Comparison of Tiger Leech Attraction to Heat and Movement Stimuli in Maliau Basin, Sabah

Karl Kmiecik[1], **Katherine O'Leary**[2], and **Ling Chea Yiing**[3]

[1] Department of History and Science, Harvard University, Cambridge, MA, USA

[2] Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA

[3] Sarawak Forestry Corporation Sdn. Bhd./Forest Research Centre, Jln Datuk Amar Kalong Ningkan, 93250 Kuching, Sarawak

ABSTRACT

To determine whether heat or movement plays a larger role in attracting leeches, two separate experiments were conducted. Each experiment consisted of a treated object and control object placed along an open transect. Three sets of 16 trials were performed on individual leeches for each experiment. Results were scored as reacting to treatment, reacting to control, or having no reaction to either. Utilizing Pearson's chi-square test, the results were compared to expected probabilities derived from the experimental design given random behavior. The p-value for the heat experiment was highly significant ($p < 2.2e-16$). The p-value for the movement experiment was insignificant ($p = 0.9687$). The results suggest that heat does play a larger role than movement in attracting leeches. However, alternative experimental designs may yield different results, suggesting a need for further research to fully answer the above question.

Key words: tiger leech, Maliau Basin, heat, movement

INTRODUCTION

Leeches comprise an abundant group of forest organisms worldwide and typically feed on warm blooded animals (Halton 1989). They tend to be seldom studied but are known to be capable of using multiple sensory mechanisms. Wallace noted that leeches will tend to stretch themselves out in anticipation of oncoming prey sensed through sound and vibrations (2000). Furthermore, leeches have also been observed to be attracted to the warmth of a petrol oil lamp (Baker 1937). According to Evans, leeches utilize two eyespots on the top of their heads to detect movement through changes in both light and shadows (2005).

Through field observations we have seen that leeches will also move in the direction of warm breath and of nearby moving limbs. The literature and our own experiences seem to suggest that both movement and heat are used by leeches to locate their prey. The purpose of this experiment was to test whether heat or movement plays a larger role in leech attraction.

MATERIALS AND METHODS

Approximately 50 tiger *leeches, Haemadipsa picta*, over the course of two days were collected from the head of the Belian Trail and surrounding forest of the Maliau Basin Conservation Area, Sabah, Malaysia. From these, 32 leeches were randomly selected for use as test subjects. Subgroups of 16 leeches were used for each of two trial days to ensure fresh leeches for the experimentation. Between trials individual leeches were stored in moist containers with both leaves and soil.

Two separate experiments were run. For both experiments three rounds of 16 trials were conducted, with at least an hour between each round to allow the leeches to rest. Tests were performed outdoors in a shaded area to simulate temperature and light conditions of their natural habitat.

The first experiment tested the attractive force of heat. Two dense, opaque polymer cups were placed on opposite ends of a 12 cm transect within a plastic tray. One control cup was kept at the same temperature as the surrounding conditions. The other was heated once every two trials by placing a 110 watt bulb inside for 90 sec prior to placement along the transect. The orientation of the transect and the position of the cups was systematically rotated between every trial to avoid hidden confounding factors. Leeches were scored as positively reacting to the heat source when they moved purposefully towards and would repeatedly touch their heads against the cup. A similar response to the room temperature cup was scored as a reaction to that object and movement along any other path out of the tray was scored as a non-response.

The second experiment tested the attractive force of movement. Two pendulums were constructed from wire, fishing line, and large centrifuge tubes. The pendulums were placed along the same transect and rotated in position and orientation as described above. For each trial one control pendulum was kept still while the other was set in motion perpendicular to the transect. Leeches were scored as positively reacting to movement when they moved purposefully towards the moving pendulum. A similar response to the stationary pendulum was scored as a reaction to that object and movement along any other path out of the tray was scored as a non-response.

The statistical program R was used to analyze the data. Pearson's chi-square test for count data was used

to compare the raw counts scored to the expected probabilities of a random distribution. Using a circle with a radius from the center of the transect to the center of one of the cups, the expected chance distribution of results was calculated by finding the percent of the circumference intercepted by the cup. Were the leech to undergo random movements each treatment would have an 11.73 percent chance of scoring a response and there would be a 76.54 percent chance of scoring a non-response.

RESULTS

Pearson's chi-square goodness of fit test yielded a p-value less than 2.2e-16 for the first experiment with the heat treatment (X-squared = 95.5231, df = 2). The same test yielded a p-value of 0.9687 for the second experiment with the movement treatment (X-squared = 0.0635, df = 2).

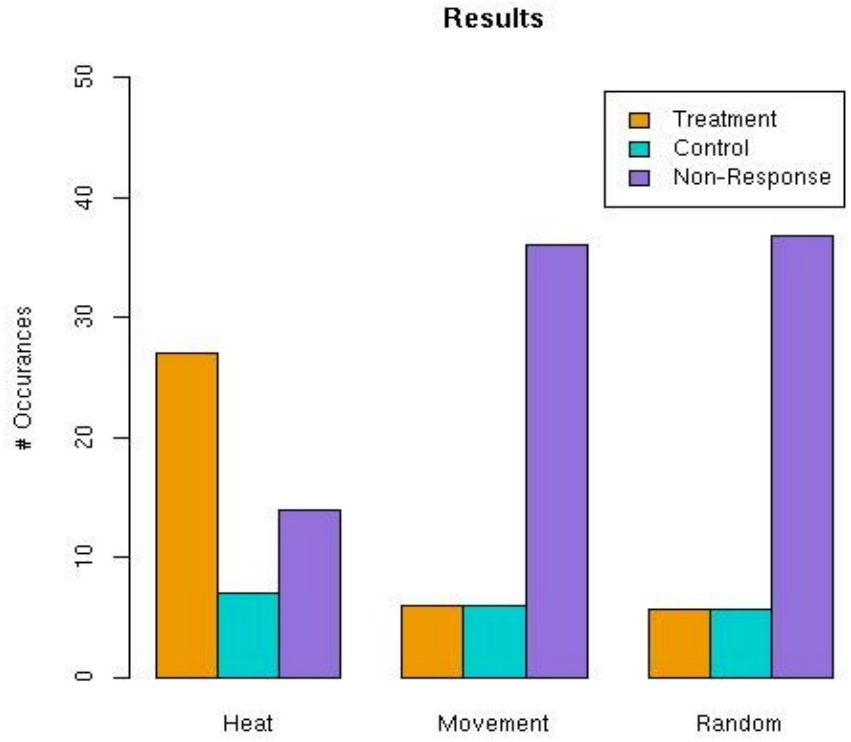

FIGURE #1: The above bar-plot shows the data generated from the heat and movement experiments as well as the expected distribution for random leech behavior.

DISCUSSION

The p-value for the heat experiment shows a highly significant result. The most probable interpretation is that the leech had a tendency to be attracted to the heat source. However, because the trials of the heat treatment and control were not independent the leech could theoretically have been repelled by the control cup. This second interpretation is unlikely because of identical temperatures of the control and surrounding area.

The p-value for the movement experiment was insignificant. The distribution of results closely fits the expected random distribution that would occur if no stimulus were influencing the leech (as illustrated in figure #1). The setup of the pendulums appeared to have no effect on the leech.

These two results suggest that heat does play a larger role than movement in attracting tiger leeches, *Haemadipsa picta,* to their prey. However, further experimentation must be done before this claim can be considered conclusive. Neither experiment utilized actual prey but inanimate objects to simulate prey with an isolated factor. The leech might have been attracted to the heat for reasons other than a potential meal.

Furthermore, a movement experiment under alternative light conditions or an experiment testing the stimulus of vibrations from movement could yield different results. Future experiments with other factors such as smell, sweat, sound, and combinations of multiple factors would also lead to a better understanding of what attracts a leech to its prey. We also advise that experiments with other species of leeches be conducted to see if attractive forces vary between species. A better understanding of these forces would allow us to use leeches perhaps as indicator species, or at a minimum make strides towards preventative measures against human leech attacks.

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