The Corpse Flower: A Thermographer's Perspective

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ABSTRACT

The Amorphophallus Titanum, Titan Arum (the Corpse Flower) is a rare specimen, with limited observational opportunities. The fact that it experiences metabolic heat generation makes it an enticing subject for a thermographer. The Corpse Flower is a unique life form with an air of mystification and questions remain regarding its specific thermal functions and their purpose. The approach this paper takes is strictly from a thermographer's perspective, utilizing limited interdisciplinary knowledge of botany and entomology. The results of our investigation confirm that the plant generates heat both at the tip of the spadix and inside at the base where the spathe and spadix intersect. The latter indicates further confirmation of the common hypothesis that the plant intentionally smells like a rotting flesh in order to attract bugs for pollination. However, the former does not appear to be consistent with this hypothesis. The tip of the spadix is not the source of the pollen and would be surprising if it aided in the propagating the stench any further. However, it may indicate that some of the plant's pollinating insects actually are able to sense in the infrared spectrum. As can be seen in the thermal images, the tip of the spadix would act like a visual beacon for locating the source of what the insect smells. This kind of investigation could lead to a better understanding of ecological interconnectivity, the potential for increased opportunities within the realm of this kind of scientific investigation, and the potential for a better understanding of our thermal world.

INTRODUCTION

Amorphophallus Titanum (the Corpse Flower) is the primary subject of this thermographic investigation. However, this paper requires an interdisciplinary exploration. To better understand this rare species we must consider the plant from a botanist' perspective, the insects that pollinate it from an entomologist's perspective; and the implications this information gives us from ecologists', agriculturists', and epistemologists' perspectives. Additionally, this paper's aim is to add to this discussion by submitting consideration from a thermographer's perspective. The result of this investigation is inconclusive, but raises interesting questions and may justify further interdisciplinary collaborations.

PLANT PROFILE

The Corpse Flower is one of nature's biggest oddities, and derives its nickname from the rotting flesh like stench it produces on the first day of its bloom. There is still much to be learned from this plant; at one point it was even thought that the flower was pollinated by elephants. Thankfully (to those with sensitive noses), this flower grows wild only in the equatorial region on the island of Sumatra. The tuber that produces the flower can weigh as much as 200 pounds, the largest in the world. The flower grows at an incredible rate. As much at 35 inches in less than 12 days as much as seven inches in a single day.

When the flower is in bloom (which only last 12 to 48 hours and may be as long as six to12 years between blooms) it has the potential to reach up to about 10 feet in height. At the time of the flowering the tuber will lose 5 to 7lbs because of all the energy that is used in the process. It is widely believed that the purpose of the smell is to attract insects for pollination. In this case Honey bees and Butterflies are not the goal of attraction but Sweat Bees and Carrion Beetles. The female flower is first to bloom then the male flower blooms about a day later, effectively precluding the possibility of self pollination. The spathe of the Corpse Flower is one, specialized leaf structure that resembles a flower. It covers the world's largest occurrence of an un-branched flower cluster located inside and at the base of the spathe and spadix structures as seen in Figure 2.

Figure 1. One observer commented that this bloom's smell was a cross between a dead mouse and a dirty trash can (amplified by many magnitudes) on a hot August day.

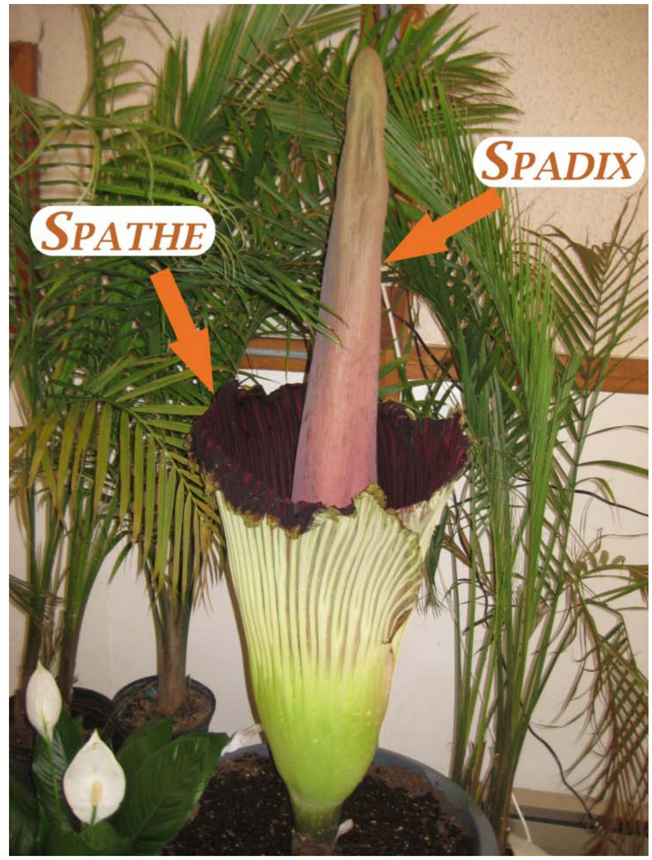

Figure 2. The spathe and the spadix work in conjunction to protect the large cluster of flowers where the two structures intersect.

Figures 1, 2, 6, 7, and 8 are of an Amorphophallus Titanum bloom displayed in Springfield, Missouri in the spring of 2010. Though this particular example is enormous relative to flower structures in general, it is small relative to the Corpse Flower's potential size.

INSECT PERCEPTION

To understand why thermally imaging this plant may be of material importance we first need to understand the relationship between the plant and its pollinating insects, and how the insects utilize their perceptive abilities to receive and interpret important information. The relationship between the Corpse Flower and its pollinating insects is simple and of an interdependent nature. The flower does not self pollinate. Therefore, it relies on the pollinating functions of insects. Conversely, the Carrion Beetles and Sweat Bees derive their own benefit as they use the pollen as a source of food. The question as to how insects locate their food through their perception of reality is still an area of much study.

We know insects sense our shared world differently than humans. An example of this is how the Corpse Flower creates an odor to attract its helper insects, but is smelling bad the only thing it does to achieve this? Insects are alerted that there is food in the area when they smell it, but how do they now exactly where to find its source?

Much study has been done in the way the honey bee sees. Studies strongly suggest that not only does its eye have the proper detectors to see ultraviolet light, but that it behaves as though it does (Hugh, 2010, p.303). This aids them in differentiating sources of food (flowers) from the rest of the encompassing plant matter.

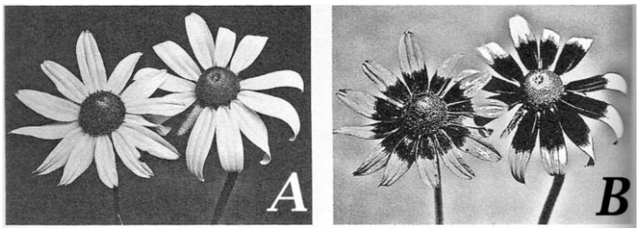

Figure 3. The images show the same black-eyed susans in the light spectrum visible to humans (A) and imaged in ultraviolet (B) displaying a target-like pattern. Other flowers have ultraviolet landing strip styled patterns (Huges, 2010, p. 304).

Image Source: (Hugh, 2010, p.304).

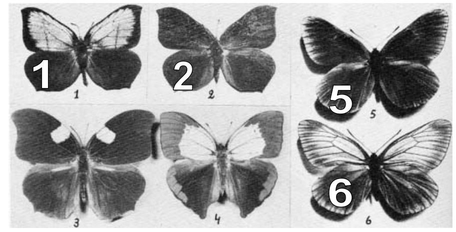

Figure 4. The butterflies labeled 1 & 2 and 5 & 6 all reflect the male and female (respectively) ultraviolet images of their species (Mazokhin-Porshnyakov, 1969, p. 272).

Image Source: (Mazokhin-Porshnyakov, 1969, p. 272).

Pollinating insects that can perceive ultraviolet light must have a tremendous added ability for finding food sources. Figure 3 displays how different (yet similar looking) flowers could appear entirely unique if viewed in ultraviolet. Not only aiding insects in differentiating flowers from the rest of the surrounding plant matter, but from each other. Figure 4 also illustrates how species of butterflies can utilize this same sensory perception to distinguish sex among their own species when they would otherwise appear virtually identical. Furthermore, some insects appear to not derive the usefulness of this information from the intensity of light sources, but the relative variation (contrast) between sources (Mazokhin-Porshnyakov, 1969, p. 95). This discussion on contrast will become important when talking about possible thermal perception insects may have, and how this perception would be useful.

Ultraviolet light is not the only sensory perception insects have that deviate from humans' (in quality or type). It has been observed that polarized light of specific wavelengths aid in flying insects' ability to navigate in flight. Honey bees have also been observed using this perception for determining their food's relative position and communicating its location to others in the colony (Mazokhin-Porshnyakov, 1969, p. 135). These adaptations have formed very specific and useful functions to aid in insect survival.

These variations are just the beginning of how human and insect image sensing differs, and ultraviolet light and polarized light are a small representation of this. To name a few more there is also image acuity, recognition of higher frame rates, and the effects of having compound eye structures. All of which can be explored in great detail. Not to mention the other four senses humans use and others of which we may be unaware insects have.

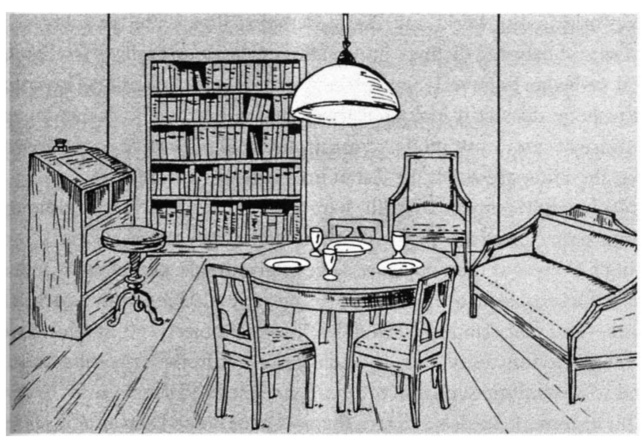

Figure 5. This image illustrates one possible interpretation of a housefly's perception. The idea is a housefly is likely to interpret the sensory information it receives from this room as equally immaterial (represented as one grey tone), except for the present food and light source (Hugh, 2010, p. 315).

Image Source: (Hugh, 2010, p. 315).

The image in Figure 5 is not used here to accurately reflect how a housefly might interpret its own sensory perception, but meant to illustrate how a housefly's subjective experience is derived in a way that aids in determining what is uniquely important to how it interacts with its environment (as it tastes through its feet and navigates by light) (Hugh, 2010, p. 315). This illustration helps raise the epistemological question of how we come to know and understand the world around us with the limited information we perceive and how that information is interpreted. Insects experience reality in ways we cannot yet completely fathom. Though, we know that insects' sensory perceptions are specially adapted to aid their unique ecological niches.

THERMAL INVESTIGATION

It is merely a thermographer's speculation when suggesting insects that benefit from decaying flesh could likewise benefit from perceiving in the infrared spectrum. Specifically, these insects would likely find it useful to be able to perceive heat variances. This assumption is based on the fact that a byproduct of decomposition is heat, and that the surrounding natural environment of matter in decay will be in contrast with the heat range necessary for effective decomposition (due to transpiration causing plants to be relatively cooler on their surface, and inorganic objects to usually be warmer or cooler on the surface dependent on their coincidental external energy input). Furthermore, an insect of this ability would only need to be able to recognize certain infrared wavelengths (in much the same way insects make use of recognizing only certain ultraviolet wavelengths) to make use of this ability. What would an organ of this capability be, would it be part of the eye structure or something else? Could it map out its surrounding thermal environment by feeling thermal radiation similar to how humans do? How would this perception be manifest in the visually? These are all difficult questions to resolve as we cannot communicate with insects (yet), and insects are particularly "recalcitrant research subjects" (Hugh, 2010, p. 303).

To our disappointment, we were not allowed to touch the exhibit. So we were unable to determine the flower's emissivity; and, thus, its temperature reading. However, a proper reading is immaterial to our present investigation. What is more interesting is that forward looking infrared imaging allowed us to perceive this thermal anomaly at a distance, and we can now visualize how this might appear to an organism that senses in the infrared. Different color pallets were used to highlight how good thermal contrast could aid an insect food location. It is important to note that some color pallets were less effective (and not included in this paper) at performing this task. Figure 6 shows the entire flower with a relatively warm spadix tip (which would appear hot in contrast with the cold sky or surrounding leaves).

Figure 6. Using an inverted grey color pallet, the thermogram on the right shows one possible way an insect may perceive this flower.

This could prove to be an incredibly useful location tool for an insect once it smells that food is in the area. To an insect, the hot tip of the spadix may appear similar to the light of lighthouse directing boats to harbor.

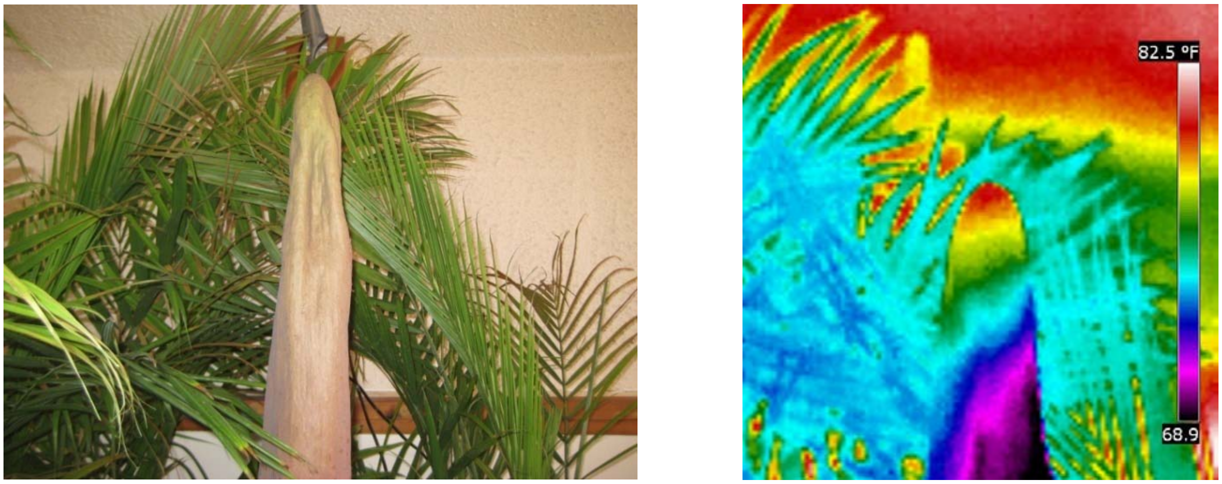

Figure 7. Notice how the rainbow pallet (right) strikes a high contrast against the standard leafy foliage. Note that this image was taken indoors, and that in the natural environment the sky would supply a cooler backdrop.

As an insect navigates its way toward the tip of the spadix, it would then be able to view inside the flower structure. An insect perceiving in infrared might see an image similar to the thermal image in Figure 8. This is the ultimate destination for both insect and plant.

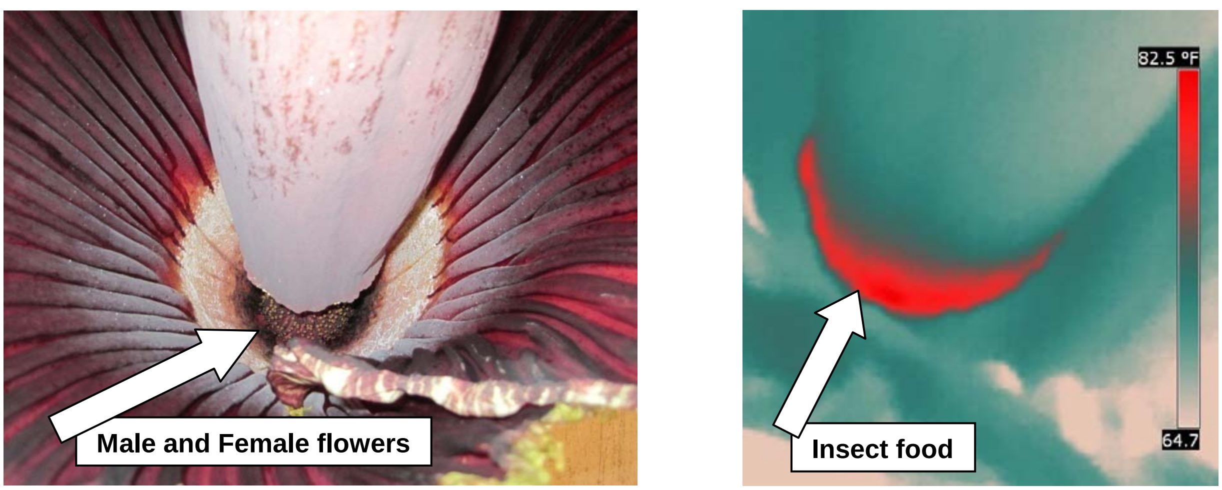

Figure 8. The greyred color pallet (right) shows how an insect capable of detecting infrared radiation may be able to use this information to aid in finding its food. Compared to the photograph (left), the food source really stands out.

The photograph in Figure 8 shows a myriad of details, displayed at about equal importance. Whereas the thermogram easily reveals a stark contrast between the location of insect food and everything else, the photograph fails to highlight this.

SUMMARY

As a thermographer looking at these photos, it is easy to believe that an infrared sensing adaptation would be incredibly advantageous to insects that need to locate decomposing organic mater (or the flower structure inside Amorphophallus Titanum). This investigation does not prove a claim that insects perceive in infrared, but it does suggest its plausibility. Accordingly, further investigation may be warranted.

Studies of this nature could lead us to better understand the interrelationships between species, and understanding how insects interpret reality could lead humans to the ability to influence their behavior. The implications of which could mean ecologists could better mitigate harmful interactions between species (like the Japanese beetle in the USA). They could also encourage endangered species to engage in healthy activity for their own proliferation (the American honey bee). Agriculturists could reduce the demand for pesticides worldwide by encouraging insects to avoid crop regions, or by creating advanced insect traps. The positive ramifications of using fewer pesticides could fill books (economic, medical, ecological, philosophical ethics, etc.).

On a more abstract level of epistemology, finding that insects do sense in the infrared (with sight or otherwise) could help us to expand our own minds. We could learn how they utilize this extra-sensory perception, and possibly understand how they actually perceive this information. Thermal imaging is merely a proxy for the real thing (thermal sensing), as we are still merely seeing a representation of the infrared displayed in the visible light spectrum. Thermographers use visual aids (color pallets) to simulate what it would be like to perceive in the infrared spectrum. The implications of understanding the world of infrared are tremendous, expanding our own understanding of our reality. Thermal imaging has already drastically impacted human understanding, from home energy consumption to the cosmos. If other sentients naturally make use of this ability, a lot could be learned about how to analyze thermal data by understanding the way those specimens utilize it as a useful tool for apprehending reality.

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ABOUT THE AUTHORS

Steve Mirowski is an ASHI Certified Home Inspector and Certified Level II Thermographer. He holds a Bachelor of Science in Business Administration and a Certificate in Statistical Analysis from Arizona State University. He is a Radon Measurement Specialist from the University of Minnesota, and is a Certified Member of American Home Inspectors Training Institute.

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Both Steves are intensely interested in understanding how the world around them functions, and feel privileged to be working in the field of Thermography.