Timing of Dropping from the Host Lizard in the Tick, *Ixodes asanumai* (Acarina: Ixodidae)

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Generally, ticks drop from the host animal after engorgement. Timing of this dropping was investigated in the tick *Ixodes asanumai* parasitic on the lizard *Eumeces okadae*. As a result, engorged larvae and nymphs dropped at night. Since this lizard has diurnal activity and shelters at night, they are considered to drop in the lizard's burrow. On the contrary, females dropped in the daytime. This suggests they drop on the ground surface when the lizard is basking or foraging. The former from the reason that it is easy for the next stage of ticks after molting to encounter the host lizard, and the latter from that larvae hatched from the egg batch can disperse, are considered to be adaptive, respectively.

INTRODUCTION

Ixodid ticks must generally repeat a chain of the following events three times to accomplish their life cycles, that is, attaching to the host, blood-sucking, and dropping from the host after engorgement. Many authors have paid attention to the timing of dropping from the host and reported its daily rhythm in 13 species of ixodid ticks (see the review by BELOZEROV, 1982). Two types of dropping, diurnal and nocturnal, are known and discussed in relation to the daily activity pattern of the host animals. One attractive hypothesis is that the timing is determined to increase the probability that the tick of next stage will easily find an appropriate host. For example, the tick should have nocturnal dropping in the case that the host is active during the daytime and shelters in the nest at night (BELOZEROV, 1982).

Almost all ixodid ticks studied on dropping, however, have rather wide host ranges of mammals including not only domestic or laboratory animals but also both diurnal and nocturnal species. This complicates the tick-host relationship and gives trouble to support the hypothesis.

In this study, we observed the dropping of tick, *Ixodes asanumai*, from the host lizard, *Eumeces okadae*. This tick specially infests *E. okadae* (HAYASHI and HASEGAWA, 1984). Since this lizard clearly has a diurnal activity and shelters in the burrow at night, the timing of dropping is predicted to be nocturnal. The result obtained was, however, not so simple but somewhat complex.

MATERIALS AND METHODS

Larval tick dropping. Unfed larvae were obtained by rearing the engorged females

which were collected from Miyake-jima, Izu Islands, in May 1981. Host lizards were also collected from Miyake-jima. Both animals were reared at room temperature (23–30°C) with natural daylength. From July 17 to 19, several unfed larvae were put on the backs of five lizards every day. These lizards with ticks were reared in the cages (30 cm in diameter) with the bottom made by wire net. The rearing temperature was 28–31°C with natural daylength. From July 21 to 24, the number of engorged larvae dropped from the lizards was counted at about 3 hr interval.

Nymphal tick dropping. Unfed nymphs were obtained by rearing the larvae engorged in above-mentioned experiment. The rearing temperature was $25 \pm 1^\circ\text{C}$ with 14 hr lighting. On both August 22 and 23, these unfed nymphs were put on the backs of seven lizards and reared at 28–31°C with natural daylength. From August 26 to 29, the number of engorged nymphs dropped was counted at about 3 hr interval.

Female tick dropping. In Miyake-jima, ten lizards with female tick parasitism were captured in April 1982 and reared separately in the cages (20 or 30 cm in diameter) with the bottom made by wire net. The rearing temperature was 11–25°C in the period from April 17 to 19 and 17–24°C from April 19 to 27 with natural daylength. During this rearing, we observed ticks as frequently as possible in order to know the time of their droppings. The same observation was also conducted in Aoga-shima of the same islands in the period from May 8 to 10, 1982. In this case, six lizards with ticks were captured and reared at 19–26°C in the same way as the case of Miyake-jima.

All experiments were close to the natural conditions and the lizards freely basked, foraged and rested under the shelter in the cage.

RESULTS AND DISCUSSION

Of 217 larvae, 191 (88.0 %) dropped at night. As shown in Fig. 1, the occurrence of droppings concentrated mainly in several hours just before dawn. Nymphs also

Fig. 1. Timing of dropping from the lizard in larval *Ixodes asanumai* ($n=217$). Triangles indicate the observation time.

Fig. 2. Timing of dropping from the lizard in nymphal *Ixodes asanumai* ($n=60$). Triangles indicate the observation time.

Fig. 3. Timing of dropping from the lizard in female *Ixodes asanumai* ($n=17$). Date and time range when each female dropped, are indicated.

had the same dropping rhythm (Fig. 2). Of 60 nymphs, 49 (81.7 %) dropped at night. Females, however, showed the diurnal dropping as shown in Fig. 3. Of 17 females, 15 (88.2 %) dropped in the daytime against only 2 females did at night.

It is considered from these results that immature ticks drop in the burrow where lizards are resting at night. However, females drop mainly on the ground surface where lizards are basking or foraging. Dropping in the lizard's burrow might give an advantage to the ticks, since the humid condition is favourable for their postparasitic developments. In addition, it is easy for the next stages of them to encounter the host lizard.

On the other hand, dispersal is an important aspect in animal life cycle. If the female tick also drops in the burrow like immature ones, the dispersal chance of her progeny will be greatly reduced. In this case, the host lizard will be infested by a great number of ticks as long as the lizard uses the same burrow. It is considered, therefore, that the engorged female which lays many eggs must have the responsibility for the dispersal in life cycle of this species. That is, the female tick drops on the ground surface after engorgement and searches the oviposition place in that neighborhood. She lays 70 to 1,400 eggs over about 20 days (HAYASHI and HASEGAWA, 1983). Then larvae hatched from this egg batch wait the chance of attaching to the host lizard near the oviposition place. They could attach to several lizards different from that their mother infested. In this way, this tick will disperse in the field.

In conclusion, the timing of dropping observed, that is, nocturnal in immature stages but diurnal in females, is very adaptive in this lizard tick *Ixodes asanumai*.

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