

A Short Review of the Ecology of *Culex pipiens molestus* in Japan

— Oviposition activity in open water —

Tsutomu ODA¹⁾²⁾ and Koichiro FUJITA²⁾

¹⁾ *School of Medical Technology and Nursing,
Nagasaki University*

²⁾ *Department of Medical Zoology, Nagasaki
University School of Medicine*

Abstract: The mosquito of *Culex pipiens molestus* usually reproduces in underground water such as a cesspool. Recently, the mosquito is commonly found in open water. This communication reviews the ecology of *Cx. p. molestus* in the open environment mainly with respect to seasonal changes in oviposition activity in open water. The oviposition activity was low in summer, and it became high in spring and autumn. The pattern of seasonal changes in larval density in the cesspool was similar to that in the oviposition activity. *Cx. p. molestus* females found in the open environment are considered to emerge generally in underground water and then finish their first oviposition there.

Key word: *Culex pipiens molestus*, Oviposition activity, Open water

Culex pipiens molestus and *Cx. p. pallens* of *Culex pipiens* complex are found from Hokkaido to Kyushu, Japan (Tanaka *et al.*, 1979). They are very similar to each other in external morphology, but quite different ecologically and physiologically. The females can be distinguished by differences in the number of ommatidia (Noguchi and Asahina, 1966; Tanaka *et al.*, 1979; Mori *et al.*, 1982). The larvae of *Cx. p. molestus* usually grow in underground water, such as cesspools and septic tanks, and the adult females are autogenous, that is, they can complete the first oviposition without a blood meal. *Cx. p. pallens* larvae are found in open water (surface water), such as drains and fertilizer pits. The females lay viable eggs after taking a blood meal, and thus are anautogenous (Tanaka *et al.*, 1979).

Yonemoto (1971) reported that *Cx. p. pallens* has decreased in number because of

Received for publication, December 18, 1985.

Contribution No. 298 from the Department of Medical Zoology, Nagasaki University, School of Medicine.

the urbanization and the resultant reduction in available breeding sites, whereas, *Cx. p. molestus* has increased with the increase in the number of breeding sites, such as cesspools. The immature stages of this mosquito are now commonly found even in open water (Asahina *et al.*, 1963; Yonemoto, 1971; Oda and Ueda, 1979), but little is known on its ecology in an open environment. This communication reviews the ecology of *Cx. p. molestus* in the open environment mainly with respect to seasonal changes in oviposition activity in open water.

The published and unpublished studies conducted at the campus of Nagasaki University School of Medicine, clearly showed that the oviposition activity was low in summer and high in spring and autumn (Oda and Ueda, 1979; Suenaga, 1982; Oda *et al.*, 1984). Suenaga (1982) suggested that *Cx. p. molestus* breed in open water such as open drains. In 1982, the presence of *Cx. p. molestus* larvae were checked in open water and underground water on and outside our campus twice a month from August to October. The larvae were not found in open water or in underground water (cesspools) on campus, but some were found in a cesspool surrounding the campus (Oda, unpublished data). As it was assumed that the egg-rafts collected in ovitraps (Oda, 1967) were laid by the females found in the cesspools, larval collections were made each season from a cesspool in Nagasaki City.

The pattern of seasonal changes in larval density of *Cx. p. molestus* was similar to that in the oviposition activity (Oda *et al.*, 1986). In addition, it was observed that many of the females flew out from the cesspool between August and October. Most of them were in an unfed state, and they were usually uniparous. A few of them were biparous, implying that the females had entered the cesspool to lay eggs after they had completed the first oviposition (Oda *et al.*, 1986).

In April, 1982, we were informed that a family living in an apartment house in Nagasaki City was being attacked by mosquitoes. The mosquitoes were female *Cx. p. molestus*. Most of the fed females were collected in autumn, some in spring, and the least in summer.

Most of the females collected were biparous and a few were triparous, suggesting that the females came to rebite after their first oviposition. The presence of larvae in the cesspool outside this building could not be established because the cover of this cesspool could not be removed. Although no mosquitoes were collected in open ground water around the house the female mosquitoes in this house were assumed to have come from the cesspool, from the fact that many females had been seen flying out from the cesspool (Oda *et al.*, 1986).

Oda and Ueda (1979) found that there was a great variance in number of eggs in the egg-raft collected in the ovitraps, and a few egg-rafts contained 180 or more eggs. The maximum number of eggs in an egg-raft laid by the autogenous females has been reported to be about 150 (Ishii, 1975). Therefore, the egg-rafts containing 180 or more eggs were considered to have been deposited by fed females.

These results indicate that the females of *Cx. p. molestus* found in the open environment are mosquitoes that had emerged and oviposited in underground water and also that the oviposition in the open environment is influenced by underground population changes. Noguchi *et al.* (1965) found that the larval population decreased considerably in summer when the temperature in the septic tanks is high. This suggests that seasonal change in the larval population in such underground environments is affected by temperature. Yonemoto (1971) reported that the larval population in open water (groundpools under a house) showed the same seasonal pattern as described by Noguchi *et al.* (1965). These breeding places are certainly a kind of open water, but they are considered to be very similar in environmental conditions to the cesspools examined by Noguchi *et al.* (1965). On the contrary, Asahina *et al.* (1963) reported an interesting finding that the larval population was abundant even in summer in open water that was groundpool in a lumber yard. The explanation for this phenomenon is very difficult, as they have mentioned.

In *Cx. p. molestus*, fewer females had mature eggs and egg-hatchability was reduced significantly at high temperatures (Oda *et al.*, 1980). These phenomena especially, the greatly decreased egg-hatchability, may be one of the factors responsible for the reduction in the immature population in septic tanks or cesspools.

There are several reports on the seasonal prevalence of the larval population of mosquitoes in underground water, such as septic tanks and wells in Japan (Kamura, 1959; Wada and Ofuji, 1962; Moriya *et al.*, 1962). The peak of larval populations appears to occur in autumn, but no common trend of seasonal changes was found. These changes may be caused by factors affecting the underground water environment, such as differences in temperature and changes in water level, as indicated by Ishii (1975).

The number of eggs in an egg-raft in the ovitraps differs. Many egg-rafts had 150 or less eggs (Oda and Ueda, 1979). Such egg-rafts are not always from autogenous females, because the number of eggs laid by autogenous unfed females overlaps with those laid by the fed females. For example, the egg-rafts laid by the females of *Cx. p. molestus* feeding on human, mouse, and chicken contained 30.8, 40 to 160, and 50 to 150 in eggs, respectively (Ishii, 1975).

In October, 1982, we were informed that the people living in a newly built apartment house which is located half way up Inasa mountain (300m above sea level) were being bitten by mosquitoes and there was no house above this building. The breeding place of the mosquitoes was a septic tank outside the building, and it had no water contact with other septic tanks or cesspool (Oda, unpublished data). This means that the females flew into the septic tank and laid eggs. Therefore, the oviposition activity in open water is considered to be a factor for their enlargement of the distribution of this mosquito.

Oda and Ueda (1979) reported that this mosquito would have difficulty in overwintering in an open environment, even in the Nagasaki area where it is relatively warm.

Accordingly, underground water such as a cesspool must be the main breeding place for this mosquito in Japan.

It was experimentally shown that the female *Cx. p. molestus* carries larvae of *Dirofilaria immitis* (Suenaga, 1972). We found that the females that had laid two batches of eggs came to bite man in the house in an open environment. From this fact, it is assumed that *Cx. p. molestus* females attack dogs in the field. They may become a vector of this disease, when *Cx. p. molestus* females take a blood meal of dogs infected with *Dirofilaria immitis*. Moreover, this possibility may be higher, considering the finding that the population of *Cx. p. molestus* has increased generally in the city, contrary to the observed decrease in *Cx. p. pallens*, the main vector of this disease (Yonemoto, 1971; Suenaga, 1973).

ACKNOWLEDGEMENTS

We wish to express our thanks to Dr. Yoshito Wada of the National Institute of Health, Tokyo, for critically reading this manuscript.

REFERENCES

- 1) Asahina, S., Yasutomi, K. & Noguchi, Y. (1963): Survey and control of the mosquitoes prevalent in Sarue lumber yard, Tokyo. *Jap. J. Sanit. Zool.*, 14(3), 167-175.
- 2) Ishii, T. (1975): On *Culex pipiens molestus* in Japan. -A short historical review of its research. *Jap. Soc. System. Zool., Circular*, 48, 1-13 (in Japanese).
- 3) Kamura, T. (1959): Studies on the *Culex pipiens* Group of Japan. IV. Ecological studies on the Nagasaki *molestus*. *Endem. Dis. Bull. Nagasaki Univ.*, 1(1), 51-59 (in Japanese with English summary).
- 4) Mori, A., Oda, T., Fujita, K., Ueda, M. & Kurokawa, K. (1982): On number of ommatidia of females of *Culex pipiens pallens* and *Culex pipiens molestus* under various temperatures. *Trop. Med.*, 24(3), 151-153 (in Japanese with English summary).
- 5) Moriya, K., Harada, Y. & Yabe, T. (1967): Observations on the seasonal prevalence of auto-genous mosquito, *Culex pipiens molestus* dwelling in septic tanks. *Jap. J. Ecol.*, 17(3), 126-134 (in Japanese with English summary).
- 6) Noguchi, Y., Ogata, K., Kazama, T. & Imai, S. (1965): Seasonal prevalences of *Culex molestus* breeding in septic tanks. *Jap. J. Sanit. Zool.*, 16(2), 133-137 (in Japanese with English summary).
- 7) Noguchi, Y. & Asahina, S. (1966): Ommatidial number as a diagnostic character for Japanese auto-genous *Culex molestus*. *J. Med. Ent.*, 3(2), 146-148.
- 8) Oda, T. (1967): Hourly and seasonal distribution of the number of egg rafts of *Culex pipiens pallens* deposited in earthen jars. *Trop. Med.*, 9(1), 39-44 (in Japanese with English summary).
- 9) Oda, T. & Ueda, M. (1979): Seasonal changes in the oviposition activity of *Culex pipiens molestus* Forskal in the aboveground water. *Trop. Med.*, 21(3), 139-144 (in Japanese with

- English summary).
- 10) Oda, T., Mori, A., Ueda, M. & Kurokawa, K. (1980): Effects of temperatures on the oviposition and hatching of eggs in *Culex pipiens molestus* and *Culex pipiens quinquefasciatus*. Trop. Med., 22(3), 167-172.
 - 11) Oda, T., Ueda, M., & Mori, A. (1984): Annual changes in number of egg-rafts of *Culex pipiens* complex in above-ground water in Nagasaki City. pp. 655. XVII International Congress of Entomology, Abstract Volume, Hamburg.
 - 12) Oda, T., Mori, A. & Fujita, K. (1986) : Observations on seasonal changes in feeding activity of *Culex pipiens molestus* in a house in Nagasaki City. Z. angew. Zool. 73 (in press).
 - 13) Suenaga, O. (1972): Studies on the filarial prevalence among dogs and the mosquito vectors in Nagasaki City, Western Japan 3. On the susceptibility of *Aedes albopictus* and *Culex pipiens molestus* to the larvae of *Dirofilaria immitis* in Nagasaki City. Trop. Med., 14(3), 144-150 (in Japanese with English summary).
 - 14) Suenaga, O. (1973): Studies on the filarial prevalence among dogs and the mosquito vectors in Nagasaki City, Western Japan. 5. on the vector mosquitoes of *Dirofilaria immitis* in Nagasaki City. Trop. Med., 15(3), 131-140 (in Japanese with English summary).
 - 15) Suenaga, O. (1982): Cytoplasmic incompatibility in a natural population of *Culex pipiens* Complex in Nagasaki, Japan. Trop. Med., 24(2), 79-85.
 - 16) Tanaka, K., Mizusawa, K. & Saugstad, E. S. (1979): A revision of the adult and larval mosquitoes of Japan (including the Ryukyu archipelago and the Ogasawara islands) and Korea (Diptera; Culicidae). Contr. Amer. Ent. Instit., 16, 987pp.
 - 17) Wada, Y. & Ofuji, K. (1962): Studies on the *Culex pipiens* Group of Japan. VI. On a case of the outbreak of *Culex pipiens molestus* Forskal in Nagasaki City. Endem. Dis. Bull. Nagasaki Univ., 4(1), 31-37 (in Japanese with English summary).
 - 18) Yonemoto, S. (1971): Morphological and ecological studies on *Culex pipiens molestus* Forskal, 1775 found in open water. J. Osaka City Med. C., 20(10/12), 59-83 (in Japanese with English summary).

日本におけるチャイエカの生態

—開放水域での産卵活動を中心として—

小田 力^{1,2}・藤田紘一郎²

¹長崎大学医療技術短期大学部

²長崎大学医学部医動物学教室

チャイエカは浄化槽のような地下水域で無吸血産卵により世代をくり返すが、近年地上水域で卵塊や幼虫が採集されている。しかし本種の地上での生態についてはほとんど知られていない。そこでチャイエカの地上での産卵活動の季節的变化を中心に種々の実験と観察をおこなってきた。これらの結果と他の報告をもとにして本種の地上での生態についての総説を作成した。夏にはチャイエカの産卵活動は低い。これは浄化槽のような地下水域でのこの蚊の幼虫個体群の減少と関係しているように思われる。この個体群の減少の原因の1つは夏の高温による卵の孵化率の激減であるかもしれない。春と秋には産卵活動は旺盛となり、地下の浄化槽の幼虫個体群も増加した。また、秋に浄化槽からとびだす雌の多くは経産雌であった。一方、人家内でも春と秋には吸血した雌が多く採集された。これからはすべて経産雌であった。チャイエカの幼虫及び成虫

が地上（開放）環境下で越冬する可能性は極めて低い。このことから本種の主要発生源は地下水域と考えられる。したがって地上でみつかるとカイエカの雌は一般には地下水域で羽化して、そこで第1回目の産卵を終えた、いわゆる経産雌であると思われる。

熱帯医学 第28巻 第1号, 73-78頁, 1986年3月