個体数の比較を行なうことが可能になると思われる.

この報文を作成するに当り，京都大学理学部動物学教室森下正明教授には，I_δ-法につきご指導をいただいた．また前京都府衛生部長故土屋夏実博士，京都市衛生研究所主幹前田理博士，三重大学農学部山下善平教授，および京都大学農学部助教授高橋史樹博士には，資料収集の上でご援助をいただき，また有益なご助言をいただいた．ここに，心から感謝の意を表わしたい.

文　　献

1) Southwood, R. T. E.: *Ecological Methods with Particular Reference to the Study of Insect Population*, Methuen, London (1966).
2) Muirhead-Thomson, R. C.: *Ecology of Insect Vector Populations*, Academic Press, London and New York (1968).
3) Chauvin, R.: 昆虫の世界（日高・平井訳），平凡社，東京 (1967).
4) Morisita, M.: *Res. Pop. Ecol.*, 6, 43 (1964).
5) Morisita, M.: *Res. Pop. Ecol.*, 13, 1 (1971).

Summary

The collection index is proposed for unbiased comparison of number of mosquitoes collected at different numbers of days in a collection unit. When the whole collection period (Z days) is divided into L collection units, each of which contains Q days, the collection index is defined as a summation of trap indeces during whole collection period, where trap index is mean catch of mosquitoes per day in each collection unit.

A method to calculate the relative error (ε) of the collection index is also proposed. Calculations for the relative errors were made by using light trap collection data in females of *Culex tritaeniorhynchus summorosus* and other 3 species of mosquitoes collected at 3 different stations in the suburbs of Kyoto City. The relative errors obtained in this work will be applicable for discontinuously collected data under similar conditions.

The relative error of the collection index is variable with the size of collection unit and collection frequency (q). Relation between ε and Q (when q=1) was discussed: there is a linear relation between ε and Q when $2 \leqq Q \leqq 12$. The differences in regression lines shown in each figure in the same species at different stations and in the different species at the same stations were not clarified in this paper.

A Method for Rough Estimating Density of Norway Rats in Poultry Farm. Yohsuke Yuyama*, Yasunosuke Ikeda** and Kiyohisa Naganuma*** (Department of Medical Zoology, Faculty of Medicine, Kagoshima University*, Sankyo Co., Ltd Tokyo** and Osaka City University, Medical School***) Received March 22, 1975. *Botyu-Kagaku*, 40, 80, 1975.

14. 養鶏場におけるドブネズミ生息密度の簡易測定法

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50. 3. 22 受理

食物消費による野外ドブネズミの生息数推定の簡易測定法について報告し，その精度を最も正確な捕獲法のそれと比較した．試験は1974年9月中旬，御殿場市内の一養鶏場においておこなった．試験の結果，ドブネズミはひき割り雑穀類からなる試験餌を1日当り自己体重の約16％の割合で摂取することを知った．このことから，平均体重のドブネズミ成獣の生息数は，餌の合計消費量を平均成獣の1日の食物消費量に相当するグラム数，40で割ることによって容易に推定できる.

本法による密度推定は，餌の豊富な場所では困難と思われる.

It is very difficult to survay and record rat infestations in various environments. Although a number of techniques to estimate the wild rat population have been used by many investigators, one of the most accurate method is assessment by trapping.

In the present paper the authors report a simple method for estimating rat population used in conjunction with a trapping method and discuss the bait consumption can provide a rough estimate

of rat density in rural habitates. The authors wish to express their appreciation to Prof. A. SATO, Dept. of Med. Zool., Kagoshima University and Prof. S. TAKADA, Osaka City University, Medical shool for their kind guidance during the present work. The authors also indebted to Mr. T. NEMOTO and Mr. N. TANIGUCHI for their assistance in the experimental work.

Materials and Methods

The site: The tests were conducted in a large poultry farm which was located near the foot of Mt. Fuji in Gotenba City, during the middle ten days of September, 1974. A floor area of the test poultry barn was about 512 square meters (8m in width and 64m in depth), and there had usually been keeping about 2500 chickens. Burrows were found in banks, weedy vacant ground, and along the edge of concrete floor around the barn.

Baiting: The test bait was most commonly used as a diet for rearing poultry in Japan. The bait was consisted of approximately 60% of ground maize, 34% of ground cereal (milo, refuse of soy-bean, and alfalfa), and 4% of fish meal.

A container for the test bait was consisted of thin carton, 18cm long and 12cm broad, and 2cm in height. Forty-six boxes containing the excessive amount (400g) of test baits were placed on either inside passages of the barn at intervals of about 3 meters. After the exposure of 24 hours, the baits were removed and weighed.

Trapping: Since a combination of one of more techniques may provide a more reliability than a single method, the following trapping was used in conjunction with a trial by bait consumption. The trap used was a simple snap trap. A small piece of fried sweet potato was used as a trapping bait because this bait had been the most acceptable to the rats inhabited in this area. Two hundred-fifty traps were placed in rat runways, near their burrows or, freshly dug earth around the test barn. The collection of trapped rats was made several times a day during the test periods so that wandering rats could not devour the trapped cadavers.

Results and Discussion

As shown in Table 1, the sum total of 286 rats were collected, and this population was comprised a relatively large number of young rats. A characteristic evidence observed in this area was the rats had searched for food not only at night but in broad daylight. Moreover, the rats were quite granivorous, they always choosen the diet for rearing poultry even though the other food such as bacon or sausage was readly available. This food habit may depend upon the habitat condition which they have been fed on this bait for a long time.

Feeding with ground cereal has been used by numerous investigators to estimate wild rat population. In this technique most investigators have compared between the amount of consumed baits and the number of individuals in disregard of body weight.[1,2,3] In the present tests, the authors have attached importance to the body weight rather than the number of individuals.

Table 1. Record of the collected cadavers and the daily consumption of the test baits.

Date	No. of rat caught			Total body weight	Ave. body weight	Bait consumed
	Female	Male	Total			
Sept. 11	44	34	78	6883	88.2	2963
12	42	58	100	7970	79.7	2632
13	21	40	61	5661	92.8	1967
14	11	11	22	1807	82.1	926
15	8	8	16	984	61.5	385
16	4	5	9	1516	168.4	180
Total	130	156	286	24821		

Table 2. Assessment of the bait consumption based on the body weight of rats in different days.

Date	No. of rat caught	Total body weight	(A) Accumulated body weight	(B) Bait consumed	B/(A/100)*
Sept. 11	78	6883	24821	2963	11.9
12	100	7970	17938	2632	14.7
13	61	5661	9968	1967	19.7
14	22	1807	4307	926	21.5
15	16	984	2500	385	15.4
16	9	1516	1516	180	11.9
				Average (M±P.E.s.)	15.9±2.7

* Bait consumption g/100g body weight/day.
P.E.s.: 0.6745σ $X^2=4.999 < X^2_{0.05}$ (d.f.5: 11.071)

Table 3. Comparison of estimates of the number of an average adult rat based on either of the accumulated body weight and the amount of bait consumption.

Date	(A) Accumulated body weight	A/250 Expected number	(B) Bait consumption	B/40 Expected number
Sept. 11	24821	99.3	2963	74.1
12	17938	71.8	2632	65.8
13	9968	39.9	1967	49.2
14	4307	17.2	926	23.2
15	2500	10.0	385	9.6
16	1516	6.1	180	4.5
Total		244		226

$X^2=13.013 < X^2_{0.01}$ (d.f.5=15.086)

Since the technique used was an essentially trapping, the accumulated total might be considered as a exposed population during the test period in this area. As shown in Table 2, a calculated formula B/(A/100), where B is the total amount of baits consumed, and A is the accumulated body weight in different days, indicated the rats ate about 16% of their body weight per day. This figure was in according with the results of the previous laboratory test[7] and the field tests by Giban.[4,5]

It is generally supposed that average adult of Norway rat is about 250 grams in weight. The population thus can be roughly determined by dividing either the acumulated body weight in grams by 250, or the total bait consumption in grams by 40, of which in grams correspond with the daily bait consumption of average adult rat. The results are given in Table 3. As shown in the results, there was a small difference in the expected number of average adult rat based on either of the body weight and the amount of bait consumption.

Although it is difficult to indicate the wild rat population with scientific exactitude, the population can be roughly estimated by using a method of bait consumption. In this method, finely or coarsely ground cereal diets are suitable for the test baits.[1,4,6] If the solid baits or whole grains are used for test baits, the results may not be accurate so that certain rats would not eat at the bait stations and the baits will be carried away to their burrows and cached. Also, the method may not be sufficient to estimate the population in the place where too much other bait is available for rats will probably feed on

other bait. The selected baits must not be replaced by the other, since the bait consumption of Norway rats may varied with the nutrient content of the bait.[7]

Summary

In the present paper, the authors dealt with a method to roughly estimate the wild rat population by using the bait consumption, and had compared the reliability with an accurate trapping method. The tests were conducted in a large poultry farm in Gotenba City during the middle ten days of September, 1974.

The results showed that rats ate the test bait consisted of ground cereal diet at rate of about 16% of their body weight per days. Thus, the number of average adult of Norway rat could be roughly estimated by dividing the total bait consumption in grams by 40, of which in grams correspond with the daily bait consumption of an average adult rat. This method may not be sufficient to estimate the population in the place where too much other bait is available for the rats will probably feed on other food.

References

1) Chitty, D. and M. Shorten : *J. Mammalogy*, 27, 63 (1946).
2) Emlen, J. T., *et. al.*: *Ecology*, 29, 133 (1948).
3) Emlen, J. T., *et. al.*: *Ibid.*, 30, 430 (1949).
4) Giban, J.: *Ann. Epiphyties*, 19, 629 (1968).
5) Giban, J.: *Parasitica*, 25, 223 (1970).
6) Krause, E.: *Prakt. Schaedlingsbekaempf.*, 25, 64 (1973).
7) Naganuma, K. and Y. Ikeda : *Botyu-Kagaku*, 39, 85 (1974).

抄　　録

米松ドクガの性フェロモン

Douglas-Fir Tussock Moth : Sex Pheromone Identification and Synthesis. R. G. Smith, G. E. Daterman and G. D. Daves Jr., *Science*, 188, 63 (1975).

米松につくドクガ *Orgyia pseudotsugata* は葉を徹底的に食いつくし，大きな害を与えることで有名であり，しかもしばしば大発生する．したがって初期の発生消長を知ることは重要で，フェロモントラップは，この目的に有用である．

そこで，6,000匹の雌の腹部末端を塩化メチレンで抽出し，粗フェロモンを得た．この状態で官能基テストを行なった結果，アルコール性の NaOH，あるいは無水酢酸と加熱還流してもどちらも活性が残り，$LiAlH_4$ で活性が消滅することから，アルデヒド，ケトン，エポキシ基の存在が示された．酢酸と16時間，105°C に加熱しても（この条件で disparlure: Z-7, 8-epoxy-2-methyloctadecane は活性を失う）活性が残ることから，エポキシ基の存在は否定された．接触水添や，オゾンとの反応，あるいは，*m*-chloroperbenzoic acid との反応で活性が失なわれることから，一つもしくは数個の多重結合の存在が示された．

アルミナのカラムクロマトグラフィーで精製したフェロモン活性部は，GLC（3% SE-30: 1.2m×6mm）で2主成分を示し，そのうちの1つのピークに強い活性があった．

このもののマススペクトラムは，m/e308 ($C_{21}H_{40}O$)，169 ($C_{11}H_{21}O$)，167 ($C_{11}H_{19}O$)，124 (C_9H_{16}) にピークを与えた．m/e 169，167は α 開裂によって生じるイオン，124の基準ピークは，McLafferty 転位による転位ピークと考えられることから，carbonyl 基は11位にあると考えまた，転位ピーク124が基準ピークになるのは，生成したオレフィンが安定化するためであると考えられることから6位のオレフィンが考えられ，フェロモンは，6-heneicosen-11-one と推定された．フェロモンのオゾン分解生成物と，1-hexadecen-6-one のオゾン分解生成物が GLC 上，同一 Rt を与えることからも6位のオレフィンの存在が支持された．

（Z）-異性体と，（E）-異性体を合成して GLC 分析したところ，（Z）-体が天然のフェロモンと同じ Rt をしめした．

以上のことから，米松ドクガの性フェロモンは，(Z)-6-heneicosen-11-one と決定された．実験室での生物検定では，（Z）-体，（E）-体，ともに強い活性を有したが，200 ng の合成物と5匹の雌腹部抽出物（1匹の雌は40 ng のフェロモンを含むと考えられる）とを，比較選択させたところ，（E）-体と雌では1：5で雌の方に誘引されたのに対し，（Z）-体と雌とでは4：1で合成物の方に強く誘引された．　（北村実彬）