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By R. L. King and R. M. Sallee

The record age for an ant nest is apparently one of *Formica rufa* mentioned by Charles Darwin in a letter written to Auguste Forel in 1874: ". . . a nest . . . the largest I ever saw . . . an old man about eighty years old told me he had known it ever since he was a boy." Forel ('28) records a nest of *Formica pratensis* which he had under observation for 56 years. Andrews ('26) found 25 of 117 nests of *Formica exsectoides* surviving after fifteen years in Pennsylvania; Haviland ('48) found 46 of 73 nests in Maryland after ten years. Dreyer ('42) observed 435 mounds of *Formica ulkei* in one locality in Illinois, of which 328 were still active ten years later. The duration of ant colonies of a given species should be an admirable indication of environmental conditions; our observations were made at the Iowa Lakeside Laboratory on the west side of Lake Okoboji in northwestern Iowa.

Buren ('44) has recorded the thatching ant, *Formica obscuripes* Forel, from nine Iowa counties, (Clay, Clayton, Hamilton, Lyon, Osceola, Palo Alto, Plymouth, Sioux and Winnebago) and as *Formica rufa melanotica,* a synonym, from Crawford County. It has also been found in Dickinson (King and Walters, '50), Delaware and Emmett Counties, and doubtless is present in many other localities, although it has not yet been recorded south of the middle tier of counties in Iowa. The thatched nests of this species are very common on the grounds of the Iowa Lakeside Laboratory: during the summer of 1940 it was estimated that there were about

Table 1

Year found	Number surviving in '45	'46	'47	'48	'49	'50	'51	'52	Deserted
1945	110	94	73	63	55	47	43	39	71
1946		32	29	26	22	21	18	17	15
1947			22	19	17	17	16	13	9
1948				8	8	8	7	7	1
1949					13	11	9	8	5
1950						7	6	4	3
1951							12	12	0
1952								5	
Totals	110	126	124	116	115	111	111	105	104

two nests per acre on the prairie to the north of the laboratory. This area has been laid out in 2 ½ acre plots, which have been marked with corner posts. One of the nests observed and marked at that time was still active in the summer of 1952.

During the summer of 1945 another survey was made; nests were marked with metal tags on wire stakes, and recorded together with descriptions so that the nests might be identified in succeeding years. The survey has been repeated every summer since, so that we now have records for eight years and survival data for seven winters. In 1945 a total of 110 nests was found and marked; 99 have been added to that number in the years since: a total of 209 nests; of these 104 have been deserted and 105 are still active. The data are given in Table 1.

Formica obscuripes is generally thought to start its new colonies as a result of temporary social parasitism on various species of the fusca group of the genus Formica (see, however, Creighton, '50). New colonies should be mixed: *Formica obscuripes* and *Formica montana;* however, none of the 99 new nests, nor any of the many other nests examined outside the area of detailed survey have been mixed. It is therefore considered likely the loss of the old, and the establishment of new nests may be the result of removal by the colony to a new nesting site; such a move has been reported previously (Sallee and King '47), and other instances are in our records: one colony moved to two different sites, although only one survived. Another colony has been observed to move three times before being lost. Certain species of *Formica* (*exsectoides, ulkei*) are known to have branch nests; this is associated with the presence of many queens in one colony, which sends out swarms. Muckerman ('02) has reported swarming in *F. obscuripes,* and Cole ('32) has stated that the "queens in a single colony vary in number, there always being two or more present." Colonies with several of many queens, and so with the possibility of branch nests through swarming are, of course, potentially immortal, since they adopt new queens, or retain nest daughters after fertilization. Colonies with only one queen do not survive the loss of their queen and so are relatively short-lived.

Even if the colony be potentially immortal, we might expect the percentage of nests deserted to vary from year to year, dependent on differences in the environment and climate. Table 2, extracted from table 1, gives the number of nests deserted over the winters from that of '45-'46 to that of '51-'52. The percentage of nests surviving varies from 81.0% for the winter of '46-'47, to 90.4% for

Table 2

Winter	Survived	Deserted	Total	Chi-square	% Survival
'45-46	94	16	110	0.3031	85.5
'46-47	102	24	126	4.4200	81.0
'47-48	108	16	124	0.0142	87.1
'48-49	102	14	116	0.0544	87.9
'49-50	104	11	115	1.4200	90.4
'50-51	99	12	111	0.3906	89.2
'51-52	100	11	111	0.8266	90.1
Total	709	104	813	7.4289	87.2

Probability between 0.2 and 0.3 with 6 d. f.
Note that the winter of 46-47 is definitely different from the average: probability less than 0.035 for 1 d. f.

'49-'50. These have been tested by the chi-square method, and have not been found to be different as a group from the average yearly survival, 87.2%. From the average survival per year it is possible to calculate the mean or half-life if we find that older nests do not differ from younger in survival rate.

The data in table 1 may be divided into the original group of 110 nests, which are seven years old or older, and the new nests, those which are six years old or younger. These data have been tested statistically in table 3 using the adjusted chi-square method; although the older nests show a greater desertion rate, it is not different at the 5% level of significance. Perhaps more information to be obtained in the coming years will demonstrate such a difference!

If we assume that the average survival rate is 87.2%, and that no important difference is present because of age; we can calculate the half-life of a nest as follows:

(1). Depreciation method.

$$\text{Half-life} = \frac{\log 0.5}{\log \text{survival rate}} = \frac{\log 0.5}{\log 0.872} = \frac{-0.30103}{-0.05948}$$
$$= 5.1 \text{ years}$$

(2). Compound interest method

$$\text{Half-life} = \frac{2.3 \log 2}{\text{desertion rate}} = \frac{0.6924}{0.1279} = 5.4 \text{ years}$$

Equation (2) is easier to calculate and is generally thought to be more appropriate for biological materials. However both the survival and desertion rate are subject to the errors of random sampling; the 5% limits in each being the same: survival rate = 0.8721 ± 0.0230; desertion rate = 0.1279 ± 0.0230. The 5% limits for (1) are 4.2 to 6.3 years; the corresponding limits for (2) are 4.6 to 6.6 years.

Table 3

	Survived	Deserted	Total
Original nests	414	71	485
New nests	295	33	328
Total	709	104	813

Adjusted chi-square—3.227; probability—0.07 for 1 d. f.

The half-life of the original nests, with a desertion rate of 0.1464, is 4.7 years calculated by the second method, as are all the following; that of the new nests of known age (desertion rate, 0.1006) is 6.9 years. Since the difference between the rates of the two groups has been shown in table 3 to be below the 5% level, there is, of course, no reason for believing that their half-life differs.

The data of Andrews ('26) gives a half-life of 7.1 years for *Formica exsectoides,* that of Haviland ('48), 15.4 years for the same species. Dreyer's figures for *Formica ulkei* give a half-life of 24.9 years; data for the same species collected at the Lakeside Laboratory give 18.3 years; for *Formica rubicunda* the half-life is 3.3 years, but there are only 20 nests for the latter species.

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