

## Abstract

Climate change is a global factor that has been implicated in many behavioral alterations across various species. We speculate and observe the potential responses to the *Plethodon shermani* mating system induced from temperature changes, which may affect the ability of *P. shermani* to rely on external cues for mating season. The courtship rituals of *P. shermani* have been well-documented; deviations from the expected patterning of behavior was measured via both initiation of and length of time spent in the “tail straddle walk” in addition to insemination success rate. It has been determined that an increase in temperature has implications in more inseminations, while the reverse is apparent for decreased temperature.

## Background



Figure 1. *P. shermani* pair (female on right) in TSW. Courtesy of Lynne D. Houck, Oregon State University

**Region:** The Unicoi and Nantahala mountains of North Carolina with a mating season from mid July to early October at 13-16°C

**The “tail straddle walk” (TSW):** A characteristic component to the courtship ritual – the female straddles over the male’s tail and they walk in unison until insemination.

**Typical success rates:** Nearly all females discover the spermatophore; ~60% of courted females will successfully inseminate.

## Methods and Materials

Adult *P. shermani* (48 males, 44 females) were collected during the breeding season 2010 from Mt. Rodgers, North Carolina. Individuals were housed in plastic boxes with moistened paper towels. A prescreening was conducted to verify that pairs would mate in laboratory settings and female were gravid. Animals were housed in their experimental temperatures with a natural photoperiod; all animals were inspected regularly and fed a weekly diet of larvae.

Mating sessions occurred three times a week from 9/5/11 – 10/21/11; experiments were conducted in rooms operating at the test temperature with red lights to aid in observing nocturnal courtships.

## Results

A summary of key data that was used for analysis of hypothesis testing is given in Table 1. A total of 888 experimental observations were done (288 control, 312 high temperature, 288 low temperature), of which 345 had TSWs occur (125 control, 130 high temperature, 90 low temperature.)

Table 1. Summary of *P. shermani* mating observations (n = 345)

	Control (13-16°C)	High Temperature (17-20°C)	Low Temperature (9-12°C)
Depositions	112	126	76
Inseminations	64	82	38
Average Time in TSW (min)	46.3	50.6	50.3
TSW Initiations	125	130	90
Success Rate	0.57	0.65	0.50

Three parameters (TSW initiations, time spent in TSW, and mating success) were used as indicators of modified mating behavior. Each consisted of two hypothesis tests comparing either high and low temperature to the control.

## Discussion

Our study reveals that there is no evidence of a significant difference for either experimental group for the time spent in TSW (Figure 2, p-value > 0.5). However, there was a significant difference in mating success for the high temperature group (Figure 3, p-value = 0.02) and a significant difference in TSW initiations for the low temperature group (Table 1, p-value < 0.01).

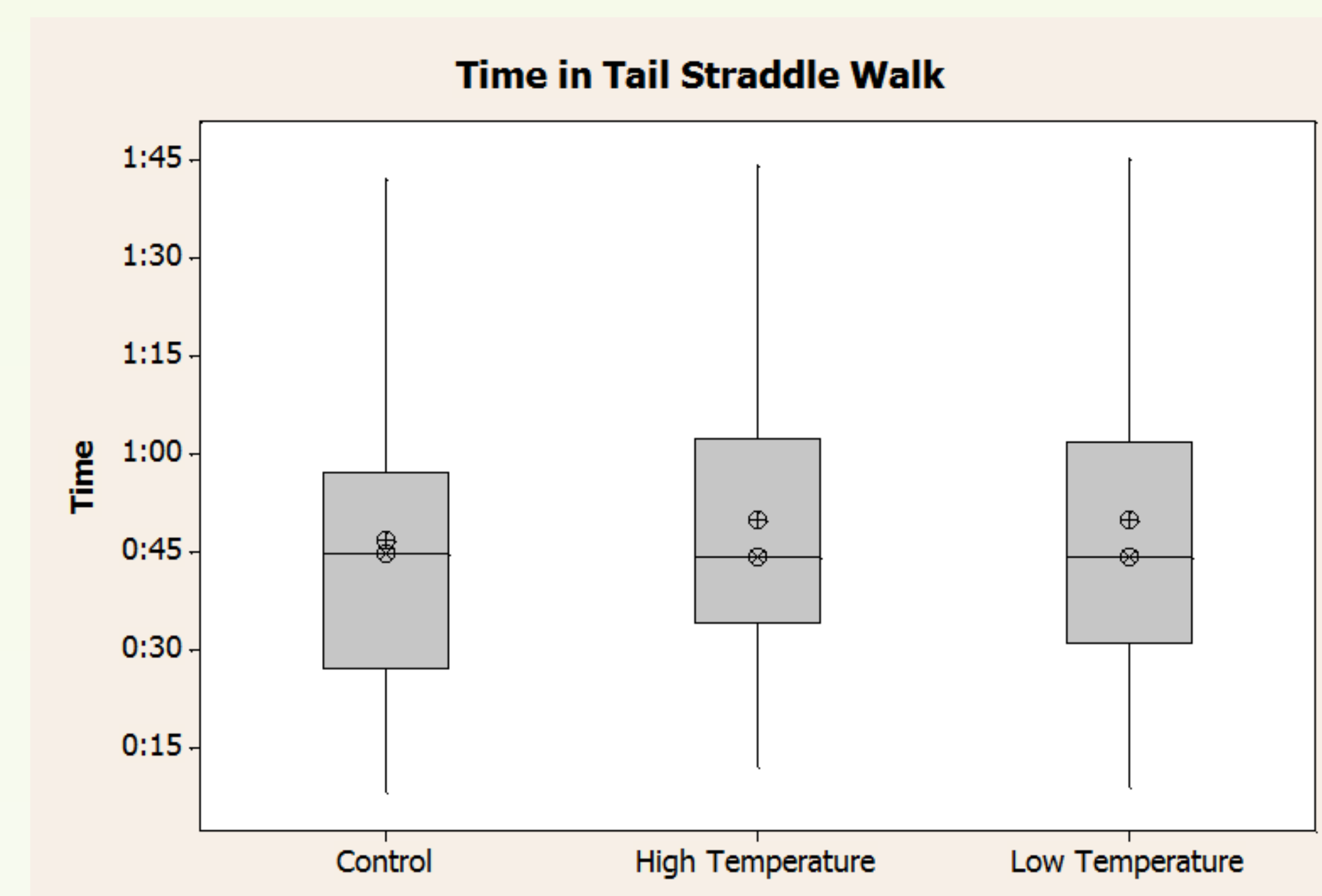


Figure 2. Average times spent in TSW across three temperature groups: Control (13-16°C, n = 125), High (17-20°C, n = 130), and Low (9-12°C, n = 90). There was no significant difference between the mean elapsed times (p-value > 0.5), which were 46.3 minutes, 50.7 minutes, and 50.3 minutes respectively.

This has led us to deduce that behavioral changes are occurring, though there is not enough evidence to indicate that such changes have an impact on the courting ritual once it is initiated – as made evident by the similar means and variances of TSW elapsed times (Figure 2).

The manifestations of such changes depend on whether or not the temperature is higher or lower than average. It appears that the high temperature group experienced a longer period of a sustained number of mating events than the control group. This gives evidence of a partly externally regulated mating season. The high temperature may be an indicator for when courting normally begins; if this exists, higher temperatures typical of late summer and early fall may lead to an earlier mating season.

## Discussion continued

Decreased temperatures resulted in less mating initiations. This also indicates a link between external temperature cues and mating season regardless of internally controlled conditions – imitating the colder fall weather may be inducing a decrease in mating attempts.

### Insemination Success Rates

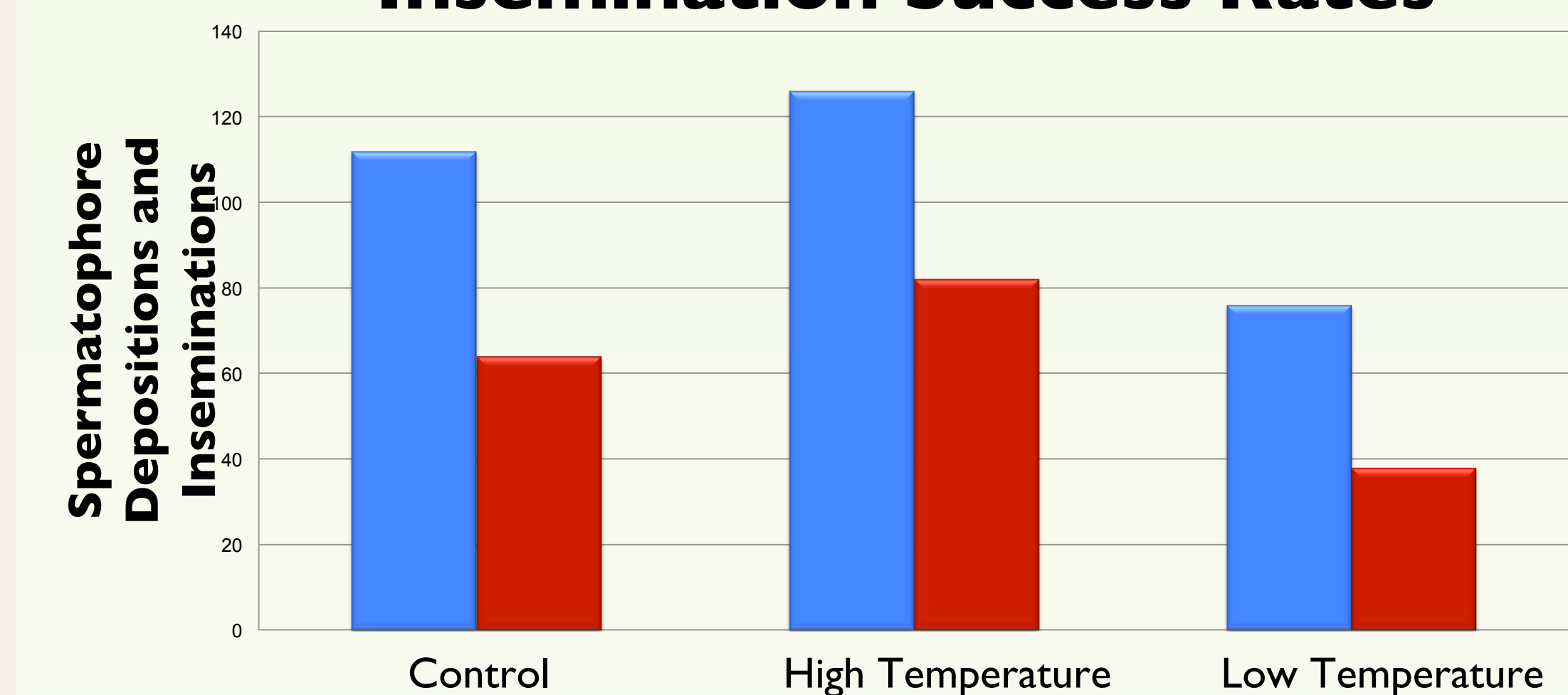


Figure 3. Insemination success rates as determined as a ratio of depositions (blue) to inseminations (red). Control group mated in temperatures ranging from 13-16°C (success rate = 0.57), high temperature mated in 17-20°C (success rate = 0.65), and low temperature mated in 9-12°C (success rate = 0.5).

## Conclusion

- Increased temperature has led to more successful mating events and an elongated mating period. Decreased temperature has led to a reduced number of mating initiations.
- Climatic changes may lead to an earlier breeding season with warmer temperatures.
- The effects on our sampling may translate either directly or indirectly to the population, community, and other amphibian-containing ecosystems. We suggest further research that may aid our ability to predict the capacity for amphibians to adjust to climatic changes.