

Studies on the Current Epidemiological Situation of Brugian Filariasis in Endemic Areas of Korea

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Abstract: An epidemiological study on brugian filariasis was carried out in endemic areas including Cheju Island in Korea, with a brief review of literatures. The results showed that the incidence among residents has remarkably decreased in Cheju Island, which was the main endemic area. Reviewing available informations on the prevalence of filariasis reported in recent years and also judging from the present socio-economic conditions which enable people to practice personal protection against mosquitos, it can be said with confidence that filariasis has almost disappeared from Cheju Island and inland areas. The disease is considered to remain at a low level of endemicity in Hugsan Islands. Certainly mass diethylcarbamazine (DEC) treatment carried out in Cheju Island in the 1960s and 1970s and remarkable economic growth followed by improved living standard and altered life-style of inhabitants could all have combined effects on the disappearance of this mosquito-borne disease in this island. If the present trends go on, the possibility of resurgence of filariasis in Cheju Island is hardly postulated.

Key words: *Brugia malayi*, brugian filariasis, *Aedes togoi*, Cheju Island, Docho Island, micro-filaremia

INTRODUCTION

Brugia malayi is the only known species of filaria in Korea. Filariasis has presumably been endemic in some parts of the country for several centuries (Seo, 1978). An intensive investigation on the prevalence of filariasis was for the first time made during the years 1942~1944 by Senoo, and the results were reported later by Senoo and Lincicome (1951). Of 5,000 persons from 25 villages in South Korea and Cheju Island (Is.) examined, 604 were shown to be infected with *B. malayi*, with the microfilaria (mf) rate of 12.1%. The highest prevalence occurred in

Cheju Is. (mf rate—30.3%), the next in south-western part of the Korean peninsula (mf rate—11.2%) and the lowest in south-eastern areas (mf rate—4.1%). Seo *et al.* (1965) carried out a night blood survey in Cheju Is. and reported 183 mf positive cases (8.6%) out of 2,139 persons examined. The rate of infection varied by village from 0.8 to 19.5%.

More intensive night blood surveys were carried out by Seo *et al.* (1968) throughout the country in 1968. A total of 30,534 blood smears were collected and the examination revealed 601 positive cases (mf rate—2.0%). Of 601 cases, 434 were found in Cheju Is. Seo (1976) summarized the results of night blood surveys

conducted during the years 1972~1975 in Cheju Is., and reported that 149 of 5,681 smears examined (mf rate—2.6%) were found infected. Recently, Lee *et al.* (1986 & 1987) reported that the microfilaria rates obtained from Dae-Hugsan Is., So-Hugsan Is. and Cheju Is. were 11.5%, 11.1% and 0.5% respectively.

Apart from Cheju Is., coastal areas and islands of south-western Korea, a few foci of filariasis were detected in the inland areas, namely Yungju-gun (County) of Kyungpuk Province in 1973 (Kim *et al.*, 1977). The mf rate was reported to be 8.1%. *Anopheles sinensis* was confirmed to be the vector of filariasis in this area. Kim *et al.* (1980 & 1987) conducted two series of night blood surveys in 1980 and 1987 in the same study area, where mf rates were found to be reduced to 2.2% and 0.0% respectively.

Summarizing the above reports concerning lymphatic filariasis in Korea, this disease was presumably on a descending trend throughout the country during 1970s. This study was carried out to obtain additional information on the prevalence of microfilariaemia among people in endemic areas and also to find out factors pertaining to the disappearance of filariasis, one of the important mosquito-borne diseases in Korea. With regard to other mosquito-borne diseases, the disappearance of malaria has already been confirmed (Paik *et al.*, 1988) and the prevalence rate of Japanese encephalitis has been kept at a very low level in recent years.

MATERIALS AND METHODS

1. Study area

In order to obtain additional information on the current prevalence of filariasis and other related data, investigations were carried out in Docho Is., Cholla Namdo, in 1987 and in Cheju Is. in 1988 (Fig. 1).

1) **Docho Island:** It is located off the coast of Cholla Namdo in between Hugsan Is. and the mainland. The southern part of the Province consisting of numerous islands is

known to be the area with sporadic endemicity of filariasis. In view of the geographical location of Docho Is. closer to the known endemic area of Hugsan Is. (Lee *et al.*, 1986 & 1987) and of active movements of population between the two islands, Docho Is. was chosen for this study. The population was reported to be 10,200 in 1987. Four villages nearby the breeding places of *Aedes togoi*, the vector of *B. malayi*, were selected for investigation.

2) **Cheju Island:** This island (Cheju Province), located off the south-west coast of the Korean Peninsula, is the well known endemic area of filariasis together with its specific ecological conditions favouring the transmission of *B. malayi*. The total population of the island was estimated to be about 500,000 at the time of investigation. Four villages with previous epidemiological data available were selected (Fig. 1).

2. Night blood survey

A 20 mm³ blood was taken from villagers by house-to-house visit, at night between 22:00 and 01:00 hrs. Members of study population were chosen without regard to age and sex. The slides were stained with Giemsa and were examined under microscope.

3. Mosquito survey

Human biting collections were carried out from 7 pm to 1 am in- and out-door to get relative biting density of *Ae. togoi*. Mosquitos feeding on a human bait were collected using a sucking tube and a torch, and they were transferred into separate cups by each hour. The number of mosquitos were recorded per man per hour by species. Fourteen houses were selected randomly for indoor resting place collections. Every bedroom of the houses was carefully checked for mosquitos resting on the walls, ceiling and furnitures.

4. Survey on life style

In order to assess the living standard of villagers and the degree of personal protection against mosquito biting, 20 houses were randomly selected in the former endemic village: Taehung-Ri. Each house was checked for social

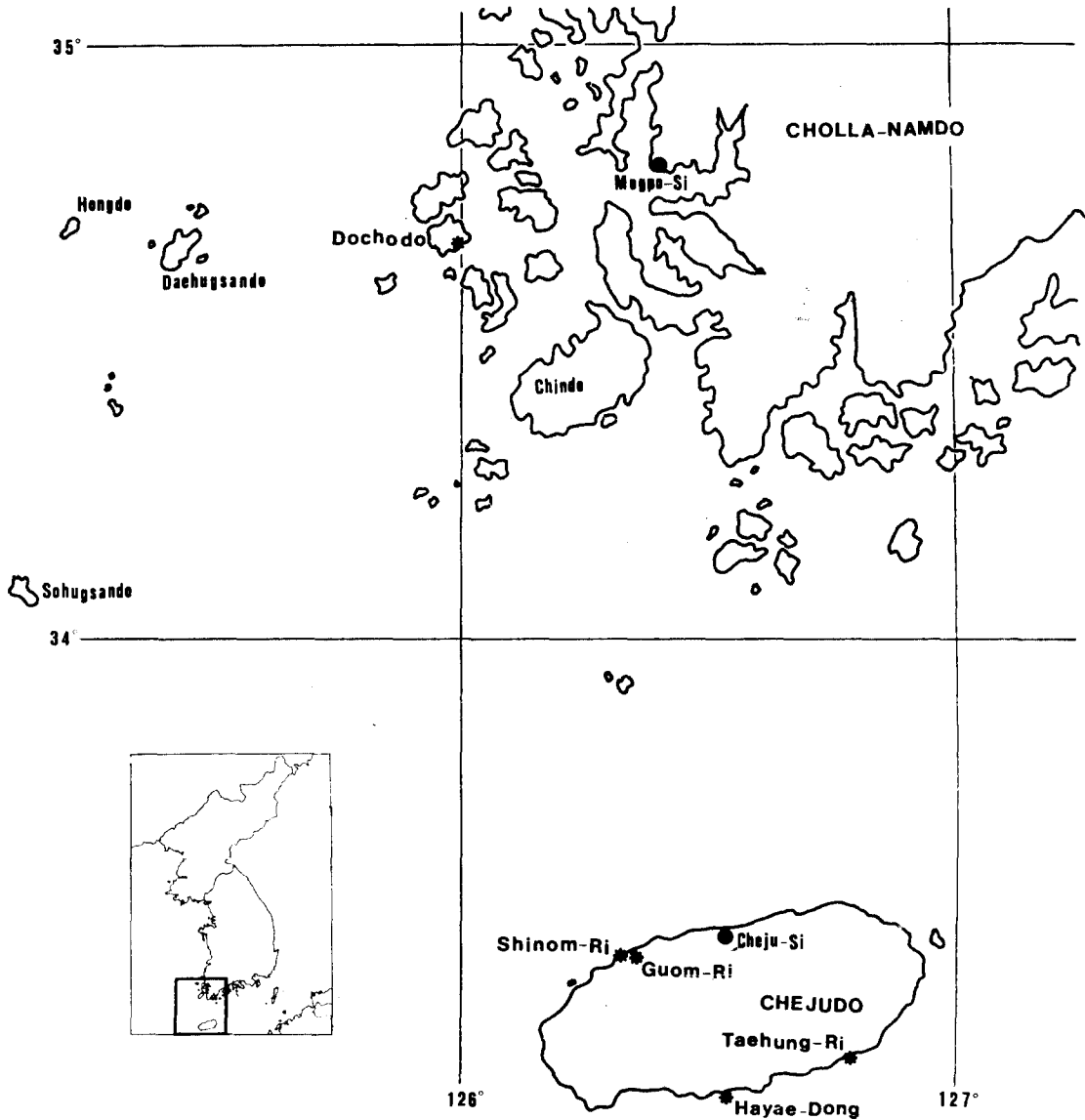


Fig. 1. Map of South-Western sector of Korean peninsula and Cheju Island, showing the study villages (*).

status, type of housing, the use of mosquito net, mosquito coil and insecticide aerosol, etc.

RESULTS

1. Docho Island

A total of 195 blood smears taken from villagers nearby the breeding places of *Ae. togoi* revealed negative for microfilaria. It was extremely difficult to assemble people for blood

survey conducted at 22:00-01:00 hrs. Therefore, smears were taken by house-to-house visit. This was the reason for low productivity. The number of blood smears taken by age-group and sex is shown in Table 1. The mosquito larval collections revealed numerous breeding sources, mostly rock pools, for *Ae. togoi*.

2. Cheju Island

1) Night blood survey: A night blood survey was conducted during May 1988 in four

Table 1. The number of blood smears taken by age-group and sex in Docho Island

| Age-group(Yr) | Male | Female | Total |
|---------------|------|--------|-------|
| 10~19 | 50 | 33 | 83 |
| 20~29 | 8 | 5 | 13 |
| 30~39 | 12 | 7 | 19 |
| 40~49 | 13 | 9 | 22 |
| 50~59 | 12 | 19 | 31 |
| 60~69 | 5 | 11 | 16 |
| Over 70 | 2 | 9 | 11 |
| Total | 102 | 93 | 195 |

Table 2. The number of blood smears taken by age-group and sex in Cheju Island

| Age-group (year) | Male | | Female | | Total | |
|------------------|---------|----------|---------|----------|---------|----------|
| | No. ex. | No. pos. | No. ex. | No. pos. | No. ex. | No. pos. |
| 0~ 9 | 18 | 0 | 16 | 0 | 34 | 0 |
| 10~19 | 49 | 0 | 43 | 0 | 92 | 0 |
| 20~29 | 24 | 0 | 27 | 0 | 51 | 0 |
| 30~39 | 24 | 0 | 24 | 0 | 48 | 0 |
| 40~49 | 16 | 0 | 22 | 0 | 38 | 0 |
| 50~59 | 21 | 1 | 31 | 0 | 52 | 1 |
| Over 60 | 15 | 0 | 27 | 0 | 42 | 0 |
| Total | 167 | 1 | 190 | 0 | 357 | 1 |

villages selected, namely, Shinom-Ri, Guom-Ri, Hayae-Dong and Taehung-Ri, in which some past epidemiological information is available for comparison with the present situation of filariasis. Of a total of 357 blood smears taken, only 1 positive case for microfilaria was found (52 years old, male) in Taehung-Ri (mf rate; 0.6% or 1/180). The density of microfilaria was 11/20 mm³ of blood. The results of the blood survey by age-group and sex, and by village are shown in Table 2 and 3, respectively.

2) Entomological survey: A preliminary entomological survey was carried out in September 1988 in Taehung-Ri where one positive case of filariasis was found in May 1988. The results of the human biting collections indoors and outdoors, and the daytime resting place collections are given in Table 4 and 5, respectively. The adult population density of *Ae.*

Table 3. The number of blood smears taken by villages in Cheju Island

| Village | No. persons examined | No. mf. positive |
|------------|----------------------|------------------|
| Shinom-Ri | 71 | 0 |
| Guom-Ri | 52 | 0 |
| Hayae-Dong | 54 | 0 |
| Taehung-Ri | 180 | 1 |
| Total | 357 | 1(0.3%) |

Table 4. Human biting collections indoors and outdoors at Taehung-Ri, Cheju Island in early September 1988 (average of two night collections)

| Time | Indoors | | Outdoors | |
|-------------|------------------|---------|------------------|---------|
| | <i>Ae. togoi</i> | Others* | <i>Ae. togoi</i> | Others* |
| 19:00~20:00 | 0 | 7 | 0 | 1 |
| 20:00~21:00 | 0 | 19 | 0 | 13.5 |
| 21:00~22:00 | 0 | 9 | 0 | 1 |
| 22:00~23:00 | 1 | 14 | 0 | 0 |
| 23:00~24:00 | 0 | 2 | — | — |
| 24:00~01:00 | 0 | 2 | — | — |
| Man/hour | 0.2 | 8.8 | 0 | 3.9 |

* Other species include *Aedes albopictus*, *Armigeres subalbatus*, *Culex pipiens pallens* and *Anopheles sinensis*.

togoi was very low. Six females and one male of *Ae. togoi* were collected from 14 bedrooms (0.4/bedroom). As the bedroom is the main resting place for *Ae. togoi*, other resting places such as kitchen and verandah were not checked. Only one *Ae. togoi* adult was collected by indoor human biting catches (0.2/man/hour). No single *Ae. togoi* was collected by outdoor human biting catches.

3) Life-style survey: The results of a survey on the life-style of inhabitants are given in Table 6. Out of 20 families, 15 lived in newly constructed modernized houses and all, except one, households were in use of mosquito nets sufficient enough to protect all family members. The use of either mosquito coils or aerosol insecticide was found in 90% of the households. Sixty-five percent of households seemed to belong to middle income bracket.

Table 5. Daytime indoor resting place collections of mosquitos at Taehung-Ri on 2 September, 1988

| House No. | Room | <i>Ae. togoi</i> | <i>Ae. albopictus</i> | <i>Ar. subalbatus</i> | <i>Cx. pipiens pallens</i> | Total |
|-----------|-----------|------------------|-----------------------|-----------------------|----------------------------|--------|
| A | Bedroom | 0 | 0 | 0 | 0 | 0 |
| B | Bedroom 1 | 1(1) | 1 | 0 | 0 | 2(1) |
| B | Bedroom 2 | 0 | 0 | 0 | 0 | 0 |
| C | Bedroom | 1 | 0 | 0 | 1 | 2 |
| D | Bedroom | 0 | 0 | 0 | 0 | 0 |
| E | Bedroom 1 | 0 | 0 | 0 | 6 | 6 |
| E | Bedroom 2 | 2 | 0 | 0 | 0 | 2 |
| F | Bedroom | 0 | 1 | 1 | 2 | 4 |
| G | Bedroom | 1 | 0 | 1(1) | 0 | 2(1) |
| H | Bedroom 1 | 0 | 0 | 0 | 1 | 1 |
| H | Bedroom 2 | 0 | 0 | 0 | 1 | 1 |
| H | Bedroom 3 | 0 | 0 | 1 | 1 | 2 |
| I | Bedroom 1 | 1 | 1 | 0 | 3 | 5 |
| I | Bedroom 2 | 0 | 0 | — | 1 | 1 |
| Total | 14 | 6(1) | 3 | 3(1) | 16 | 28(2) |
| Average | — | 0.4(0.1) | 0.2 | 0.2(0.1) | 1.1 | 2(0.1) |

*Number in brackets: number of male mosquitos

DISCUSSION

Although the population sample examined in Docho Is. is very small, the finding of no positive case may suggest that endemicity of filariasis is limited to Hugsan Is. within Cholla-Namdo nowadays. The movements of people between Docho Is. and filaria-infected Hugsan Is. are active by regular passenger shippings connected between the two islands. The density of *Ae. togoi* was found to be abundant in Docho Is. Thus, Docho seems to be very vulnerable to infection of filariasis, though in this study no single case of microfilaremia was found.

As regards the past epidemiological situation of filariasis in Cheju Island, some landmarks on the prevalence of filariasis in selected villages are summarized as given in Table 7. Of three villages where the endemicity of filariasis was high in the past, the inhabitants of two villages, Goum-Ri and Taehung-Ri, had received selective treatment with diethylcarbamazine (DEC) during 1960s (Paik, 1986; Kim *et al.*, 1987). The rapid reduction of filariasis almost

to nil (only 1 positive case) in these villages might be due partly to the intervention with medication. Even in the untreated control village, Hayae-Dong, the authors' survey revealed no single positive case. Lee *et al.* (1985) reported that mf rate among inhabitants of 9 villages in Cheju Island was 0.7% in average out of a total of 1,229 persons examined.

The 1970s saw a tremendous development in economic situation in Cheju Is. owing to the introduction of tropical farming practices cultivating citrus, banana and pineapple, and a gradual expansion of tourism industry. A rapid economic growth resulted in a betterment of all aspects of human services such as education, environmental sanitation, medical and health facilities, traffic systems and housing. The gross domestic product (GDP) per capita increased roughly from US \$1,500 in 1982 to US \$2,150 in 1986.

Under these circumstances, the authors intended to find out factors pertaining to the disappearance of filariasis in Cheju Is. from the view points of entomology and life-style of inhabitants. The conditions of main breeding

Table 6. The results of a survey on life style of inhabitants in Taehung-Ri, Cheju Island

| House No. | Type of housing | No. of family members | No. of Mosquito nets | Use of Mosquito coil | Use of aerosol | Social* status |
|-----------|-----------------|-----------------------|----------------------|----------------------|----------------|----------------|
| 1 | old | 2 | 1 | — | + | + |
| 2 | new | 4 | 0 | + | + | ++ |
| 3 | old | 6 | 2 | + | + | + |
| 4 | old | 4 | 1 | — | + | + |
| 5 | new | 3 | 2 | — | + | ++ |
| 6 | new | ? | 1 | + | — | ++ |
| 7 | new | 3 | 1 | + | — | ++ |
| 8 | new | 1 | 1 | + | — | + |
| 9 | new | 6 | 2 | — | + | ++ |
| 10 | new | 3 | 2 | — | + | ++ |
| 11 | new | 5 | 1 | + | — | ++ |
| 12 | old | 6 | 2 | + | — | + |
| 13 | new | 3 | 2 | + | — | ++ |
| 14 | new | 4 | 2 | — | — | ++ |
| 15 | new | 3 | 2 | + | + | ++ |
| 16 | new | 4 | 2 | + | — | ++ |
| 17 | new | 2 | 2 | — | — | + |
| 17 | new | 2 | 2 | — | — | + |
| 18 | new | 4 | 2 | + | + | ++ |
| 19 | new | ? | 2 | + | — | +++ |
| 20 | new | ? | 1 | + | — | + |

* Remarks: +++=upper, ++=middle, +=low

Table 7. Summarized records of microfilaria rates obtained from the selected three villages

| Mf rate(%) | Investigator | Remarks |
|---------------------------|--------------------------|--------------------------------|
| Guom-R₁ | | |
| 28.5 | Paik(1965) | Before select. DEC Tx. |
| 15.9 | Seo <i>et al.</i> (1965) | |
| 0.9 | Lee <i>et al.</i> (1985) | |
| 0.0 | Present paper | |
| Hayae-Dong | | |
| 12.8 | Seo <i>et al.</i> (1965) | |
| 13.4 | Kim <i>et al.</i> (1968) | |
| 15.2 | Kim <i>et al.</i> (1970) | |
| 11.1 | Kim <i>et al.</i> (1979) | |
| 0.0 | Present Paper | |
| Taehung-Ri | | |
| 19.5 | Seo <i>et al.</i> (1965) | |
| 29.6 | Kim <i>et al.</i> (1968) | Before select. DEC Tx. |
| 4.3 | Kim <i>et al.</i> (1970) | One year after select. DEC Tx. |
| 7.0 | Kim <i>et al.</i> (1979) | 10 yeras after select. DEC Tx. |
| 0.6 | Lee <i>et al.</i> (1986) | |
| 0.6 | Present paper | |

places of *Ae. togoi* seemed not much changed at all as compared with that in 1960s and 1970s. The main breeding places were rock pools along the coast; almost all of which were found positive for numerous *Ae. togoi* larvae. It seemed almost impossible to treat the vast number of rock pools with insecticide or to drain them. Therefore, the absolute density of *Ae. togoi* in the community seemed not significantly changed since the last decade but relative biting density of this vector in terms of man/mosquito contact seemed to be reduced greatly as the human population increased and the area of villages had been expanded following the type of housing was modernized. These factors might have brought about a greater dispersion of *Ae. togoi* adults in the community.

The only entomological datum comparable was the result of indoor human biting collection obtained by Wada *et al.* (1973) in the same

Table 8. Comparison of *Ae. togoi* collection in two villages

| Island | Daytime resting place collection | Indoor human biting collection(19h.—01h.) |
|------------|----------------------------------|---|
| Hugsan Is* | 1.2/bedroom | 0.35/man/hour |
| Cheju Is. | 0.4/bedroom | 0.20/man/hour |

* from Ree *et al.* (1987)

area in early September of 1971 which was recorded to be 1.12/man/hour (19:00—01:00). This was higher than 0.20/man/hour obtained by the present authors.

It is estimated that the relative density of *Ae. togoi* adult population is lower in Taehung-Ri, Cheju Is. than in Sim-Ri, Hugsan Is. (filaria-infected). A comparison of *Ae. togoi* in the two villages in the month of September is as shown in Table 8.

The wide use of personal protective measures now available for inhabitants in Cheju Is., e.g. 95% use of mosquito nets to cover enough for whole family which is supplemented by the use of mosquito coils and aerosol insecticide, might have further brought down the rate of man-mosquito contact. As *Ae. togoi* bites human mainly indoors (endophily), the combined use of mosquito nets and mosquito coils should repel mosquitos from biting. This seems to be another helping factor for the interruption of the transmission of filariasis in Cheju Is.

ACKNOWLEDGEMENT

This work was supported by the World Health Organization Regional Office for the Western Pacific. The authors would like to appreciate greatly the logistic supports provided by Mr. Hong-Jong Kim, Director of the Public Health Institute of the Cheju Province.

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—國文抄錄—

最近 國內 絲狀蟲症의 疫學的 狀況에 관한 調査

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 白永漢·趙俞貞·具燾書*·李漢一**·沈載澈***

近來에 全南 新安郡 大黑山島 및 小黑山島와 濟州道에서 보고된 住民의 microfilaria(mf) 陽性率은 각각 平均 11.5%, 11.1%, 0.5%였다.

著者 등은 黑山島와 本土와의 中繼港인 全南 新安面 都草面(島)에서 1987年 7月 住民들의 microfilaria 양성률을 調査하였다. 이 섬의 海崇岩礁에서 *Aedes togoi*가 採集되었다. Mf 調査 方法은 *Ae. togoi* 棲息處에 가까운 4개 부락(화도, 지남, 지북, 지동)의 住民 195名(男 102, 女 93)을 21:00~01:00時 사이에 戶別 訪問하여 採血하고 厚層塗沫(20mm³)한 후 Giemsa 染色하고 檢鏡하였다.

檢査 結果 全 標本이 陰性이었으며 이 地域에서 絲狀蟲症의 分布는 黑山島에만 限局되어 있을 것으로 推測되었다. 著者 등은 또한 1988年 5月 過去 絲狀蟲症의 流行度가 높았던 濟州道 南濟州郡 南元面 泰興里, 西歸浦市 下貌(예)洞, 北濟州郡 涯月邑 舊巖里 및 新巖里的 4個 부락에서 住民 357名(男 167, 女 190)에 대하여 上記 都草島에서와 同一한 方法으로 microfilaria를 調査하였던 中 1件의 mf 陽性者(52才, 男)가 泰興里에서 發見되었고(1/180 또는 0.6%), mf 密度는 11/20 mm³이었다.

上記와 같이 濟州島에서 絲狀蟲症의 消滅에 관련된 諸 因子를 究明코자 1988年 9月 泰興里에서 昆蟲學的 調査와 住民의 生活樣態의 一端을 觀察한 結果는 아래와 같다.

*Ae. togoi*의 棲息處는 여전히 많아 *Ae. togoi* 個體群의 絕對密度에는 變動이 없는 것으로 思料되나 晝間 家屋內 休息 모기 密度(平均 每 家屋當 0.4)와 人/모기 接觸度(man-mosquito contact)는 部落住居 地域의 擴大, 인구의 增加, 生活水準의 向上등에 依해 減少되었음이 나타났다(indoor human biting catches-0.2/man/hour, outdoor-0/man/hour) (相對的 密度的 減少를 의미). 총 20가구의 標本 調査에서 19가구는 모기향, 에어로졸 使用과 함께 모기帳(全家族 保護 可能한 數)을 使用하고 있었으며 이와 같은 良好한 個人 防禦(personal protection)는 屋內 吸血性(endophagy)을 가진 *Ae. togoi* 의 媒介 能率을 決定的으로 阻止하는 結果를 가져왔다고 생각된다.