L., where snow lies for two or three months. Authors have investigated on the development and mortality of larvae of the rice stem maggot in *A. fulvus* at Takada.

(1) The length of skeletons in mouth and larynx of larva was measured. The frequency distributions of the results of measurement are clearly divisable into three independent groups. Therefore, it is clear that the instars of larvae can be identified by that skeleton-length, and they have three instars.

(2) The larvae hatch in October and somewhat grow till December. Then, the larvae stop their development and most of them enter into overwintering at the first instar. Shortly after snow-break in spring, the larvae grow again. Therefore, the time of adult emergence of the first generation is regulated by the date of snow-break. But the later snow melts, the shorter is the time interval to adult emergence.

(3) Even under the snow, larval mortality is very low. So, in Takada province, authors consider that the lower temperature in winter, that is, abundance of snow is not by itself the main controlling factor to abundance of adults in the first generation of rice stem maggot.

After the larvae have begun to regrow in spring, the larval mortality becomes gradually higher and it becomes highest in duration of the later half of the third instar which is just before the pupation. In this duration, the larvae move to the other host stems or to the inside of lower leaf sheath where they pupate. So that it can be considered reasonably that if there were important factors controlling the abundance of the rice stem maggot adults in the first generation, they are in that duration.

On the Effects of Setting Places and Structures of Traps of Flies. Studies on the Methods of Collecting Flies. I. Nanzaburo OMORI and Osamu SUENAGA (Department of Medical Zoology, Research Institute of Endemics, Nagasaki University, Isahaya, Nagasaki Pref.). Received Oct. 29, 1956. *Botyu-Kagaku*, **22**, 51~57, 1957.

9. ハエのトラツプの設置場所および構造の効果について　ハエ類の採集方法に関する研究 第1報

大森南三郎・末永斂（長崎大学 風土病研究所 衛生動物学研究室）31. 10. 29 受理

謹んで春川忠吉博士の古稀を祝賀し奉る.

魚肉を餌としたハエのトラップは，設置する場所によつて採集効果が異なり，木蔭で効率が有意的に大である．然し木蔭で採集されるハエ群集は日向でのそれとは多少構成を異にする．
トラップの構造によつても採集数に有意の差がみられ，新しい，外底部にブリキバンドを付けた（バンドの影響については不詳であるが）而も倒ロート内面にハエの上行歩行を障げるような障害物のない金網トラップが最も効率的である．然しトラップの構造及び材料によつては採集されるハエ群集の構成が可成りに異なる．ハエ群集の構成の異なりは，数種類のハエ類が特に，摂食の場及びトラップの構造を偏好する結果によると思われる．以上のことから，ハエ類の調査に当つては，同型の，上記金網トラップを少なくとも木蔭と日向の2ヶ所で設置することが望ましい．

As one of the studies on the methods of collecting flies, an experiment was carried out in the duration from April 28 to May 11, 1954 to examine the effects of setting places of fish-baited traps and of their forms or structures on the efficiency in trapping flies.

Place and method of the experiment

In the courtyard of the Research Institute of Endemics, seven stands from Nos. I to VII as shown in Fig. 1 were set up one another at two meter distance. Seven traps from Nos. 1 to 7 as shown in Fig. 2 were used. As a bait, 150 grams of fish meat of one or two days old were used for each trap. On the first day of the experiment, the traps in the Arabic numeral order were set on the fixed stands of the same number in Roman numerals and then each trap was made to take a round of seven stands during seven days as shown in Table 1. The traps were set on the stands every day from 8 a. m. to 5 p. m.

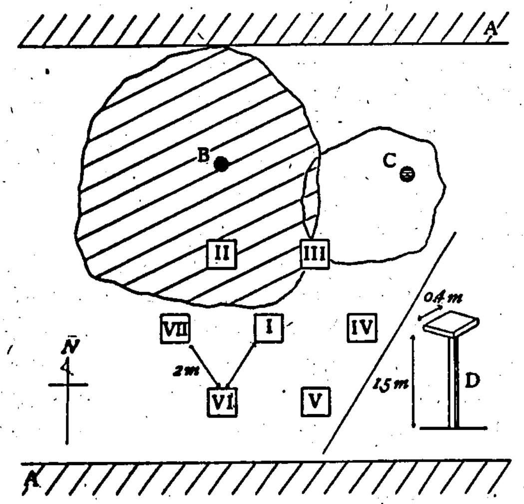


Fig. 1. Setting place of fly traps. Experiments were made from April 28 to May 11, 1954. A, two-storey wooden building, The Research Institute of Endemics. B, the spread of the sparse branches of a high tree : *Cinnamomum Camphora*. C, the same of a willow : *Salix babylonica*. D, stand for trap. Remarks : The stands for traps were fixed at seven points to have a 2 meter distance between adjacent ones. Stands Nos. I and IV-VII stand on the open yard. Stand No. II, just under the sparse branches. Stand No. III, under the sparse and high branches. At 8 a. m., all 7 stands were in the sun. At 10 a. m., No. II was partly in the shade of the tree; Nos. V and VI, in the shade of the building. At 1 p. m., Nos. II and III, in the shade of the trees; Nos. V and VI, the same as above. At 3 p. m. and afterwards, II, III, and IV, in the weak shade of the trees; I, V, VI and VII, in the sun.

Results of the experiment

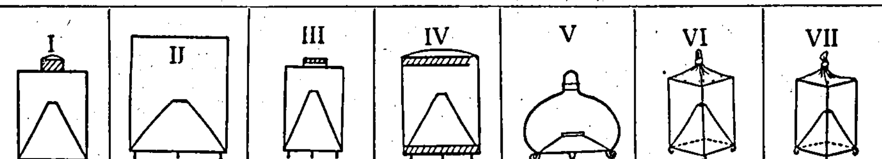
One day catches of flies by stand and by trap are tabulated in Table 1. From the result of the analysis of variance, significant differences are found among the total flies summed up by days, by stands and by traps, and the difference larger than 371 between any two totals of flies can be regarded as significant.

That there occur great differences among days is reasonably conceivable because the weathers and temperatures in the seven days were not the same day by day. The flies were active on fine and warm days and not so on cloudy and cold days. This is unavoidable in this kind of experiment and that to inquire into this subject is now out of question. Accordingly we leave off inquiring into the problem further.

The species names of flies caught in this experiment are shown in Table 2. The number of flies of a species or a group trapped at each stand and that of trapped in each trap during seven days are given in Table 3.

Effect of setting places of the trap

It is noteworthy that at the stands No. II and No. III, which were set up under the branches of



Trap No. & rough sketch of the traps	I	II	III	IV	V	VI	VII
Name	Wire-netting cage trap				Glass bottle trap	Silk cage trap	Vinyl cage trap
Form & size (cm)	Cylindrical 18×30	Cylindrical 20×30	Cylindrical 19×22	Cylindrical 20×25	Conical 25×15	Square 15×20	Square 15×20
Height of leg (cm)	2.0	2.0	2.0	2.0	1.5	1.5	1.5
Age of trap	oldest	older	a little old	new	—	new	new

Fig. 2. Forms and structures of traps used in this experiment.

1) The top opening of the inversed-funnel of No. II trap is soldered with a wire ring at the inside end.
2) No. IV trap has a band, 1.5 cm in width, of a tin-plate soldered at the base, not to get out of the shape.
3) Size : Diam. × height, for round forms; Length of a side × height for square forms.
4) Bait : As a bait, 150g of fish (sardine) meat of one or two days old is used for each trap everyday.

Table 1. Fly catch per stand per day.

Figures from 1 to 7 represent the trap number. Those given in parentheses represent the number of flies per stand per day which obtained making each of seven traps to take a round of seven stands during seven days.

Stand No. / Day	I	II	III	IV	V	VI	VII	Total
1st	1 (44)	2 (9)	3 (75)	4 (50)	5(126)	6 (19)	7 (22)	345
2nd	7 (11)	1 (78)	2 (34)	3 (25)	4 (65)	5 (51)	6 (33)	297
3rd	6 (41)	7 (15)	1 (49)	2 (2)	3 (48)	4 (90)	5 (77)	322
4th	5(201)	6 (71)	7 (13)	1 (51)	2 (21)	3 (49)	4 (88)	494
5th	4(152)	5(200)	6(141)	7 (24)	1 (79)	2 (7)	3(103)	706
6th	3(148)	4(391)	5(379)	6(112)	7 (30)	1 (92)	2 (9)	1161
7th	2 (19)	3(237)	4(298)	5(361)	6(129)	7 (49)	1 (88)	1181
Total flies	616	1001	989	625	498	357	420	4506
No. of species	21	23	24	20	23	22	22	32

Total flies for each trap

Trap No. / Total	1	2	3	4	5	6	7	Total
Flies	481	101	685	1134	1395	546	164	4506
Species	19	11	24	25	20	22	13	32

From the result of the analysis of variance, significant differences are found among stands, traps, and days respectively at 1 per cent level and the difference larger than 371 between any two totals of flies can be regarded as significant at 5 per cent level.

Table 2. Species name of flies trapped in this experiment.

a	*Scopeuma stercorarium* *Ophyra leucostomia* *Ophyra chalcogaster* *Fannia scalaris* *Anthomyia illocata*	g	*Lucilia cuprina* *Lucilia caesar* *Lucilia ampullacea* *Lucilia papuensis* *Lucilia porphyrina* *Hemipyrellia ligurriens* *Chrysomyia pinguis*
b	*Muscina stabulans* *Musca domestica vicina* *Musca hervei*	h	*Sarcophaga peregrina*
c	*Calliphora grahami*	i	*Sarcophaga melanura* *Sarcophaga albiceps* *Sarcophaga similis* *Sarcophaga misera* *Sarcophaga erecta*
d	*Calliphora lata* *Triceratopyga calliphoroides*		
e	*Lucilia sericata*		
f	*Lucilia illustris*	j	Unknown seven species

Each of dominant species and that of groups including several rare or unknown species, alphabetical letters are given in order to simplify the tables and figures which follow this table.

Table 3. Total number of flies of a species or a group trapped during seven days.

Letters represent a species or group	(A) at each stand							(B) in each trap						
	Stand number							Trap number						
	I	II	III	IV	V	VI	VII	1	2	3	4	5	6	7
a	13	15	10	6	7	12	15	5	0	18	25	14	13	3
b	32	70	42	18	27	13	30	27	9	40	62	48	35	11
c	222	390	400	279	185	155	177	248	70	305	384	688	71	42
d	15	21	28	11	15	13	9	14	3	25	20	28	10	12
e	128	55	88	105	90	59	60	82	4	77	94	152	141	35
f	101	191	222	78	78	37	52	46	2	102	243	188	147	31
g	12	35	29	15	22	14	11	17	3	14	41	23	29	11
h	18	18	37	25	16	7	21	9	6	20	21	64	13	9
i	30	13	47	27	23	11	22	15	4	17	37	69	27	4
j	45	193	86	61	35	36	23	18	0	67	207	121	60	6
Total	616	1001	989	625	498	357	420	481	101	685	1134	1395	546	164

trees, the flies assemble significantly more numerously to feed on bait than at the open (although the difference between stands III and IV is not significant, we can not necessarily take the difference to be insignificant, because of the total number of flies obtained at the former being too large), and that the number of species which entered the traps are more numerous. This is due to the fact that the number of flies of many species trapped at these stands being larger than those at the others except only one or two species. Among the other five stands which were set up at the open, no significant difference is found. As we have learnt that it is very efficient in trapping flies to set the trap under the tree, now the structure of fly associations thus obtained will be closely examined.

To compare the structure of fly association being different in setting places or stands, a series of correlation coefficients between any one association obtained at a stand and the other associations from I to VII, were computed in Fig. 3.

In the upper part of Fig. 3, the seven series thus made are illustrated. The figure shows that the trends of upper five series are nearly similar, while the series for stand II is roughly reverse in trend to the above ones and that for stand III seems transitional of the above two types. This is clearly explainable from Fig. 4 where, at stand II, the relative abundances of species "e" or *Lucilia sericata* and group "i" or some sarcophagid flies are significantly lower but those of "f" or *L. illustris* and "j" or unknown species (to be exact, unknown species No. 12) are higher, and at stand III that of "e" is lower while "f" is higher than those at five other stands respectively.

As a conclusion on the effect of setting place, we can say that significantly larger number of flies can be collected by the traps set up under the trees than those at the open, and that the number of species trapped is apparently larger under the trees. The structures of associations obtained under the trees, however, somewhat differ from those obtained at the open. Accordingly, it has need to set up two traps of the same type, one under the tree and the other at the open, to obtain exact data concerning the fly population at a locality.

Effects of form and structure of traps

As seen from Table 1, the numbers of flies collected by traps No. 4 and 5 are significantly larger while those by traps Nos. 2 and 7 are significantly smaller than the others. Between Nos.

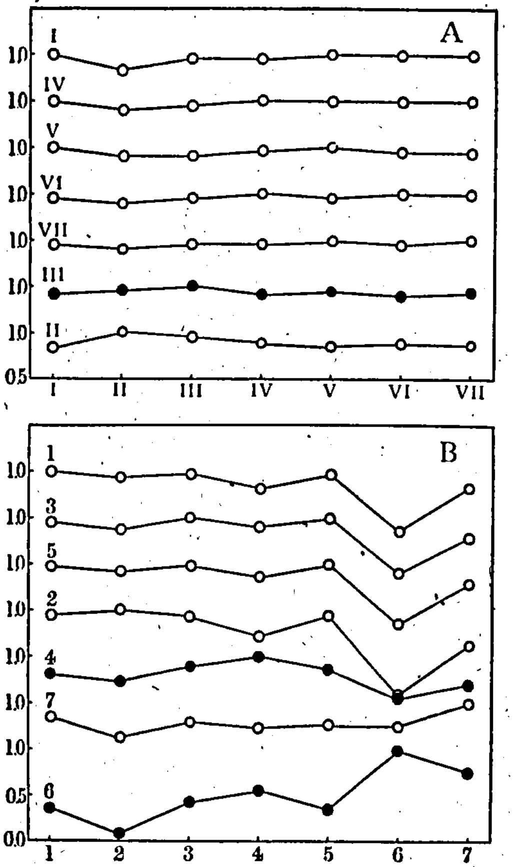


Fig. 3. Seven series of correlation coefficients obtained by the reciprocal treatments of seven fly associations. A, series for associations by stand. B, series for associations by trap.

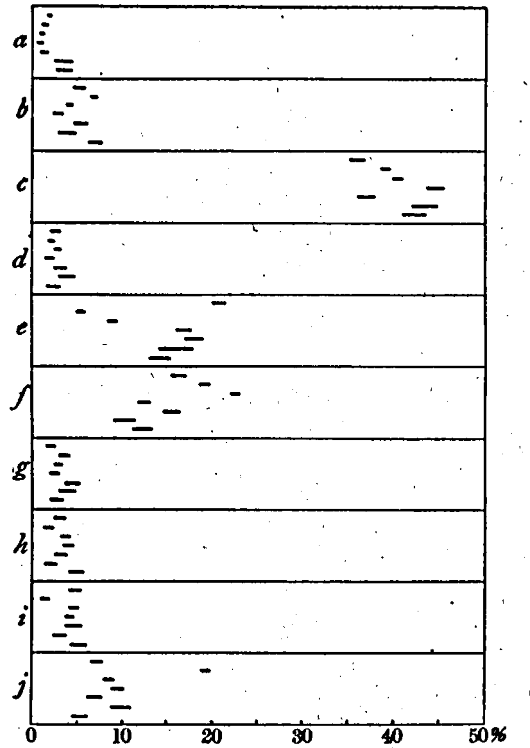


Fig. 4. Relative abundances of each constituent species or group in each association, given by 60% confidence intervals of percentage numbers of the constituents shown in Table 3, (A), are compared with seven stands or places.

4 and 5, Nos. 2 and 7, and among Nos. 1, 3, and 6, no significant differences are found respectively.

Trap No. 2 is peculiar in the structure of its inverted funnel. The funnel is lined with four wire rods, the ends of which being soldered with a wire ring just under its top-opening. Observations show that, on reaching the ring, some numbers of flies which are climbing up on the underside of the funnel after their full meal, begin to come down to the lower end of the funnel and fly away. This is the reason why this trap is inefficient in collecting flies.

Among the remaining three wire-netting cage traps, the new one is the most efficient and becomes less so with the oldness of them.

Trap No. 7 is made of transparent vinyl sheet and is airtight and glassy. The reason of inefficiency of this trap is now unknown.

Trap No. 5 or the glass bottle trap is the most efficient among the seven traps, but it is inconvenient in that some species of flies become difficult to be identified because of their being soaked in water which is kept to kill the falling flies at the bottom of the trap, and that the glass trap is very brittle.

Trap No. 6 or the silk cage trap is collapsible and portable and moreover the number of flies trapped is fairly large but it is to be noted that the structure of fly association obtained by this trap differs greatly from those obtained by wire-netting cage traps as will be mentioned later.

Now, further analysis will be made concerning the structures of fly associations obtained by the different traps. The lower illustration given in Fig. 3 shows that the upper four series for traps

Nos. 1, 3, 5, and 2 are nearly identical in their trends; the series for No. 6 is clearly inverse to the above ones and those for Nos. 4 and 7 are transitional of the above two types. It is surprising to find out that the series for No. 4 is somewhat different from the other wire-netting traps, in spite of its being made of the same material.

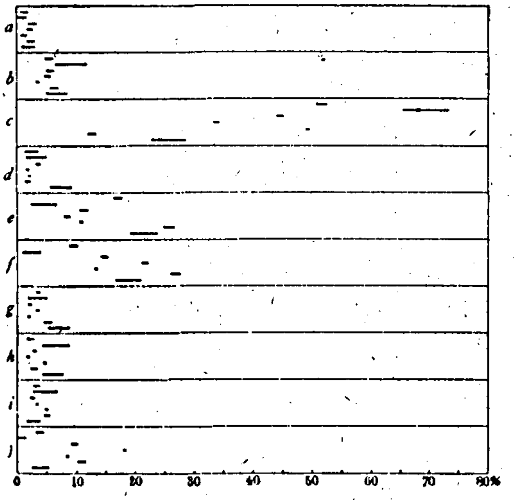


Fig. 5. Relative abundances of each constituent species or group in each association, given by 60% confidence intervals of percentage numbers of the constituents shown in Table 3, (B), are compared with seven traps.

The above is more clearly recognizable from Fig. 5. In the cases of traps Nos. 1, 3, 5, and 2, the relative abundances of each fly species or group are in many cases approaching with one another, although in trap No. 2 the value for species "c" is very high owing to the very low values of the other flies. In trap No. 6 or silk cage trap the value for species "c" is very low and those for "e" and "f" are high. Trap No. 4 or new and banded wire-netting cage trap differs from the other wire-netting ones in those the value for "c" is fairly low and those for "f" and "j" are high.

Thus we see again four types in the structures of fly association, those are; wire-netting cage type, silk cage type and two transitional types; vinyl cage type and banded wire-netting type. The species which are contributing to cause such a variation in the structure of fly association are *Calliphora grahami, Lucilia sericata, L. illustris* and unknown species No. 12. In the other words, these species can be said to show fairly strong partiality in entering the trap.

The partiality of flies in entering traps seems to be appreciated from a different aspect, that is, from the number of species which entered the trap. As is seen from the figures given in the lower part of the Table 1, the greater number of species preferred to enter the traps in the following order: trap No. 4 or new and banded wire-netting cage trap; No. 3 or a little old wire-netting one; No. 6 or silk cage trap; No. 5 or glass bottle trap; No. 1 or the oldest wire-netting one; No. 7 or vinyl cage trap; and finally the least efficient one, No. 2 or older wire-netting cage trap with a wire ring on the underside of the top-opening of the inverted funnel.

Summary and conclusion

To examine the effects of setting places of fish-baited traps and the forms or structures of them on the efficiency in trapping flies, an experiment was made in the duration from April 28 to May 11, 1954, setting a trap on a stand for a day from 8 a.m. to 5 p.m. and making each of seven types of traps to take a round of seven fixed stands or setting places during seven days. The results of the experiment are as follows:

Significantly greater number of flies can be trapped under the branches of trees than at the open, although the structures of fly associations obtained under the trees slightly differ from those at the open. Accordingly it is desirable to set at least two traps, one under the tree and another at the open in a locality in which an exact fly population is to be studied.

As to the form and structure of traps, new and banded wire-netting cage trap having no projection on the underside of its inverted funnel which may hinder the flies from entering the top-opening of the funnel, is very efficient and most recommendable. The glass bottle trap with water at its bottom is the most efficient in trapping flies among the seven traps used in this experiment and the structure of fly association obtained by it is nearly similar to those by wire-netting ones; moreover, it is very cheap in price but is inconvenient in that it is brittle and it makes us difficult to identify the species of flies soaked in the water. Silk cage trap is cheap and convenient in its collapsible and portable nature and is fairly efficient in collecting flies but it is to be noted that the structure of fly association obtained by this trap differs markedly from those obtained by wire-netting cage traps.

It must be remembered therefore that in the collecting flies by fish-baited traps to examine the fly population at a village or at several villages at the same time, at least a set of two traps of the same construction and material must be used at a locality, one under the trees and the other at the open, as flies of several species show fairly strong partiality in selecting places of taking food and in entering the trap. For this purpose, the most recommendable one is a new and banded wire-netting cage trap having no projection on the underside of its inverted funnel. (It cannot now be determined whether the efficiency of this new and banded trap is due to its newness or to the occurrence of the tin band at its outer base as shown in Fig. 2).

"Logistic" Growth Tendency in the Population Fluctuation of the Rice Stem Borer, *Chilo suppressalis*. II. Syunro UTIDA (Entomological Laboratory, College of Agriculture, Kyoto University, Kyoto). Received Oct. 30, 1956. *Botyu-Kagaku*, **22**, 57～63, 1957, (with English résumé, 62).

10. ニカメイチユウ個体数の長期変動に見られるロジスチツク性　第2報*

内田俊郎
(京都大学、農学部　昆虫学研究室) 31. 10. 30　受理

このつたない一文を恩師春川忠吉先生の古稀の御祝として捧げる.

ニカメイチユウの誘蛾燈による年次的の個体数の変動にロジスチツク性，すなわち増殖に対する密度効果の認められることを前報に報告した．それはしかし西日本の場合のみであつたが，こゝでは東日本でも同様の傾向の認められること，さらにそれがニカメイチユウの棲息密度の変動機構にどんな風に働いているかを論じた．

春川忠吉先生のもつとも輝かしい御業績のひとつにニカメイガ *Chilo suppressalis* の棲息密度の変動についての大きな研究[6]がある．それによれば，ニカメイガの年々の個体数の変動が他の多くの害虫類と同じように著しいことがわかる．10年ぐらいの短期間について見ても発生量の最高と最低との開きは10倍以上にも達している．この変動の原因を明かにする為には従来から多くの人達によつて，いろいろの面からの追求がなされているのであるが，まだはつきりと問題が解決されたという域にまでは達していない．

たとえば，低温のために1化期の発蛾が遅延すること[7]とか，7月の低温のために1化期幼虫の死亡率が低く保たれること[2]などが大発生を導くという様に気象的要因の重要性を説く人たちがある．深谷[3]もこのように気象的要因の働きを重視してはいるが，同時にこれに従属して寄生菌などいわゆる天敵類の作用も大きく作用しているだろうとした．これらに先立つて，すでに春川たち[6]は6年間にわたつて水田内のニカメイガ幼虫の棲息密度を調査した結果，このように気象だけに左右されて個体数の変動がおこつているとは考えられないとして，天敵などの生物的要因の働きをも正当に評価すべきであるとした．

しかし，たゞニカメイガのみに限らず，いろいろの害虫類また一般動物の個体数の変動機構の解析の行われた例を見ると，気象的の要因が決定的に働くとか，天敵など生物的の要因の作用が非常に大きいとかを論ずる段階はすでにすぎ去つて，これらの棲息密度に依存したりしなかつたりする要因のひとつが決定的に働いているという場合はむしろ稀で，それらの要因群がすべて何等かの形で作用し合つているのであつて，現在ないしは今後の問題はこれらの要因群がそれぞれどのような結び方でどんなに働いているかということを明かにすることではないかと思われる．

このような見地から問題を理論的に解く一手段として，筆者はさきにニカメイガの年次的の個体数変動にロジスチツク理論の適用を試みた[5]．その結果は一般的の個体数ないしは棲息密度の変動機構を論ずるのには余りにも貧しいものであつたが，従来とは異つた新しい解析方法を提示したともいえよう．前報では予察燈による誘殺蛾の年次的の観察資料を材料として用いたが，それは主として西日本の各地とくに岡山県内の各地のものに偏つていた．ニカメイガの発生型は地方により相当著しい差を示し，石倉[8]によればおよそ7

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* 京都大学農学部昆虫学研究室業績，第283号．
害虫個体群の長期変動についての研究，第2報