AN OBSERVATION ABOUT SIRUP ABSORPTION
BY *POLYRHACHIS DIVES* F. SMITH
FOR THE ESTIMATION OF COLONY SIZE[*]

Masaki KONDOH

It is very hard to estimate the colony size of ants without damage of the nest. Many authors, such as CHEW (1959), ODUM and PONTIN (1961), BRIAN *et al.* (1965 and 1967), GOLLEY and GENTRY (1964), MEDLER and WAGNER (1964) and STRADLING (1970), tried to adopt the mark-release-recapture method by LINCOLN (1930) for this purpose. However, no evidence that the marked worker ants are mixed up with the others homogeneously in the nest can be demonstrated. AYRE (1962) suggested that the estimate is applicable to only the workers of the out-door type. In the case of the adoption of this method, it is indispensable to check the ratio of the out-door types to whole at each season.

On the other hand, PONTIN (1961) showed a suggestive work in which territory size was adopted as a parameter of the colony size. But BRIAN *et al.* (1965) notice that territory size was merely the size of foraging area.

A classic work by MORLEY (1954) have suggested that the amount of sirup absorbed by ants is one of indices of the colony size. Following this, a trial observation was scheduled for the estimation of colony size.

MATERIALS AND METHODS

The observation was carried out at the campus of Chung-Hsing University, Taichung, Republic of China (Taiwan), by using eleven colonies of *Polyrhachis dives* F. SMITH, which are shown in Fig. 1, on 17th, 18th and 19th August 1969. Each colony settled in the nest of silky tent on trees of *Ficus wightiana* WALL., *Murraya paniculata* JACK and *Pinus thumbergi* PARLAT.

For easy handling, the neighbouring twigs of the nest were sheared off on the previous day. Some workes which agitated and dropped out became quiet in the nest until the next morning.

Paper cups including 50% honey sirup with a little drop of whisky were set at the base of twigs which were weared the nest. A cup for the control was set on the trunk of *Rostonea regia* COOK, which was prevented from ants by repellent paste.

The sirup was weighted by Mettler balance of 0.05mg unit. The amount of the sirup absorbed by ants was estimated after correction according to the evaporation factor, or the reciprocal of the ratio of evaporation. The ratio of evaporation seemed to be the same in each cup. No absorption by ants was estimated in the case of the corrected amount of absorption exceeding the initial amount.
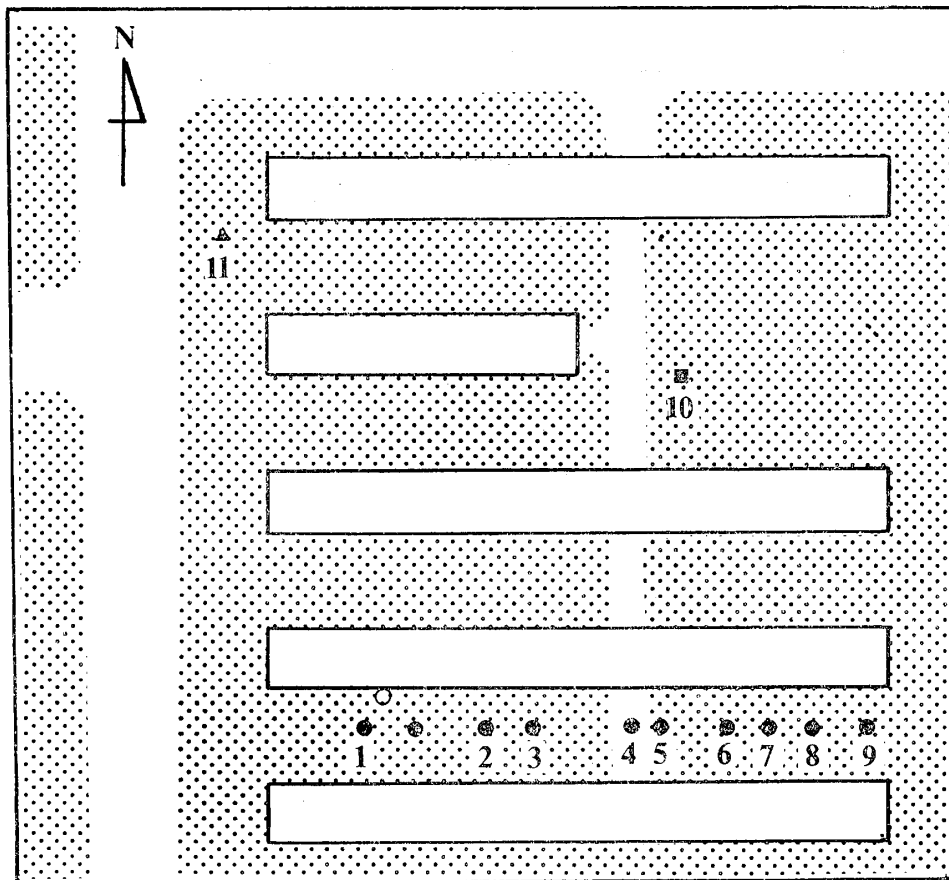

Fig. 1. The map showing a part of the campus of Chung-Hsing
University, where the observation was carried out. Nos.
1~9 show the host plant, *Ficus wightiana* WALL. (●) ;
No. 10 *Murraya paniculata* JACK (■) ; No. 11 *Pinus
thumbergi* PARLAT (▲). Open circle shows *Rostonea regia*
COOK on which trunk the control cup was set. The dotted
area shows the place overgrown with weeds and grasses.

The experiment was started at 17:00. The observation was done at 20:30, and
at 9:00, 16:30 and 20:00 on the next day.

After the experiment, the twigs were cut off into plastic bags and the ants
were killed by ethylacetate. The ants were reserved in 85% ethyl alcohol solution
and numbers of these were counted after four months in Japan.

The shape of the tent was observed, the size of the tent was measured, and
its volumes were calculated.

RESULTS

Firstly, the duration exposing the sirup to ants must be determined for the
estimation of colony size. Fig 2, which is arranged from Table 1, shows that the
most of the sirup absorption by worker ants is finished within 24 hours. Table 2
makes clear this by the percentage of the absorption with time.

Table 1. The population structure and the amount of the sirup absorbed by eleven colonies
of the ant *Polyrhachis dives* F. SMITH

Colony number	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Population structure											
Workers	126	2619	188	391	1242	996	2052	2787	490	467	2786
Eggs	0	3007	479	245	645	382	1205	1146	0	164	5172
Larvae	29	6437	550	510	1517	649	3641	2098	57	407	7029
Pupae	81	2812	135	58	597	509	1327	1290	56	150	1716
Males	29	206	7	15	106	91	98	278	90	22	10
Alated females	0	2	0	0	1	0	1	14	0	0	0
Dealates females	0	14	1	1	7	3	12	13	0	1	13
Amount of sirup absorbed											
17:00—20:30	0	8.2901	0.4089	0.7511	2.6870	3.4991	6.0111	7.2764	1.7624	1.9115	7.0408
20:30— 9:00	0	1.1067	0.2779	0	2.1535	2.5976	2.8417	0	0.5462	*	3.7327
9:00—16:30	0	0.8200	0	0.2865	2.2822	0.3545	0.5387	0	0	0	2.4716
16:30—20:00	0	0	0	0	0.2757	0.3900	0.1939	0	0	0	0.0719
Accumulated amount of sirup absorbed											
17:00— 9:00	0	9.3968	0.6868	0.7511	4.8405	6.0967	8.8528	7.2764	2.3086	*	10.7735
17:00—16:30	0	10.2168	0.6868	1.0376	7.1227	6.4512	9.3915	7.2764	2.3086	*	13.2451
17:00—20:00	0	10.2168	0.6868	1.0376	7.3984	6.8412	9.5854	7.2764	2.3086	*	13.3170

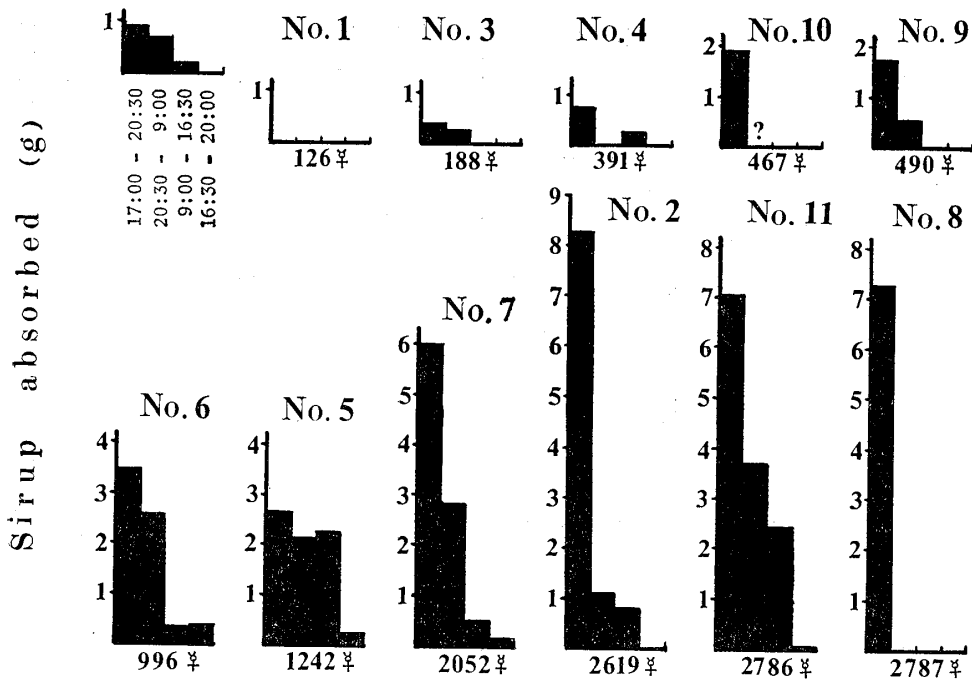* Disturbed by *Pheidologeton diversus* JERDON

Fig. 2 The amount of sirup absorbed by eleven colonies of
Polyrhachis dives F. SMITH, on 18th and 19th August,
1969 at Taichung.

The correlation between the amount of the sirup absorbed by worker ants and their colony size is very high (Figs. 3~6). The correlation coefficients are 0.97 and 0.98. The data of the colony number 10 are excluded in Fig. 4 to Fig. 6, because its cup was occupied by *Pheidologeton diversus* JERDON. Also, the regression lines
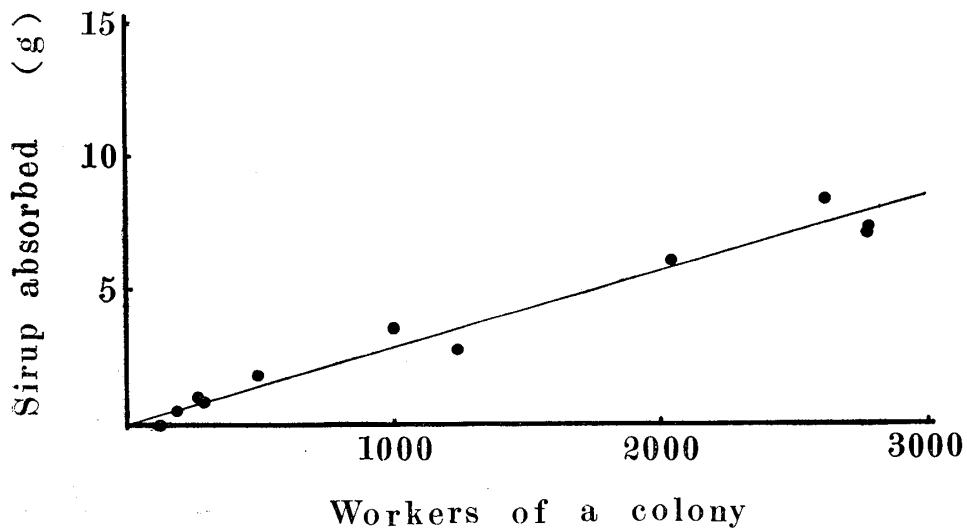

Workers of a colony

Fig. 3. The correlation between the colony size and the amount
of sirup absorbed by *Polyrhachis dives* F. SMITH, during
17:00~20:30 on 18th August, 1969 at Taichung. The
line shows the regression of the colony size on the amount
of the sirup absorbed (r=0.98).

on Fig. 4 to Fig. 6 are drawn by the data excluding that of the colony number 8, because the member of the colony number 8 ceased abruptly their activity during the experiment. The regression of the colony size (X) on the accumulated amount of the sirup absorbed (Y) is
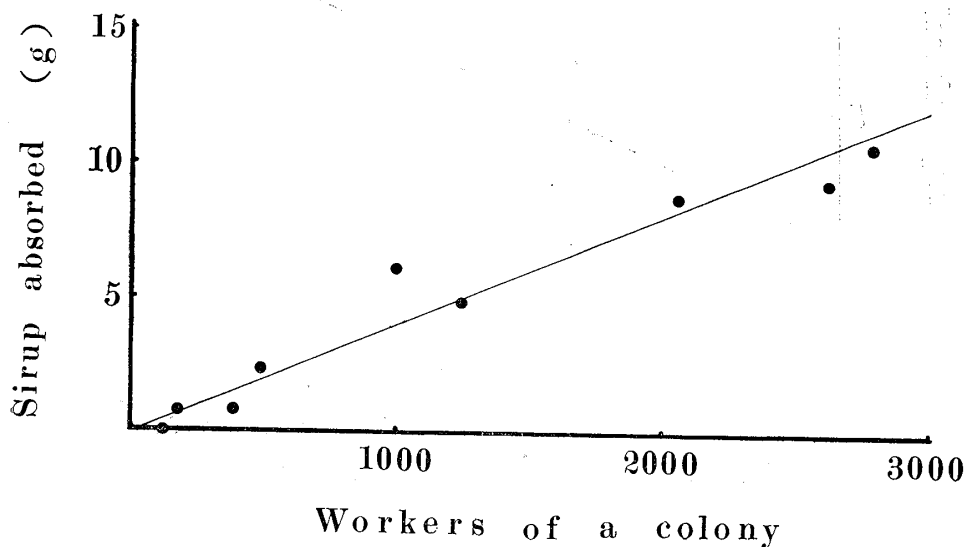

Fig. 4. The correlation between the collony size and the amount of sirup absorbed by *Polyrhachis dives* F. SMITH, during 17:00 on 18th to 9:00 on 19th August, 1969 at Taichung. The line shows the regression of the colony size on the amount of sirup absorbed (r=0.97).
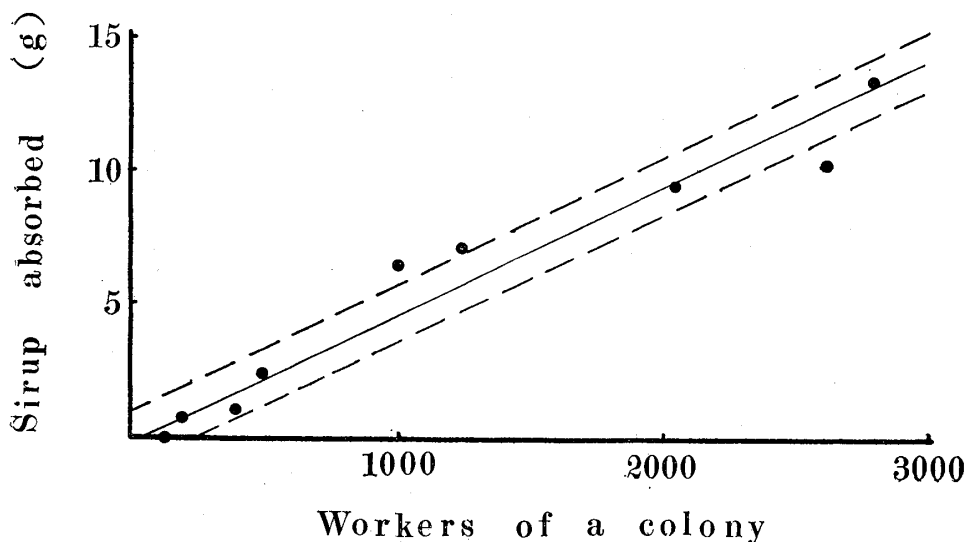

Fig. 5. The correlation between the colony size and the amount of sirup absorbed by *Polyrhachis dives* F. SMITH, during 17:00 on 18th to 16:30 on 19th August, 1969 at Taichung. The line shows the regression of the colony size on the amount of sirup absorbrd (r=0.97). The broken lines show the standard deviation from the regression line for the colony size.
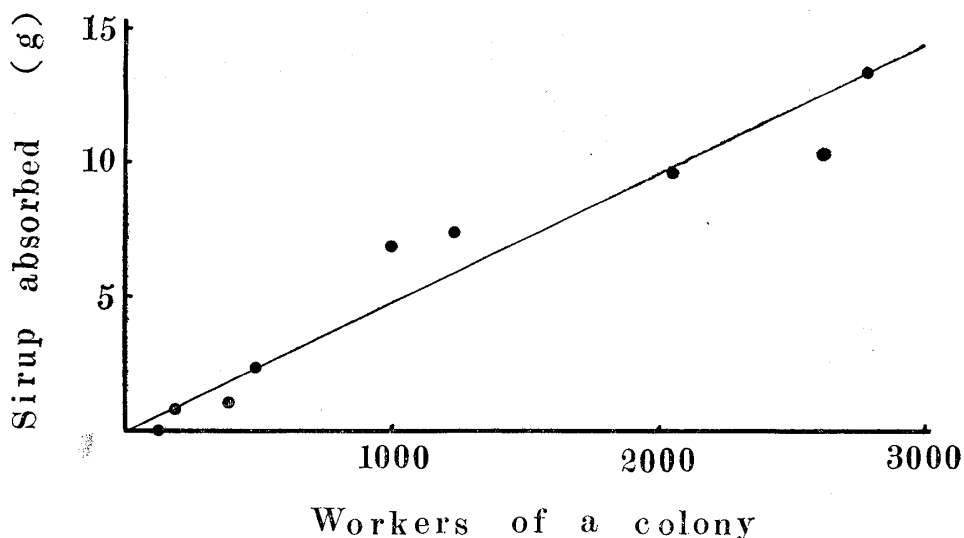
Fig. 6. The correlation between the colony size and the amount
of sirup absorbed by *Polyrhachis dives* F. SMITH, during
17:00 on 18th to 20:00 on 19th August, 1969 at Taichung.
The line shows the regression of the colony size on the
amount of sirup absorbed (r=0.97)

$$X = 210.552Y + 29.497,$$

in the case of the third observation at 16:30 on the next day.

This shows the average amount of the sirup absorbed by *Polyrhachis dives*
being 4.2~4.5mg/worker in this season.

DISCUSSION

The preceding observation about sirup absorption by *Camponotus japonicus*
MAYR have suggested that lapse of sirup absorption by ant is able to distinguish
into two phases, that is, "initial phase" and "following phase". The former is
characterized by eager absorbing behaviour of worker ants until the most workers
filling up their crops. This phase is continued throughout a day or two. After
short interruption of absorption, it becomes the following phase, which is characterized
by intermittent absorption by a few worker ant. This type of sirup absorption
means the replenishment of the consumed amount of sirup. Fig. 2 and Table 2
seem to show 24 hours being necessary and sufficient for the estimation of the
former absorption.

There is a high correlation between the amount of the sirup absorbed by ants
and their colony size. For the confirmaion of this method being the better one, it
is necessary to check the correlation between the tent size and the colony size.
The volumes of the tent were roughly calculated. Results of these calculation are
shown in Fig. 7 with the shapes of the tent.

In this case, the correlation coefficient is 0.81, which is lower than that of the
sirup absorbed being 0.97 or 0.98 (Fig. 8). The standard deviations of the colony
size from the regression line are 226.4 workers in the case of the sirup and 591.6

Table 2. The percentages of the accumulated amount of the sirup absorbed by *Polyrhachis dives* F. SMITH. This absorption is nominated in the text as that in "initial phase"

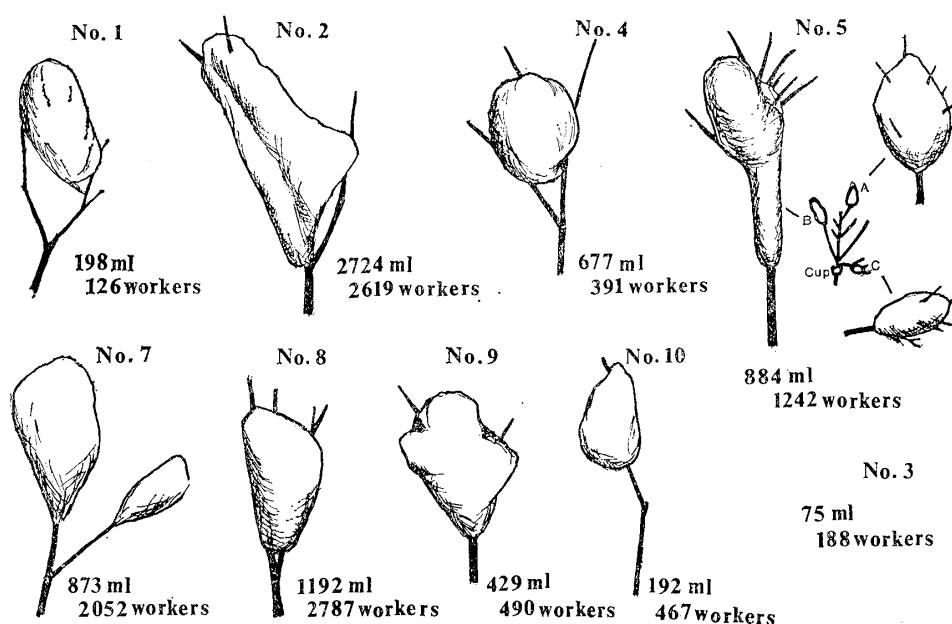| Colony number	Colony size (workers)	Accumulated absorption of the sirup at			
		20 : 30	9 : 00	16 : 30	20 : 00
No. 1	126	0	0	0	0
No. 3	188	59. 5	100. 0	100. 0	100. 0
No. 4	391	72. 4	72. 4	100. 0	100. 0
No. 10	467	100. 0	100. 0	100. 0	100. 0
No. 9	490	76. 3	100. 0	100. 0	100. 0
No. 6	996	51. 1	89. 1	94, 3	100. 0
No. 5	1242	36. 3	65. 4	96. 3	100. 0
No. 7	2052	62. 7	92. 3	97. 9	100. 0
No. 2	2619	81. 1	92. 0	100. 0	100. 0
No. 11	2786	52. 9	80. 9	99. 5	100. 0
No. 8	2787	*	*	*	*

* incomplete

Fig. 7. The shapes and the volumes of the tents made by *Polyrhachis divs* F. SMITH, showing with worker ant population.

workers in that of the tent size. These confirm that the amount of the sirup absorbed by worker ants is an useful parameter for the estimation of the colony size of *Polyrhachis dives*.

For the practical use about population estimation, the factors according to
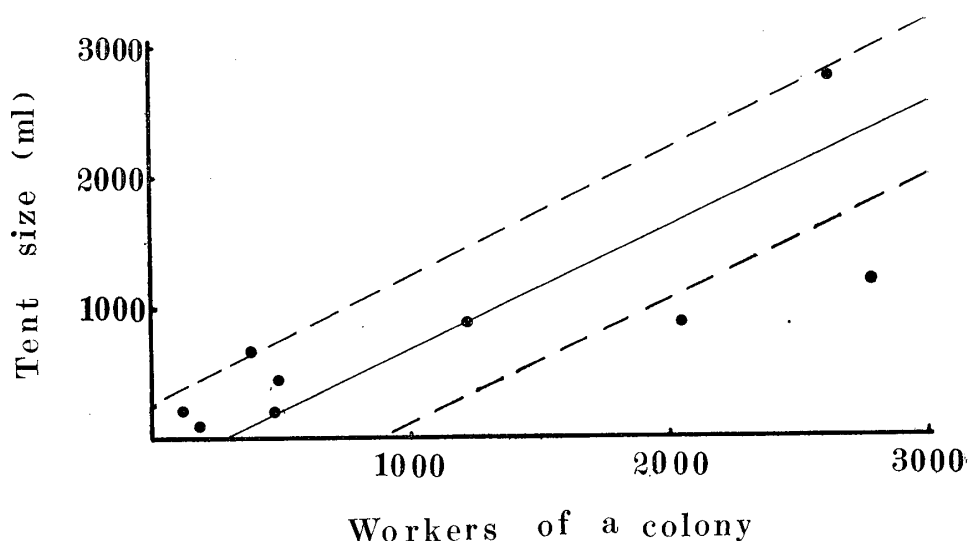
Fig. 8 The correlation between the colony size and the tent size
of *Polyrhachis dives* F. SMITH. The line shows the
regression of the colony size on the tent size (r=0.81).
The broken lines show the standard deviation from the
regression line for the colony size.

season and the limits of application must be checked further.

ACKNOWLEDGEMENTS

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コロニー・サイズを推定するために行ったクロトゲアリの

吸蜜量に関する一観察

近 藤 正 樹

アリのコロニー・サイズの推定のために，アリの体にマークをつけて放し，採集を重ねる方法は，多くの研究者によって行われて来たが，推定された個体数は実数よりかなりかけはなれている。

筆者は吸蜜量こそ個体数推定のためのパラメーターとして適当であると考え，台湾のクロトゲアリでテストをしてみた。結果は良く，吸蜜量と個体数の相関係数は 0.97 となった。この値はクロトゲアリのテント状の巣の体積の相関よりもはるかに良い。

実用化のためには吸蜜量の季節変化やこの方法の適用範囲を追究しなければならないがアイディアの一端を報告する。ちなみに，今回の吸蜜量は 4.2〜4.5mg/ant であった。

（こんどう　まさき　生態学）