

Dispersal Experiment on *Culex tritaeniorhynchus* in Korea

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韓國產 *Culex tritaeniorhynchus* (Diptera: Culicidae)의 分散에 관한 調査

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적 요

1974년 8월 포항시에서 표식-방사-재채집 방법에 의한 작은 빨간집 모기(*Culex tritaeniorhynchus*)의 비상 및 분포 조사를 실시한 바 그 결과를 요약하면 다음과 같다.

1. 총 23,115개체의 *Culex tritaeniorhynchus* 암모기에 표식 방사하여 그 중 120마리가 재채집되어 0.519%의 재채집율을 나타냈고 조사기간중 채집된 총 57,514마리의 암놈중 0.00208의 표식 모기 양성비를 나타냈다.

2. 방사지점으로 부터의 분산율은 0~2km에서 77.5%, 2~4km에서 11.7%, 4~6km에서 5% 그리고 6~8km에서 5.8%였다.

3. 1일간 최고 비상 거리는 7.5km였다. 1일 평균 분산거리는 1.55km였고, 방사후의 경과일수와 분산 거리와는 연관성은 보이지 않았다.

INTRODUCTION

The flight range of *Culex tritaeniorhynchus* is related to the transmission pattern of Japanese encephalitis, and for this reason several dispersal experiments with this mosquito have been conducted in southern Japan. The difference in the physiology of *C. tritaeniorhynchus*, particularly with respect to photoperiodic

response in the induction of winter diapause has recently been demonstrated among colonies of latitudinally different origins (Mori *et al.*, 1971).

According to Wada (unpublished data), the morphology of male terminalia and the critical photoperiod for the induction of female diapause are closely associated with each other in populations of *C. pipiens pallens*. This evidence suggests the possibility of correlation between morphological, physiological, and ecological characteristics of mosquitoes. Therefore, it is probable that the dispersal pattern in the Korean population of *C. tritaeniorhynchus* is dissimilar to the pattern in the physiologically different Japanese population.

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LOCATION AND METHODS

The dispersal experiment on *C. tritaeniorhynchus* was conducted in an south area of Pohang city, Korea. The area included rice fields among which small villages were scattered, and was bounded by the sea on the northeast side, as illustrated in Fig. 1.

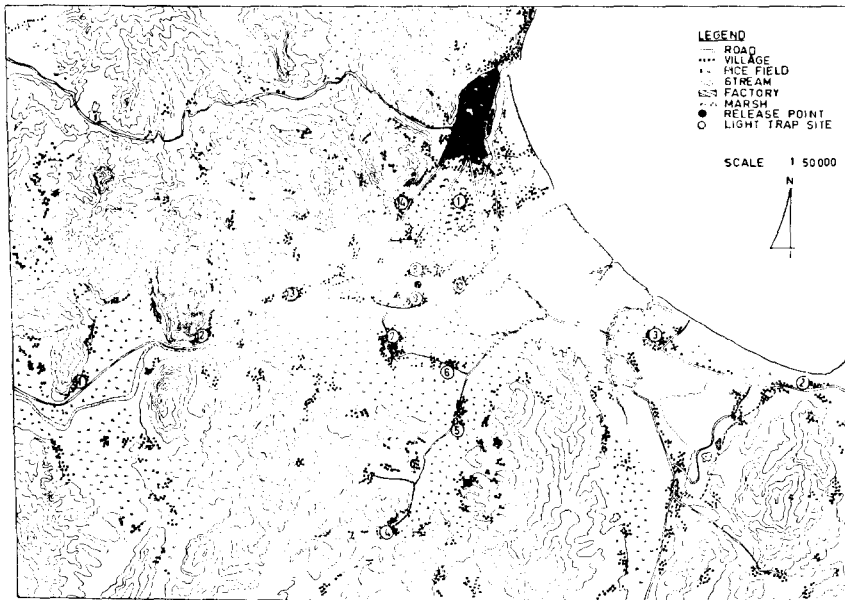


Fig. 1. Map of study area

Table 1. Number of *C. tritaeniorhynchus* females released, according to dye by which marked, at Pohang city, Korea, August 1974

Dye by which marked	Date of release	No. released
0.5% Rhodamine B	15	3,630
	16	3,494
	Total	7,124
1.0% Yellow 8G	18	1,857
	19	1,448
	20	2,242
	Total	5,547
1.0% Whitex BB	21	4,379
	22	2,062
	24	4,003
	Total	10,444
Total		23,115

Females of *C. tritaeniorhynchus* were collected on the cow bait in a village, north of Pohang city. The females collected were kept overnight in the laboratory with 2% sugar solution; the following morning they were marked by spraying with three kinds of fluorescent dye, i.e., 0.5% Rhodamine B, 1.0% yellow 8G, 1.0% Witex BB. At 22:00 hours on the same day, the marked females were released from the site shown in Fig. 1. This procedure was repeated eight times during the period from 15 to 24 August, 1974. The number of females released each day is presented in Table 1.

Recovery catches of released females were made every day from 16 to 27 August by using light traps (Yoshizawa type, provided with black fluorescent lamp), set at 14 sites near cow sheds which were located 0.3 to 8.4 km from the release site. The light traps were operated from 19:00 to 06:00 hours. Mosquitoes collected in the traps were brought to the laboratory and killed by chloroform. *C. tritaeniorhynchus* females were sorted out to permit recording the number and detecting the sprayed fluorescent dyes. The detection of the dyes was done with the aid of a fluorescence-detection lamp after a drop of ethanol have been placed on each female body on filter paper.

RESULTS

Of the 23,115 released *C. tritaeniorhynchus* females marked by the three different dyes (7,124 by Rhodamine B; 5,547 by Yellow 8G; 10,444 by Whitex BB), a total of 120 females (0.519%) were recaptured by 14 light traps between

Table 2. Number of *C. tritaeniorhynchus* females recaptured according to the light trap site, Pohang city, Korea, August 1974

Light trap No.	Distance (km)	No. recaptured				No. of <i>C. trit.</i> collected	Recovery ratio
		Rhodamine	Yellow	Whitex	Total		
8	0.3	2	9	7	18	10,719	0.00167
9	0.3	1	5	3	9	4,113	0.00218
10	0.8	26	11	9	46	21,287	0.00216
7	1.3	0	0	0	0	535	—
6	1.6	0	0	18	18	1,238	0.01453
14	1.8	0	2	0	2	3,439	0.00058
1	2.1	1	1	2	4	6,435	0.00062
13	2.5	0	0	1	1	357	0.00230
5	3.2	5	3	1	9	2,735	0.00320
12	4.6	0	0	3	3	606	0.00495
3	5.0	1	0	0	1	1,080	0.00092
4	5.8	0	2	0	2	1,663	0.00120
11	7.5	0	5	2	7	3,162	0.00221
2	8.2	0	0	0	0	145	—
Total		36	38	46	120	57,514	0.00208
Recapture rate (%)		0.505	0.685	0.440	0.519		

16 and 27 August, as shown in Table 2. The recapture rate in respect to the three dyes used in the experiment showed little difference between the dyes, i.e., 0.505% of Rhodamine B, 0.685% of Yellow 8G and 0.440% of Whitex BB. It was by the light traps near the release site that large numbers of females were recaptured. The number recaptured by light traps, No. 8, 9 and 10, which were located from 0.3 to 0.8km from the release site, were as many as 18, 9 and 46 respectively, and the total by these three traps (73 females) was ca. 60.8% of all recaptured.

It is shown in Table 2 that the *C. tritaeniorhynchus* dispersed fairly long distances. The maximum distance covered in this experiment was 7.5km, to light trap No. 11, at which 7 females were recaptured.

The recovery ratio of marked mosquitoes for each trap site was slightly different, with no apparent relation to the distance from the release site. The average recovery ratio was 0.00207. This evidence implies that *C. tritaeniorhynchus* females disperse easily throughout an area at least of 8km radius. No marked females were collected in traps No. 7 and 2, and the total numbers of *C. tritaeniorhynchus* females collected in these traps were low. Directional difference in the dispersal of released females was not observed. One female was recaptured

Table 3. Number of *C. tritaeniorhynchus* recaptured by distance from the release site and by days after releasing, Pohang city, August 1974

Days after 1st release	No. recaptured, by distance (km)						Mean distance
	0—1.9	2—3.9	4—5.9	6—2.9	Total	%	
1	9	1	2	1	13	10.8	1.73
2	19	1	1	1	22	18.3	1.14
3	8	1	0	0	9	7.5	0.94
4	8	5	1	1	15	12.5	2.17
5	3	3	1	2	9	7.5	3.28
6	25	0	0	0	25	20.8	0.50
7	2	1	0	0	3	2.5	1.50
8	0	1	0	2	3	2.5	5.17
9	19	0	0	0	19	15.8	1.39
10	0	0	0	0	0	—	—
11	0	0	0	0	0	—	—
12	0	0	0	0	0	—	—
13	0	1	0	0	1	0.8	3.5
14	0	0	1	0	1	0.8	5.50
Total	93	14	6	7	120	100	1.55
%	77.5	11.7	5.0	5.8	100		

in trap No. 3, located in an east-south-east direction, inspite of the fact that a large factory site, located midway between this trap and the release site, acted as an obstacle to the dispersal flight of the mosquitoes.

Table 3. shows the number of recaptured females by distance of the light traps from the release site and by the day of collection as related to the day of the first release of mosquitoes. During the first nine days of collection, the number of females recaptured daily was irregular, showing large catches at 2—3 day intervals. This means that the dispersal activity of *C. tritaeniorhynchus* females did not show any correlation between distance and days after release. Mean distance from the first to ninth days after release indicates this evidence more clearly, showing average mean distance of 1.55km.

DISCUSSION

Several large scale experiments by a mark-release-recapture method on the flight range of *C. tritaeniorhynchus* which were done in Japan, showed that the females of this species have the ability to fly very long distances (Ishino *et al.*, 1967; Maeda, 1968; Uemoto *et al.*, 1967; Wada *et al.*, 1969). Ishino *et al.* (1967)

reported that released females flew 3.4km and reached a mountain of 800m high several days after release. Maximum distances which released females covered were recorded to be 3km in five hours (Uemoto *et al.*, 1967), 5.1km in one day and 8.4km in 3days (Wada *et al.*, 1969), and 5.7km in one day (Yamaguchi *et al.*, 1969). Our experiment showed that two Whitex marked females flew 4.6km and one female flew 7.5km in one night. It is assumed from the number recaptured at each trap site that *C. tritaeniorhynchus* females have an ability to fly much longer distance than 7.5km. Asahina and Noguchi (1968) collected many *C. tritaeniorhynchus* females by a light trap set at the National Institute of Health in Tokyo, and considered that those mosquitoes had travelled more than 10km by wind, in view of the distribution of significant breeding places. Moriya *et al.* (1971) reasoned, in a similar way, that *C. tritaeniorhynchus* females found on a small artificial sland in Tokyo Bay had come from an area at least 8km away. Asahina and Noguchi (1968) and Asahina (1970a,b) recorded much longer migratory flights of this mosquito. Their records were based on mosquito catches made on a weather ship in the North Western Pacific and on survey boats located in the East China Sea. The locations where *C. tritaeniorhynchus* were captured were 500km south of Cape Shionomisaki and 200km east of Shanghai. These facts indicated that *C. tritaeniorhynchus* can be brought for a very long distance probably by wind, under some circumstances.

Maeda (1968) estimated that ca. 50% of released females dispersed to an area over 1km from the release site during the night of release, and ca. 20% over 4km and ca. 10% over 5km 1—2days. The present experiment gave similar results, showing dispersal rates of 77.0% in 2km, 11.7% in 2—4km, 5% in 4—6km and 5.8% in 6—8km through the collection period. However, it is to be noted that this experiment did not show longer dispersals on each subsequent day after release, and that 19 marked females were collected within 2km distances from the release site after 9 days, corresponding to about three gonotrophic cycles. Closely associated with the activity of the gonotrophic cycle would be the much higher collections of females at two to three days intervals, giving 18.3%, 12.5%, 20.8% and 15.8% respectively on the 2nd, 4th, 6th, and 9th days after first release. Yoshida (1971) observed that the flight activity of *C. tritaeniorhynchus* females is increased until 3—4 days after emergence, and the decreased activity by blood feeding is recovered when the females become gravid. A similar result was obtained by a tethered flight method (Mogi and Wada, 1975). There seems to be an indication that the flight and feeding activities are closely associated with each other.

SUMMARY

A dispersal experiment on *Culex tritaeniorhynchus* females by a mark-release-recapture method was carried out at Pohgang city, Korea, in August 1974. The results are summarized as follows:

1. Of 23,115 females of *C. tritaeniorhynchus* released, 120 females were recaptured, giving 0.519% recapture rate and 0.00208 recovery ratio.
2. Dispersal rates from the release site were 77.5% in 0–2km, 11.7% in 4–6 km and 5.8% in 6–8km.
3. *C. tritaeniorhynchus* females flew 7.5km in one day. The average of the daily mean distances was 1.55km, and it showed that the dispersal distance did not correlate with days after release.

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