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RAPHIA

Newsletter of Caño Palma Biological Station

Making Strides in Our Monitoring of River Otters

(P 4)

COTERC & Caño Palma : Celebrating 30 years of discovery

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30 years

As we move past a year that has brought the station to pretty much of a standstill, this is a good time to look back at what we've been up to in the 30 years of our existence.

In fact, let's make 2021 the year that we celebrate 30 years of accomplishments - and all that we're going to accomplish in the years ahead.

This will be the year of Caño Palma.

And we have accomplished a lot. Think of all the research that's been done. Or how many people have furthered their learning and contributed to the education of people in the San Francisco area. Plus we have dedicated ourselves to conservation.

It's always been *Raphia's* mission to highlight the successes of those who have been to Caño Palma. In the past several issues, we've spotlighted researchers who have published papers on bats, frogs, ants, and turtles.

In this issue, we have another good example: the article on pesticides and caimans on Page 9 by Paul Grant, a former station manager. He investigates the possible negative effects of pesticide runoff on life in the waterways around the station. This was an important piece of research and was featured in many publications internationally, including *National Geographic*.

Beyond Paul's article, this issue presents the exceptional range of research and study possibilities in our region.

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Thank You Alessandro

We said a bittersweet goodbye to Research Coordinator Alessandro Franceschini in December.

While we are extremely grateful for his work over the past 18 months and will miss him, we are incredibly happy that, after 9 months of jungle isolation, he was able to make it home with family for the holidays. If anyone deserves a hot bath and a home-cooked meal, it's this guy!

We wish him the very best as he returns to Italy before heading off on his next (post-Covid) adventure. The station won't be the same without you. Thank you and **fino allá prossima volta. Until next time sir!'**

- CF -

And Welcome Morgan

Morgan Hughes took over the Research Coordinator's reins from Alessandro in mid-December. But let's allow Morgan to introduce herself.

When asked to introduce myself, I often cringe because, like many in the wildlife field, my resumé and story can be best described as diverse. At 16, my childhood dreams to be a veterinarian were derailed by my father's well-founded belief that I'd spent too many summers as a lazy teenager. Perhaps to live vicariously through me, he shipped me to the Rocky Mountains where a few summers of building trails in the wilderness left me captivated by the mystifying appeal of wild places. Like many students on their first visit to Caño Palma, I quickly realized that I was happier at my worst moments in the wilderness than I had ever been in a city. In fact, my first three years of conservation work involved lugging rocks and cleaning bathrooms, yet my face often ached from happiness.

In 2015, I gained my Bachelor's in Wildlife Management from Utah State University. Their amazing program and staff provided me with leadership opportunities, allowed me to complete independent research, and opened the door for seasonal positions with state and federal agencies where I got to work with hawks, owls, hare, frogs, moose, rodents, prairie dogs, fish and much more.

Upon graduating, I joined the Peace Corps and lived for two years in a small town in the dry forests of northern Peru where I worked with trash management, reforestation and environmental education. While anyone who knows me can assert to my love of the town, living in one of the most threatened ecosystems in the world was nothing short of heartbreaking. I watched as the last (cont'd on next page)

Welcome Morgan (cont'd)

patches of habitat were removed for an expanding agricultural industry only for production to drop due to a lack of native pollinators.

These experiences made me realize the need for sustainable conservation work driven by local realities. I brought these experiences back to the US and the University of Florida where I focused my Master's research on taxa that directly impact the food security of millions of people - that is bats. I documented the regular consumption of mosquitos, corn earworm and dozens of other pest species by the most common bat species in the region.

Following my Masters, I returned to Peru and worked with the National Parks system to assess the ecosystem services present in two Parks in the Piura region. By documenting the importance of native vegetation on groundwater levels and the impact of grazing on native vegetation, we were able to work with the private water company to develop a plan to improve grazing management while increasing the income of locals. I was inspired by the local university student's passionate attempts to fill the huge research gaps in the region while he worked with few resources and little support.

All these experiences strengthened my belief in the importance of research stations such as Caño Palma that work to train future scientists, develop environmental ethics in the local community, and use research to answer questions critical to conservation. I'm thrilled to be a part of the program and look forward to continuing the legacy of research and mentoring. In particular, I'm excited about examining the station's mammal data through the lens of landscape ecology, and the bat data through the lens of population ecology. Beyond the research, I'm excited to be a part of the collaborations and life experiences that emerge from Caño Palma and have a compounding effect on the world.

Otter Scat & New Techniques by Morgan Hughes

Currently, the Neotropical river otter is listed as Near Threatened by the IUCN. Unfortunately, data on this species is still limited. One of the purposes of a research station such as Caño Palma is to expand the database for such vulnerable species by engaging in long-term monitoring. Here Morgan explains how the station is updating its techniques for capturing more and better information about the river otter.

In conjunction with the otter surveys, we are collecting scat samples to examine the DNA they contain, and ultimately to estimate the otter population/sex ratio as well as learn what these otters eat. This information would allow us to draw much stronger conclusions as we pair it with our existing dataset.

Let's look at diet first. By using next-generation sequencing, we can identify prey items in the scat. When otters consume prey -- a fish, for example -- the otter's digestive system breaks down the scales and bones, making it difficult to identify all prey items as to species. These processes can completely prevent the identification of other food items that lose all identifiable markers within the otter's digestive tract. Instead of relying on physical clues from prey items such as scales to identify what otters eat, we can rely on the DNA that makes it through (cont'd on the next page)

Otter Scat & New Techniques (cont'd)

their digestive systems. This form of DNA sampling results in more accurate and consistent results than visual inspection (and identification of scales and bones). By using the environmental DNA (eDNA) found in the scat, we are able to identify snippets of DNA that have previously been established to be unique for a given species. We can then compare these DNA codes with online databases such as the Barcode of Life Data System. These systems, containing the genome of hundreds of thousands of species, allow us to compare the sequences that we found with their database. These databases are made from the hard work of thousands of scientists such as Dr. Nathan Lovejoy who is metabarcoding a variety of fish species found in the channels around the station. Altogether, this process will result in a list of species whose DNA is present in the otter scat, otherwise known as the prey items of the otter.

Now let's move to population analysis. Just as we can identify the animals an individual otter ate using the eDNA from their scat, we can also use the otter DNA found in the scat to distinguish unique individuals. The otter's own DNA in its scat can be sequenced, allowing us to identify the individual otter that produced each scat as well as to establish its sex, and possibly even relatedness to other otters. At present, our otter surveys consist of documenting otter scat and anal jelly found along canals in the area. While these methods are used in other studies, and scat density is correlated with otter density, the conclusions that we can draw from these methods are very limited because of the many other factors that affect scat density. These factors include rain which washes scat away; a flood level which reduces the number of available scatting sites; diet which affects the amount of scat produced; shoreline structure which affects the number of suitable scatting sites; and territoriality which affects the proportion of scat deposited in these conspicuous sites. Given that these factors fluctuate across seasons and locations, it's impossible to accurately compare otter density or activity across seasons or locations (which would theoretically provide insight into important behaviors such as habitat selection). Instead, we can presently only compare long-term trends within a single location. By using DNA analysis to identify the individuals associated with each scat, we could explore individual movement, home-range size, territoriality, relatedness, and population size. We could compare these traits across seasons, locations and habitat types, and will be able to thoroughly and accurately address research questions and make meaningful contributions toward the conservation of this species.

In addition to the studies outlined above, assistant research coordinator Sam Orpin is assessing microplastics found in the otter scat. He'll compare microplastic levels across seasons and locations. In particular, he wants to compare the amount of microplastics found in scat around the station to amounts found in Tortuguero National Park. The purpose would be to see if the Park's proximity to the village of Tortuguero is associated with increased microplastic levels. Due to present budget constraints, we've been unable to sample in the Park. However, Sam's detection of microplastics does show that we have successfully refined our methods and are ready for large-scale sample collection.

Barry Hugh McKee -- R.I.P.

August 9, 1948 – December 7, 2020

It is with great sadness that I report the passing of a good friend and a strong supporter of COTERC.

Barry McKee was a special kind of person. He was always calm, logical, easy-going, generous and practical. As a traveling companion, he was a steadfast and took everything in his stride with a smile. In a meeting, he was the one that kept things moving, brought logic to disagreements, and sense into issues that most people found complicated.

At home Barry and his wife, Collette raised two wonderful children, Caroline and Andrew; and their son-in-law Devin was a welcome addition. He was also very proud of his grandson, Archie. His family was his life, but he also had soft spots for Nascar, football, his friends and tropical fish. In the past couple of years, he walked 10 kilometers a day just to keep active.

It was his passion for tropical fish that first introduced me to Barry. We met in the 80s as members of the Durham Region Aquarium Society where we set up conferences, spoke at meetings, and helped keep the society successful. He traveled often to fish conventions with friends and family. I occasionally joined him when I got the chance.

In 1999, Barry joined me as part of a group that travelled to Caño Palma to survey the freshwater fish in the region. From that point, Barry regularly visited COTERC's research station whenever he could. In 2001, Barry became a member of COTERC's Board of Directors and remained on the Board until 2014. In that time, he was Director of Finance, participated in fundraising events, and made regular visits to the station. Many of the photos of Caño Palma and its wildlife were taken by Barry as solid references of what had been observed.

In 2014, Barry was an instrumental member of the group that re-wrote and organized COTERC's bylaws. Barry brought what he had learned in his positions with Ontario ministries to us. It was Barry that compiled and distilled all the information to the bylaws we have today. I must admit that it was his logic that allowed me to understand the foundations and structure of such documents.

Our condolences go out to all his family. He shall be greatly missed.

Tom Mason

Barry and Tom Find a Pool by Tom Mason

Tom is a former member of COTERC's board, and has been a long-time supporter of the station. In his spare time, he was curator of birds and invertebrates at the Toronto Zoo. This story illustrates the opportunities for research that can be found around Caño Palma when you take the time to look.

In 2003, I led a group to Caño Palma, mostly reptile enthusiasts, most I'd known for years. There were also two members of COTERC's Board, Blue Enright and Barry McKee. Barry is the only one that shared my interest in the native freshwater fish. In those earlier days of CPBS, volunteers, students and interns were few. Often were the times when we were the only visitors to the station for a month or more. So we were bringing much-needed income to the station. It was also how we began an inventory of the local flora and fauna.

With every trip, I tried to cater to what the people wanted. Reptile people liked (cont'd on next page)

Barry and Tom Find a Pool (cont'd)

to walk trails often. If the path had little traffic, reptiles and amphibians would hopefully be more prevalent. So, we'd spend the day searching quiet trails. Timing was important as different species used habitats at different times. So we'd also walk the best trails after dark. It was during a night walk on the Raphia Trail that we discovered "the pool".

It was February. Winter flood waters were receding. Small pools could be found throughout the forest. This particular pool, formed naturally from a fallen tree, was only 120cm by 60cm and no more than 20cm deep. What attracted me to this pool was the number of fish breathing at the surface. In the dark, it was difficult to identify species, but I could tell there were a number of varieties.

On getting back to the compound, I mentioned the pool to Barry, and we decided to visit it the next day. It would be interesting to see what was in the pool. In other pools throughout the forest, we'd found a species of killifish, *Rivulus isthmensis*. But except for one case of a swamp eel (*Synbranchus marmoratus*), we'd seldom seen any other species.


"The Pool"

There had been several trips to assess the freshwater fish in our area. However this had been done by amateur enthusiasts from local tropical-fish clubs. Most collecting was done with dip nets in shallow parts of the canal. At this time in COTERC's evolution, professional ichthyologists had not started looking at the waterways around the station, and the only work available was from the University of Costa Rica's Dr. William Bussing, "Freshwater Fishes of Costa Rica".

So, Barry and I packed up a couple pails, some dip nets and fish bags, and headed for the pool. The plan was to collect as many fish as we could, bring them back to the compound, and identify and photograph every species. Then we'd release everything. It turned out to be a little more than we expected.

At the pool, we got ready. We filled the pails with water. We used our dip nets to remove the pool's dead leaves and branches. Fish showed up immediately, and we transferred what we could to the pails. Then we started sweeping through the water with our nets. The fish kept coming. Soon we had to stop. The pails were filling. We had to return to the compound to give them fresh water and more space. By then it was getting dark, so we waited until the next day to see what we'd caught.

In total, Barry and I captured 107 fishes of 11 species and 6 families. There were the killifish and one swamp eel. But there were also tetras, two species of cichlids, three species of livebearers, a catfish, a sleeper goby, and a species of knifefish (a first for us in Costa Rica). Besides all this, there were a few specimens of freshwater shrimp (*Macrobrachium sp*).

How had such a variety of fish made it to a little pool?

After all, we were several hundred meters from the canal. And there was dry land between the pool and the next closest water. The answer was where we were. CPBS lies in a lowland rainforest. Periodically, high quantities of rain fall, especially in the highlands. So much water flows down that the rivers and canals can't handle the flow - and the lowlands are flooded. At the station itself, it means that the (cont'd on next page)

Barry and Tom Find a Pool (cont'd)

entire 100 acres is covered except for "the Rock", a small volcanic plug at the south-west end of the property. In a heavy flood, the kitchen and office may have two feet of water in it.


Knifefish

The water level can rise quickly. I've observed the canal rise over a meter in an hour with only a light rain at the station. Another time we recorded close to 80 cm of rainfall in one evening, but the canal only rose 15 cm.

So It was a flood event that had created this phenomenon of the fish isolated in the forest.

Caño Palma and the region surrounding it are very similar to the Amazon Basin. At times of high water, the fishes within the canal follow the water into the flooded area since it can provide more food, and the increased habitat can reduce the risk of predation that the smaller fish face at all times. So, fish had dispersed and fed. Then, as the water gradually receded, they'd sought out the deeper water. Unfortunately for our fish, it did not mean a return to the canal. They'd been trapped and ultimately through predation or suffocation would have become fertilizer to the forest. We'd been fortunate enough to find this pool before it disappeared.


Cichlids

It was one discovery among many that makes Caño Palma such a special place.

Barry and Tom's Amazingly Long Species List From Their Amazingly Tiny and Isolated Pool

Family	Species	
Characidae	*Astyanax aeneus*	Banded tetra
Gymnotidae	*Gymnotus maculosus*	Knifefish
Pimelodidae	*Rhamdia guatemalensis*	Pale catfish
Rivulidae	*Rivulus isthmensis*	Isthmian killifish
Poeciliidae	*Alfaro cultratus*	Knife-edged Livebearer
	Brachyrhaphis holdridgei	Olomina
	Poecilia gillii	Molly
Synbranchidae	*Synbranchus marmoratus*	Swamp eel
Cichlidae	*Archocentrus nigrofasciatus*	Convict cichlid
	Parachromis loisellei	Guapote Amarillo
Eleotridae	*Eleotris amblyopsis*	Sleeper goby

Pesticides in blood from spectacled caiman downstream of banana plantations in Costa Rica

by Paul Grant

We continue our look at papers based on research that took place at Caño Palma Biological Station

Below is a summary of Paul's paper, which originally appeared in *Environmental Toxicology and Chemistry* (Volume 32, Issue 11). Paul's co-authors were Million Woudneh and Peter Ross. The abstract for this paper can be found at **https://setac.onlinelibrary.wiley.com/doi/abs/10.1002/etc.2358** Paul was station manager at Caño Palma during the years 2001 and 2002.

A very good one-page information poster of the research is available from our website at http://**www.coterc.org/all-resources---by-year.html**. Scroll down to 2007 and go to last entry "Crocodilians as sentinels of current use pesticide contamination in Costa Rica".

Bananas are of course a major part of Costa Rica's economy. In 2018, exports reached an estimated 2.2 million tonnes, about 10% of the global total.

But growing bananas in Costa Rica requires the use of large amounts of pesticides to fight various pest infestations and fungal diseases that can devastate plantations. Bananas also like rain, which northwest Costa Rica provides in abundance. Put pesticides and rain together and you get runoff into nearby waterways. So, while pesticides may keep the plantations operating, our paper investigates whether that runoff is causing harm beyond the plantation.

For instance, I've witnessed, and locals have pointed out, that there have been massive fish kills as a result of high levels of pesticide exposure. We wanted to know whether these pesticides are also ending up in animals that eat the fish. In particular, we were interested in the spectacled caiman (***Caiman crocodilus***), a small, quite common species of crocodilian whose main diet item is fish. We studied caimans just downstream from some of the biggest banana farms in the country. Sites were located at the base of the Rio Suerte where it drains into the Tortuguero Conservation Area near Caño Palma.

After taking blood samples from 14 adult caimans, they were analyzed to detect 70 current-use and legacy pesticides, and their breakdown products. Our analysis found nine different pesticides, seven of which were legacy pesticides listed as Persistent Organic Pollutants (POPS), banned under the 2011 Stockholm Convention. As these pesticides are no longer in use, this demonstrates their persistence in the environment as they slowly break down over time, despite decades-old regulation. The remaining two pesticides detected were in current use.

What was revealing was that, relative to caimans in more pristine, remote areas, caimans near banana plantations not only had higher concentrations of pesticides, but they were also in a poorer state of health. This suggests that either the pesticides caused toxic effects in caimans, resulting in diminished overall health, or that the quantity and quality of their prey was reduced by pesticides downstream of plantations.

As a long-lived species atop the food chain, these pesticide-related health effects on crocodilians are all the more troubling because they may signal consequences for the entire ecosystem. (cont'd next page)

Pesticides in blood from spectacled caiman downstream of banana plantations in Costa Rica (cont'd)

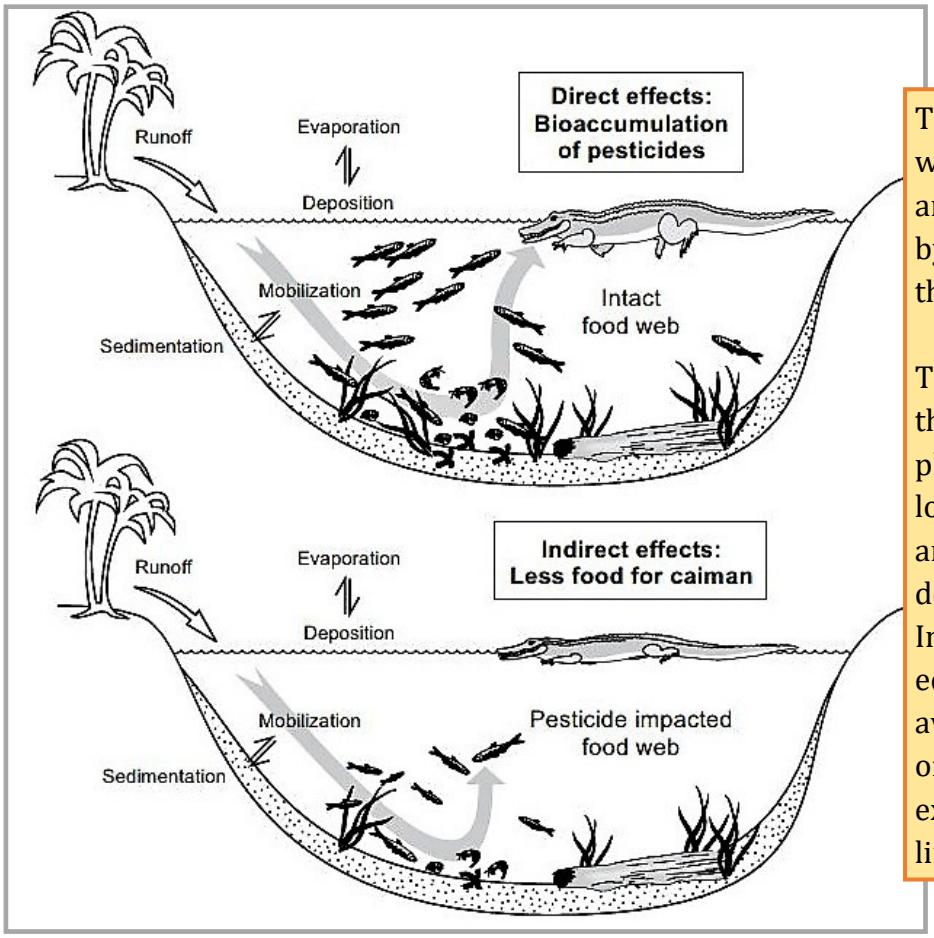
So yes, bananas are economically important to Costa Rica. But when aquatic ecosystems are being damaged by these pesticides, it's important that proper regulations are in place accompanied by adequate enforcement of those regulations.

Further Reading

Are banana farms contaminating Costa Rica's crocs? -- ScienceDaily

Global demand for bananas, pesticide use harming Costa Rica's caimans, study finds - (ticotimes.net)

https://www.theguardian.com/environment/world-on-a-plate/2013/sep/19/bananas-pesticides-spectacled-caiman-costa-rica



The top panel depicts how caiman, which are high in the food chain, are directly exposed to, and affected by, pesticides that accumulate in their food web.

The bottom panel, which the authors of this paper consider a more plausible scenario, depicts how the lower levels of the caiman food web are impacted by pesticides, which do not bioaccumulate in the caiman. Invertebrates and/or fish are affected, leading to a reduction in food availability for the caiman. Reports of fish kills and pesticide levels that exceed water and sediment guidelines support this scenario.

From NATIONAL GEOGRAPHIC:

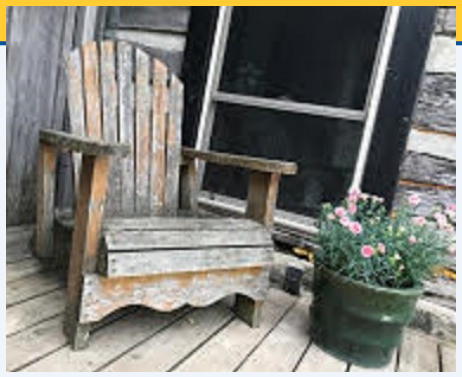
New research from the journal *Environmental Toxicology and Chemistry* found that spectacled caimans (*Caiman crocodilus*) near banana plantations were significantly thinner and had higher pesticide concentrations in their blood than caimans in more remote locations.

"The animals are very, very thin - about 50 percent thinner than those away from the plantations," said study co-author Peter Ross, an aquatic eco-toxicologist and associate professor at the University of Victoria in British Columbia.

It's unclear whether the pesticides are directly toxic to the caimans or are impacting their health indirectly by diminishing the quality and abundance of their food supply.

Ross thinks the latter scenario is more likely given the moderate pesticide concentrations he and his colleagues found. Since all of the pesticides detected were insecticides, the chemicals could be knocking out the bottom of the food chain. This would affect the fish that eat the insects, resulting in caimans having to search farther for food and use more energy to try to find the few fish that remain. - Allie Wilkinson, NG, Oct 1/13

Notes from the Chair by Kym Snarr



As I listen to the news again today about the current pandemic, I hear the numbers of those infected and dying going up across the globe, perhaps due to the rise of new, more contagious variants of COVID-19. While it concerns me for my own health, the health of my family and friends, and the COTERC/CPBS community, I understand that pandemics are not new. Pandemics have been with humans since the rise of civilizations. You can find a quick review of the big ones here: **https://www.livescience.com/worst-epidemics-and-pandemics-in-history.html.**

As with all pandemics, there's a blame game about who originally caused it and the social chaos that results. In Dr. Jacalyn Duffin's book, *History of Medicine: A Scandalously Short Introduction*, she has a brilliant chapter laying out this repeated and predictable pattern. What is new to this deep history of pandemics is the rise of science and vaccinations over the past 100 years, plus the incredible speed with which science can now produce vaccines. Words from my own 93-year-old mother recall the polio epidemic of the early 1950s and the social-distancing issues of that time: "We worried about letting you kids go outdoors". The Salk vaccine of 1954 has helped to curb this infectious disease globally save for a few areas. Let's hope we have the same success with the various vaccines now making their way across North America and the rest of the world.

Safety during this pandemic is certainly paramount for our work at CPBS. With new interns arriving from various countries, staff remain vigilant and work with caution to continue data collection as per the rules and permitted work as laid out by the Ministry of Environment in Costa Rica. Outgoing Research Coordinator, Alessandro Franceschini, and his successor, Morgan Hughes, are facing different dangers to keep our research moving forward in this pandemic. With standard safety protocols in place, work continues.

In the face of the pandemic, we have entered into our 30th anniversary year of operation. In this year, we continue to support our initial objectives – to educate, to carry out research, and to promote conservation in the Neotropics. With a new RC in place, we continue surveys and spreading the findings as far as possible. Certainly, in years to come, it will be interesting to see what changes in trends come from this pandemic. As pointed out by our vice chair, Shelley Hutchinson, in her article on Page 12, a new term, Anthropause, has been coined by a team of UK researchers in June 2020 (see: **https://www.nature.com/articles/s41559-020-1237-z** for original article). Indeed, while we continue our work, it will be interesting to see how reduction of our conservation work has impacted the local wildlife populations. One thing we are seeing is increased poaching due to reduced tourism and hungry mouths.

Over 2021, across all our platforms, we will be looking back at our accomplishments over the last 30 years and where we are now with our work. Think about your connections to COTERC and to the station. What are your contributions? What are your current goals to aid this important work? Look in coming editions of *Raphia*, on our social media and our website for reflections on our last 30 years and what is yet to come.

The Anthropause by Shelley Hutchinson

Shelley is a long-time member of COTERC's board.

In a word, how would you describe the year 2020? Unprecedented? Precarious? The Oxford Dictionary's annual task is to capture a novel word or expression that best reflects the past year's occurrences. However, no number of words could encapsulate the events of 2020. The world saw and felt the effects of what could be described as a 'science fiction' novel as an animal-originated pandemic caused by a coronavirus, specifically COVID-19, spread worldwide, decimating the human population. This airborne virus can cause severe respiratory issues in humans that may not be recoverable. Looking back before the surreal effects and events brought on by COVID-19 was the backdrop of the previous year -- when the Oxford Dictionary declared the phrase of 2019 to be 'climate emergency'.

As the pandemic spread worldwide, most governments responded with preventative measures by declaring emergencies and invoking lockdowns to halt the spread of this highly infectious respiratory disease. Within weeks, mobility restrictions had a ripple effect socially, economically, and, surprisingly, ecologically. As a result of these restrictions, human's impact on the planet was considerably lessened. Comparable to that of a significant pause in time (1), the result was a stark contrast to the current epoch, the Anthropocene (2), a term adopted to describe the detrimental impact humans have had on **planetary boundaries** (3) (See Figure 1). Therefore, it seems fitting to refer to this considerable slowing of modern human activities, notably travel, as the "**Anthropause**." (4)

The Anthropause had its effects on Caño Palma Biological Station (CPBS). Students who had arrived before the pandemic left, and their departure meant a monetary loss for the station. There could be no other incoming personnel until the government eased restrictions. Ultimately, only one person, the Research Coordinator (RC), remained at the station throughout the COVID-19 lockdown.

Many surveys were cancelled as access to sites away from the station was limited due to social-distancing measures. Since turtle surveys typically involve more than one person on beach patrols, they were stopped. COVID-19 restrictions only allowed the RC to research in the vicinity of the field station. So, weather data, plant phenology and other local surveys could continue. (cont'd on next page)

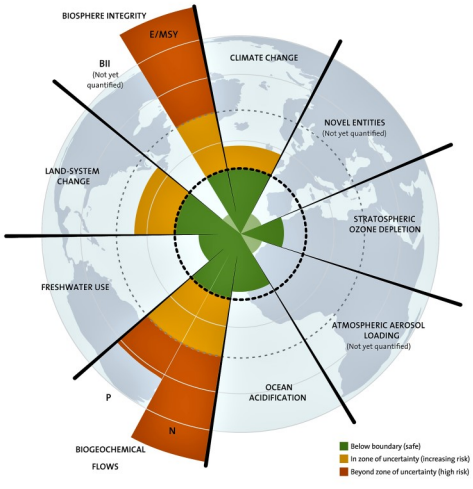


Figure 1: **Planetary Boundaries:** a concept proposed by Johan Rockström from the Stockholm Resilience Centre and Will Steffen from the Australian National University in 2009. **https://www.jstor.org/stable/26268316?seq=1#metadata_info_tab_contents**

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(1) Laura L. Bierema(2020) HRD research and practice after 'The Great COVID-19 Pause': the time is now for bold, critical, research, Human Resource Development International, **https://www.tandfonline.com/doi/full/10.1080/13678868.2020.1779912**

(2) Kolbert, Elizabeth. (2014). The Sixth Extinction: An unnatural history. New York: Henry Holt and Company

(3) Rockstrom, J., W. Steffen, et al. 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2): 32. [online] URL: **https://www.jstor.org/stable/26268316?seq=1#metadata_info_tab_contents**

(4) Rutz, C., Loretto, MC., Bates, A.E.et al. COVID-19 lockdown allows researchers to quantify the effects of human activity on wildlife. Nat Ecol Evol 4,1156–1159 (2020). **https://doi.org/10.1038/s41559-020-1237-z**

The Anthropause (cont'd)

Upon the RC's departure in December, he said that the combination of fieldwork and research coupled with the paucity of human contact during COVID-19 was an experience that very few people would be lucky enough to encounter in their lives. It was a valuable lesson. Despite the devastating effects COVID-19 has inflicted, the RC illuminated something many of us do not recognize -- the Anthropause has created a once-in-a-lifetime experience.

The human population that has endured the Anthropocene epoch and experienced the Anthropause has faced a time that no other human before has undergone and may not in the future. The Anthropause brings unprecedented opportunities for scientific research now and in the future. Many researchers reported early in the pandemic seeing environmental changes. They included changes in animal movement and behaviour, increases in species' populations, noise-reduction effects, and decreased global seismic noise.

For biological stations like CPBS that have been studying, monitoring, and compiling data for a lengthy period, post-COVID-19 presents new research opportunities. It offers an occasion to compare earlier theories and advance knowledge and understanding of biodiversity and conservation in this unique lowland tropical rainforest. It is clear, even more so now than at its inception 30 years ago, that the research conducted at Caño Palma Biological Station is essential. However, the station is vulnerable to becoming collateral damage of the pandemic due to the economic downturn unless it is strongly supported.

Before COVID-19, the planet witnessed the adverse effects of humans on other species and the Earth. The globe was in a state of climate emergency. Western culture led humanity to believe economic growth was paramount, and to stop this growth meant the collapse of civilization as we know it. However, if a single virus can shatter this false premise, it opens the prospect of connecting environmental outcomes to public policies to facilitate biodiversity conservation. Post-COVID-19, through the Anthropause, students, scientists and interns will be presented the opportunity to see what humans are capable of when they curtail their activities.

Wild deer roam the deserted streets of Trincomalee, Sri Lanka during the pandemic lockdown.

If COVID-19 has proven anything, it's that humans can adapt and change in ways that hopefully can positively affect other species and the planet. Humans have been compelled, by the Anthropause, to reflect on cultural inheritance and have discovered it can be modified. With cultural adaptations and modifications, social reform is possible. The Anthropause has provided a unique opportunity where conservation research could be the catalyst that leads to transformative policies that improve worldwide ethical attitudes towards the planet and all that inhabit it. Perhaps the next phase will be referred to as the Anthro-reset.

Notes from the Station by Charlotte Foale

With all the surprises that it could bring, 2020 is finally behind us. We are still operating with thanks to the amazing support that we received from you when the pandemic hit, enabling us to maintain a research coordinator, and keep projects going.

We have faith that 2021 will see us regaining our feet, and the year seems to be off to a promising start. December brought a flood of inquiries and many interviews with prospective interns. Things have still seemed somewhat uncertain, but with our new coordinator Morgan joining returning intern Sam Orpin, travel started to seem like a more realistic option. This was confirmed with the even more recent arrival of French interns Elody and Lucas. We see light at the end of the tunnel!

With these new arrivals we can start to survey more sites, start caimans and snakes again, revisit our forest plot, and start thinking about repeating the beach-erosion study launched this time last year. With 6 snakes observed on caiman survey this week, we were exceptionally happy that our friends at Estación Biologica La Suerte had managed to bring us new PIT tags when they were visiting the area for the invaluable community veterinary campaign they run.

While we are still reevaluating every month, we are also starting to get excited for a turn-around for the marine-turtle project. After a season of devastating poaching levels on the beach, we are hoping that we will be able to get both returning patrol leaders and new volunteers and interns to help to both protect and gather data on the nesting turtles.

We hope that the New Year not only spells a turnaround for the Station in its 30th year, but is also a safe and successful year for our entire COTERC family – we are very well aware that there are many individuals who have been through our doors who are also struggling with uncertainty about the future. Among the many lessons of 2020 has been the incredible fragility of the work we do, and our undeniable reliance on everyone that we at Caño Palma call family. We wish you all the best for 2021, and hope that coming home to Caño Palma featured in your New Year resolutions!

More Decoys and Sea Turtles by Doug Durno

Buried treasure - Turtles don't 'disguise' or 'camouflage' their nests but avoid them, and create a decoy trail

Why do hawksbills and leatherbacks spend considerable time and energy scattering sand around their nest site? After all, it keeps them on the beach exposed to predators when they could just hightail it back to the ocean after simply pushing some sand over the nest to refill the egg chamber.

The obvious answer is that they're camouflaging the nest site. Alternatively, it's been suggested that they're attempting to optimize temperature and moisture conditions above the nest in order to provide the most favorable environment for the eggs to develop successfully.

A third possibility has recently been postulated: that sea turtles are creating decoy nests. The researchers of the paper (linked to below) found that both hawksbills and leatherbacks, after laying their eggs, were moving away from the nest and stopping intermittently to scatter sand about. Their movement appeared random.

The researchers postulate that the mother turtles, by scattering sand at multiple spots around the nest, might mislead predators attempting to locate the nest by scent or feel, decreasing the odds that they'll find the real nest. Since predation risk has been found to be highest for freshly laid nests, the immediate creation of decoy nests could be a winning strategy.

The number of scattering events each turtle undertook was quite variable. Hawksbills made from 1 to 14 stops, and leatherbacks 5 to 24.

The end result is a highly disturbed area of beach. For predators, this means increased search and excavation costs. Other research has shown that predators have altered their foraging behavior in such circumstances. After all, a predator would be wasting a lot of time and energy digging up decoy holes.

Though this study focused on leatherbacks and hawksbills, the researchers think this behavior probably applies to all species of sea turtles.

However, one scientist says that the research doesn't actually show that fewer nests were predated. More work for researchers, eh.

Reference

https://royalsocietypublishing.org/doi/10.1098/rsos.200327

Summer Tanager by Doug Durno

You'll find the summer tanager in Costa Rica in winter. But, because it's a migrator, you won't find it there in summer. So, why's it called the summer tanager then? Heck, even its Spanish name translates as summer tanager.

The answer goes all the way back to 1730 when the summer tanager was first described by the naturalist Mark Catesby in his book *The Natural History of Carolina, Florida and the Bahama Islands*. With communications being pretty rudimentary in those days, Catesby would only have known the summer tanager in, you guessed it, summer.

But Catesby didn't call it the summer tanager. He christened it the summer red-bird. That was to differentiate it from the winter red-bird, what we now call the northern cardinal. So, it's all quite logical - there was a red bird for summer and a red bird for winter.

Now the tale takes a twist - it turns out the summer tanager isn't even a tanager. Recent DNA studies have established that it and other 'tanagers' that migrate to North America - like the scarlet, hepatic and western - should be placed in the cardinal family. So, Catesby was right all along when he 'classified' the summer tanager and northern cardinal together.

Still, if you're at the station in winter and looking for a summer tanager, they can be difficult to spot. They hang out in the treetops, slowly moving along branches looking for insects to eat. Your best chance to see one might be when they fly out to nab an insect in mid-air.

What kind of insects are they looking for? Well, they'll eat many types, but their favorites are bees and wasps. They're one of the few birds willing to take on their stingers. That's one reason their bills are so big - it keeps the stinger a sufficient distance away from their face. Prior to eating one, they'll whack it against a branch to kill it, and then rub it against the branch to get rid of the stinger. (Next article on Page 18 provides some information on the stinger of a wasp.)

Killing wasps could be part of a larger strategy too. It could be that they're terrorizing nests to get access to them. Once (cont'd on next page)

Female eating wasp

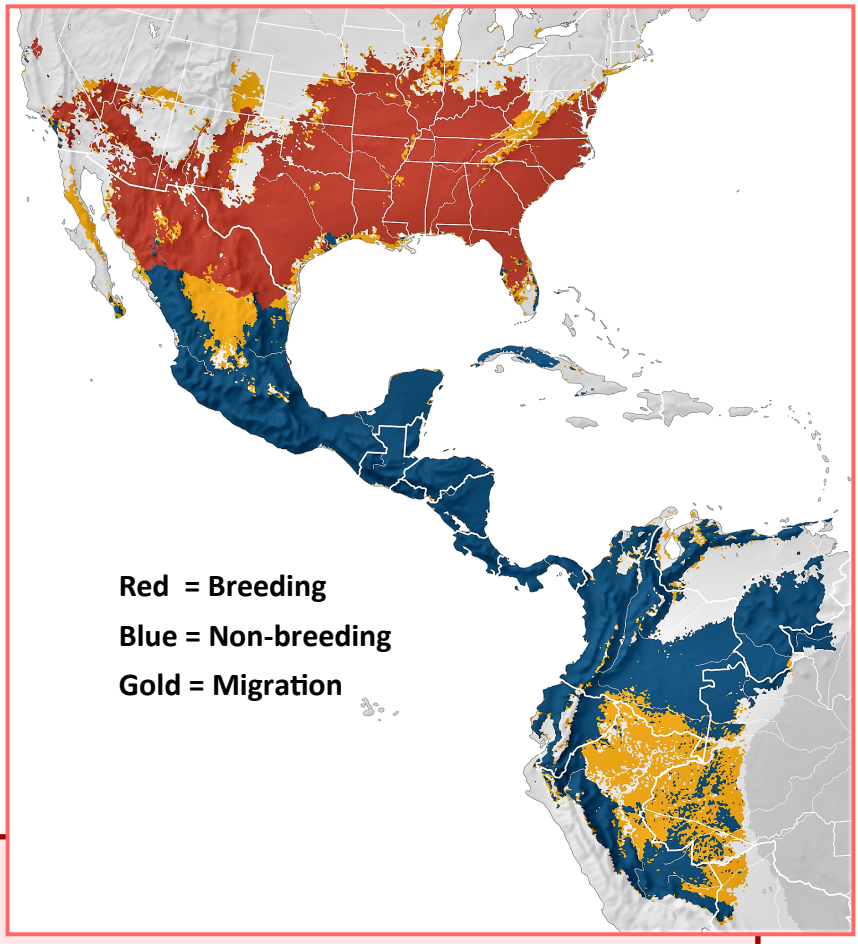
Male

Summer Tanager (cont'd)

they have that, they rip the nest apart and dine on the larvae inside. (See first-hand account of this behavior in the box below.)

Note on Catesby

Intriguingly, Catesby was one of the first people to describe bird migration. He even referred to summer tanagers as "birds of passage, leaving Virginia and Carolinas in winter". Of course, he wasn't the only person to realize that some bird species disappeared in winter. But, in his time, most believed that they were hibernating in caves, pond bottoms or, as Aristotle suggested, hollow trees. One otherwise intelligent Englishman, Charles Morton, having been unsuccessful in finding swallows in those places, reasoned that they must go to the Moon. A true case of lunacy?



Observation of a summer tanager's strategy in attacking a wasp nest - *This is a condensed account of observations by Miguel Alvarez del Toro at the Natural History Museum in Chiapas, Mexico, appearing in The Auk.*

Gazing out a window in my work room in the museum, my attention was drawn toward a summer tanager on a nearby tree. The bird was making short flights from a branch to a wasp's nest 3 meters away. On each foray, the bird grasped with its bill a wasp from the nest. The angry insects followed the bird a short distance. Once perched, the summer tanager tore the wasp apart and swallowed it. An instant later, the bird was making another sortie and capturing another wasp, Many times it merely killed the wasp and dropped it to the ground. This went on all morning.

Sometimes the tanager didn't capture a wasp in passing near their nest, but as the wasps rushed after the bird, it would suddenly turn, snag one of them and dive to escape the insects.

This continued until noon when, after another attack from the tanager, the wasps suddenly en masse deserted the nest. Promptly, the bird alighted on the nest and gorged on the larvae and pupae, and caught any wasp that approached the nest. After the bird left the scene, the wasps eventually returned to their damaged nest.

The following morning, the tanager returned and a similar chain of events occurred. This time though, the wasps retreated at 10:45. The bird finished off any larvae that were left, leaving the nest in shreds.

This raised the question in my mind - Was the tanager there to eat the adult wasps or was its interest focused on trying to force them away so that it could feed on their tender young?

Kill A Wasp? Don't. A Hundred Will Come To Its Rescue by Doug Durno

In wasps and bees, only the female has a stinger. There's a very good reason for that - stingers evolved from the female's ovipositor, the egg-laying organ on the female's hind parts.

Originally, parasitic wasps laid eggs onto a live insect, which their larvae could feed on after hatching. Then nature found another way - lay the eggs inside the victim. To accomplish this though, evolution had to help again. After all, to get inside the victim, the wasps needed something sharp. Over time, the ovipositors got sharper to the point of becoming saw-toothed .

Such a stinger can penetrate even our thick human skin - obviously. Once it has, the wasp injects its venom, which contains enzymes and peptides that can break down our cells' membranes. If it's hit a nerve cell (neuron), pain signals are sent to our brain and we know we should put some distance between us and any wasps in the vicinity. How else can a tiny wasp warn us away from its nest?

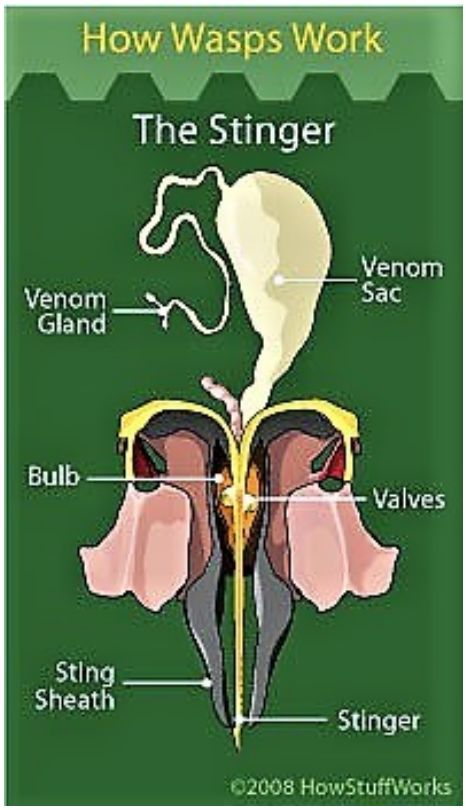
On the other hand, insects that are stung are being issued a death certificate, not a warning. The venom paralyzes them, making it easier for the wasp to get its victim back to the nest to be eaten.

The next evolutionary step was nests, which have the advantage of sheltering the eggs and larvae while the female worker wasps hunt for food and care for the young. And that takes us back to this article's title -- when a wasp is killed or the nest is threatened, wasps release a pheromone that rallies the troops. They'll attack anything they see as a threat. And why not? They're reacting like any human parent when they feel their young are in danger.

Legend has it those attacking wasps sting you and then they die. But that's only true for honeybees, which have stingers that are barbed at the end. When they take off after a sting, the barb catches in our skin, rupturing its abdomen, killing it. However, that's only true when it stings humans and other thick-skinned mammals. With thinner-skinned insects, a honeybee can remove its stinger quite easily.

On the other hand, the stingers of wasps and other bees are smooth and can be extricated from skin without difficulty. The stinger then retracts into the venom sac, and can be used over and over again.

One other note - When getting a needle, the worst part is usually the initial pain of insertion. If the same initial pain occurred with wasp and bee stings, we'd likely swat them away before they got their venom injected. So, the shape and composition of stingers evolved to minimize that pain. Accordingly, researchers would like to apply the stinger's design to needles. What they found is that the tip of the stinger has the least amount of hardness and that lessens the pain on insertion. The base is harder, preventing the stinger from bending too much. The stinger is notched, which lessens insertion forces. In addition, bees and wasps appear to have found the ideal angle at which to penetrate the skin for greatest efficiency. By incorporating such information into a needle's design, injections should be more comfortable experiences.



References

https://animals.howstuffworks.com/insects/wasp2.htm

https://www.sciencedaily.com/releases/2018/10/181009102420.htm

https://en.wikipedia.org/wiki/Bee_sting

Costa Rica's Ongoing Debt Problems by Doug Durno

In the 2018 Winter issue of Raphia, we had a story on Costa Rica's debt problems and the strike that resulted from President Alvarado's plans to address them. Here we are three years later and history's being repeated.

Over the past 20 years or so, Costa Rica has diversified its economy so that there's a good mix of agriculture, manufacturing and tourism. That's much of the reason that it has the most stable of Central American economies. Given a relatively prosperous country, few Ticos emigrate.

But, when a crisis like Covid-19 hits, those advantages become drawbacks. With so few of its citizens having moved to more prosperous countries, remittances sent back home are quite low compared to its neighbors (and outward remittances going to Nicaragua make the net flow quite a bit smaller).

Last April, needing funds to prepare their healthcare system for an expected eruption of Covid-19 cases, a request was made to the International Monetary Fund (IMF) for a US$500 million loan. With these funds, hospital capacity was doubled, and helped limit the impact of the pandemic.

Still, Costa Rica has experienced a whopping decline in tourism in 2020, down at one point over 75%. Unemployment followed, reaching record highs in the 24% range. Government revenues have fallen precipitously.

Costa Rica was now facing a financial crisis. With revenues dropping and spending having to be increased because of Covid, Costa Rica was running up a big deficit in 2020. This follows several years of big deficits. The result is that the country is carrying a huge debt load. Accordingly, credit credit-rating agencies are looking at lowering their ratings for Costa Rica. As a greater credit risk, the government would be saddled with higher interest rates for future borrowings - and thus would be adding even more to their debt load.

It's worth a short look at Costa Rica's debt issues. The debt-to-GDP ratio has increased from 53% in 2018 to 66% in 2020. This is the third-highest ratio in Latin America (behind Brazil and Argentina). And one credit-rating agency is forecasting a rise to 80% by 2022. Interest payments on the debt grew faster than any other Latin American country last year when 21% of government revenues went to interest payments. (Remuneration to public-sector workers is twice as high as the OECD average.)

Facing a crisis, Costa Rica approached the IMF again. Another loan at a favorable rate from the IMF could reduce their interest costs substantially. This time Costa Rica requested US$1.75 billion. This time the IMF, as it usually does, required that Costa Rica institute fiscal changes that address "economic and structural problems". While President Carlos Alvarado proposed both spending cuts and new taxes, critics said his proposal relied too heavily on the taxation side. Among the proposed taxes were a 0.3% fee on banking transactions, higher income taxes for Costa Rica's top earners, and a 0.5% increase in property taxes.

Large and angry protests erupted throughout the country as opposition groups demanded that deficit reduction come from reducing government expenditures rather than tax increases. On October 4th, President Alvarado withdrew the proposed measures. Soon thereafter, national strikes were called by trade unions to oppose the government's dealings with the IMF. Alvarado has since said the government's new proposal to the IMF would primarily center on reductions in public spending, particularly wages and bonuses for government workers. He added there would still be new taxes, but they would play a lesser role.

As of mid-January, negotiations with the IMF are just beginning.

References

https://qcostarica.com/distrust-of-sectors-complicate-signing-an-agreement-with-the-imf-this-year/ - at end, shows the original proposals of government.

https://www.fitchratings.com/research/sovereigns/costa-rica-would-face-debt-challenge-even-with-imf-deal-14-12-2020

Research coordinator's Report

October **River Otter Survey -** With the arrival of Sam Orpin, we were able to restart this survey in 3 transects. The most scat piles (97) this month were found in the Caño Palma North transect, six more than the 91 found in Caño Palma South. Nevertheless, the South transect has a higher density given that it's much shorter than the North transect.

Mammal Survey - A total of 262 mammals were detected this month. On a per survey basis, that's an 11% increase over last year. However, the big news was the detection of two elusive and rarely seen species. The margay, given its arboreal behavior, hasn't been detected around the station in 20 months (since February 2019). As far as the puma, we've known it was present as we started seeing its tracks outside the station's mammal transect. But this was the first time that we've ever recorded this species in the mammal survey.

Margay

Sam Orpin - Since his arrival, Sam has been learning all the tasks and responsibilities required for his new position of Assistant Research Coordinator. As well, as the station transitions to a new Research Coordinator, he has to make sure that all the work and surveys continue to be carried out in the same way as in the past.

November **Great green macaws** - Surveys were restarted in San Francisco this month. On 4 surveys there, 184 greens were seen and 67 scarlets. Compared to previous Novembers at this site, this was a bumper month for both species.

Tent-making bats - A newcomer to the scene, the Northern little yellow-eared bat (Vampyressa thyone), was detected on the Cerro this month (6 individuals). Though uncommon, this species is widely distributed throughout Central and South America, ranging from southern Mexico to Bolivia and western Brazil, and is extant throughout Costa Rica. Though it's listed as of Least Concern by the IUCN, there are still many gaps in the knowledge about this species, and further assessment of their basic ecology, threats and taxonomy has been recommended (Tavares et al. 2015).

Northern little yellow-eared bat

December **Great green macaws** - Though only two sites were surveyed, the highest number of greens in a couple of years were observed - 331, the majority in San Francisco.

Spectacled caiman surveys - This survey has been on hiatus due to Covid. On the single survey carried out this month, seven caiman were observed. Interestingly, six were juveniles. Also of interest were the six adult agami herons observed along the survey route.

Neotropical river otters - The eight surveys carried out in December produced a lower number of scat piles than usual. This is likely due to the higher precipitation this month. An article on enhanced analysis of otter scat appears on Page 4.

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