Mem. Shiraume Gakuen Coll. No. 12 (1976) 29—33

SEASONAL CHANGES IN THE AMOUNT OF SYRUP ABSORPTION BY *FORMICA JAPONICA* COLONIES

Masaki KONDOH

In the preceding paper (KONDOH, 1975) it was suggested that the amount of the syrup absorbed by ant colony is an effective parameter to estimate the worker population of the colony. This idea should be further supported by following evidences; that the adequate period for the observation can be determined reasonably, that the seasonal change in the amount of the syrup absorbed draws a definite pattern and that this phenomeon is supported by the biological meaning.

For the demonstration of these problems the author examined the seasonal change in the amount of syrup absorbed by five colonies of *Formica japonica* MOTSCHULSKY.

MATERIALS AND METHODS

The observation was carried out for five colonies of *Formica japonica* MOTSCHULSKY, which settled in the campus of the College, Kodaira, Tokyo from May to December 1968. Three colonies of them (A, B, and E), seemed smaller, were in the soil disturbed by the building construction at 1963. The other two colonies (C and D), seemed larger, were in the soil of undisturbed old farm.

The observation for three days was scheduled every two weeks as a rule, and attained actually as follows: May 26～28, June 9～11, June 23～25, July 6～8, July 20～24, August 3～5, August 17～19, August 31～September 2, September 15～17, September 26～28, October 14～16, October 26～28, November 9～11, November 23～25 and December 7～9. These interval are decided to be out of effects of the previous observation, especially of the previous feeding.

During the observation 50 percent solution of honey was used for feeding by the use of the watch glasses and the capirally tubes. The latter is effective to avoid the evaporation from the syrup. The transparent plastic plates were used as a rainproof. The barriers of galvanized iron plate were set and were smeared with repellent greese to make closed areas. The sea sand was set beneath the iron plate as an edaphic barrier.

Sometimes the amount of the syrup in the vessel was checked and new syrup was added in the vacunt vessel. The amount of syrup absorbed was calculated from the difference of weights for respective observation period. The effect of evaporration of syrup water was diminished by the use of adequate vessels.

The weight was measured by the balance with the scale of 0.01g.

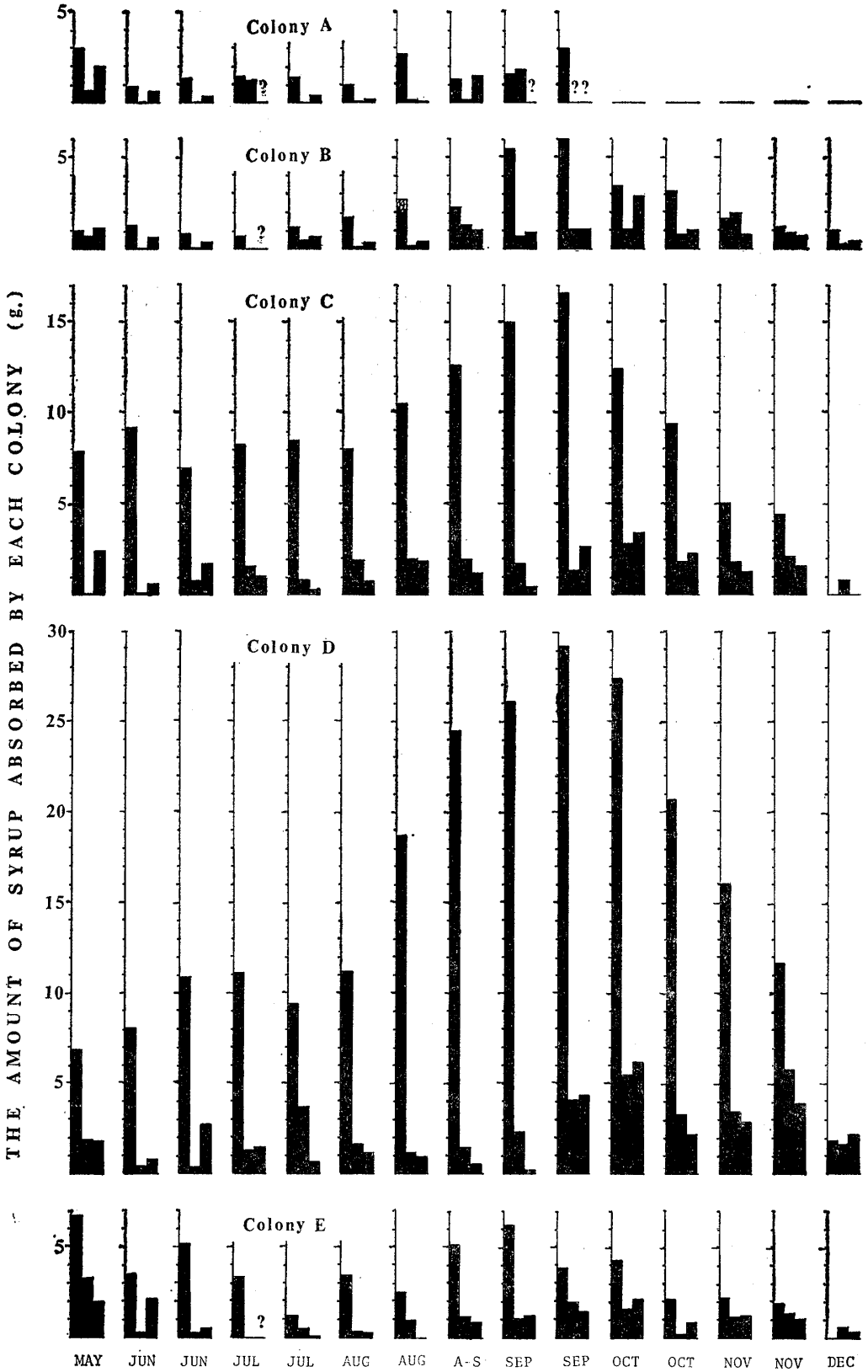

Fig. 1 The seasonal changes in the amount of syrup absorption by the five colonies of *Formica japonica* for three days of respective observation periods. The dotted part of histogram shows the range of the estimate.

OBSERVATIONS

Seasonal change in daily amounts of the absorbed syrup for the observation time by the respective colonies of *Formica japonica*, including their estimates, are summerized in Fig. 1. When the feeding site of the *Formica japonica* were sparse or vacunt, the workers of *Tetramorium caespitum* LINNÉ, *Pheidole fervida* F. SMITH, *Camponotus japonicus* MAYR, *Lasius niger* LINNÉ and *Paratrechina flavipes* F. SMITH visited there to feed the syrup. The amount of feeding by *Paratrechina flavipes* was so little to correct the weight of syrup, but those by the other species were considerable. The question marks in Fig. 1 are the sign of these troubles. The amount of syrup absorbed by each colony for the first day of the feeding is so much throughout the year, and the seasonal pattern draws a common characteristic curve, having nearly constant level respectively from late May to early August, followed by the ascent to late September and the decent to early December, with the exception of that of the colony A (Fig. 2). Seasonal pattern in the amount of the syrup absorbed in the following two days in the feeding period draws a curve with a peak in early October.

DISCUSSION

From the evidence that the feeding activity of the worker ants is ceased in the evening twilight on the first day, it is considerable that each colony takes within a day to fill their all crops with the honey syrup. The facts that the syrup was rest and the feeding site was occupied by other species mentioned before, will be also an indication of the plentiful feeding, because the night temperature is not so low to disturbe their feeding activities in each case. On the second day of feeding the amount of absorption is so little. From the author's experience of breeding, it is clear that the workers of "the out-door type", termed by KONDOH (1968), are still in their nest until their crops become empty. It takes about eight days under the breeding condition of 20°C. Therefore, the feeding activity of "the out-door type" workers depends on the condition of their crops, in spite of the food consumption of "the in-door type" workers or of their broods. On the following days the amount of the syrup absorption often increases again. This phenomenon corresponds to increase of the hungry workers of "the out-door typs".

From such observation it is considered that the process of the syrup absorption is able to devide ethologically into two phases. One of them is a phase characterized by the prominent absorption for the first day. The other is one characterized by the supplemental absorption for the following days. These two phases are termed here as "initial phase of syrup absorption" and "following phase of syrup absorption" respectively. The amount of syrup absorbed is, therefore, also devided into two terms, such as "the initial absorption" and "the following absorption".

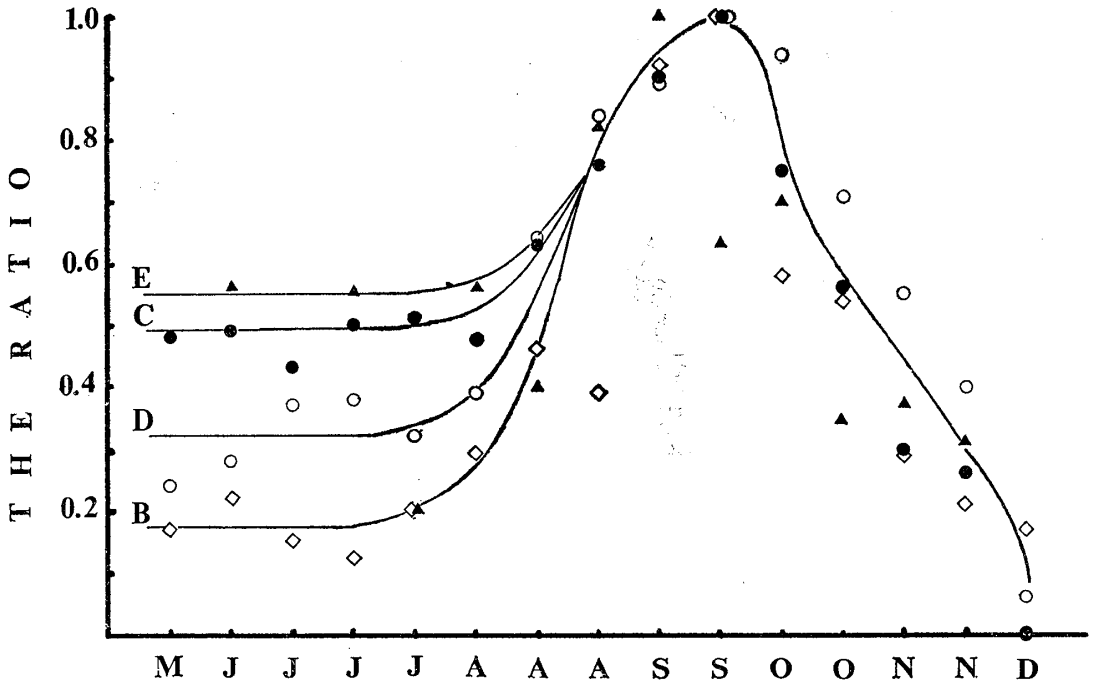

Fig. 2 Seasonal changes of the amount of syrup termed as "the initial absorption", by the colonies of *Formica japonica*. The ordinate express the ratio to the maximum amount of syrup absored by respective colony.

"The initial absorption" is able to represent as a function of two variables, that is,

$$Initial\ absorption = F(population\ size) \cdot F(mean\ crop\ capacity)$$

in which the both variables, such as population size and mean crop capacity, are fluctuate throughout the year. This is the basic idea to estimate the population size by using the amount of syrup absorption as a parameter.

"The following absorption" may be corresponding to net consumption of the syrup by the whole colony members, because this absorption is the supplemental absorption caused by diminution of stored syrup in the crop. This absorption is the most important term of the bioeconomy of the colony.

Fig. 2 shows "the inital absorption" in relative ratio to maximum amount for each colony. From late May to early August, B, C, D and E colonies keep the nearly constant level of absorption respectively. This suggests that both of the population size and the mean crop capacity may be constant throughout the season. From middle August to late September, the curves are ascending. This phenomenon is corresponding to the appearance of new workers, as reported previously (KONDOH, 1968). From early October to early December, those show a descending curve, with

a commom tendency as represented an average solid curve for the four colonies. The decent of "the initial absorption" of the season is mainly corresponding with the reduction of the crop capacities instead of the development of the fat bodies. From the report by KONDOH (1968 a), as "the index of corpulency" is constant during the summer, it is considered that the mean crop capacity is also constant from late May to late September. So, the change of "initial absorption" during that period may be resulted from the change of the population size of workers. Moreover, it is notable that the inversed number of the ratio above may be an indication of the worker productivity of the colony. Under these assumption, it is possible to say that the colony B is the most productive one.

ACKNOWLEDGEMENT

The author wishes to express his thanks to Mr. Masao SHINDO, Department of Entomology, Faculty of Agriculture, Tamagawa University for generous assistance in carrying out the observations.

REFERENCES

KONDOH, M. (1968) Bioeconomic studies on the colony of an ant species *Formica japonica* MOTSCHULSKY. 1. Nest structure and seasonal change of the colony members. *Jap. J. Ecol.* 18 : 124-133.

KONDOH, M. (1968a) Bioeconomic studies on the colony of an ant species *Formica japonica* MOTSCHULSKY. 2. Allometric study of the body weight and the corpulency relating to the body size of workers. *Jap. J. Ecol.* 18 : 171-179.

KONDOH, M. (1975) An observation about sirup absorption by *Polyrhachis dives* F. SMITH for the estimation of colony size. *Mem. Shiraume Gakuen Coll.* (Nat. Sci.) 11 : 17-25.

クロヤマアリ・コロニーの吸蜜量の季節変化

近 藤 正 樹

クロヤマアリの5コロニーについて，2週間ごとに3日間，1/2に薄めたハチミツを与えその減量を測定し，吸蜜量とした。

調査第1日目の吸蜜量は多く，第2日目以後の吸蜜量は少かった。前者はハタラキアリの個体数と嗉嚢の平均容量との反映であり，後者はコロニー全体の蜜の消費量の反映であると考えられる。したがって嗉嚢の平均容量の季節変化が求められれば，個体数の推定が可能になってくる。この観点から第1日目の吸蜜量の消長が考察された。

（こんどう　まさき　生態学）