**Supplementary Table S1.** List of constants (used except where otherwise noted)

|  |  |  |  |
| --- | --- | --- | --- |
| **Constant** | **Definition** | **Value** | **Source** |
| *xmin* | Minimum energy reserves | 1.4 μg | Steele and Randolph (1985) |
| *xstart* | Starting energy reserves | 54 μg | Yoder and Spielman (1992) |
| *wmin* | Minimum water reserves | 91 μg | Yoder and Spielman (1992) |
| *wmax* | Maximum water reserves | 0.0397 days-1 | Randolph and Steele (1985) |
| *cr* | Daily energetic cost of resting | 0.016 μg/day | Randolph and Storey (1999) |
| *cq* | Daily energetic cost of questing | 1.5 μg/day |  |
| *τ* | Final day of season | 20 |  |
| *kT* | Transpiration water loss constant | 9.55E-08 μg/(hr\*K2) |  |
| *An, Bn* | Water gain constants | Variablea |  |
| *aw* | Tick body water activity | 0.99 | Wharton and Richards (1978) |

a See Section 2.1 in the main text and Supplementary methods S1.

**References**

Randolph, S.E., Storey, K., 1999. Impact of microclimate on immature tick-rodent host interactions (Acari: Ixodidae): implications for parasite transmission. J Med Entomol 36, 741-748.

Steele, G.M., Randolph, S.E., 1985. An experimental evaluation of conventional control measures against the sheep tick, *Ixodes ricinus* (L.)(Acari: Ixodidae). I. A unimodal seasonal activity pattern. Bull Entomolog Res 75, 489-500.

Wharton, G., Richards, A., 1978. Water vapor exchange kinetics in insects and acarines. Annu Rev Entomol 23, 309-328.

Yoder, J.A., Spielman, A., 1992. Differential capacity of larval deer ticks (*Ixodes dammini*) to imbibe water from subsaturated air. J Insect Physiol 38, 863-869.

**Supplementary Table S2.** Summary of *Ixodes ricinus* nymph lipid state data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | **Conditions** | **Dates** | **Value** | **Source** |
| *cr* | Dark storage area, 15C  | May | 0.016 μg/day | Randolph and Storey (1999) |
| Average lipid loss rate | Outdoor arena, UK | May | 0.14 μg/day | Randolph and Storey (1999) |
| *xmin* | Outdoor arena, UK | May | 0.4 μg | Randolph and Storey (1999) |
| *xstart* | Field enclosure, UK | 14 April | 7.6 μg | Steele and Randolph (1985) |
| Median percentage of time questing | Outdoor arena, UK | April | 11.1% | Van Es et al. (1999) |

See Supplementary methods S1 (section 1.1).

**References**

Randolph, S.E., Storey, K., 1999. Impact of microclimate on immature tick-rodent host interactions (Acari: Ixodidae): implications for parasite transmission. J Med Entomol 36, 741-748.

 Steele, G.M., Randolph, S.E., 1985. An experimental evaluation of conventional control measures against the sheep tick, *Ixodes ricinus* (L.)(Acari: Ixodidae). I. A unimodal seasonal activity pattern. Bull Entomolog Res 75, 489-500.

 Van Es, R., Gettinby, G., Hillerton, J., 1999. Models of temporal variation in questing activity in individuals of *Ixodes ricinus* (Acari: Ixodidae). Exp Appl Acarol 23, 977-986.

**Supplementary Table S3.** Summary of *Ixodes* nymph water state data

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Species** | **Value** | **Source** |
| Cuticle permeability | *I. ricinus* | Various | Beament (1959) |
| Critical equilibrium activity | *I. scapularis* | 0.88 | Yoder and Spielman (1992) |
| Avg. rate of water uptake over 24 h at *aV*=1 | *I. scapularis* | 0.6 μg/h | Yoder and Spielman (1992) |
| LT50 at various *aV* | *I. scapularis* | Various | Stafford (1994) |
| Transpiration at *aV*=1.5E-02 | *I. scapularis* | 0.02971 h-1 | Yoder and Spielman (1992) |

See Supplementary methods S1 (sections 1.2-1.4).

**References**

Beament, J., 1959. The waterproofing mechanism of arthropods: I. The effect of temperature on cuticle permeability in terrestrial insects and ticks. J Exp Biol 36, 391-422.

 Stafford III, K.C., 1994. Survival of immature *Ixodes scapularis* (Acari: Ixodidae) at different relative humidities. J Med Entomol 31, 310-314.

 Yoder, J.A., Spielman, A., 1992. Differential capacity of larval deer ticks (*Ixodes dammini*) to imbibe water from subsaturated air. J Insect Physiol 38, 863-869.