ISSN: 2755-9904

Journal of Clinical Images & Reports

SCIENTIFIC Research and Community

Research Article

Open Access

Mosquito Control, Alluring Them Away from Humans

Phi Tran

School of Liberal Art, University of St. Thomas of Houston, Houston, USA

ABSTRACT

Mosquitoes are the most harmful insects who cause 2 million illnesses, kill 28 thousand people daily [1,2]. The challenge for researchers has been to develop a bait combination that attracts female mosquitoes and keeps them away from humans. In the animal kingdom, as a matter of survival, millions of years of natural selection have been guiding species toward prey that they can successfully kill. This is true for mosquitoes. Among the 250 billion mammals and birds as potential victims, mosquitoes choose birds with a 42 °C body temperature 50% of the time, humans at 37 °C 4% of the time, and other warmer mammals (40 °C) 46% of the time. Previous research has shown that 40 °C toxic bait traps successfully attract and kill female mosquitoes [3]. A series of individual and side-by-side group experiments gradually identified the chain of events process that female mosquito use to locate hosts and meals. Upon the calls of nature, female mosquitoes sought warm-blooded animals to feed on. They first targeted accessible at or on approximate 42 °C hosts, then hosts with 40 °C, and finally those with 37 °C. In these situations, they had success rates in feeding of 50%, 46%, and 4%, respectively.

***Corresponding author**

Phi Tran, School of Liberal Art, University of St. Thomas of Houston, Houston, USA. Tel: 832-605-2220.

Received: February 12, 2024; **Accepted:** February 15, 2024; **Published:** February 23, 2024

Keywords: Mosquito, Malaria, Dengue, West Nile Virus, Zika, Yellow Fever, Chikungunya

Introduction

At 700 million illnesses the mosquitoes cause yearly [1]. If each patient comes with three other family members enduring more hardships, we are looking at 2.8 billion people, or one third of the entire human population suffer yearly because of them. In just one year, mosquitoes cause approximately the same number of illnesses and kill more people than the entire 3 years of the COVID-19 pandemic [1-4]. Most of their victims come from underdeveloped countries. The majority are children. People become sick from the mosquitoes' bites. They are usually bitten in their homes or workplaces. Thus, efforts to control them at people's houses should be at the forefront of research. We must address mosquitoes in the places where they cause the most harm. This is not an academic paper in which we begin with theoretical concepts and set out to prove or disprove them. We began with observations to further our understanding; then, we designed a trap in response. Our entire endeavor began with a simple observation: mosquitoes do not bite dead animals. We hypothesized that warmth was what attracts mosquitoes. Our investigative process may raise new findings. That was not our objective but unintended consequences.

During the developmental phase of the 40 °C bait system, when we stood a few meters away from the system, mosquitoes bypassed us and flew straight to the bait. When we saw this, we knew that this bait system had a strong possibility of success.

Over the years, we tweaked the design of this trap. Unfortunately, there is no protocol or published research to identify and measure the activities of female mosquitoes. We did not know if a particular design would deliver the desired result. Therefore, we had to test each design. Please refer to Appendix A for the protocol we used to test whether mosquitoes would consume whether also experimented with the water + 5% boric acid baits individually within the temperature range of 38.5 °C to 42 °C; they produced the same result as the 40 °C system,

Our traps did not emit any odor. The only thing emitted from the system was water vapor, which is naturally plentiful. We experimented with a 15 x 15 cm, temperature-regulated, warm pad situated next to a bait at natural temperature, as shown in Figure 1. This gave us the same result with almost no maintenance required. However, the bait had to be placed within 15 cm of the pad for the insects to believe that the bait was a part of the make-believe host.

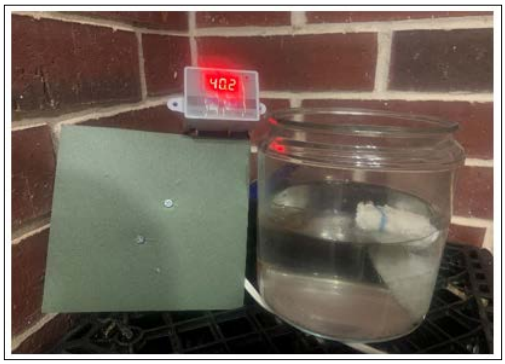

Figure 1: Improved Female Mosquito Killer

Objects at different temperatures emit different infrared wavelengths like different 'colors' [5]. Blood-seeking female mosquitoes often pick on windows or land wind on window screens as they attempt to reach (warm) ray-emitting targets they have identified from the other side of the glass. Warmth is an obligatory condition that mosquitoes look for in hosts. We

designed an experiment to search for the mechanism by which mosquitoes locate their hosts from afar. To determine whether they can 'see' the infrared 'colors' of the hosts, we placed a clear acrylic sheet 1 cm in front of the pad to block the heat but not the rays. With or without the sheet, the system functioned the same, attracting and killing female mosquitoes in the area. The aforementioned indicators enabled us to assume that they do from there, explanations started to make sense.

The topic of infrared 'colors' is not within the scope of this study. Further experiments were needed to strengthen the conclusiveness of this notion. We also created another mosquito trap using a 6.5 cm x 5.5 cm (D x H), 41.5 °C, aluminum-puck lure inside an acrylic enclosure to make sure the tests were without the effect of heat, scents, and chemicals on the mosquitoes' behavior, as shown in Figure 2. As expected, the trap caught female mosquitoes while excluding their male counterparts. We can conclude the female mosquitoes were attracted by the rays the puck emitted. In other words, they can see the warmth of their potential hosts and use it to identify their targets, like how researchers observe animals in the wild using thermal images.

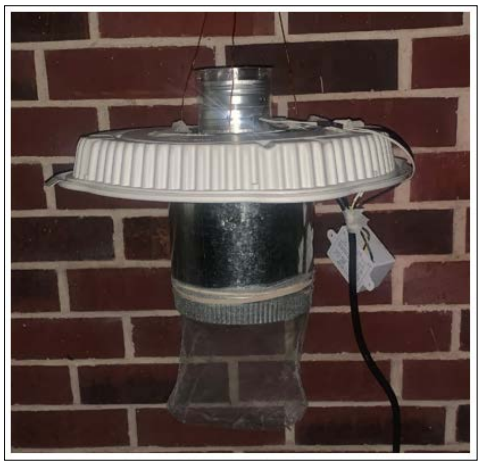

Figure 2: Thermal Female Mosquito Trap

In the animal kingdom, food is a matter of survival. Species evolve and adapt according to food availability. If food is more available, the size of individuals of species grows otherwise, it shrinks. Mosquitoes have remained relatively small throughout millions of years of evolution. If mosquitoes encounter difficulty getting a meal from a host, they will abandon this choice and search for other hosts.

Equipment

The experiments required three systems, as described in Figure 1. The temperatures of the pads were regulated by a digital thermostat, and a half-gallon glass jar was used for the bait. We set the temperatures of the pads at 41.5 °C, 39 °C, and 36.5 °C, to emulate three different hosts: birds, warmer mammals, and humans. We hoped to find if the mosquitoes had a preference.

Methods

To identify the mosquitoes' preferences, we conducted three separate experiments. Each experiment compared one food source to another in a side-by-side manner. The systems were unobstructed, 5.5 m apart, 50 cm in height, and placed in a semi-outdoor environment (on a front porch).

Experiment 1: Birds Vs. Humans (41.5 °C vs. 36.5 °C)

Experiment 2: Warmer Mammals Vs. Humans (39 °C vs. 36.5 °C)

Experiment 3: Birds Vs. Warmer Mammals (41.5 °C vs. 39 °C)

Because female mosquitoes deposit their saliva in microscopic volumes as they visit their food sources, it took 4 days for the experiment to yield meaningful results.

Results

The baits representing the warmer host attracted the female mosquitoes in all three experiments. These baits contained crystal rings resulting from the saliva of the mosquitoes, while the other baits did not. Figure 3 shows a typical result of these experiments.

Figure 3: Typical Have and Have Not Results

Data Analysis

A ratio of all vs. none clearly indicates a deliberate choice that does not result from chance. In the bird vs. human sitting, female mosquitoes chose birds over humans. In the warmer mammals vs. human setting, male mosquitoes chose the warmer over humans. In the bird vs. warmer mammals setting, male mosquitoes chose birds over mammals. Therefore, the order of preferences shown in our experiment is birds, (warmer mammals), and then humans.

According to these results, female mosquitoes seek out warm places to find food. In addition, they prefer hosts with body temperatures of 41.5 °C, 39 °C, and 36.5 °C, in that order. Finally, their hosts must be within view.

Discussion

In this study we used heat to attract mosquitoes and bait to kill them. Currently, there is no similar device on the market. However, alternatives are available online and in pet shops. To replicate this experiment, we recommend under tank reptile heating mats heated to a temperature between 38.5 °C and 42 °C.

Between the original warm bait system and the lure and bait we described in the experiments, we recommend the second one. The traps should be placed in a semi-outdoor, visible location, such as a porch, to catch and kill mosquitos before they can enter the house. We did not have the opportunity to observe and report our trap's effectiveness indoors. However, we assume that it would work in this environment also.

Our trap caught the most mosquitoes around sunrise when mosquitoes come out from their hiding places and are preparing for their daily activities. The trap only attracts blood-seeking mosquitoes, not those searching for a place to lay eggs. Those mosquitoes prefer corners, and mosquito eggs, larvae are often found there.

Theoretically, a living host, such as a bird, should have the same effects as our experiments. Therefore, if the bait is close to any animals or humans, safeguards should be in place to protect them from mosquito bites and the toxic bait.

Conclusion

At a minimum, this study provides a possible method to create residential mosquito-free environments. Of course, the end goal of mosquito control is to avoid or reduce the chances of contracting mosquito-borne illnesses. This study and its findings are not a silver bullet; however, they provide a simple method to reduce the presence of blood seeking mosquitoes in most environments.

Appendix A

Protocol to Indicate Feeding Visitations of Female Mosquitoes
When a mosquito bites and drinks blood, it injects saliva to prevent clogging. The saliva of the mosquito causes itching. Researchers have used cotton balls soaked with carbohydrate solutions to lure and feed mosquitoes. The mosquitoes leave a yellow substance on the cotton balls, as shown in Figure 4 [6]. The female mosquitoes inject saliva into the cotton as they drink the solution.

Figure 4: Cotton Ball with Yellow Substance

The breakthrough we learned from the uses of the 40o bait system is the leftover crystals from the result of the chemical reaction when boric acid meets mosquito saliva, they appear as white rings at the water edge as shown in Figure 5.

Figure 5: Crystal Rings Formed by Mosquito Saliva

Figure 6: Yellow Crystal Grains

In an enlarged view from a magnifying camera, the white/yellow substance clearly shows a crystalized structure as shown in Figure 6. Because the trap only killed female mosquitoes, the crystal rings must result from the mosquito saliva meeting the boric acid. A female mosquito deposits less than 1 µl of saliva during feeding, resulting in just a few crystal grains. A full ring took days to form and represents an impressive number of female mosquitoes killed. The rings are evidence that feeding occurred at the locations.

References

1. 6 Mosquito Diseases That Can Be Deadly (2023) Pfizer https://www.pfizer.com/news/articles/6_mosquito_diseases_that_can_be_deadly.
2. Mosquito and Disease, Illinois Department of Public Health https://dph.illinois.gov/topics-services/environmental-health-protection/structural-pest-control/mosquitoes-disease.html.
3. Tran P (2024) Mosquito Control, Killing off the Females. Open Journal of Animal Sciences 14: 14-22.
4. COVID-19 CORONAVIRUS PANDEMIC (2024) https://www.worldometers.info/coronavirus/.
5. Wikipedia, Infrared https://en.wikipedia.org/wiki/Infrared.
6. Anopheles Colizzi (2018) https://www.researchgate.net/publication/326320242_Infection_of_highly_insecticide-resistant_malaria_vector_Anopheles_coluzzii_with_an_environmentally_friendly_entomopathogenic_bacteria_Chromobacterium_violaceum_reduces_its_survival_blood_feeding_prop/figures?lo=1.