LOCAL DISTRIBUTION OF *FORMICA ULKEI* MOUND-
NESTS WITH REFERENCE TO CERTAIN
ECOLOGICAL FACTORS¹

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Introduction

The existence of a number of mound-nest colonies of the ant *Formica ulkei* Emery at Palos Park, Illinois, has been known for several decades. In recent years various phases of ecology and physiology of this ant and its nests have been analyzed and published. Holmquist (1928) reported at length on its life-history and hibernation; Orlando Park (1929) discussed certain myrmecocoles associated with it in the nests; Thomas Park (1929) reported the occurrence and behavior of a thief-ant intimately found in the mounds, and Dreyer (1932) has analyzed certain aspects of the respiratory behavior of this ant in relation to its hibernation. Up to the present time no accurate description of the extent and distribution of these mounds has been attempted. In this paper they will be discussed with reference to their individual form, their distribution, and certain environmental factors correlated with this distribution.

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Field Survey

The Palos Park region lies in the Valparaiso moraine about twenty miles southwest of Chicago. It is a rolling upland, situated to the south and east of the Des Plaines river, traversed by the Sag¹, a small stream flowing in a westerly direction into the Des Plaines. Most of the region is covered with a thick growth of the mesic oak-hickory type of subclimax forest characteristic of the morainic uplands of the Chicago region. (Cowles 1901). The mounds of *Formica ulkei* found here are concentrated in an area of approximately one quarter mile square in which the forest is cut up by a number of open lanes of swampy meadow providing for local drainage towards the west. Several temporary ponds are present in the spring but by early summer there is no surface water except at times of rain. The substratum consists of a thick layer of glacial drift, yellow clay and boulders, with a thin layer, two to six inches, of black humus surface soil.

A careful survey of this area in which all the mounds were tabulated according to size, location, and activity, reveals the presence of 435 mounds of *Formica ulkei*. These vary in size from mounds about one foot in diameter and six inches in height to five feet in diameter and three feet in height. Typically, the mounds have a somewhat matted thin surface layer composed of finely divided soil and organic debris such as twigs, stems, bits of leaves, and fragments of insects. The surface is perforated with many entrances to the interior which is finely ramified with well defined galleries, one to two centimeters in diameter. These extend throughout the mound and into the substratum down to the soil-water level from one to five or six feet below the surface. (Holmquist 1928). In most cases the mounds are free from living vegetation. The smaller mounds are round to oval at the base and bluntly conical in shape. The larger mounds are in general somewhat elongated and consequently show a definite orientation in that the long axis is east and west. In addition, the south face has a longer more gentle slope with considerably greater surface

¹ At the present time the Sag canal is used for drainage.

area (sometimes double that of the north slope) than the shorter, steeper north slope. Among the 435 mounds tabulated, sixteen are dead or inactive colonies. In these cases the mounds possess a weather-beaten appearance. The surface layer is not so evident, and vegetation has begun to invade the soil of the mound.

In the enumeration and mapping of the mounds it was observed that their distribution in the area is definitely

Fig. 1. Sample of typical distribution of *Formica ulkei* mound nests. Small, medium, and large mounds are indicated by the size of the black dots. The forested area is ruled with parallel lines. Clearings are shown by the circles around the dots in the interior of the forest. Scale is $\frac{1}{2}$ inch = 25 yards.

limited. The majority, 48.7%, are located along the margin of the forest where it is traversed by open lanes or where it adjoins open meadow to the east, north, west, and south-west. This number includes mounds of all sizes, classified as small, medium, and large, although the two latter classes predominate. A small percentage, 17%, nearly all of the small type, are located in the open, i. e. 10 to 40 yards from the forest margin. The remainder, 34.3%, invariably occur in small open clearings in the interior of the forest. As in the case of the marginal nests the medium and large sizes predominate. The following table gives the complete

classification of the mounds as to size¹, and distribution on the margin, open, or in a clearing. The accompanying figure, showing a typical portion of the map on which all the mounds are located, clearly illustrates this sort of distribution.

	Margin	Open	Clearing	Total
Small ¹	54	56	33	143
Medium	74	11	48	133
Large	84	7	68	159
Total	212	74	149	435
Per cent	48.7%	17.%	34.3%	100.%

Relation of Mound Distribution to Certain Environmental Factors

In addition to mapping and classifying the mounds of this particular region, some attention was directed towards the status of the local environmental factors in order to detect any correlation between the particular conditions and the distribution of these nests. Inspection shows a relation between the nest distribution and light since all colonies are situated to receive direct sunlight for the greater part of the day. Also, the mounds themselves are so constructed that the maximal surface area is exposed to the sun rays while the perpetually shaded north side of the mound becomes, in many instances, a steep slope from the apex of the nest to the ground. This suggestion of light as a factor is further substantiated by the fact that wherever nests appear within the forest, rather than along the margins, they are located within an actual clearing, which permits practically the same amount of light to fall upon the mounds as does on the marginally located nests and those of the open territory. Using the Macbeth Illuminometer, the intensity of the light was measured in foot-candles, to ascertain if the margins and clearings, where mounds are found, are actually receiving more light than the shaded forest floor. This is summarized in the second table.

¹ Small mounds are those 6 inches to 1 1-2 feet in diameter; medium mounds, 1 1-2 to 3 feet in diameter; large mounds, 3 to 5 feet in diameter.

Test-location	Date	Time	Foot-candles
Open margin	8-21-31	9:45 A. M.	2400
Open margin	8-26-31	9:45 A. M.	1750
Forest clearing	8-21-31	9:55 A. M.	2260
Forest clearing	8-26-31	9:55 A. M.	1665
Shaded forest	8-21-31	10:05 A. M.	44
Shaded forest	8-26-31	10:05 A. M.	18

The data of the table indicate that both margins and forest clearings are receiving essentially similar sun-radiations, while the shaded forest floor receives very low foot-candle intensities. There is no difference between the open meadow and the open margin of the forest. Relating these data to the fact that active nests are abundantly found along the open forest margins, in the open, or in clearings and are not located in the shaded forest areas, the conclusion is suggested that light intensity plays a definitely positive role in that a certain range of light intensity, i. e. of unobstructed sun, is favorable to mound building.

Such a distribution of the nests with respect to light in the visible range, also connotes a correlation between nest location and temperature; the latter being, in part, an expression of sunlight. The relation of temperature to mound nests of *Formica exsectoides* which are essentially similar to those of *Formica ulkei* has been treated by Andrews (1927). This investigator found that the temperatures of the upper part of the mound were higher than those of the lower part, and that these internal temperatures vary daily being due to heat received from the sun. These observations are in accord with our own. Andrews (1926) has also noted that *Formica exsectoides* nests increase in sunny regions and decrease in shaded areas; a further indication of the role of sunlight and temperature in connection with ant mound distribution.

The effect of soil moisture content on the nest distribution becomes a limiting factor only in the region of the marshlands which exist in some of the lanes between the forested areas. Here the surrounding substratum, for some thirty feet about its center, is too moist to permit nest building. Apparently the greater soil moisture of the lower

land confines the nest building to the narrow strip along the forest margin. It thus exerts a negative or prohibitive influence which prevents the further spread of the mounds into the open where similar sunlight intensity prevails. It may be further noted in this connection that the greater number of mounds in the open are of the small type, the galleries of which do not extend far below the surface of the ground. Inspection shows soil conditions, other than moisture, to be quite similar in various parts of the area. There has been little erosion or deposition and the morainal drift is uniform in character. The ants build mounds and subterranean galleries with facility in both the loose surface soil and the hard clay below.

The relation between the presence of a colony and damage to surrounding vegetation has not been studied but a possible correlation is suggested in the well developed clearing surrounding all colonies in the interior of the forest. Andrews (1928) reports damage of mound building ants to vegetation. In this instance, however, consideration of the light conditions and the complete absence of either mounds or clearings in the denser parts of the forest indicate that the clearing is a cause rather than an effect of mound presence.

An interesting aspect of the problem not yet investigated, is the extent to which *Formica ulkei* modify the fauna of the region, or the extent to which certain species are absent or present here in comparison to similar areas not so populated by these ant colonies. Finally, observations on the unequal activity of mounds of the various sizes recorded indicate the need for careful analysis of the relations between size, age, and population of ant mounds. Such an analysis depends on subsequent periodic observations of these mounds, announcement of which will be made when their significance becomes apparent.

Summary

1. A survey of Palos Park, Illinois region records the presence of 435 mound-nests of *Formica ulkei* Emery in an area one quarter mile square.

2. Measurement of light intensity with the Macbeth Il-

luminometer shows an average of 2047 foot candles on the open margin and 1963 foot candles in the forest clearing as opposed to 31 foot candles on the shaded forest floor.

3. The distribution of the mounds is directly correlated with light intensity and attendant temperature conditions. Apparently a certain range of light intensity is a positively limiting factor in the location of these ant mounds.

4. Soil moisture limits the distribution of the mounds in such a way that it is considered in the role of a negatively limiting factor.

5. Several other interesting aspects of the complete ecological analysis of this unusual group of ant mounds are suggested for further study.

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