INTRODUCTION

• Immune function in ectotherms is highly temperature dependent (Wright & Cooper 1981).
• Temperature deviations outside the optimal range have been shown to alter innate immunity in some ectotherms (Dittmar et al. 2013).
• We analyzed how temperature stress might affect immunity in juvenile newts.
• We also analyzed how housing newts at three different temperatures spanning the range of preferred body temperatures affected their immune response.
• For both studies, we hypothesized that temperature and healing rate would exhibit a positive relationship.
• Alternatively, newts may have an optimal temperature at which they perform best.

METHODS

• Biopsy punches were used to create small uniform cutaneous wounds on each of the newts which were then measured over a period of 15 or 18 days for adults and juveniles, respectively.
• Juvenile newts were either transferred to a different temperature (7°C) or remained at the same temperature (14°C).
• Adult rough-skinned newts (Taricha granulosa) were divided into three temperature groups, 21°C, 14°C, and 7°C.
• Size of the wounds over time was used to indirectly evaluate immune response.

RESULTS

Figure 1. Juvenile newts that underwent the temperature change showed a suppressed healing response early during the primary innate immune response period (day 6), relative to those that remained at a stable temperature throughout the study.

![Graph showing percent healed over days for 7°C and 14°C temperatures.]

• Adult newts housed at 7°C mounted a greater initial immune response, followed by 21°C, and finally 14°C (Figure 2).

![Graph showing healing in an adult newt over days 0 and 6.]

Figure 2. Juvenile newts that remained at 14°C 7°C had the greatest immune response.

DISCUSSION

• There is good evidence that the immune system is temperature sensitive (Butler et al. 2013).
• Interestingly, juvenile newts that were acclimated to 14°C and then underwent a temperature stress via switch to 7°C, showed reduced healing during the initial, stress-sensitive (French et al. 2006), immune phases of wound healing.
• Results from the adult newts suggest that early during the innate immune response animals from 7°C healed faster relative to the other temperatures.
• In either case, these results suggest immune function is heavily impacted by environmental temperature.
• Our results for adult newts are similar to those of the study on temperature stress on immunity in three-spined sticklebacks, where animals at lower temperatures resulted in greater immune response (Dittmar et al. 2013).
• Finally, increased immune response at lower temperatures could be a result of varying bacterial growth in the aquatic environment, which is also temperature-dependent. It is possible that at colder temperatures, while immune response may be suppressed, bacterial growth is suppressed even further.
• These two experiments taken together indicate that other variables, abiotic and biotic, work alongside temperature to affect the overall healing profile of a wounded animal.

ACKNOWLEDGEMENTS

We would like to thank Dr. Edmund D. Brodie, Jr., Gareth Hopkins, and Jory Johnson for their assistance and support.

REFERENCES

Wright RK, Cooper EL. 1981. Temperature effects on ectotherm immune responses. Developmental & Comparative Immunology. 5: Suppl. 1: 197-224.

Photo courtesy of Gareth Hopkins.