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**BOTANY**

## An Ecological Study of the Upland Conifers of Itasca State Park

This project was undertaken to study and compare the composition of different stands of upland coniferous trees in the Itasca State Park. Particular emphasis was placed on the pattern and progress of ecological succession from the initial stage to the climax stage as well as the forces that have operated together to produce the climax or earlier stages of stabilization.

The objectives of this project were:

1. To gather and organize information on the climate, geology, soil, vegetational history and wildlife of the area, which might be valuable in interpreting the region.
2. To examine stands of different coniferous trees with emphasis on the relations of the various stands to each other and to their physical environment.
3. To give the author experience in making such a study so that subsequent studies can be made with increasing efficiency in other areas.

### **METHODOLOGY**

#### *Random Pairs Method:*

1. Ascertain the number of points and the number of compass lines needed in the stand.
2. Use this to determine the number of paces between points.
3. Walk the divided number of paces minus 1.
4. Set 4 poles (3.3') around a point marking off a quadrat.
5. Record the presence of seedlings within the quadrat.

6. Take poles up and use them to mark the exact center of the quadrat at the point.
7. Determine the nearest tree (upland conifer over 4" d.b.h. or 12" circ.) and then determine a line ( $180^\circ$  exclusion angle) through point at  $90^\circ$  to a line between the point and the tree.
8. Determine the tree outside the exclusion angle that is nearest the first tree.
9. Take the diameter and basal area of the first tree and record by species.
10. Measure distance to the second tree.
11. While walking between the trees, count the saplings in a 3.3 strip measuring with outstretched hand.
12. Record the number of saplings encountered in the transect strip by species.
13. Measure the diameter and basal area of the second tree and record.
14. Recover equipment and pace compass line to the next tree. Use 40 points per stand.

#### LABORATORY METHODS

1. Mean distance: This is determined by adding all of the distances between the random pairs of trees in a stand and dividing this figure by the total number of distances in the stand.
2. Correct distance: Originally in the random pairs method an exclusion angle of  $160^\circ$  was recommended but it was later shown that the average distance between pairs was a linear function of the angle of exclusion for  $0^\circ$  to  $260^\circ$ . Since a  $180^\circ$  angle is most convenient in the field, its use is recommended. The actual distances obtained with the  $180^\circ$  angle should be multiplied by a factor of 0.80 to obtain the correct distance.
3. Mean area: The mean area is the correct mean distance squared.
4. Relative density in percent: The number of individuals of the species is divided by the number of individuals of all species and this answer is multiplied by 100.
5. Relative dominance in percent: The total basal area of the species is divided by the total basal area of all the species and the result is multiplied by 100.

6. Frequency in percent: The total number of points in which the species appears is divided by the number of points in the stand multiplied by 100. Then, this percent is divided by the total percent of all the species of the stand.
7. Total trees per acre: Calculated by dividing 43,560 by the mean area.
8. Trees per acre per species: Determined by multiplying the number of trees per acre by the relative density.
9. Basal area of average tree: Determined by dividing the total basal area of the species by the number of trees of one species.
10. Basal area per acre per species: The trees per acre per species is multiplied by the basal area of the average tree.
11. Climax adaptation number: Pioneer and climax are used here to refer to the attributes, which enable the one to live in the high light, variable moisture and immature soil conditions of initial stands and the other in the low light, medium moisture, and mature soil conditions of the terminal forests. The climax adaptation number rating was accomplished by arbitrarily assigning relative values for the species. Higher numbers indicate good adaptation to the conditions of initial stands. The climax adaptation numbers are as follows: *Abies balsamea*—10.0, *Picea glauca*—8.0, *Pinus strobus*—6.0, *Pinus resinosa*—4.0 and *Pinus banksiana*—2.0.
12. Importance value of each tree: This is calculated by adding the relative density, dominance, and frequency.
13. Vegetational continuum index: The adaptation number of each species was multiplied by its importance value in a particular stand. The products were added and the resultant weighted total was used as a basis of placing the stand in its proper relation to other stands. The range of weighted numbers is termed the vegetational continuum index. The range of these weighted numbers may range from 300 in the case of pure jack pine to 3000 for a stand composed entirely of balsam fir.

## RESULTS

Stand 7 located north of the Itasca post office is pure jack pine. There is successful jack pine reproduction in this stand. Jack pine grows on sandy soil, which are scenes of frequent fires. Stand 1 north-

east of Douglas Lodge is 70% jack pine. The remainder is composed of mixed red and white pine. There are white pine and balsam fir seedlings along with red and white saplings. White pine is often found mixed with red pine following jack pine on better soils but pure white pine stands never follow jack pine. The canopy is quite open, and consequently jack pine retains its lower branches and a great deal of hazelbrush is present. The hazelbrush is a serious obstacle to the successful establishment of pine seedlings. Attempts have been made to control the hazelbrush by plowing and spraying. This retards the brush until the young trees come through. The older conifers are not immune to the spray but they become more resistant with age. The litter on the forest floor is usually dried out rapidly by the sun and is not of very great thickness.

Stands, which have medium low continuum indices fall between the range of 800 and 1700. The dominant trees are red and white pine. Stand 4 located northeast of the biological station is 74 percent red pine and the remainder is white pine. The young trees include red pine, white pine and balsam fir. Red pine sometimes seeds in on burned-over areas, which have no large trees. It requires nearly bare ground for reproduction. The bark on this tree, once it has reached maturity, is quite fire resistant. Consequently, it is not uncommon to find a forest which has large red pine bearing fire scars, surrounded by a second growth of aspen. Red pine grows most often in association with white pine. White pine can grow under a red pine canopy, but not in its own shade therefore white pine is replacing red pine. The pines in this area are quite far apart. The correct mean distance is about 18 feet. The canopy is dense enough so the trees are self-pruned and little brush grows beneath them. On the forest floor is a thick mat of litter in various stages of decomposition. An excessive accumulation of pine needles in the forest floor produces tannic acid, which causes leaching and is unfavorable to the growth of seedlings. The soil types of these sites are loam and sandy-loam.

Between continuum indices of about 1500 and 2000 are found stands which have a great many species. The most important are white pine and balsam fir. Stands 9 and 10 are illustrations of this. Stand 9 is located on LaSalle Trail about 1 mile southwest of the gateway to the park. This is 82 percent white pine. There is also some red

pine and balsam fir. Many of the white pine are victims of blister rust. Gooseberry and currant bushes are the intermediate hosts for this fungus. Attempts are being made to eliminate the growth of these shrubs. Most of the white pine in the park are large old trees, bearing fire scars. Hazelbrush is also found in this area. Stands 9 and 10 are close on the continuum index because they have a similar importance value. The reproduction in these stands is composed mainly of very shade tolerant trees such as white spruce and balsam fir. The white pine seedlings will not mature because white pine does not reproduce under its own canopy.

Over a range of continuum indices between 1900 and 2600 is found stand 2, consisting primarily of red pine and balsam fir almost evenly distributed. There are a few jack pine and white spruce. This stand is situated northeast of Chambers Creek. The red pine is not reseeding very well. Instead, the balsam fir is invading the area. The soil type found in stands such as this is sandy-loam or loam.

Stands with a continuum index over 2500 are usually dominated by balsam fir. Occasional disturbances provide enough opening in the canopy for growth of slightly less tolerant trees. There are 3 stands in this classification. Stand 3 has a continuum index of 2704, stand 6 of 2962 and stand 5 of 3000. The latter is pure balsam fir. Stand 3 is 84 percent balsam fir and is located west of the Itasca post office. The trees in this stand are far apart because wind storms destroyed the central part of the stand. The correct mean distance is about 16 feet. White spruce is present but it cannot endure shade as well as balsam fir. Stand 6 is situated opposite the entrance to LaSalle Trail. 94 percent of this stand is balsam fir. High winds also damaged trees in this area. Stand 5 is pure balsam fir and is located near Bohall Trail. Many of the firs are windblown. The canopy is very dense and prevents the growth of herbaceous plants on the forest floor. I suspect past disturbance in stand 8 and probably 2 and 3 because white pine should have tapered off gradually in these stands, not jack pine. In stands 8, 3, 6 and 5 the balsam fir is taking over.

In conclusion, the results indicate all the stands studied are parts of one great community complex, arranged along a gradient from the pioneer conditions to the climax conditions. The most pioneer forest stands are dominated by jack pine. Slightly less pioneer stands

are dominated by red and white pine. The most climax stands are dominated by white spruce and balsam fir. The main controlling feature is the interaction of the plants themselves.

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