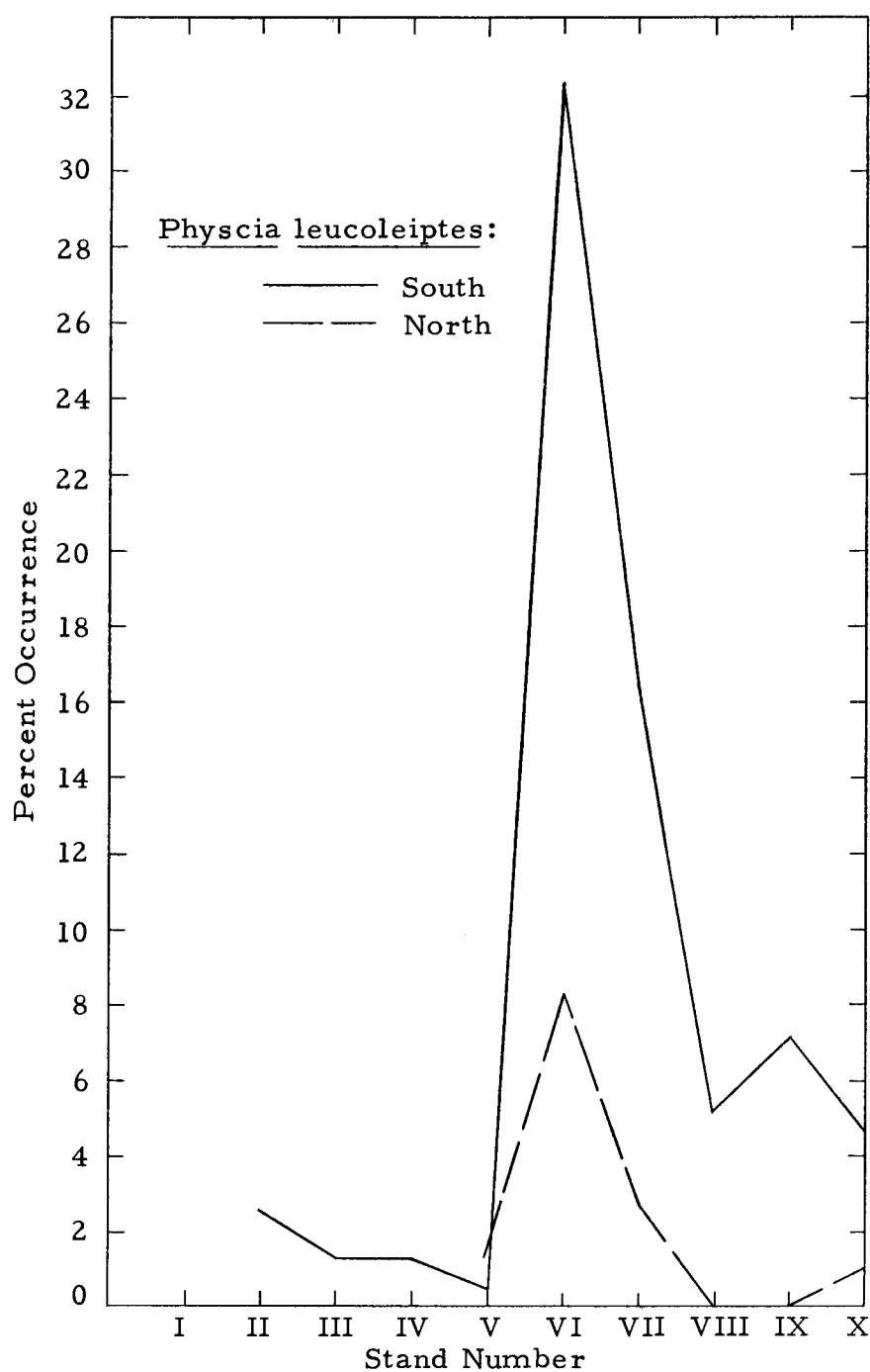


Figure 4. The percent occurrence of Physcia leucoleiptes on the north and south sides of the trunks of Quercus Garryana throughout the ten stands.

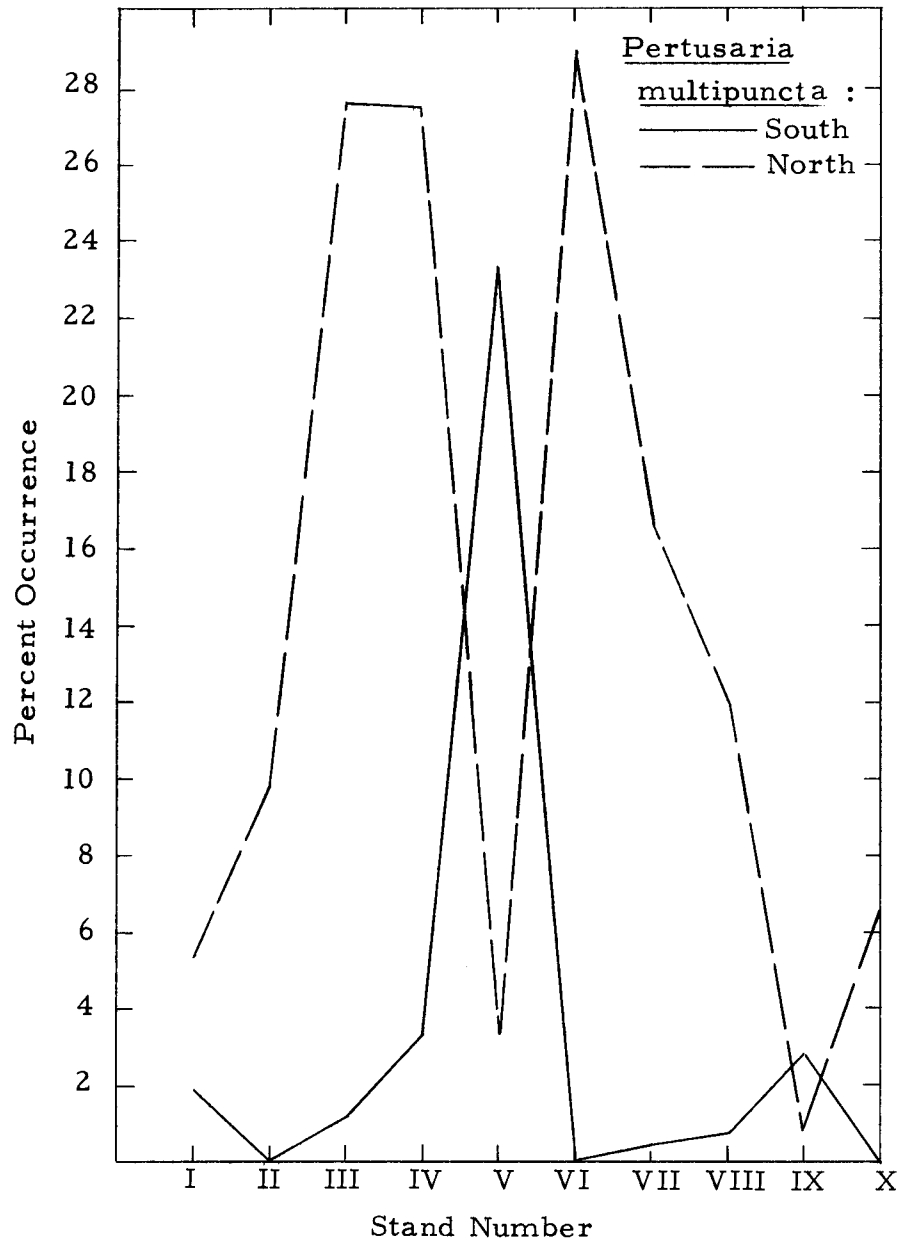


Figure 5. The percent occurrence of Pertusaria multipuncta on the north and south sides of the trunks of Quercus Garryana throughout the ten stands.

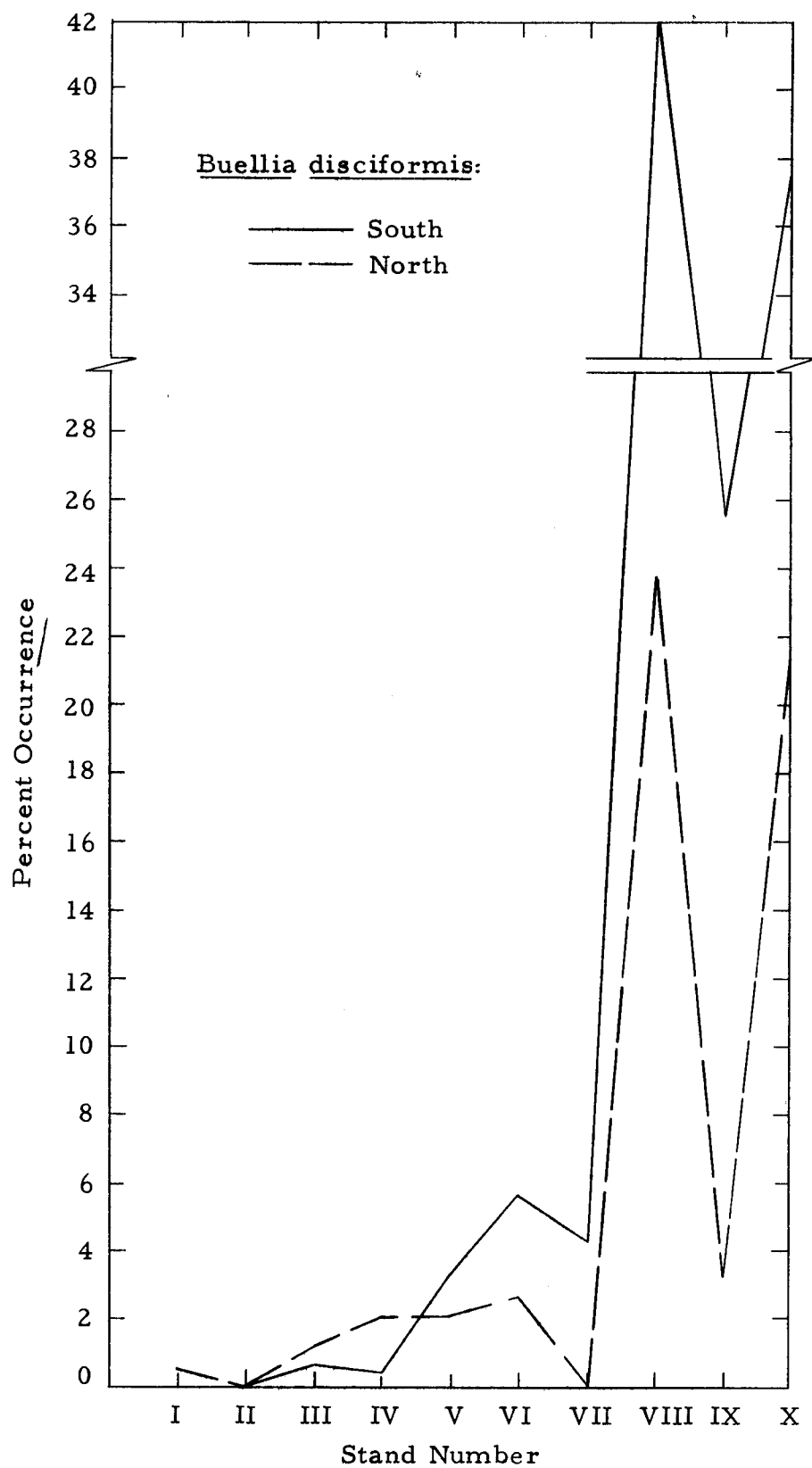


Figure 6. The percent occurrence of Buellia disciformis on the north and south sides of the trunks of Quercus Garryana throughout the ten stands.

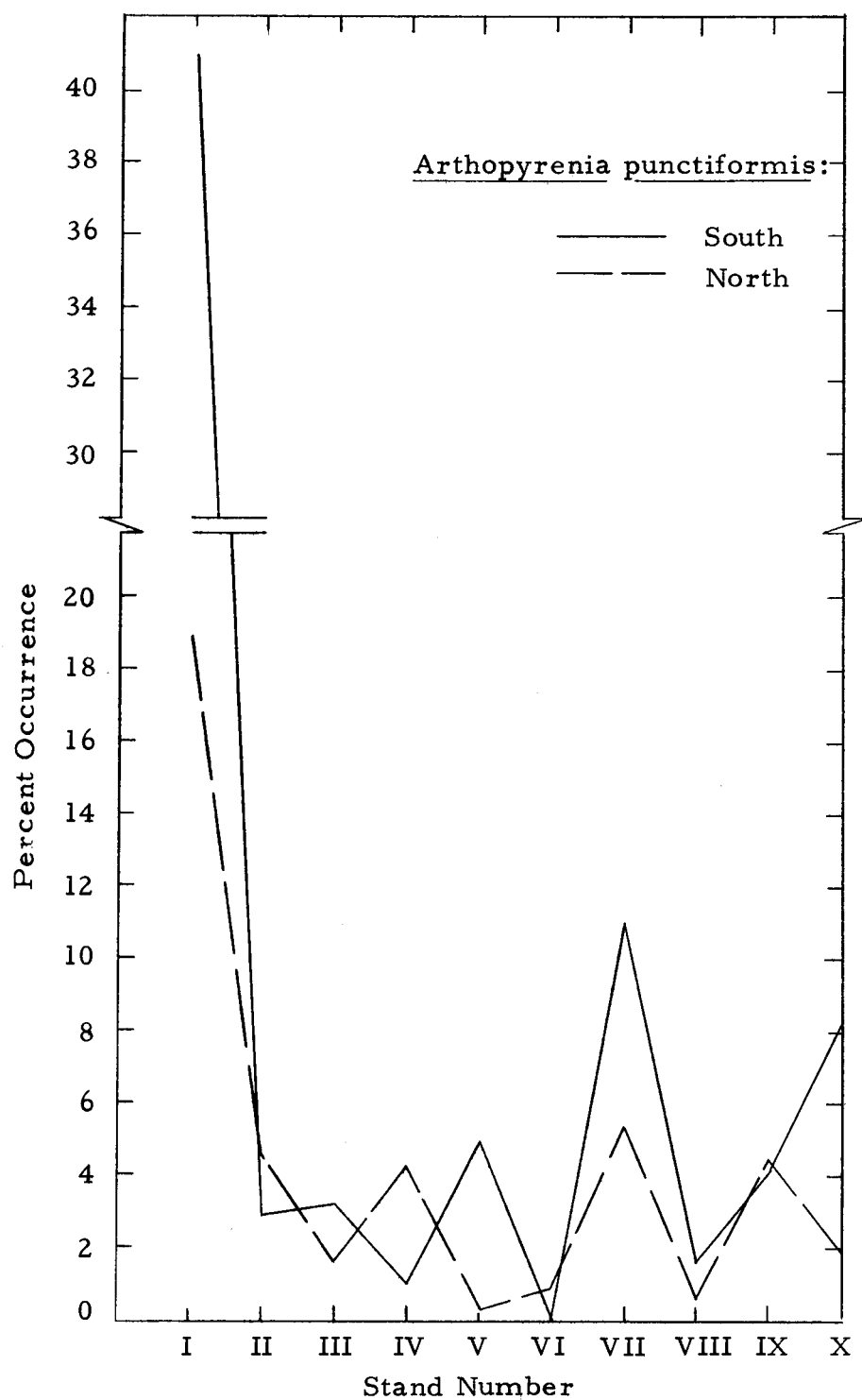


Figure 7. The percent occurrence of Arthopyrenia punctiformis on the north and south sides of the trunks of Quercus Garryana throughout the ten stands.

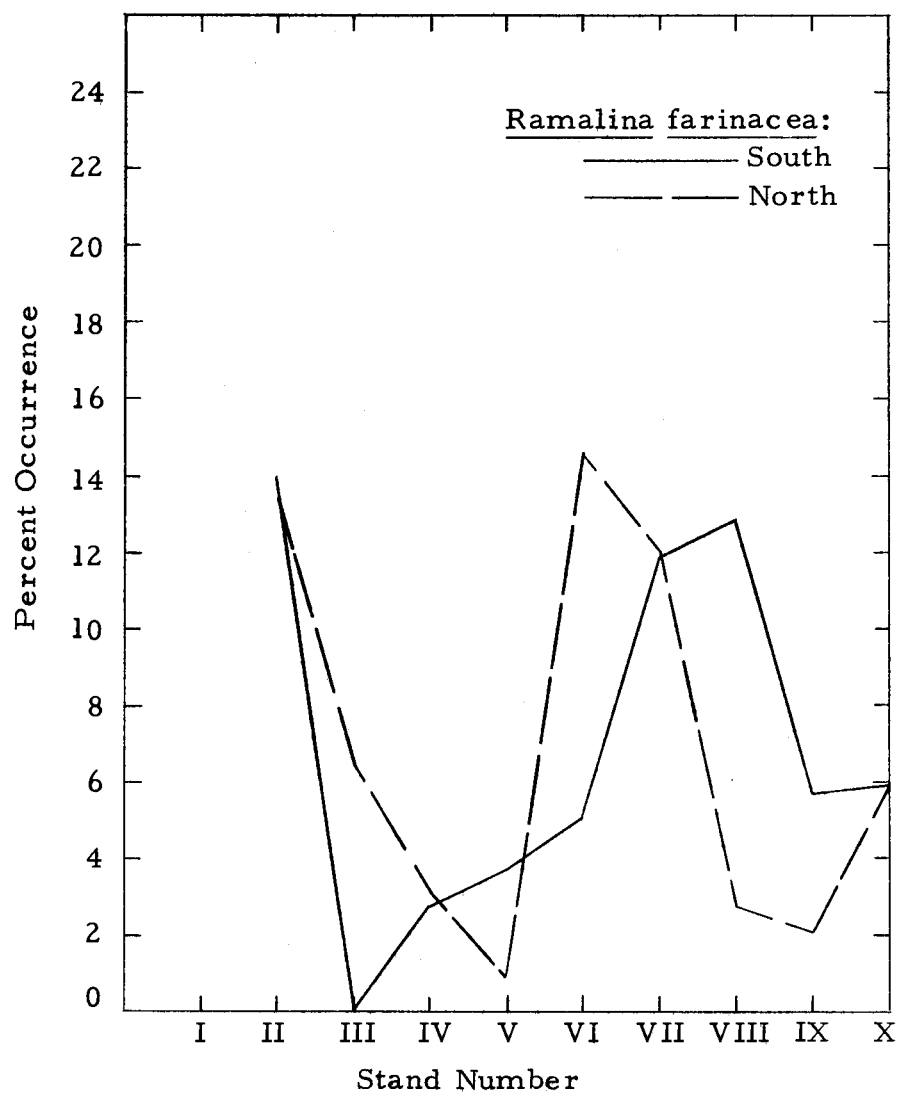


Figure 8. The percent occurrence of *Ramalina farinacea* on the north and south sides of the trunks of *Quercus Garryana* throughout the ten stands.

## DISCUSSION

It appears that certain species of lichens have a higher frequency of occurrence in certain stands than others. In addition, many lichens are apparently able to tolerate a broad range of variable environmental conditions (2). Therefore, it is nearly impossible to state reasons for specific patterns, although patterns of distribution have been noted for a few species studied on Quercus Garryana.

Light and humidity have an effect on the distribution of lichens (21). Also, the size of the trees involved and the dissimilarities in the bark of the young and more mature Oaks causes a variation in the distribution (10). It is true that the trunks of each tree varied in circumference and that this made the stand size variable; however, the uniformity of the quadrat size used made the data from all quadrats comparable and this phytosociologic data from 100 individual trees with a total of 200,000 individual counts permits a general and meaningful result for the entire ten stands.

To best understand the frequency of occurrence as shown in the data it is helpful to arrange the ten stands of Oaks as to their characteristics.

Stands I and IV are similar because they occur on level, very moist ground during the spring and winter months, have a density

of about ten feet apart, with small groups of two to four in a group less than one foot apart, and a circumference of not less than one foot (see Plates 3, 4, 5, 6, 12, 13, 14). The understory did not grow over two feet above the ground and was sparse. Yet the difference between these two stands as shown in Tables IV and V and Figures 1 and 2 is significant enough to require some explanation for the great increase in number of species and frequency of occurrence of these species.

Stand V was similar in all respects to stands I and IV with one exception--it occurred on a northern slope of  $10^{\circ}$  (see Plates 15, 16, 17). Stand V had one additional species than stand IV with a frequency of occurrence of less than 1%. From the results in Table IV, five lichens show a similar frequency of occurrence in stand V and they are within 2% or less of each other. All other lichens showed a frequency of occurrence greater than 3%.

The seven remaining stands were similar in density (20-30 feet apart), maturity (over 2.5 feet in circumference) and dryness. The only difference among these stands was the slope on which they were growing. Stand II (Plates 7, 8) was on a southern slope of  $11^{\circ}$ ; stand III (Plates 9, 10, 11) was on a western slope of  $12^{\circ}$ ; stands VI, VII, (Plates 18, 19, 20, 21) and IX (Plate 25) were on level ground; stand VIII (Plates 22, 23, 24) was on a slope of southern exposure from  $17^{\circ}$  to  $36^{\circ}$ ; and stand X (Plates 26, 27) was on a



western slope of 8°.

It is interesting to note that in stands II and III Quercus Kelloggii (California Black Oak) was present. It was found in stand II on the average of 40 feet apart and in stand III only occasionally. Moreover, visual observation of the visible corticolous lichens on Quercus Kelloggii differed in numbers and species from Quercus Garryana.

Lichens occurred occasionally that were not a common part of the regular lichen flora. Perhaps these should be considered "accidental" species because they occur on only one or two trees at a less than 1% frequency in an occasional stand. As Tables III and IV indicate, these species are Blastenia atosanguinea, Calicium hyperelium, Xanthoria polycarpa, Ramalina dilacerata, Parmelia sulcata, Parmelia olivacea, Peltigera scutata and Nephroma helveticum. Two species occur in only one stand but their frequency is higher than 2%: Lecanora pacifica, 2.6%; and an unknown, 7.5%.

It may be noted that the species and abundance of species of corticolous lichens growing on the trunks of Oaks is definitely different from the lichens growing on the branches. Many that are extremely abundant on the branches, such as Parmelia olivacea, are rare on trunks, and many that occur on trunks, such as Pertusaria multipuncta, are rare on branches. This makes the calling of a lichen an "accidental" on trunk bark necessary because the same lichen may be present in abundance on the upper branches.

Hale (10) indicates that Graphis scripta and other crustose lichens begin growth on smooth bark of young trees, and as the cork periderm is formed these lichens are lost because of rupturing of the cork. Therefore, these species of crustose lichens would have a low frequency of occurrence on older trees and a high frequency of occurrence on young trees. The data collected in this study does not completely support this idea. Graphis scripta was found in two stands out of ten with a total high frequency of occurrence of 23% in stand IX. This was on mature, rough bark Oaks with a circumference of over two feet.

Examination of Table III and Figures 1 - 8 shows that each species must be considered individually to determine its habitat preference. Where one lichen is found in abundance in one stand, another stand with similar characteristics may rank that species very low. For example, Lobaria pulmonaria occurs in stand IV on flat, shaded trunks and damp ground at a high frequency of occurrence of 36.8%, while in stand X, with dry ground and a slope of  $8^{\circ}$ , it occurred at  $11.5^{\circ}$ , the second highest occurrence. Still, this lichen prefers a southern exposure according to the data (Figure 3). In this study there was no particular stand that indicated an overall desirable habitat for any one or group of corticolous lichens. The possible exceptions to this are indicated in Table IV. Five lichens showed a preference for particular stands by having an outstanding frequency

of occurrence in these stands compared to the other stands in which they were found. These five lichens included Arthopyrenia punctiformis, stand I, 29.9%; Caloplaca citrina, Stand VII, 7.6%; Graphis scripta, stand IX, 23.%; Physcia leucoleiptes, stand VI, 20.3%; Lobaria pulmonaria, stand IV, 36.8%.

From the data gathered in this study it was shown that some species of corticolous lichens are found more frequently on either the northern or southern exposure (Table III and Figures 3-8). A few species may occur only on one particular exposure; other species are found on both exposures, but are more abundant on one exposure than another. Some species are not influenced by exposure, occurring with approximately uniform frequency on the north in one stand and south in another stand. It will also be noted that in these species, the occurrence on the north or south side may even have contrasting frequencies in the same stand.

The grid used in this study proved to be reasonably successful in determining frequencies of occurrence of all three form of lichens: crustose, fruticose, and foliose. With a few modifications it is felt that the grid could possibly be used to estimate amount of cover as well as frequency of occurrence of the crustose and foliose lichens. The structure of the fruticose forms, however, would make cover estimates difficult because of the very nature of the lichen. In conclusion, this method of investigation opens up an interesting quantitative approach to the study of lichen relationships to the particular substrate on which they are found.

TABLE V Total number of species observed

| Stand no. | Total number of<br>species observed |
|-----------|-------------------------------------|
| I         | 3                                   |
| II        | 7                                   |
| III       | 8                                   |
| IV        | 10                                  |
| V         | 11                                  |
| VI        | 14                                  |
| VII       | 13                                  |
| VIII      | 13                                  |
| IX        | 13                                  |
| X         | 15                                  |

## SUMMARY

This study was made to present any evidence as to differences in the frequency of occurrence of corticolous lichens from east to west in the Willamette Valley on a bark substrate of Quercus Garryana.

Twenty-four species of lichens were observed to be present within the grid area of the 100 trees used in the study, i. e., ten trees in each of ten stands of White Oak. At the western base of the Cascades the total number of species present was 15. This number diminished to a total of three species at the eastern base of the Coast Range.

Only two lichens, Arthopyrenia punctiformis and Pertusaria multipuncta, occurred throughout the ten stands in some frequency. Among the stands nine species of lichens were found in one stand out of ten. Variations in the frequency of occurrence were found to exist among the other 14 species, and in many cases not necessarily in direct relationship to their habitats. This was especially true of Lobaria pulmonaria which occurred most frequently in stand IV, but in stand I, which was environmentally similar in all respects to stand IV, it did not occur at all.

Certain species of corticolous lichens have a greater tendency to appear on the north or south side of the trunk, while others appear

in approximately equal frequency on the north or south sides of the trunks.

The grid method, applied to determine the frequency of occurrence, was successful for all three forms of lichens: crustose, fruticose and foliose. This made possible a quantitative approach to the study of lichen relationships.

The corticolous lichens studied do occur at different frequencies from east to west. In addition, the number of species and kinds of species are different.

Plate 1



Plate 2



Counting frequency of occurrence with grid.

Plate 3



Stand I Looking West

Plate 4



Within Stand I Looking West



Plate 5



Stand I Looking West

Plate 6



Stand I Looking West

Plate 7



Stand II Looking East  
A Southern Exposure With An  $11^{\circ}$  Slope

Plate 8



Stand II Looking East  
A Southern Exposure With An  $11^{\circ}$  Slope

Plate 9



Stand III Looking East  
A Western Exposure With A  $12^{\circ}$  Slope  
Plate 10



Stand III Looking North

Plate 11



Stand III Looking North

Plate 12



Stand IV Looking Northwest

Plate 13



Stand IV Looking West

Plate 14



Stand IV Looking West

Plate 15



Stand V Looking West

Plate 16



Stand V Looking West

Plate 17



Stand V Looking West

Plate 18



Stand VI Looking East



Plate 19



Stand VI Looking East

Plate 20



Stand VII Looking East



Plate 21



Stand VII Looking East

Plate 22



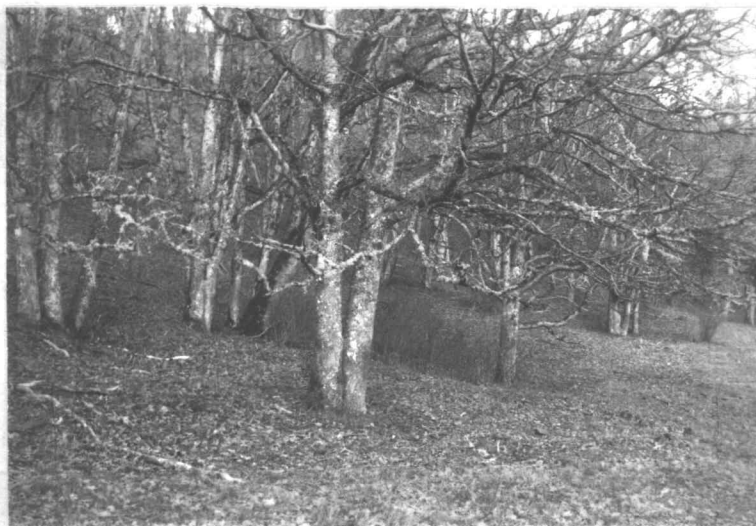
Stand VIII Looking North  
Southern Exposure,  $17^{\circ}$  to  $36^{\circ}$  Slope

Plate 23



Stand VIII Looking North

Plate 24



Stand VIII Looking North

Plate 25



Stand IX Looking West

Plate 26



Stand X Looking Northeast

Plate 27



Stand X Looking West

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