The Relationship Between Seasonal Stressors and Innate Immunity in Wild Deer Mice Chronically Infected with Sin Nombre Virus

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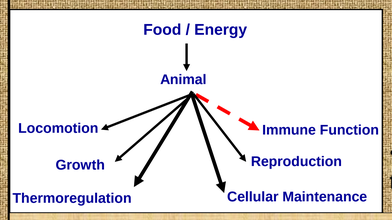
REGULATION OF IMMUNE SYSTEM FUNCTION IN WILD ANIMALS IS NOT WELL UNDERSTOOD

Resource Allocation Hypothesis:
Energy budgets of animals are dynamic and are altered to meet seasonal energy demands.



DOES IMMUNITY FLUCTUATE WITH SEASONAL ENERGY AVAILABILITY?

• During winter, food resources are scarce but thermoregulatory and maintenance costs are high.

Hypothesis: Because of low food availability and high energy demands, allocation of resources to immunity may decline during winter.

IS IMMUNE SYSTEM FUNCTION TIED TO REPRODUCTION?

• During spring, energetic demands of reproduction are high.

Hypothesis: Because of high energetic demands, allocation of resources to immunity may decline during reproduction.

NATURAL HISTORY OF SIN NOMBRE VIRUS

Deer mice (*Peromyscus maniculatus*) are the primary host for Sin Nombre Virus (SNV). SNV infection in deer mice is not lethal, but infection is maintained for life. Thus, SNV represents a chronic immune challenge to this species.

OBJECTIVE: EVALUATE SEASONAL PATTERNS OF INNATE IMMUNITY IN WILD DEER MICE EXPOSED TO SIN NOMBRE VIRUS

PREDICTIONS:

1. Innate immunity should decline during winter, a physiologically stressful period.
2. Innate immunity should be positively correlated with body mass, an indicator of resource availability.
3. Reproductive activity should suppress the innate immune response.
4. Mounting a chronic immune response to SNV will result in suppression of the innate immune response.

METHODS:

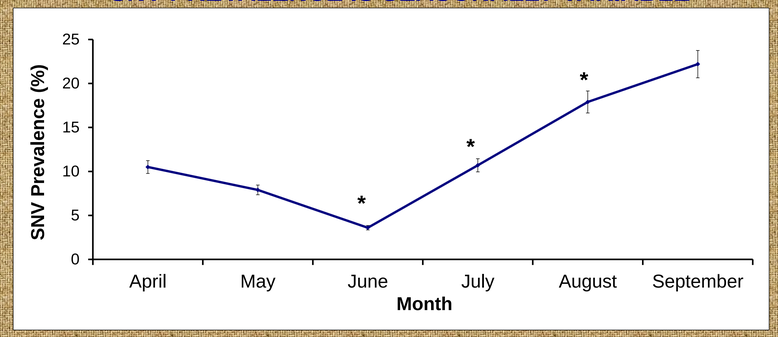
Deer Mice were sampled from 4 separate populations monthly from April to September 2011. Spring sampling included April-June; Fall sampling included July - September

SNV Infection Status was determined by the presence or absence of SNV antibodies in blood (ELISA).

Innate Immunity was determined by culturing serum with *E. coli* and determining the percentage of bacteria killed following a 2 hour incubation.

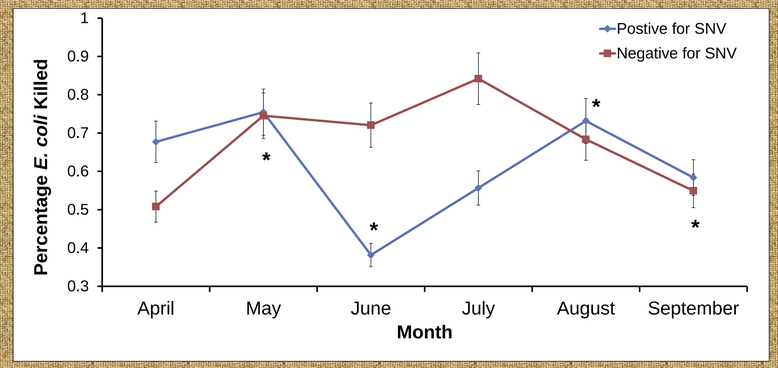
Reproductive Activity of adult (>14g) deer mice was assessed by examining condition of external genitalia. Females were classified as non reproductive, pregnant or lactating; males were classified as non reproductive or scrotal.

SNV PREVALENCE IS SEASONALLY VARIABLE



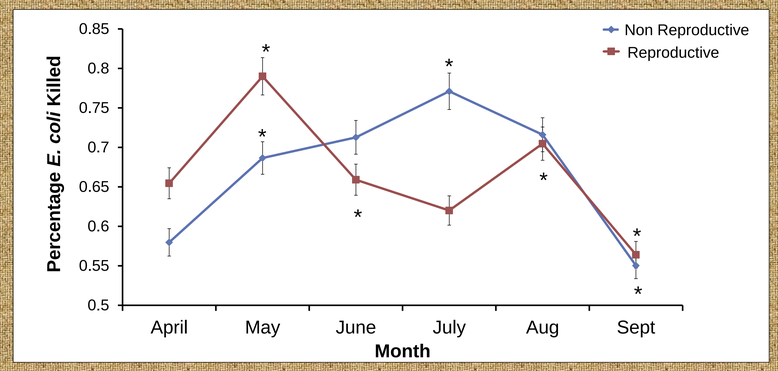
•SNV prevalence declined during spring and increased into fall ($F = 12.83$, $P < 0.01$).

INNATE IMMUNITY IS SEASONALLY VARIABLE AND IS STRONGLY INFLUENCED BY SNV INFECTION STATUS



• During spring, SNV infected deer mice had lower percentages of *E. coli* killed compared to uninfected mice ($F = 13.54$, $P < 0.01$).
• During fall, the percentage of *E. coli* killed did not differ between SNV infected and uninfected mice ($F = 3.62$, $P > 0.05$).

REPRODUCTIVE CONDITION STRONGLY INFLUENCES INNATE IMMUNITY

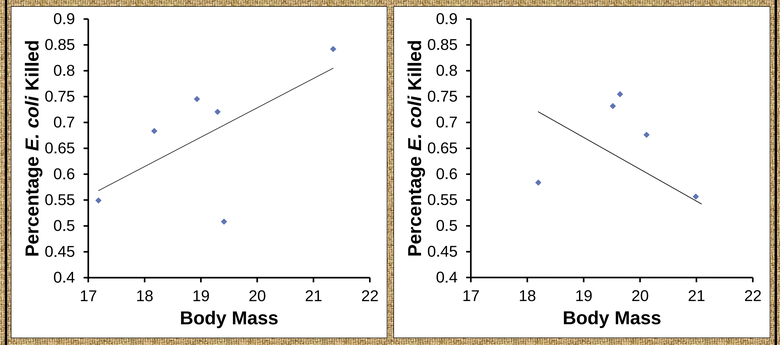


•During spring, reproductive mice experienced declines in innate immunity ($F = 21.23$, $P < 0.01$).

• Non-reproductive mice experienced increases in innate immunity during spring ($F = 11.03$, $P < 0.01$).

•During fall, innate immunity did not differ between reproductive and non-reproductive mice ($F = 6.67$, $P > 0.05$).

BODY MASS INFLUENCES INNATE IMMUNITY



• Among uninfected mice, higher body mass was positively correlated to innate immunity ($r^2 = 0.39$, $P < 0.01$).

•Among SNV infected mice, there was a negative relationship between body mass and innate immunity ($r^2 = 0.44$, $P < 0.01$).

CONCLUSION: DEER MICE DIFFERENTIALLY ALLOCATE RESOURCES ACROSS SEASONS

During spring, reproductive activity peaks. During these periods, deer mice infected with SNV experienced reductions in innate immunity. In contrast, reproductive activity did not appear to influence innate immunity in uninfected mice.

CONCLUSION: BODY MASS AND SNV INFECTION STATUS INFLUENCE INNATE IMMUNITY

In SNV infected mice, innate immunity declined with increased body mass. Body mass is a function of age in deer mice; older mice have higher body masses.

Our results suggest that infection with SNV does not appear to diminish innate immunity of younger mice, but with prolonged SNV infection, innate immunity is compromised.

LONG TERM IMMUNE INVESTMENT IN SNV COULD RESULT IN LONG-TERM ENERGETIC TRADEOFFS

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