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THE EFFECT OF WINTER STRESS ON ADULT DERMACENTOR VARIABILIS (ACARI: IXODIDAE)

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Abstract. The resistance of overwintered adult *Dermacentor variabilis* to mild water stress was related to the previous winter conditions. Favourable winter conditions result in increased resistance to water stress, and an increased area of winter survival microhabitat. Increased resistance to water stress of overwintered ticks can forcast an above normal infestation.

Adult *Dermacentor variabilis* (Say), which enter spring activity, have passed the winter as diapause adults. The winter stress on these adults results in an age effect which reduces their resistance to water stress (McEnroe 1974). This age effect decreases the metabolic reserves required for the active uptake of water vapor and the maintenance of a positive balance (Lees 1964). This study compared the resistance to water stress of spring adults to determine if it was related to the previous winter conditions in Bolton, interior Massachusetts, Hatchville on Cape Cod, and southwest Nova Scotia.

METHODS

Adult *D. variabilis* were collected in the field at the start of their spring activity in 1973 and 1983. The new adults were from the Rocky Mountain Laboratory culture. The ticks were held under saturation for 1 day and their survival was then followed at 25 °C and 85 % RH*, and 0 °C and 5 % RH The humidity was maintained over saturated salt solutions (Winston and Bates 1960).

RESULTS AND DISCUSSION

Overwintered adult survival at 25 °C and 85 % RH is shown in Fig. 1. The survival of newly moulted adults (line 5) shows the response without an age effect. The survival of the ticks from Hatchville shows an increase in survival time between 1973 and 1983 (line 2 and 4). The winter 1972—1973, at this site, has 2 monthly means below 0 °C, and extended periods of frozen bare ground. The extreme desiccation at the surface of frozen bare ground (Geiger 1965) exposes the ticks to a high degree of water stress. The winter of 1982—1983 at Hatchville had only a 2 week period with a mean below 0 °C. However, snowcover was present during this time. The increase of survival time of the Hatchville ticks between 1973 an 1983 is associated with the change from high winter stress to low stress. The survival time of ticks from Bolton, collected in 1983, showed the short survival (line 1) similar to that found in 1973 at Hatchville. The winter in this area had 3 monthly means below 0 °C with extended periods of frozen bare ground. As in Hatchville, 1973, the high winter stress was associated with reduced

*The equillibrium humidity for spring adults is 93 % at 25 °C (McEnroe 1971)

survival time. The survival of the 1983 Nova Scotia ticks (line 3) was similar to that of the 1983 Hatchville ticks. Although Nova Scotia has a harsh winter climate similar to that of interior Massachusetts, the winters in the tick infested area are characterized by continuous snowcover (Gates 1975). The extended survival of the ticks indicated that they were subjected to low winter stress. It was postulated that a factor involved in the maintenance of the heavy tick infestation present in Nova Scotia was low winter stress (McEnroe 1982a). The extended survival of Nova Scotia ticks showed that they were subjected to lower winter stress then that of interior Massachusetts.

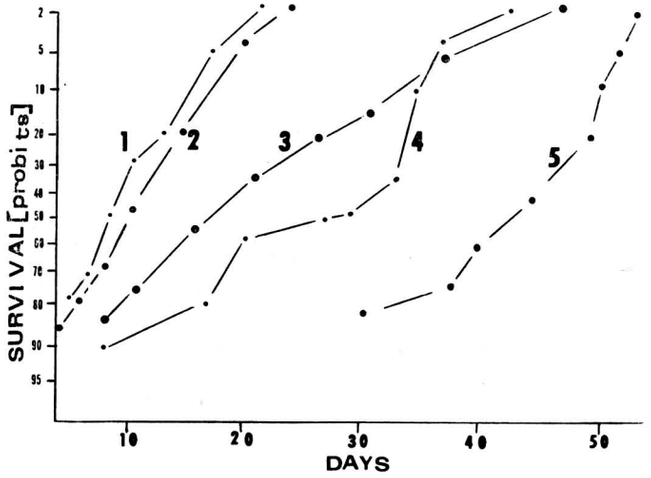

Fig. 1. Survival of adult *D. variabilis* at 25 °C and 85 % RH. 1 — Bolton ticks 1983. 2 — Hatchville ticks 1973. 3 — Nova Scotia ticks 1983. 4 — Hatchville ticks 1983. 5 — new adults from the Rock Mountain Laboratory culture.

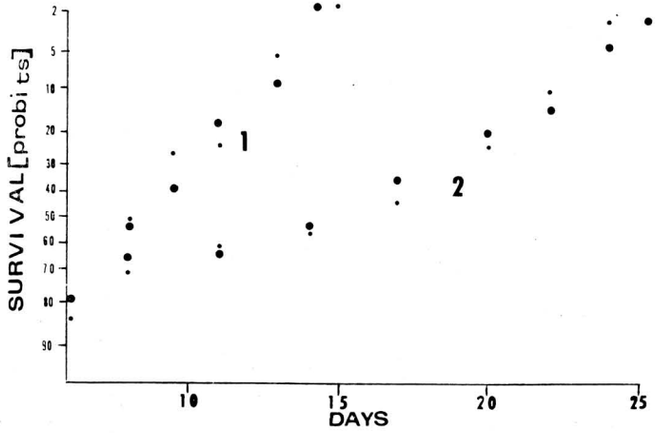

Fig. 2. Survival of 1983 adult *D. variabilis* at 0 °C and 5 % RH. 1 — Bolton ticks. 2 — Hatchville ticks. Small circles, males. Large circles, females.

The survival of ticks at 0 °C and 5 % RH (Fig. 2) is equivalent to that on frozen bare ground. As shown by the difference in survival of the Bolton and Hatchville ticks, the length of survival is dependent upon the cumulative age effect. Under these conditions there is a continuous water loss, and mortality will ensue. Warm periods will allow for the active recovery of water (McEnroe 1971). Snowcover will retard water loss.

The ticks overwinter in the soil level microenvironment. The coarse grain of suitable microenvironments has been related to the isolated populations present in the interior, and the variable tick density found in Hatchville where survival was shown to be related to the microenvironment (McEnroe 1978, 1979, 1983).

The increased variability of survival time from cca 10 days for Bolton and Hatchville 1973, versus cca 25 days for Nova Scotia and Hatchville 1983 (i.e. 1 standard deviation) is a measure of the increased variability of survival microhabitats. Favourable winters increase the survival area by the expansion of minimum survival conditions into normally lethal areas, as well as shifting normally minimum areas toward optimum conditions.

The level of tick infestation has consistantly increased following winters with either means above 0 °C or continuous snowcover (McEnroe 1975, 1979, 1982b). On Cape Cod, the area of infestation has also expanded in years of high infestation. Differences in the length of survival under water stress from year to year for the same location, or between locations for the same year reflect the level of the previous winter stress. This measure can help forcast the infestation level.

ВЛИЯНИЕ ЗИМНЕГО СТРЕССА НА ВЗРОСЛЫХ КЛЕЩЕЙ ВИДА *DERMACENTOR VARIABILIS* (ACARI: IXODIDAE)

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Резюме. Устойчивость перезимовавших взрослых клещей вида *Dermacentor variabilis* к умеренному водному стрессу связана с предшествовавшими зимними условиями. Благоприятные зимние условия повышают устойчивость к водному стрессу, и способствуют увеличению площади стации зимнего выживания. Повышенная устойчивость к водному стрессу перезимовавших клещей может предсказать их паразитирование выше нормального объема.

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