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POPULATIONS OF THE ANT APHAENOGASTER (ATTOMYRMA) TREATAE FOREL ON ABANDONED FIELDS ON THE EDWIN S. GEORGE RESERVE

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INTRODUCTION

THIS paper is a study of colonies of the ant Aphaenogaster treatae nesting in a field on the Edwin S. George Reserve in Livingston County, Michigan. The study was undertaken for two reasons: first, to continue a series of ant population studies (Talbot, 1943, 1945, 1948, 1951); second, to supplement a study of abundance of colonies made in the summer of 1951 in an adjoining field (Talbot, 1953). This last work was part of an investigation of an old-field community begun in 1948 by the Institute of Human Biology, University of Michigan, and directed by Francis C. Evans (Evans and Cain, 1952). During the summer of 1951 the number of species of ants living in the field studied by Evans had been ascertained, and an attempt had been made to record abundance of colonies. A knowledge of the number of individual ants in this field was also desired, but could not be obtained because the mean size of colonies for most species had not been determined. To establish range of colony size for one species, 30 colonies of A. treatae in an adjacent field were

collected and counted in the summer of 1952. To establish abundance of the colonies, those in a restricted area were staked and counted. From these data an estimate was made of the total population of this one species. The work was assisted by a grant from the Edwin S. George Reserve fund for visiting naturalists. Facilities of the Reserve were made available by J. Speed Rogers, Director, and Irving J. Cantrall, Curator of the Reserve.

DESCRIPTION OF THE HABITAT

Aphaenogaster treatae seemed restricted to open places and was a characteristic field ant on the Reserve. The field selected for its study was similar to the Evans old-field, but was separated from it by a small strip of oak-hickory woodland. These sandy, upland fields had been cleared before 1900, but had not been cultivated for at least twenty-five years. The whole study area was primarily a Poa compressa-Aristida purpurascens grassland community. For the count of colonies, a strip of the field 120 by 100 feet bordering the woods to its east was selected. Over most of this strip Poa compressa furnished a rather sparse ground covering without a thick matting of dead stems. Other grasses (Poa pratensis L., Danthonia spicata (L.) Beauv., and Andropogon scoparius Michx.), sedges (Carex pensylvanica Lam. and Carex Muhlenbergii var. enervis Boott), and lichens and mosses were scattered over the area, as were a variety of forbs. The most conspicuous of the forbs were Erigeron strigosus Muhl., E. canadensis L., Rumex Acetosella L., Potentilla arguta Pursh, Euphorbia corollata L., Lespedeza capitata Michx., Tragopogon pratensis L., Monarda fistulosa L., Oxalis stricta L., Asclepias syriaca L., Solidago nemoralis Ait., and Verbascum Thapsus L. This bit of field, though small, was not entirely uniform in plant composition. To the north Poa compressa was largely replaced by Poa pratensis, which formed a thick ground cover of matted culms. Near the woods Poa compressa was sparse, and much of the soil was covered by the red-tipped lichen, Cladonia cristatella var. vestita Tuck, an encrusting moss, Ceratodon purpureus (Hedw.) Brid., and patches of a taller moss, Polytrichum piliferum Hedw.

METHOD OF STUDY

To determine the number of individuals in an A. treatae colony, 30 colonies were dug and counted between the middle of June and the end of August. Records were also kept of time of maturing of brood and of nest structure. Colonies were discovered by scattering cake crumbs and then following the foraging ants to the nests. These were staked for future use because digging was carried on during the high temperature period of the day when workers were not foraging. In digging, the

soil was cut away slowly so that all of the ants, brood as well as adults, could be collected, and the number and location of the galleries and chambers could be recorded. Digging a colony required from three to five hours, depending on its size and the depth of the nest.

NEST STRUCTURE

Nest entrances were rarely visible because they usually slanted under clumps of grass or lichen. Occasionally, where ground cover was sparse a round hole could be seen, often surrounded by a little chimney of lichen or moss fragments similar to the turrets of Myrmica americana. Nest entrances varied from one to five (most nests had one or two), and they usually led into the superficial chambers built partly or wholly aboveground. From above, such a chamber looked like a little mound of dead grass stems. Closer inspection showed that the stems had been filled in with soil pellets to make a definite structure. When multiple entrances occurred, they led into this structure from different sides. Often a vague path made of excavated soil led away from an entrance and ended in a larger fan-shaped dumping ground or refuse heap for soil and food remains. It was noticed that the pathways were used not only by ants traveling out with excavated soil, but also by those coming in from foraging.

Of the 30 nests dug all but eight had some development of a superficial chamber. Internally, this consisted of a main cavity almost entirely aboveground and roofed by the dome-shaped mound of thatch, and a deeper part below ground level, which extended out into little side pockets, so that a very irregular outline resulted. Furthermore, there was no distinct floor to the chamber. Instead, large holes were excavated around pebbles and grass roots, and at lower levels other pockets extended out into the soil, with the result that two or three layers of shelves seemed to be formed at the sides. Thus, the whole formed an elaborate three-dimensional labyrinth of spaces.

This first chamber often led by several large openings to another just below it, which was also labyrinth-like in that it had two or three layers of shelflike projections at its sides and grass roots across its center. Beyond this the nest usually narrowed to one, two, or three definite galleries (17 had 1, 8 had 2, and 5 had 3). These were large, one-fourth to one-half inch in diameter, and extended almost straight down into the soil. Lower chambers radiating from the galleries were apt to be typical single-domed rooms. These were usually about two inches long, one and one-fourth inches wide, and one-fourth inch high. The total number of chambers of a nest varied from 2 to 17, and the mean for the 30 nests was 8.8.

Depth of the nest varied from 9 to 40 inches, with a mean of 29.5 inches. In general, the larger nests in terms of number of chambers were the deeper ones (Table I).

The soil in this upland field was light and porous sandy loam of the

Fox or Bellefontaine series. The upper gray humus layer of three to seven inches had many grass roots growing through it and was wet after each rain. In it were the first large chambers. Beneath this a layer of leached sandy loam, extending downward 15 to 20 inches, was dry almost all summer. Rather permanent moisture was evident below this, where enough clay had accumulated to hold the water which seeped down from melting snow and spring rains. This layer of moist red clay-sand reached a depth of from three to four feet. Under this was the unaltered parent material of coarse gray sand or gravel.

Chambers were distributed all through these layers except in the gray gravel. Brood distribution was correlated with soil levels because most of the larvae and pupae were in the moist red clay-sand, that is, in the lower half of most nests. After a rain brood would sometimes be brought to chambers near the surface, but, except in very small colonies, chambers in the dry light-colored sandy loam were empty. About one-half of the total number of chambers contained brood. The others sometimes contained workers, sometimes were empty. Often one chamber was used as a refuse dump of discarded insect parts. Mites usually were abundant in these latter chambers.

TABLE I

Correlation of Number of Chambers with Depth of Nest in Colonies of Aphaenogaster treatae

Number of Nests Examined	Mean Number of Chambers	Mean Depth of Nest In Inches
10	4.6	21.0
10	8.6	30.4
10	13.2	37.3

COLONY SIZE

Populations of colonies. — Aphaenogaster treatae colonies averaged 1331 individuals and varied in size from 191 to 3221 members (Table II). One queen was found with each colony except in two instances. One colony may have had no queen, since it produced males but no females and had very few eggs. The other probably had a queen which was not found. Workers averaged 682 or 51 per cent of the colony. Eggs, larvae, and pupae were present in all of the colonies dug, and males and females were present over a period of two and one-half weeks (June 28 to July 16). Pupae averaged 162 (12 per cent); larvae, 285 (21 per cent); eggs, 181 (14 per cent); and winged individuals, 20 (2 per cent).

TABLE II

Populations of the Ant Aphaenogaster treatae Forel Nesting in a Sandy Upland Field on the Edwin S. George Reserve, Livingston County, Michigan

Date	Queen	Workers	Males	Females	Pupae			Larvae	Eggs	Total
					Worker	Male	Female			
6-16-53	1	1662	...	...	61	48	132	692	625	3221
6-18-53	1	944	...	...	16	37	131	200	293	1622
6-20-53	0	877	...	...	53	251	71	302	347	1901
6-23-53	1	1450	...	...	4	156	144	495	513	2763
6-25-53	1	1196	...	...	100	199	132	379	327	2334
6-28-53	1	586	...	9	173	26	52	215	113	1175
6-30-53	1	179	...	...	109	...	...	350	167	806
7- 2-53	1	282	59	...	162	23	...	292	182	1001
7- 4-53	1	505	39	31	147	4	...	250	213	1190
7- 7-53	1	1071	138	67	237	...	...	447	252	2213
7- 9-53	1	203	...	...	60	...	...	271	91	626
7-10-53	1	1077	198	25	475	4	...	698	664	3142
7-12-53	0	675	40	...	111	...	...	114	20	960
7-14-53	1	254	...	...	60	...	...	204	153	672
7-16-53	1	1068	8	...	142	...	...	421	103	1743
7-18-53	1	116	...	...	38	...	...	166	82	403
7-23-53	1	257	...	...	70	...	...	204	106	638
7-24-53	1	214	...	...	57	...	...	113	80	465
7-26-53	1	771	...	...	181	...	...	363	77	1393
7-29-53	1	883	...	...	131	...	...	363	126	1504
8- 1-53	1	784	...	...	120	...	...	486	124	1515
8- 3-53	1	1116	...	...	121	...	...	330	120	1688
8- 5-53	1	420	...	...	70	...	...	204	49	744
8- 7-53	1	522	...	...	174	...	...	154	38	889
8-10-53	1	225	...	...	98	...	...	118	113	555
8-12-53	1	1184	...	...	143	...	...	280	114	1722
8-14-53	1	65	...	...	24	...	...	48	53	191
8-23-53	1	508	...	...	96	...	...	196	110	911
8-26-53	1	1034	...	...	114	...	...	119	93	1361
8-29-53	1	322	...	...	96	...	...	77	90	586

These colonies were not exceptionally large, but were a little larger than those of the related A. rudis, whose colonies in northern Ohio were found to have a mean of 657 (Headley, 1949).

Development of brood. — The study could not begin until the middle of June, and by that time there were already male, female, and worker pupae in the nests as well as worker larvae and eggs. Male and female pupae presumably came from over-wintered larvae and probably the first worker pupae did also. It is not known whether A. treatae is like A. rudis in over-wintering eggs as well as larvae, but certainly the eggs in nests by June 10 were spring-laid.

Pupae were white at first and darkened as time for the emergence of the adult approached. Female pupae began to darken first. In the colony dug June 25 almost all of the female pupae were brown, about one-eighth of the male pupae were black, and all worker pupae were still white. The first light-colored callow females were found two days later, on June 28, and the first males on July 2. In contrast to the females, males were black before they emerged and needed no period of darkening. Callow workers were first seen in the colony dug June 28. So, in general, females emerged slightly before males, but needed a few days to darken the pigment. At this time the first workers appeared, and they continued to be produced throughout the summer.

Emergence of males and females went on rapidly, and no more of these pupae were found after July 10. Flights occurred surprisingly soon. None was witnessed, but on July 9 and 10 dealate females were seen moving about on the ground, and after July 16 no winged forms were found in any nest, so flights must have occurred during these days.

Of the 10 colonies which had a full quota of males and females (either as pupae or adults) all had males and only one lacked females. Seven of the 10 had more males than females, and the 10 averaged 118.2 males and 79.4 females, or 197.6 winged forms per colony. Colonies producing winged ants averaged about 1000 workers, the smallest producing both males and females had 505 workers. The one with males but no females had only 282 workers. During this time three colonies were dug which had no males or females. They averaged 212 workers, and may be considered to be young, immature colonies.

TOTAL POPULATION OF COLONIES IN A GIVEN AREA

To determine the density of populations, nests were hunted and staked throughout the summer in the 120- by 100-foot piece of field described above. Sixty-three colonies were found, and a chart was made to show their distribution (Fig. 1). They were scattered rather evenly and seemingly at random over most of the field. There was, however, an obvious spacing of colonies with respect to each other; no two were less than three feet apart and most were five feet or more from the nearest neighbor. This does not mean that they maintained a distinct feeding

territory, for ants foraged as far as 12 feet from the nest and often crossed close to nest entrances of the other colonies without provoking show of hostility. Only one colony was found in the 20-foot strip bordering the woods to the east. Along this edge large oak and hickory trees overhung the field keeping it in the shade until almost noon. Evidently so much shade was detrimental to the field-living Aphaenogaster treatae and favored its relative A. rudis. Five colonies of the latter species nested in the 20-foot strip.

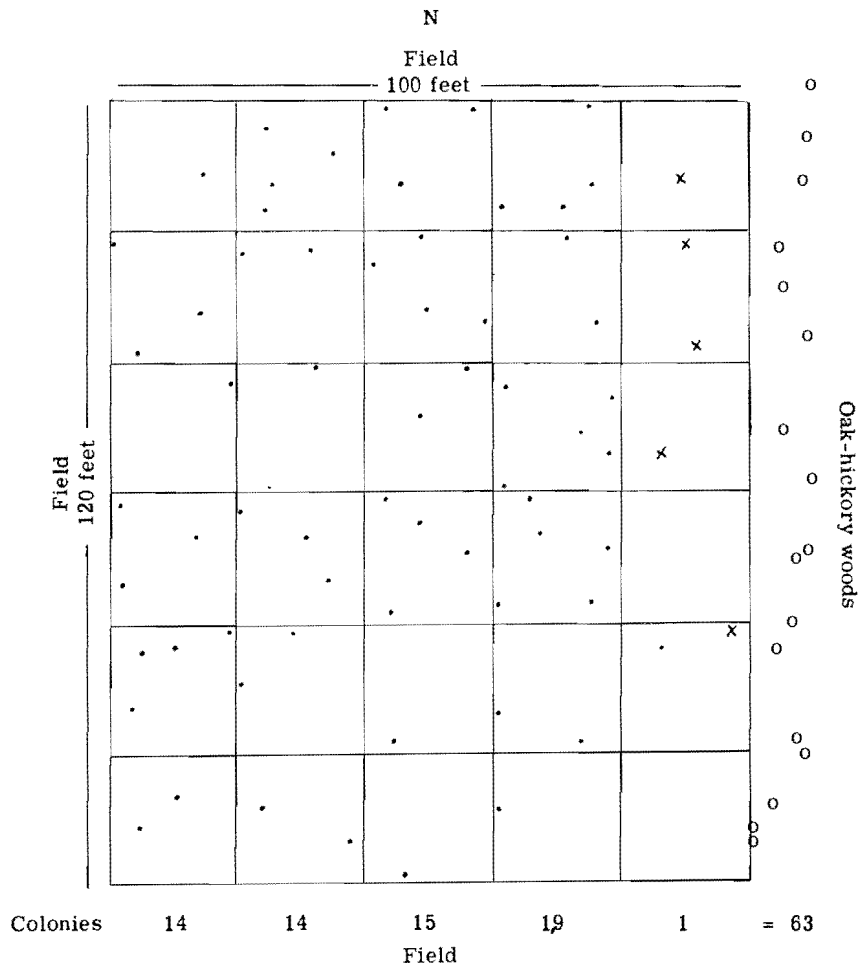

Fig. 1. Distribution of Aphaenogaster treatae colonies in a sandy upland field on the Edwin S. George Reserve, Livingston County, Michigan. Dots represent A. treatae colonies. Crosses represent colonies of A. rudis. Circles indicate oak or hickory trees bordering the field and shading the eastern 20 feet until almost noon.

Since there were 63 colonies in the plot (one colony in 21 square yards) and colonies averaged 1331 ants, the plot supported a population of almost 84,000 ants of this species, or 63 ants per square yard. Thirty-two workers foraged over each square yard, gathering food. Of course, Aphaenogaster treatae was not the only ant present. Myrmica americana Weber and Lasius niger neoniger Emery seemed more abundant. Formica pallidefulva nitidiventris Emery and Formica lasioides Emery were constantly walking over the ground. Monomorium minimum (Buckley) and Solenopsis molesta (Say) nested among plant roots, and Prenolepis imparis (Say) was seen late in August after its midsummer lull. At the edge of the woods were nests of A. rudis Emery and Myrmica pinetorum Wheeler. One mixed colony of Formica rubicunda Emery and F. fusca Linné occurred in the southeast corner, and Camponotus americanus Mayr had an extensive nest in the sandy soil near by. Two hypogaeic species, Ponera coarctata pennsylvanica Buckley and Acanthomyops murphyi (Forel) were found just beneath the surface of the soil. Camponotus pennsylvanicus (DeGeer) workers constantly foraged from the nearby woods.

A. treatae workers, like those of Myrmica americana, did not forage during the heat of the day, but were usually most active during the morning and again in the late afternoon when temperature at the ground surface was between 70° F. and 90° F. They collected insects unceasingly, and some colonies brought in great numbers of ripening Panicum depauperatum seeds. On another part of the Reserve, A. treatae was found to be quite aggressive in carrying off dealate females of Acanthomyops latipes (Walsh) after a flight and also in capturing males of various other species of ants.

SUMMARY

During the summer of 1952, 30 nests of the ant Aphaenogaster treatae were dug in an old-field located in southern Michigan. The number of ants making up a colony and the number of colonies in a given area were determined.

Colonies averaged 1331 individuals, of which 682 were workers. Males and females developed early in the season, from over-wintered larvae, and had flown by the middle of July. Eggs were laid throughout the summer, and larvae and pupae developed continuously.

Nests were always located in the soil of the sandy loam field. They had a mean depth of 29.5 inches and averaged 8.8 chambers.

Sixty-three colonies were found nesting in a strip of field 100 by 120 feet in area. This gave an average of one colony in 21 square yards and a mean population of 63 ants per square yard, of which 32 were workers.

Workers patrolled the ground vigorously and were most active when surface temperature was between 70° F. and 90° F. They collected insects continuously and at times gathered grass seeds.

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