

RAPHIA

Newsletter of Caño Palma Biological Station

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Tent-making Bats: The Hidden Gems of Our Jungle (Page 3)



**CANADIAN ORGANIZATION FOR TROPICAL
RESEARCH & RAINFOREST CONSERVATION**

In The Fall Issue of Raphia

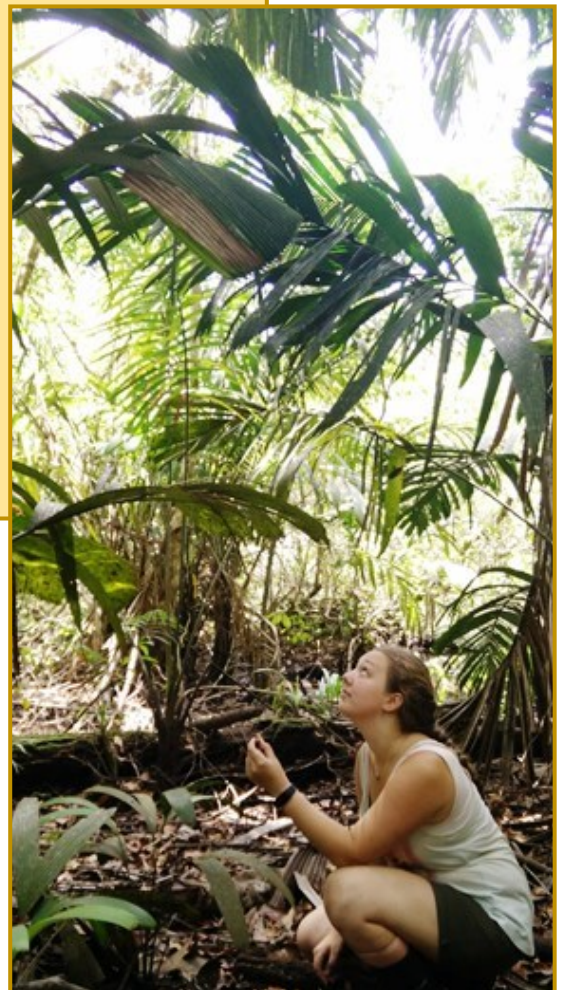
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Feature Story

Tent-making bats are charismatic creatures of the forest. However, you're unlikely to find them unless you know what you're looking for.

Recently, a cement path was built into the forest at the bottom of the Cerro to encourage tourism

On Page 3, Ireen Heuvelmans (at right), a former intern at the station, details her research and conclusions in her investigation to find out if the cement path has affected the behavior of the tent-making bats by fragmenting their habitat.



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Tents, Bats and the Cerro

by Ireen Heuvelmans

There's a special type of bat living in Costa Rica, namely tent-making bats. Around Caño Palma, three such species are known to use leaf tents as their primary roosting structure: Watson's fruit-eating bat (*Artibeus watsoni*)**, the Honduran white bat (*Ectophylla alba*), and the tent-making bat (*Uroderma bilobatum*). (The tent-making bat was not present in earlier or current studies, and neither was their preferred tent-type, conical.)

Tent-making bats construct "tents" by modifying the shape of leaves to build roosts. During the day, the tent protects these bats from rain, sun and predators. At night, when roosting, the bats hang upside down, snuggling close together in the center of the leaf. Each bat species uses a specific pattern of cuts and prefers certain plants. A specific angle to the ground is important so predators can't reach them. Height is also critical: if a tent is too high, it can be vulnerable to arboreal predators, and if it's too low, it may be vulnerable to snakes or other ground-dwellers. Eight different tent types are found: conical, umbrella, pinnate, apical, bifid, paradox, inverted boat and boat/apical.



Ireen creating artificial tent

A lot of research has been conducted on tent-making bats in the Barra del Colorado National Wildlife Refuge where Caño Palma is located. My research focused on El Cerro Tortuguero where the concrete path was recently built to facilitate tourism - however it also fragments the habitat. Such fragmentation can affect the natural movement of

both terrestrial and aerial animals. Additionally, tourism can have negative consequences for wildlife because it can alter and even destroy habitat, increase accidental mortality, and allow people to feed the animals. As such, there's a need to monitor any potential consequences of this newly constructed path.

Fortunately, research was done on the bats in the Cerro prior to the path's construction. I used the earlier study as a baseline with which to compare the results of my study. Additionally, as a way to explore a potential management option, we investigated whether bats would use artificial roosts (that is, artificially constructed leaf tents), and with what frequency.

Once a week for 14 weeks, we walked the transect, collecting data on all the tent-making sites we could locate. We noted the tent type, the density of tents in the area, basal area, and the density of vegetation in the understory. In a transect behind Caño Palma, artificial tents were placed in four plots and observed weekly.

Discussion - The number of bats observed during our monitoring was lower than before the path was built. One explanation could be that bats find the area suitable for foraging, but not for resting and sleeping. Watson's fruit-eating bat and the tent-making bat are known to use different tents and can move between them weekly or even daily. So it is not unheard of to find a lot of tents with fresh bat signs while not seeing any actual bats in these tents.

I also found that the number of tents was lower after the path's construction. It could be that vegetation was destroyed, leading to a lower understory density that the bats didn't favor. With vegetation density lower, wind can more easily penetrate the forest, potentially damaging and breaking tents during storms.

Watson's fruit-eating bat was found in boat and boat/apical style tents after construction, but only in apical tents before construction. This differs from their normal behavior as this species is most commonly found using

Tents, Bats and the Cerro (cont'd)

bifid tents in Costa Rica. This discrepancy may be due to the lack of understory palms in the Cerro. Although the Cerro did host a small number of bifid tents before construction, there were none found after construction.

The other commonly observed species in the area, the Honduran white bat (*E. alba*), was observed before construction but not afterwards, although their obligate tent type, boat, was still present after construction, if in slightly decreased numbers. Additionally, umbrella tent styles were not found after construction, whereas they were previously found to comprise 15% of all tent styles found on the Cerro. As both Watson's fruit-eating bat and the tent-making bat construct this style of tents, this could mean that both are now lower in density or less active in this area.

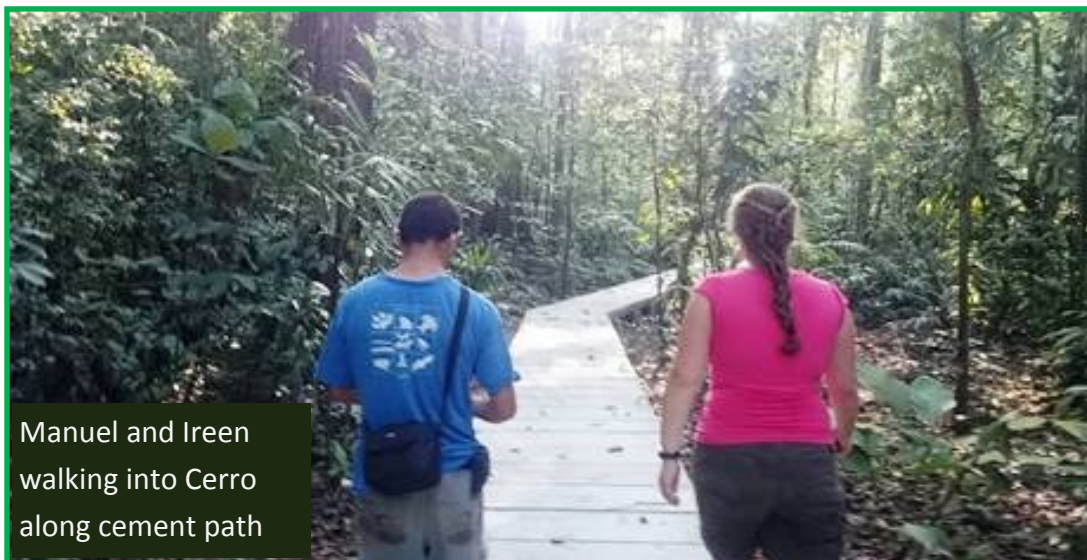
No differences in basal area, understory density and tent density were found between the occupied and unoccupied tents before or after construction of the path, indicating that the bats don't have a specific preference for these variables in creating tents. Additionally, bats don't seem to have a preference for new or old tents as both were occupied. However, given that we observed a higher amount of foraging activity than actual roost-site construction, fragmentation could still be affecting bat behavior. As fragmentation is known to have a negative impact on the natural movement corridors of aerial animals, it's conceivable it may play a role in the lower amount of occupied tents observed.

As far as the artificial tents behind Caño Palma, none were used. There could be many reasons for this: bats hadn't yet found the artificial tents; they didn't make the tents themselves; the tents weren't positioned beside their fly route; the tents were placed in the wrong spots in the forest; or the bats don't like the area around the tents. Additionally, we only used the bifid tent style for the artificial tents because bifid was the most common tent in the area.

But there's more. During a mammal survey around the station (outside the plots of this study), an artificial tent was spotted with signs of bats present (i.e. fruit seeds and feces). As such, we are confident that it is still worth pursuing artificial tents as a management option despite the fact that the ones constructed within our study plots weren't used.

Main conclusion – The construction of the concrete path has had an impact on bat activity in El Cerro Tortuguero. The amount of observed bats and tents had decreased. The fact that artificial tents (outside the study plots) have been used for foraging activity offers hope that they may eventually be used as sleeping roosts as well. If successful as both foraging and sleeping roosts, artificial tents may serve as a way to increase bat activity to previous levels on El Cerro Tortuguero, or other similarly fragmented landscapes.

** Watson's fruit-eating bat is also called Thomas's fruit-eating bat. As well, based on molecular data, some sources have placed it in its own genus, *Dermanura*.



Manuel and Ireen
walking into Cerro
along cement path

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Further Facts about Tent-Making Bats

All species of tent-making bats have things in common:

- **Firstly**, they're relatively small. Too much weight would only cause the leaf where they roost to sag and make their tent virtually useless to them. A small size also enables them to fly with little difficulty through the dense tropical forest.
 - **Secondly**, a male has a harem of several females (polygyny), which he vigorously defends. Groups tend to stay together for years.
 - **Thirdly**, all tent-making bats are frugivores (fruit eaters). So they build their tents in the vicinity of fruit-bearing trees.
- The foliage within which the bats build their tents are good triggers that warn of the approach of predators since predators inevitably will disturb the surrounding foliage.
 - Tent-making bats distribute the seeds of up to 65 plant species.
 - It's been suggested that the main selective force producing the evolution of tent-making is their polygynous mating system. Under this hypothesis, males construct tents to attract females.



Honduran
White Bat



Watson's Fruit-eating Bats in the Cerro

Notes from the Chair by Kimberly Snarr



While I have been involved with COTERC and CPBS for the past 25 years, I'm seeing the greatest challenges in my new role as Chair of COTERC. As I head into semi-retirement, I have come to embrace my new responsibilities with increased time and energy, and hope to help guide COTERC into a bright future. Being new as Chair, I'm grateful that the Directors on the Board continue to aid me in being effective, reminding me of some rules and how certain procedures are to work. Thank you to all Board members as I forge forward in this new role!

Some news from the station. Much of Costa Rica was heavily damaged during Hurricane Nate (see page 21). The northeast coast where the station is situated was spared from the devastation. Station work continues in earnest, hosting interns, training the next crop of biologists who come from various international locations, and passing on the message of conservation to local and international groups.

After a deserved break over the summer, the COTERC Board has moved into the fall by updating our websites, addressing local organizations with educational talks, and delivering sound fundraising to support the station's endeavours. As well, we've been working to secure the administrative and banking privileges once held by Marilyn.

As we move forward, there is a need to re-evaluate COTERC's future trajectory. As a Board, we have been evaluating our short, medium, and long-term goals. In the short term, we are working on making our annual fundraising event, Fiesta Verde, a tremendous success. In addition to your attendance, your support of the auction allows COTERC to move forward in fulfilling its mission. I hope to see many of you on November 4th.

One aspect of our goals involves the use of the Save-An-Acre Fund. This fund was originally created to aid in expanding the land the station holds. When the project was started in the mid-1990s, such land was affordable. However, exponential hikes in prices have meant that buying land near the station is cost prohibitive. Plus, the increasing complications of even 'owning' land in a protected area in Costa Rica have led us to rethink the original goal. One idea the Board is considering is to use these funds to support much-needed infrastructure and upkeep at the station. For example, the dock needs to be rebuilt to ensure ongoing safety, and a bay for larger boats should be included. The small greeting nest at the top where quiet time and observations take place requires shoring up. Further repairs around the station are also needed, and saving the acres we have is vital for its ability to remain safe and productive. For anyone who wishes to comment on this change in direction of funding, please contact me directly at kym.snarr@utoronto.ca.

Woven into the long-term goals is the achievement of self-sustainability for the station in terms of revenue generated versus outputs for infrastructure and the daily costs of staff and materials. The station has been working diligently in this area and often comes close to achieving it on an annual basis. However large capital outlays for infrastructure needs are difficult to come up with, and as such, one of COTERC's long-term goals is to maintain and build on the current infrastructure. This fits with the necessity to maintain the station as a desirable location for researchers to collect data and deliver breakthrough science. We must sustain project output. Our monitoring programs involving various flora and fauna continue to attract the attention of the Costa Rican Ministry of Environment (MINAE). We have been engaged by them to collect data and conduct monitoring programs at the station and beyond. This would include the Cerro, Barra del Colorado Wildlife Refuge, and most recently, the Dr. Archie Carr Wildlife Refuge. We have strengthened our relationship with MINAE

Notes from the Chair (cont'd)

and continue to work cooperatively in delivering much needed data to guide their future decisions about conservation in the region.

As mentioned, to attract more researchers, we must continue to maintain and upgrade infrastructure for incoming researchers, interns and class groups. We are currently fine-tuning a proposed budget for basic lab facilities, which could potentially be a 2nd floor addition atop one of our existing buildings. In honour of Marilyn Cole, our late founder, we will call this lab The Marilyn Cole Legacy Lab.

I want you to see yourself as part of this plan – make yourself part of this plan. Volunteer in Canada, volunteer at the station, come to our fall fundraiser (<http://www.coterc.com/store/p29/FiestaVerdeTickets.html>) and dedicate yourself to filling a table with friends or family who can learn about the rainforest. For those of you who are not in Ontario, Canada, feel free to make a donation to COTERC at <http://www.coterc.com/donate-now.html>. All donors receive a tax receipt.

I wish all of you a safe and productive fall and hope to hear from you personally about what you can do or your views on the path of COTERC.



Cameras – Another Reason To Smile at Caño Palma

By Amy Cocksedge

Amy is a YIIP, part of the York International Internship Program. As Amy describes her time at Caño Palma, it gave her and many other YIIPs a meaningful, hands-on experience in their field. As well, the program gives participants an advantage for future studies and job searches.

Amy has just graduated from York with a Master's in Environmental Studies, focusing on the relationship between animal behavior and wildlife management, a field that tries to manage human-wildlife conflict e.g. when animals raid crops or kill livestock. She hopes this will propel her into a career studying wildlife and getting involved in participatory management projects, which allow people affected by an issue to be included in the solution.

Five a.m. Untuck the mosquito net. Lazily pull yourself out of bed. Pull on long pants and long-sleeve shirt. Socks, still damp from the days before, are pulled over pants to stop unwanted visitors. On top of all this, add rain pants and rain jacket. Despite the heat, you know this is the only way to keep from being eaten alive by mosquitoes. Just grin and bear it. After meeting with your team in the kitchen, you're soon on your way into the rainforest in search of animal tracks because today you're on mammal survey.

The ironic thing about mammal survey is that you rarely encounter an actual mammal. In fact, if it wasn't for the tracks you find, you'd be fairly certain that no mammals existed and it was all a clever ruse. But, despite the lack of physical encounters, there are new footprints every week. Today you're on the Raphia trail, which runs behind the station. This is always an exciting survey because not only is there usually an abundance of tracks, but it also means the animals that made them were right behind the buildings where you live.



You find the usual stuff: a few agouti footprints, tracks of a red brocket deer, and evidence of an armadillo digging for food. Then things get exciting - jaguar footprints cut across the path. Though not unheard of, jaguars are far less common than the other critters out here. But the tracks are unmistakable - overnight rain has made the soil perfect for leaving imprints. So when did the jaguar leave these? You're especially excited by this question because two nights ago you were on the Raphia trail looking for snakes. Knowing jaguars are primarily nocturnal, there's a chance this mysterious beauty was on the path at the same time you were! Regrettably, there's no way to know.

You continue on, searching for more tracks but all the while wondering just how close you were to seeing the jaguar - or it seeing you. You come across peccary tracks. Of the two species in the area, collared peccaries are the far more common, and their tracks are fairly easy to tell apart. The closed toes of this footprint identify it as a collared. You also know that collareds travel in small groups of 2-6 compared with groups of up to 100 for the white-lipped. However, you can't tell how many collared tracks you're looking at. They're going all over the place. If they were in a straight line, it would be easy to determine their numbers. Unfortunately, these tracks seem to indicate the peccaries were having a dance-off. Because of the overlapping and chaos, there's no way to know for certain how many there were. Based on the number of tracks and your knowledge of peccary behavior, the team settles on 6 adults and moves on.

Cameras (cont'd)

After finishing the survey and removing the endless layers of clothing, which are far damper than they were this morning, you settle in with a cold cup of coffee down by the canal to relax, watching kingfishers fly past and turtles bob below. But you can't stop thinking about how close you might have been to encountering a jaguar during the snake survey. Or how many peccaries there were. You wish there was a way to know exactly when the jaguar went by. Or to count the number of peccaries that danced in the forest. Because, without that knowledge, elements of the data you collected are just best guesses.

Emily to the rescue. Former research coordinator, Emily Khazan, received a grant for 6 camera traps through a crowd-funding site called *Instrumentl* and generously left them behind on her departure from Caño Palma. These camera traps have been incorporated into the mammal surveys along the Raphia trail. A camera is placed on a tree at knee height facing an open area of trail. Triggered by movement, they're set to take photos until they're retrieved a week later when the pictures are downloaded onto a computer. After the memory cards are cleared, the cameras are set out again. This allows almost continuous coverage of 6 areas along the trail in order to complement the tracking data.

These traps have proven a valuable addition because, unlike us surveyors who only see tracks, the cameras see the actual animals, providing data that is far more precise. We'll now know exactly when footprints were made and how many individuals were present. The camera traps also allow us to compile a much larger inventory of mammals. On tracking surveys, some animals might be missed because they walked on vegetation rather than dirt, thus leaving no tracks, while other tracks may not last between surveys due to weather or being too faint. Many species - opossums, monkeys, even coatis - that are rarely, if ever, found on tracking surveys are actually quite common along the transect.

Thanks to the camera traps, we no longer have to guess how close we were to a jaguar - we simply have to hope it doesn't see us as a snack!



Jaguar



Peccary

Notes from the Station by Charlotte Foale, Station Manager

This year has seen the realization of a dream for me – the initiation of two more long-term, full-time research projects. While I shouldn't have a favorite, the macaw project is it.

When I first arrived here, I was fascinated by the variety of bird species I saw, but the grating calls of the Great Green Macaw made my heart skip a beat. Initially, we saw or heard them infrequently. Maybe 3 or 4 pairs, just a few months a year. Then their presence became more constant, but still just 6 to 9 birds in any group. The green macaw is an endangered species with global numbers estimated around 3000 and in decline. Costa Rican population estimates vary, in part because we share a population with southern Nicaragua. But is thought to be, combined, around 1500 – although in 2007 I was told that Costa Rica was home to just 30 breeding pairs. Given those statistics, when we started to consistently observe groups of 30-50 individuals, we were both thrilled and a little worried as it was more likely that the population was being displaced from another territory than increasing at such a rate. Whatever the reason for their presence, we knew that the time had come for us to start both studying the population and educating about this species.

We began in 2014 by utilizing the young citizen scientists in our Conservation Club. They worked with community interns Javier and Elena, documenting the time of every macaw observation and the number of birds in each group. This enabled us to informally document population peaks in the area as well as confirm our suspicions that the green macaw is now present here year-round. From that point on, we began to plan a full-time macaw research project, and what we hope will be an annual event, the San Francisco Macaw Festival.

Had our original plans come to fruition, we would have launched the festival in 2016, but I had some serious lessons to learn about small-town politics!

With a clear vision in mind, I approached the president of our local community association to discuss the idea, and was met with positivity and enthusiasm. This was a welcome surprise as we don't see eye-to-eye on a number of issues. Her support was important as she's not just the president, she's also related to a healthy percent of the town's population.

The goals of the festival were several. Obviously, celebrating the presence of and providing education about the Great Green Macaw were key. But, by inviting hotels to get to know the cultural experiences and attractions that were being developed in the town, we also wanted to

make this an event that benefitted locals in the short and long term. We wanted to present San Francisco as a different side of Costa Rican culture to that experienced in Tortuguero. We also wanted to raise funds for the local school, and for macaw research as well as give motivated residents the opportunity to make a little money for themselves.

Something was lost in translation, and I didn't get the memo about making side deals. So, during community meetings, the "festival" became a football game, with fast-food sales... and participants paying for the privilege of being, well, participants... with all profits going to the Community Association, which would decide the project on which it would be spent.

For the sake of upholding democratic ideals, I went along with it, watching my dream dissolve because part of that dream was that the festival would be "by the community, for the community". Then someone told me, "This isn't the way we want it, but this always happens". So, with 3 days to go, I cancelled the whole thing.

Shortly afterward, I visited all the people who had expressed disappointment, and we began again. This time, I was a proper little dictator.

The 2016 process did pay off as I now knew the common ground we held, and I had a good idea who the truly moti-



ated were. We made plans and agreements in one-to-one meetings, and I doggedly pursued confirmations. We visited hotels with information, we put up banners and sent out fliers. Then we hit a major hitch.

With just 5 days to go, we found out that the Community Association, which had been running the Cerro walking trail, had lost the contract, effective immediately. This was a major blow as we were promoting visits to the trail and the use of newly qualified local guides by offering dis-

Notes from the Station (cont'd)

counted tours on the day of the festival. This was a main draw for the hotels, many of which expressed commitment to coming to the festival to take advantage of the \$20 package we were offering. The view from the top of the hill is beautiful, but at \$42, it was one of the most expensive tours offered.

To say my nerves were frayed at this point would be a laughable understatement. Then one of our speakers cancelled, and the road between Tortuguero and San Jose (where the other speaker, Hersson Ramirez lives), was closed by landslides.

The road reopened, Hersson arrived. The land slid - and closed the road behind him.

The day of the festival, August 5th arrived. I spent most of the day believing it to be a disaster, and trying not to let it show. As the inevitable end neared, and I stopped to listen to what people were saying, I realized that we had exceeded most people's expectations, and I began to take stock of what had gone well.

Highlights:

- The sun shone – all day
- The performances of traditional dance by the students from the town of Palmitas were a massive hit. They've won prizes and we could see why! They inspired some of the local girls to start practicing for this year's Independence Day, and to participate in next year's festival.

- People who don't normally participate in local events not only showed up, but they sold out of traditional food and drinks, honored our request not to sell in disposable plastics, and did so well with sales that they independently donated money to the school.
- Local boat drivers joined together to provide a low-cost shuttle service between Tortuguero and San



Francisco and La Pavona so that tourists and Costa Rican locals could easily access the festival.

- Despite the San Jose highway being closed (which delayed new arrivals to hotels by so many hours that the hotels decided not to bring them), guides from Mawamba Lodge rallied some of the longer-term tourists together in the afternoon, and brought them over. The guides said that it was better than they thought it would be, and made us promise to hold it again next year .
- A young entrepreneur in San Francisco was able to solicit tourists to come to the festival and stay in some of the new cabinas in the village.
- Hersson's presentation on his genetic research was

so well received by the tourists that an American teacher described it as the highlight of her trip to Costa Rica.

I learned that, as in any community, we have some spectacular neighbors in San Francisco. While possibly one of the most stressful events of my life (!!), this is something I can see us repeating and growing, with the hope it will provide a foundation for ma-caw education and conservation in the area.



More pics from the Macaw Festival



Raphia

Fall 2017

And more pics



Presentation by
Hersson Ramirez



Raphia

Fall 2017

Dr. Roberta Fulthorpe

Roberta is a new member of the COTERC board, joining in early 2017 as a Director at Large. Presently she teaches Environmental Science at the University of Toronto Scarborough (UTSC) as a full professor.

Her student days saw her obtain a BSc in Biology. Roberta went on to earn an MSc in Aquatic Ecology and Environmental Management from UofT and a PhD in Microbial Ecology from Carleton.

With a CV that is only slightly shorter than *War and Peace*, it's impossible to cover all aspects of Roberta's accomplishments here. However, it's easy to conclude that she has dedicated her life to improving the environment and educating others about it. For instance, Roberta was a director of the Sierra Club of Ontario, co-chaired "Forests for Tomorrow", and was president of the Wildlands League for a few years. One focus of Roberta's teaching and papers is the many aspects of protecting the environment. For a few years, she taught a course entitled "Cleaning up our mess: remediation of air, water and soil".



Raphia

Her research life has taken her to several tropical locations to sample soils and plants in order to study their bacterial communities. Originally focusing on the natural evolution of bacteria that can break down man-made toxic chemicals in waste waters, natural waters and soils, she now specializes in the study of bacteria that form previously unknown and interesting associations with plants. Many of these bacteria can enhance the degradation of contaminants in polluted environments and hold promise for using plants in clean-up operations. Other bacteria enhance the growth of plants under other stressful conditions such as drought and too much salt.

For many years, Roberta was the Chair of Graduate Studies in Environmental Science at UTSC, but is now happy to leave those administrative duties behind to spend more time, again, carrying out research and helping with conservation efforts.

Station Happenings from past Research Coordinator Molly McCargar and present Research Coordinator Anna Harris

June

The 40% increase in rainfall this month signals the start of the rainy season, which peaks in July. (The winter rainy season is in December/January.)

Boa Constrictors – Though snake surveys were cut to two this month, two boas were found, an unusual occurrence as a boa hadn't been seen since last September.

EURIs (European Undergraduate Research Interns) – Three interns, all from the Netherlands, wrapped up their data collection this month and will spend their remaining three weeks at the station writing up their reports. Danny Bregman was studying bird diversity in the village of San Francisco. Ingmar Rondeel continued past research by studying the behavioral responses of tent-making bats to the presence of artificial tents. Huub van Gijn was comparing the current usage of bat tents along the base of the Cerro to data gathered over the last two years. This survey will hopefully become a long-term monitoring program so that we can provide reliable data on trends of these bats' habitat use. (For more on the tent-making bat research, see our feature story on Page 3.)

MSc students – Mathieu Jegu (France) and Martijn Terpstra (the Netherlands) departed the station after satisfying all the requirements for their programs through their internships at Caño Palma and their ensuing reports, and they are now proud holders of MSc degrees.

Macaws – Over half the great green macaws observed (397) during the 18 surveys carried out this month were seen at the Tortuguero site. San Francisco had 225 sightings, the Cerro 102, and Caño Palma 40. Caño Palma had the most scarlet macaw sightings with 24. (Note that these figures don't indicate how many macaws there are in total as birds could be re-sighted on multiple surveys.)

July

Research Coordinator – Anna Harris has arrived from Grand Valley State University in Allendale, Michigan to take over the research coordinator position from the departing Molly McCargar. Anna recently received her MSc with a thesis focused primarily on aquatic macroinvertebrate community composition and aquatic/terrestrial food-web structure in 3 low-order cloud forest streams in Ecuador. At the same time, Jess Hedgpeth, returned as our new assistant turtle coordinator. Jess recently graduated from the University of Saskatchewan with a BSc in biology.

Community Intern – This month we also welcomed a new community intern, Sariah Estrada from Mexico. Sariah is looking forward to working with the community and leading the village Conservation Club.

Poached Eggs – Returning to the station after 18 months away is Helen Pheasey, a former turtle research coordinator. Helen is testing an innovative technique to combat the poaching of turtle eggs. She also plans on conducting interviews in San Francisco to gather local opinions regarding turtle eggs and poaching. Helen is presently working on her PhD at the Durrell Institute of conservation and Ecology at the University of Kent.



Photo by Mathieu Jegu
in San Francisco

Station Happenings (cont'd)

Marine Debris – With 13,000 pieces of trash collected in the beach transect, these numbers were a huge increase over preceding months. The increase is likely due to the increase in rainfall during the rainy season. About 93% of the pieces were plastics.

Macaws – Similar to last month, there were 644 great green macaws sighted this month. However there were only 16 surveys in July compared to 18 in June. San Francisco had the most sightings with 352 while sightings in Tortuguero dropped from 397 to 252. Caño Palma had only 9 sightings. Scarlet macaws dropped from 42 to 24.

August

Mammal Tracking – This month, the station transect had the highest number of animal detections with 393. most were the white-lipped peccary. However, tracks of the greater grison (*Galictis vittata*), endangered in Costa Rica, were also found.



Greater
Grison

September

Rainfall – Although much of the Costa Rica was devastated by Tropical Storm Nate, the station was not impacted by the storm or by residual flooding. In fact, with the end of the summer rainy season, September's rainfall decreased 82%.

Macaws – The number of surveys was stepped up in September to 41, more than double previous months' surveys. For the first time, the Dr. Archie Carr Reserve was included and it had the second-most sightings of green macaws at 150. Tortuguero had 282. As far as the scarlet macaws, San Francisco and Caño Palma were almost tied with 83 and 82 respectively. Scarlet macaw sightings were way up in numbers compared to previous surveys.

Macaw Research – Chris van Roosmalen of HAS University in the Netherlands arrived to research great green macaws and how they use different tree species.

Marine Debris – 854 pieces of debris were collected in September along the transect. This is a remarkable fall-off from previous months and is likely the smallest monthly amount ever collected. As far as plastics, only 537 pieces were picked up whereas the usual amount is in the thousands.



How manta rays and turtles
see plastic floating by

Station Happenings (cont'd)

Sea Turtle Monitoring

Nesting activity – All three species showed large increases in June compared to the same month in 2016. That means that total nesting activity in 2017 has increased over 100% versus last year.

	<u>June/16</u>	<u>June/17</u>		<u>YTD</u>		
				<u>2016</u>	<u>2017</u>	
Leatherbacks	1	5	+4	15	24	+9
Hawksbills	8	17	+9	12	30	+18
Greens	<u>1</u>	<u>7</u>	+6	<u>2</u>	<u>8</u>	+6
Total nests	10	29	+19	29	62	+33

Poaching – After 3 incidents in May, poaching continued to be a problem as another 5 incidents were reported in June. One night patrol came across 3 people on horses dragging a turtle. It was reported to police who said they couldn't help. In the 4 other incidents, eggs were poached from nests. All these events were reported to the Ministry of the Environment (MINAE), and they said they would send some help.

Human Impact – White lights remain a main issue, notably the bright flashlights that the security guards at Turtle Beach Lodge use at night in prime turtle nesting areas. People walking the beach substantially increased this month. Disturbingly, people on horses were spotted 3 times, including the incident where they were dragging the turtle.

Night Patrol – On most nights in June, we were able to have more than one patrol on the beach. A total of 53 teams patrolled for 276 hours.

Collaboration and Outreach

- In September, the station received permits to conduct surveys in the Dr. Archie Carr Reserve, which is set to open for ecotourism within the next 2 years. We'll be extending some of the surveys we already do into the Reserve. These will include large-mammal monitoring, tent-making bat surveys, snake surveys, macaw surveys and ACER plots. (The latter are 20 x 20 m forest plots where we tag, identify and measure the diameter (at breast height) of trees. By remeasuring the trees annually, we can monitor forest growth over time.)
- Linda Dahlstrom of Sweden is a Master's student who will be conducting interviews with the village people to get an understanding of how they view the brand of San Francisco.
- A Nature Expedition group from the USA made a short visit to the station and helped with a beach cleaning, a part of the station's efforts to regain Bandera Azul certification for the village. The group also participated in morning census. Though they were eager to do night patrol, most were underage so couldn't participate.
- Station personnel are planning on giving more presentations on the environment at the school in San Francisco similar to the one Diana Morales and Erin Rehm gave about The Day of the Farmer.

Monitoring - Another Key Role of Research Stations

Excerpted from an article by Shreya Dasgupta on 24 August 2017 in Mongabay, a non-profit provider of conservation and environmental science news on the internet. The story focuses on a key role of research stations – monitoring populations of wild animals and plants. It follows an article in the Summer issue of *Raphia* on collecting, another role of research stations.

A biodiversity crisis is looming. We are in the middle of a "sixth great extinction" of animal species, scientists warn, with loss of species about 1,000 times higher than it would have been without human impact.

Nearly every country in the world has committed to reducing the rate of loss of biodiversity under the Convention of Biological Diversity (CBD) 2010 and 2020 biodiversity targets. One of the first steps to achieving this is to understand the changes in animal and plant populations in the wild over time.

However, population monitoring surveys are often poorly designed, scientists report in a new study published in *Biological Conservation*. And this could pose a serious challenge to halting species loss, they warn. "To understand the changes in biodiversity and develop conservation programs that will be suitable to mitigate or reverse the losses, it's critical to have good quality surveys that satisfy criteria to produce reliable trends in biodiversity," said Stephen Buckland of the Centre for Research into Ecological Environmental Modelling at the University of St Andrews, U.K.

Well-designed surveys should satisfy five criteria, Buckland and Alison Johnston of Cornell Lab of Ornithology write.

First, monitoring programs must choose sample locations that are representative of the region that the researchers are interested in and not biased towards particular habitats or locations.

Second, conservation practitioners must sample a "sufficiently large" number of sites. Sampling too few sites can lead to high bias and low precision of population-change estimates.

Third, monitoring programs must ensure that eve-

ry target species - both common and rare - are adequately counted.

Fourth, species that the practitioners select for monitoring should be representative of all the species in a community. Choosing only common and easily detectable species for monitoring can lead to misleading trend estimates.

Finally, the researchers call for repeated surveys over time (for example, every year or once every three years) to help arrive at reliable long-term population trends.

As an example of how surveys can sometimes be misleading, Buckland points to the Living Planet Index (LPI). The LPI measures global population trends of mammals, birds, fish, reptiles and amphibian species by using data from sources like government reports, scientific articles and research programs. While cost-effective, LPI suffers from several biases, a study published in January found. Some regions like Europe are heavily over-represented relative to others as are temperate bird and mammal species while several tropical species and marine fishes remain under-represented. The level of expertise required to survey species reliably is also often lacking. Given the constraints with respect to resources and expertise, practitioners frequently compromise on survey designs.

"Technologies such as camera traps, acoustic detectors, high-resolution images, drones, etc mean that it is feasible to collect data across wide regions for more taxa than has been possible to date," Buckland said. Existing monitoring programs that have been in place for decades, and where strong biases have been identified, also need to be improved, he added. "This was done for the Common Birds Census in the UK, which monitored a biased set of locations. It was replaced by the Breeding Bird Survey in the 1990s. The two schemes overlapped for several years, allowing bias in the old scheme to be assessed."

Johnston added: "Environmental decisions rely on accurate information about the state of biodiversity. We should continue to collect high quality data and create the best measures we can about the natural world."

Raphia Palm Swamps by Walter Glooschenko

From the *Raphia Archives* - Fall 1991

*Walter Glooschenko was a member of the Faculty of Environmental Sciences at York University when he wrote this article for *Raphia* in 1991.*

When one thinks of palms, swaying trees on a sandy tropical beach come to mind.

But palms are often the dominant form of treed vegetation in tropical freshwater wetlands, especially those subjected to increased periods of inundation. Flooding followed by a dry season and fire appear to assist the development of these palm-dominated wetland ecosystems. Zonation frequently occurs. So, next to a lagoon or river, a freshwater herbaceous marsh may develop, and it could give way to a mixed-tree swamp dominated by palms. Such palm swamps tend to occur in wet depressions and they tend to be of very low species diversity in contrast to most tropical forests. The main threat to these *Raphia* palm swamps are agriculture, both crops or pasture.

There are three major types of palm swamp and they're named after the dominant palm species. The first of these is the *Mauritia* swamp, which contains up to 21 species of this palm. This is typical of South American wetlands. The second type, the *Metroxylon* swamp, often called Sago palm swamp, is found in the South Pacific and Far East.

The third type of palm swamp is dominated by two species of oil palms, *Raphia taedigera* and *Elaeis oleifera*. These two species occur from southern Nicaragua to the Caribbean lowlands of Colombia and the Amazon delta, and cross the Atlantic Ocean to tropical Africa. Or perhaps it's the other way round as it's likely that these two species originated in Africa and were somehow transported to the Americas.

In Costa Rica, *Raphia* swamps are found on both the Atlantic coast and in the Golfo Dulce region of the Pacific coast. The Atlantic coast, where Caño Palma is located, is ideal habitat as it is characterized by barrier islands with lagoons landward of them. The barrier islands protect the lagoons from high-energy waves and allow the palms to become established. The islands also prevent the inland flow of salt water, which would lead to mangrove-dominated ecosystems. The high rainfall as well as proximity to steep mountains and their high runoff also favors freshwater wetland formation on this coast.

The *Raphia* palm is locally called 'yolillo' and the *Raphia* swamps are called 'yolillales'. Besides the *Raphia* palm, the other dominant tree in the yolillales is the royal palm (*Manicaria saccifera*). Besides low plant diversity, these swamps are characterized by waterlogged soil and an extended hydroperiod (period of time when a wetland is covered by water). These swamps make up 7% of all Costa Rican forested wetlands, and some 5% of wetlands in general in the country. Though *Raphia* swamps are certainly an important habitat for a diverse range of birds, reptiles, amphibians and mammals, little is yet known about their ecology. Tapirs and peccaries use them for feeding on palm fruits and seeds. So they present a major opportunity for research in all areas of tropical biology and ecology.



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Tropical Storm Nate by Marshall Cobb in the *Tico Times*

On October 5th, Costa Rica was hit by another devastating storm. Though the station had to be evacuated last November for Hurricane Otto, the Tortuguero area wasn't affected by Nate. This story, about Monteverde, combines two articles from the Tico Times, both written by Marshall Cobb, a resident.

A friend here atop the mountain in Monteverde warned that we would soon experience torrential rains, probably accompanied by mudslides, power outages and related chaos.

"That can't be right," I thought. "Nate is going to turn into a hurricane in the Caribbean. We're atop a mountain on the western side of Costa Rica. Why would we suffer from torrential rains?"

The hours progressed, and the rain came in - sideways. At 40 to 50 kilometers an hour. For almost two days.

All of us atop our small mountain were stuck in the middle. It had already been raining for three weeks straight. The ground was completely soaked. Every new drop was run-off - and then our little temporal [storm] added another 20 or 25 inches of rain to the mix.

The effects started in the wee hours of Friday morn-

ing. As power, water and telecommunications went out, the landslides started.

As dawn approached on Friday, the lack of utilities was compounded by the rain that pooled within the houses on the westward-facing side of the mountain.

Reports started filtering in, but with most utilities out, it was more in the way of rumors and less in the way of facts. Most of my news came from the cashier and a few other people wandering around the only business in town with power (a grocery store with a generator). The word was that our area was cut off from the rest of world by landslides and bridges that no longer existed. There are only a few routes up the mountain to the Monte Verde District to begin with, and much of this highway system involves dirt road roads that are challenging even when it is dry and sunny.

Power began to return to much of the zone on Saturday. Our local team of firemen set up a line to get those who needed to flee Monteverde out. With the return of power, working phone lines eventually came on for many. It soon became clear that the damage to property and roadways was severe, but at least in our general area, the population itself had emerged intact.



Tropical Storm Nate (cont'd)

It will take quite a while for those in this region, and the entire west coast of Costa Rica, to regain their footing both physically and financially. October is generally the worst month for tourism in our area as few care to come for daily doses of rain. With access to Monteverde blocked for some time yet, the jewel of the eco-tourism business in the area - the Monteverde Cloud Forest Reserve - is closed. Many other businesses and tourist attractions in the greater area are also damaged or inaccessible. This issue extends beyond tourism dollars as it also affects teachers, farmers, workers at the Cheese Factory, and just about everyone in the zone.

However, by October 16th, with credit to all District authorities, water and telecommunications were reestablished, grocery stores were fully stocked, buses were running, and major tourist attractions,

reserves, hotels and restaurants were open.

How did all of this happen so quickly? After many conversations with many different parties, I can say that the spirit of collaboration and the willingness to act were, and still are, operating at levels rarely seen here – or anywhere. In terms of problem solving, *pura vida* is often more of a, "Relax, take a deep breath, and know that this, like a bad shrimp, will eventually pass." The version of *pura vida* reflected now is much more of a, "We're all in this together - now let's get out there. Quickly!"

www.ticotimes.net/2017/10/09/one-communitys-story-tropical-storm-nate-landslides-fear-resilience

www.ticotimes.net/2017/10/17/pura-vida-on-a-mission-monteverde-recovers-from-tropical-storm-nate



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COTERC would like to thank the following individuals for their generous donations that will assist in furthering the research we do at Caño Palma.

Pennie Mason	Michelle Hunwicks
Jim Taylor	Rob Hamilton
Lillian & Larry Hall	Lauren Stewart
Susan Kunanec	Durham Region Aquarium
Vanessa Phelan	Society

We would also like to thank Microsoft for the donation of MS Publisher and Windows 10 software.

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