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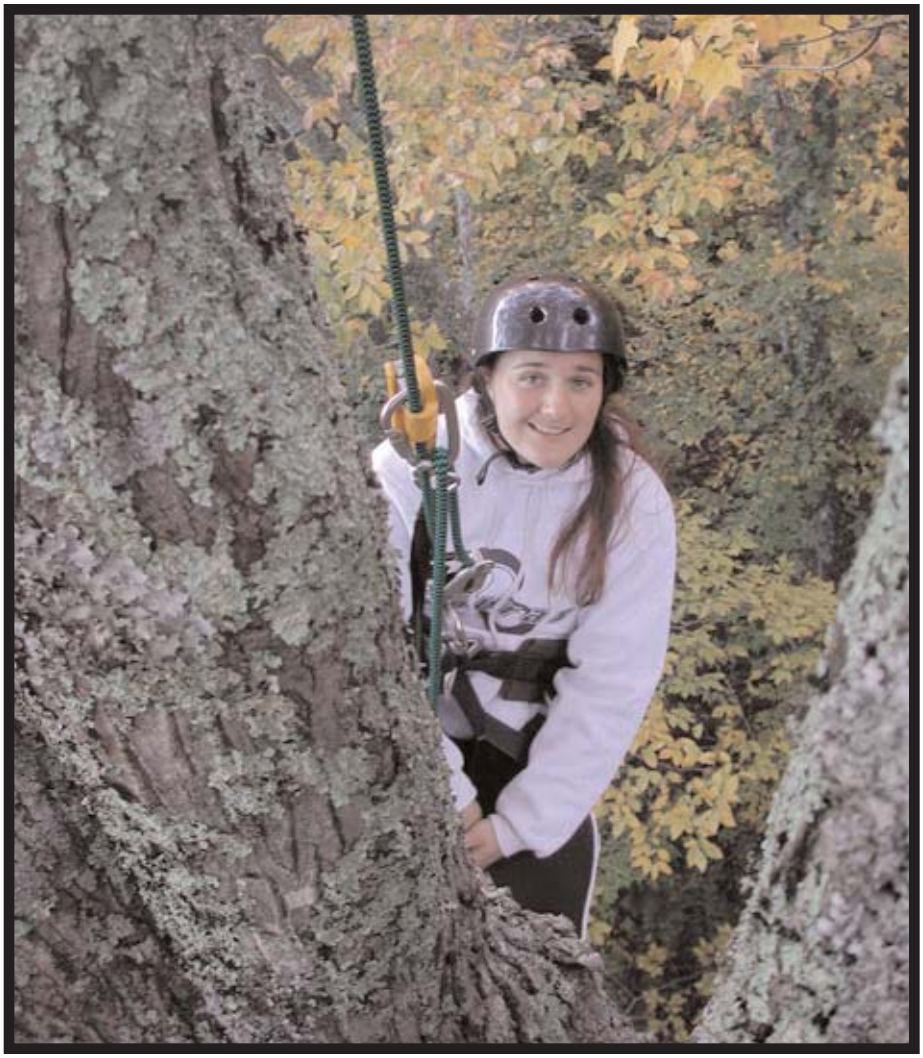
The Gliding Behavior of Tropical Ants

Rachel Sheppard, a student from Virginia Intermont College in Bristol, Virginia, and a student at the Institute for Tropical Ecology and Conservation (ITEC) did a study of the gliding behavior in one species of tropical arboreal ant in the rainforest canopy.

Rachel's study adds to the body of data previously collected by another ITEC student, Kirsten Blomdal, and available in another PDF file on this site



Rachel, on a climb in the mountains near the campus of VIC, Virginia Intermont College.

Preferential Gliding Behavior by *Camponotus sericeiventris*

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Introduction to Tropical Ecology

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Abstract

Some species of ants from the tropical rainforest canopy have been found to glide toward and land upon a tree bole when they are dropped from the canopy. This is theorized to be an evolutionary adaptation that minimizes foraging costs and predatory threats. From this theory it can be hypothesized that gliding ants should preferentially glide toward the tree from which they fell, if they fall from a point equidistant between their home tree and a non-home tree. *Camponotus sericeiventris* individuals of the same colony were taken from adjacent tree boles and dropped from a point equidistant between each bole. The ants did not display preferential gliding behavior, and a very low proportion of the ants glided at all. This suggests that ants may not show homing behavior when gliding, but further research using species that are more proficient gliders than *Camponotus s.* should be conducted.

Key Words: Gliding ants, preferential gliding behavior, homing, tropical rainforest, Camponotus, Camponotus sericeiventris, arboreal ants.

Preferential Gliding Behavior

by *Camponotus sericeiventris*

Ants who live and forage in the canopies of tropical rainforests tend to glide to a nearby tree bole if they are dropped into the air (citation). Yanoviak, Dudley, and Kaspari (2005) theorize that gliding is an evolutionary adaptation that canopy ants have developed to minimize foraging costs and predator threats when they fall from the canopy. From this they have hypothesized that a species of ant is more likely to be able to glide if the species is characterized by having arboreal nests, costly workers (heavily armored workers, or a very small colony) that forage at the tips of the branches (Yanoviak, 2005). Early research focused on *Cepholotes atratus*, which has been shown to glide with an 80% success rate (where success is defined as landing back on the tree) (Yanoviak, Dudley, and Kaspari, 2005). The ants are able to guide their descent back to the tree through the use of visual cues (Yanoviak and Dudley, 2006), and the shape and orientation of their appendages during descent (Yanoviak, Dudley, and Kaspari, 2005; Dudley, 2000).

Yanoviak, Dudley and Kaspari (2005) found that ants are no better at gliding towards unfamiliar trees than they are at gliding back to a tree that they regularly traverse. This suggests that they do not show the ability to discriminate between trees when they are gliding - they simply glide to the nearest vertically standing object. However, if - as Yanoviak and his colleagues claim - gliding is an evolutionary adaptation that helps to minimize foraging costs, it would seem to be yet more advantageous for an ant falling through the air to show a preference to glide back to a tree that they regularly traverse (homing) rather than a tree which is of equal distance away, but is not regularly traversed.

In the summer of 2006, Kirsten Blomdal, a student at the Institute for Tropical Ecology and Conservation in Bocas del Toro province, Panama conducted a research project exploring gliding behavior in the canopy species *Camponotus sericeiventris* (commonly known as "fuzzy butts"). *Camponotus s*. is a species of carpenter ants that are found in the tropics, and excavate arboreal nest chambers in partially rotting trees. While variations exist between the different ant castes, *Camponotus s*. can be recognized by their "butt," which does actually appear to be fuzzy, and has a yellow-gold hue.

A *Camponotus S.* of the worker caste. Picture from a web page created by Alex Wild.

Individuals of the species *Camponotus s*. vigorously defend their nests. While the jaws of this species are formidable enough reason to avoid being bitten (a study that was conducted simultaneously with the current research found one soldier with a head width of 5.0mm), *Camponotus s.* belong to the Formicidae family, so are capable of spraying a caustic fluid onto its victim once the jaws have been locked in (Sullender, 2007). Once the jaws have been locked in, experience during this experiment showed that the ants would not let go. Gliding ants are thought to direct their descent using the orientation of their appendages. While most gliding ants tend to orient their abdomen and back legs toward the tree, those species of camponotus who glide "appear to descend head-first to the tree" (Yanoviak, Gliding Ant FAQs). This is particularly interesting because, even though the size of *Camponotus s*. individuals dictates their role in the colony (as with other species) (Busher, Calabi, and Traniello, 1985), the head size of the fuzzy butts increases disproportionately to body size, perhaps necessitating the different gliding style they exhibit. The previous research at ITEC sought to ascertain whether *Camponotus s*. tend to glide back to the tree from which they were taken, IN PREFERENCE TO another tree that is an equal distance away. Ants were taken from the bole of one tree, and dropped from a point that was equidistant from this bole and two other boles. Ants from a colony in a completely different area were also dropped from this point. Those from the first bole almost always returned to the bole they came from. The ants from a different area glided to the three different boles in almost equal proportions. The results indicated that *Camponotus s*. tend to home back to the tree they were taken from. However, the experimental method did not stand up to peer review. One reviewer suggested that if ants from the same colony were taken from two different boles, and showed a greater propensity to glide back to the bole they were taken from, this would provide more definitive evidence of homing behavior.

This study sought to more definitively explore whether *Camponotus s*. exhibits preferential gliding behavior, by modifying the experimental method in the way suggested by the peer reviewer.

Methodology

This research was carried out in a mature tropical rainforest in Bocas del Toro province, Panama. The experiment was conducted on two consecutive days in June, when rain was absent during the time the experiment was conducted, and light was sufficient for the ant-dropper to see the ant fall all the way to the ground from the drop point. On the first day of the experiment there was a very light breeze.

Two trees that were 2.34meters apart at a height of 16meters, and whose boles were relatively clear of vines and epiphytes were selected for the experiment. The trees were designated A (a *luaha semanii*) and B (a tree of the nutmeg family). *Camponotus s*. were observed to be on both trees. Ants were collected from a height of approximately 18 and 19meters on the trees, within a two-foot radius of a nest. Ants from both trees were collected prior to the experimental days in order to ascertain whether the ants are of the same colony. Ants from the same tree were placed in one container together, while ants from another tree were placed in a second container. Individuals of the camponotus genus are thought to be able to recognize members of their own colony through odors disseminated by the queen, odors they develop themselves, and environmental cues (Carlin and Hölldobler, 1986), and will attack individuals who are not part of their colony. The ants in both containers displayed the similar behaviors (locking jaws briefly) at a similar frequency (5-6 times in the first two minutes, and intermittently thereafter), and this behavior appeared to have the quality of grooming rather than aggression. This suggests the ants were from the same colony, and were simply traversing different boles when they were collected.

On each morning of the experiment, ants were collected from the area surrounding the nest and placed in zip lock bags (30 collected the first day, 63 on the second day). The ants were taken to the ground, where their heads were measured for the purpose of another experiment. The source tree for the ant was recorded, and then the ant was placed in a pre-numbered 20cm plastic tube, and this tube number was recorded.
The researcher took all of the tubes containing the ants collected that morning up to a height of 16metres, at a point equidistant from each of the tree boles. The researcher would then pick a tube haphazardly from the climb bag, dropped the ant within, and observed the fall. The researcher called out the landing point to a second researcher, who recorded the landing point with the appropriate tube number. Their point of landing was recorded as Tree A, Near A, No Landing, Near B, and Tree B.

"Researcher" transferring ants from Ziploc to plastic tubes.

Ant within plastic tube, ready for the drop.

Researcher suspended between trees A and B, in the process of dropping ants.

Results

A total of 96 ants were collected, 93 of which were dropped (3 were lost in the transfer from the Ziploc bag to the tubes). 31.2% (29) of these were observed to glide and land on one of the tree boles. A chi-squared analysis was conducted to show whether those ants taken from tree A showed a greater propensity for either tree. This analysis was repeated for tree B. In order to have significance of a = 0.05, the chi-squared index must be higher than 3.841 for this case. The index for ants from A was 0.5798, and was even lower for ants from tree B, at 0.5000. It was considered (as addressed in the discussion) that perhaps the ants did not have a great enough fall distance, and so analysis should include those ants that landed near A or B.

When the data from these ants was included in analysis, 52.7% (49) of the ants were considered to have exhibited gliding behavior. A chi-squared analysis was performed, and the index for ants from tree A was found to be 0.0138, and 0.2592 for ants from tree B.

Table 1: Number of Ants That Glided to Each Tree with Reference to the Source Tree of the Ant, and the Definition of Gliding Behavior.

	Gliding is defined as landingon Tree A or B		Gliding is defined as landing on OR NEAR Tree A or B	
	# that glided to A	# that glided to B	# that glided to A	# that glided to B
Ants from Tree A	3	10	13	11
Ants from Tree B	4	12	8	17

Interpretation of Results

These results suggest that Camponotus s. do not exhibit preferential gliding behavior. Specifically, they do not appear to home towards the tree from which they were taken.

Discussion

There were a number of shortcomings in the experimental method that may have effected the results. For instance, when I spent time observing the behavior of the fuzzy butts, it was apparent that they take very consistent routes through the rainforest canopy and floor. They create ant highways from which they are rarely seen to stray. When the ants were dropped in this research, the ants from tree A were dropped from the opposite side of the tree from which they were taken (see Diagram 1). If an ant relies on visual cues to direct their descent toward a tree, but they are dropped from a point where they don't recognize one tree as that from which they were taken, then it makes sense that they would not glide to their home tree preferentially. Another possibility is that the soldier castes of ant that are around the nest have far less foraging experience than the workers. This suggests that they would be less familiar with any visual cues for the home tree than workers who regularly traverse the ranches in their daily foraging, and may have previous experience with falling and gliding. As such, taking ants from the nest may have been a factor in the low rate of gliding success observed in this study, as well as the finding that the ants showed no preference for their source tree. An informal trial of this possibility was conducted, where ants were collected from the boles of both trees. These ants were held in tubes overnight due to deteriorating weather conditions and subsequent diminished light, making it impossible to observe the ants' falls. When these ants (a total of 20) were dropped, only 1 glided back to the tree it came from, providing further evidence that these species may not home.

Another possibility is that because the ants are from the same colony, they may traverse both trees, and gliding to one tree does not minimize foraging costs any more than gliding to the other tree. Heck, it may even help them get where they wanted to go (the other tree) more quickly. In this light, the study conducted in 2006 was probably of better experimental design because the ants from a different area would not present this issue.

While this discussion outlines a number of shortcomings in this experiment, it is possible that this experimental design was in fact valid, and that the 2006 results were a part of the 5% of statistically significant findings that are actually found by chance. Nonetheless, further experiments need to be conducted that replicate both the 2006 research and this study, in order to provide a more accurate picture of what is going on. Given the high gliding success rate of cephalotes atratus (Yanoviak, Dudley, and Kaspari, 2005), I would recommend using this species for further research into preferential gliding behavior in canopy ants.

Personal Reflection

I conducted this research because I found ants interesting from the get-go in Panama…and - let's be honest - because I wanted the opportunity to do a project in the canopy.

A lot of the fun I had was because I was hanging from ropes and knots that I tied with my own hands, and I was maneuvering around another little world within the slightly larger little world of Panama. "This is a real adventure… there is no guarantee of safety," Joe would say. He was right, it was kind of weird to have my life literally in my own hands. Weird and empowering. People don't have to take so much responsibility for our own safety so much any more… people are so scared of being sued that they have to make everything as safe as it can possibly be, so even we do bugger up, we will be okay. It wasn't like that in the trees. I had to look after myself. I had to make sure I was rigged safely. I had to rest when the sweat dripping off my brow told me rest was what I needed. I had to keep my cool when I was sitting on a branch and ants were biting me. I had to look after myself. We all had to do that everywhere in Panama. We had to take responsibility for ourselves, make our own mistakes, and learn from them. And we relied on each other to help us through our mistakes, and even just the conditions.

The conditions… I didn't mind the physical conditions at all. What bothered me when I was in Panama, and that I still think about now, was seeing a woman walk into the hospital with her infant, while right next door was the morgue, and right next door to that was the cemetery. Okay, it doesn't really mean anything, I know. But what if it does? Are the health and death services in such near proximity for the purpose of practicality? It amazes me that Paradise was a place where people of the land have barely what they need to survive, and we were often all sweating like pigs, covered with grime, swimming through the rainforest air,

drinking two liters of water in two hours in order to stay hydrated. It is depressing to think that the beauty of the forest and the people that make del Drago might be rapidly disappearing…

So I will continue to maneuver myself around my own little world, but I definitely want to go back to Panama one day. I want to go back before I cannot recognize it anymore. And I will buy handcrafted arts from the Indians. I will eat in locally owned restaurants. I will converse with those who serve me my food, only this time in Spanish. I will visit ITEC wherever it may be. And I will appreciate the time I have in Paradise.