

P LATO NEGRO, THE BLACK-HEADED BUSHMASTER IN COSTA RICA: A TALE OF SURVIVAL AND CONSERVATION, FROM A PERSONAL PERSPECTIVE



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When I arrived to Costa Rica in 2010, there was one species of viper that I knew was going to be important in my life. Yes, I do not know how or why, but since I saw pictures of the black-headed bushmaster, I was immediately in love. I needed to see it, I needed to feel its presence and power. While I spent the first years in Uvita, in the Southern

Pacific, close to the distributional range of the species, I never could see one. Talking with some friends and colleagues, some of them with much longer experience in the country, I started to understand that to watch this species in the wild could be a little bit more than just difficult. Most people, even old peasants, which I interviewed, just saw maybe

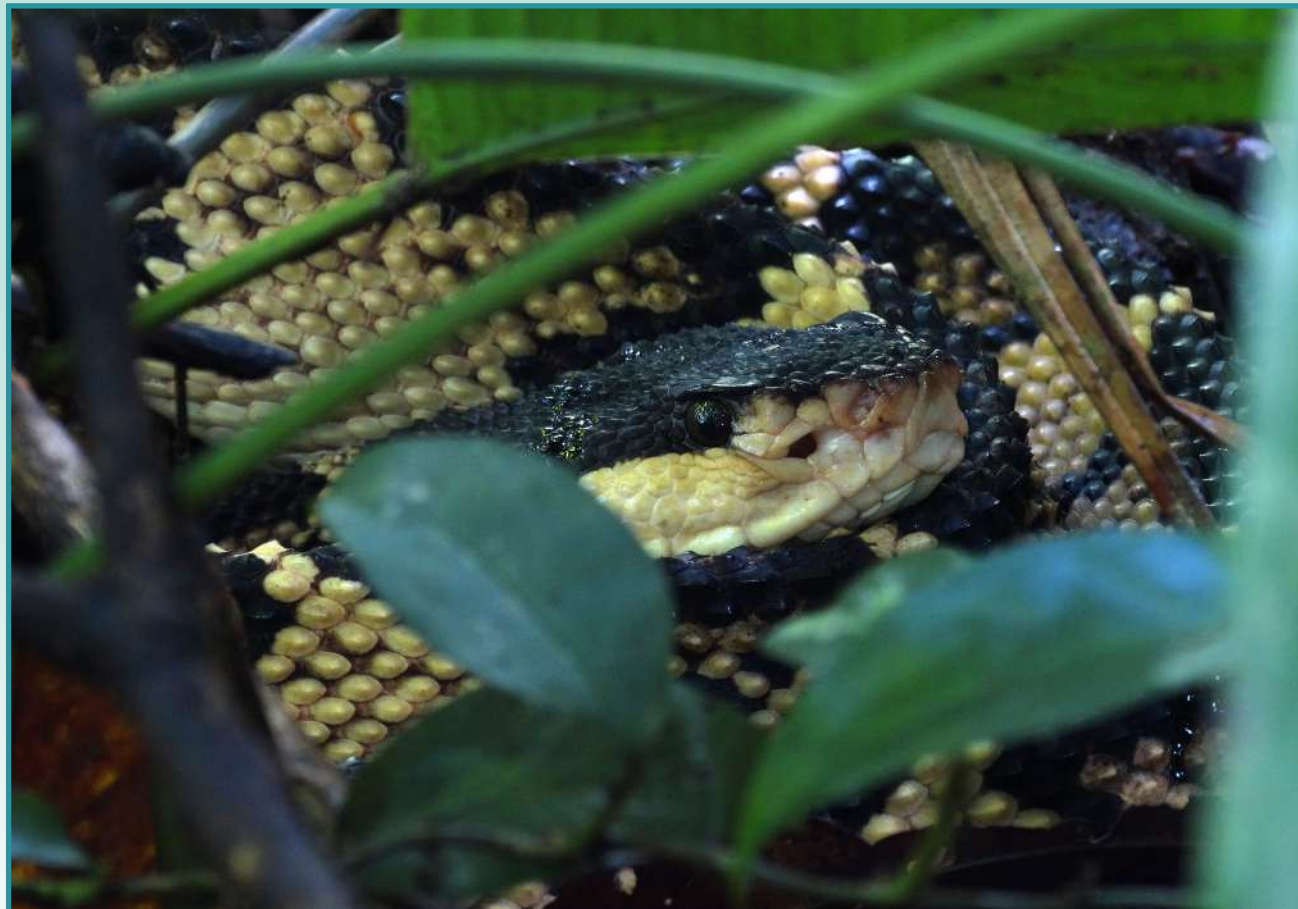


Figure 1. First black headed bushmaster I saw in 2014, thinking it will be the last one!

one in their lives, or heard stories, but never saw one. In 2014, a friend in the Osa Peninsula called and told me it was one to see in a private reserve if we were quick to arrive. We went immediately (3 hours ride through dirt roads) and finally saw it after a long walk in the rainforest, took pictures from a prudent distance, and that was all (Fig. 1)! I thought it would be the only one I ever would see. Some people at that time tried to convince me that they were doing a serious research project about the species, but in the end, that was just a bluff. Afterwards, it was considered a real ghost among Costa Rican herpers, and I did not know anyone else that saw one in the wild, until 2020.

The hotspot

But all this changed in September 2020, when I was called to see another animal also in the Osa Peninsula. I went quickly with a friend, and at last, I not only saw that animal, but I could handle it to put it in a place where it was easier to take pictures (Fig. 2, 3). This was immediately after the COVID pandemic, and many people in Costa Rica (naturalists, guides, photographers) were so eager to go out of their homes to travel and get into nature, that many went to the same spot to see that very same animal. For five days, at least 30 people arrived from all over the country and saw the bushmaster, which remained in the same area. The owners of the land were so surprised! They could not believe so many people went there to see such "horrible" animal, that normally they would kill at first sight. And everybody there paid a tip or recognition to the family. In a few

days, this animal gave them all they need for the month, just leaving it there, alive. A dead animal would not be of any value. This was a real-life change for them, who from the beginning joined the idea of its conservation instead of its extermination.

The last day of observation of this same individual, I returned with my crew to film better



Figure 2. First individual seen in 2020 after the pandemic, in Peninsula de Osa, Costa Rica.



Figure 3. Maybe my favorite picture of the species so far.



Figure 4. Second individual seen the very first night in September 2020.



Figure 5. Third individual seen in 2 days search for the species, indicating that the area was a real hotspot.

the animal, without any interaction; just in situ pictures and footage. We spent almost all day filming; after a while, we returned at night to discover that the animal left. We searched again for hours with no luck. When we were tired and sweaty, going back to our hostel, just resting close to our local guide's home, by miracle, in front of us, under a big trunk in the creek, there it was! We all thought that was the same animal, around 70 m from the first place; but quickly understood that this one was much clearer, bigger, and had different markings (Fig. 4). A second animal, on the same day! But we left it there, after some pictures and filming, as it

started to rain. Next day we searched for it, with no luck. At night, two more friends joined the team, and we split into two groups. After a while searching in the same forest, we received the call of the other team: they had another one!! This time on the move! I could not believe it! We ran until we found it; that animal was moving slowly and lifted the head several times as a periscope to watch calmly those strange primates, without losing its noble path; it arrived under a trunk and just coiled, while the apes were filming (Fig. 5).

The raising of the Project

In summary, in two days we saw three wild animals! This is highly unusual, but told us that we were in a hotspot of this rare species. And of course a crazy idea was born in my head. We needed to start a research project about this species. *Lachesis melanocephala* Solórzano & Cerdas, 1986 is only known by a handful of specimens in museums and observations (see iNaturalist), most concentrated in the Osa peninsula, and many in the same hotspot. I wrote all people intended to be interested in joining a comprehensive effort, including the author of the species, some people at the Cloromido Picado Institute, the guys of the Bushmaster Conservation Project (BCP), and the head of the other project in the area (Plato Negro Project). While some answered that were not interested, the Plato Negro Project even did not

answer, but the BCP, both the Costa Rican part (Greivin and Aaron) and the Belgian part (Bryan and Laura) responded quickly that they were so interested in joining efforts. Once we knew who and how many we were, we wrote and sent our own proposal (Melanocephala Project; MP) to the MINAE-SINAC (the Environment Ministry) to obtain the permit, which was granted in April 2021.

The Project starts

In the rest of 2021, only one animal was located, unfortunately recently hit on the road.

Victor, one of our local partners, took it still alive, but it died after a few hours. The specimen was stored in a big jar full of alcohol. This would help our educational purpose in workshops, as everybody could see it from close, and even touch it, feel it (if necessary) out of the preserving liquid (Fig. 6) and later to be deposited at the Universidad de Costa Rica when the Project ends.

The project was intended to last for 5 years, from 2021-2026. Said so, SINAC approved it, and they were very aware of that. We didn't know that every year was necessary to renew the project, and in June we realized that. Immediately, we sent a report of the year (April 2021-April 2022), in which the main highlights were to report that animal killed on the road, and the workshop we made with the community (Fig. 7). And then, await the renewal.

Talking to the official in charge of our project, she told us that it would be ready within a month at most. By August, it still wasn't, and that's when things started to get weird. The first *Lachesis* appeared and was captured. The project's methodology involved transferring the animal to a private vet clinic in Uvita, the nearest town with this service. The only veterinarian experienced with *Lachesis*, who was also part of the team, traveled from San José to perform the radio transmitter implant (Fig. 8). All of this was done following the methodology approved by SINAC. After the animal recovered, it was returned to the exact same spot where it had been captured for release (Fig. 9). It stayed in a burrow for five days, and once it started moving, we began tracking it with our equipment. This became our male A4. A few days later, another animal appeared, and the process repeated. This one was male C3. Problems arose when another specimen was found crossing a road near Rancho Quemado. We notified Victor to capture it, but someone also alerted SINAC. When officials arrived, they asked Vic for an explanation. Unaware that the permits were being replaced, he showed them, and officers claimed they were expired, confiscating the animal. Expired? Remember the project was of 5 years, and we were awaiting the permit renewal. Should we have stopped there? Or continue with the project knowing that the permits were going to be renewed, since SINAC had confirmed that to us, and that finding such rare animals is extremely hard? That should not even be an issue to continue our investigation.

That situation not only made it difficult to complete the number of animals assigned to us for the first year, but the "Plato Negro Project" quickly intervened to "advise" on the animal's release.



Figure 6. This unfortunate specimen was found recently hit by a car, and died after a few hours. The Project uses it to show the species in talks and workshops to local people.



Figure 7. The local community at Rancho Quemado was open to learn about the species, and very especially the kids were fascinated!



Figure 8. Surgical intervention to implant a radio transmitter inside one of the two males captured.



Figure 9. The individual A4 after releasing it with the radio transmitter.



Figure 10. Victor Merella, one of the original farmers, changed radically his perspective and now is fundamental part of the project.

Remarkably, one of the members of this parallel project, who had never done anything up to that point, was also a SINAC official, not comfortable to see the *Melanocephala* Project gain more prominence.

With all that in mind, and with that official clearly influencing SINAC's decision, which initially should have been a mere formality, the bureaucratic response took five months, until November 2021, when they (under the influence of that official from the other project) decided not to renew our permit. Not only that, but they also issued an order to remove the radio implants from the two males as soon as possible. Through an appeal to the court of justice, we managed to overturn that order, as it was illogical to disturb the animals again, at least until the batteries had run out.

Currently, after several legal battles, thanks to one of the country's most active and incisive environmental lawyer's bureau, our lawsuit against SINAC has been successful, and the project will move forward.

Can sustainable tourism help to preserve a venomous snake?

But how do you make a town that has always feared a species due to its apparent

danger change its mind and dedicate itself to its protection? First, it's important to understand that Rancho Quemado has a more or less extensive tradition of nature conservation, and several residents have participated in projects monitoring and defending the white-lipped peccary from unscrupulous hunters. It wasn't difficult to convince many of the guardians that this species, which they had considered dangerous until now, not only wasn't a threat but that their main hotspot was centered around their own village. Very especially two of the owners of the land where the animals were seen became clearly convinced to help and now they are fundamental part of the Project (Fig. 10). It became a point of pride to have the privilege of enjoying an animal that people from all over the world would come to see, paying and benefiting for specific tours. And so, just as it happens in many other parts of the world, the troubled species became a beloved and protected creature. If someone wants to see jaguars safely, they should go to the Pantanal; for grizzly bears, certain reserves in Alaska and Canada; and undoubtedly, to see the black-headed bushmaster, they should head to Rancho Quemado and take a special tour that strictly follows safety protocols.

OBSERVATION PROTOCOLS

Herping and Biotourism are currently gaining unprecedented popularity. Naturalists, biologists, herpers, and others with a keen interest in nature would undoubtedly relish the chance to closely encounter the *Queen of the Rainforest*. However, as bushmasters are large and potentially dangerous snakes, certain risks are associated with such encounters. To minimize the impact on the bushmaster and ensure the safety of observers, we strongly recommend adhering to the following observation protocols. These guidelines, initially developed by the Bushmaster Conservation Project and CRWild for their respective initiatives, are widely applicable and beneficial.

- 1. Limited Carrying Capacity:** when observing bushmasters, limit the number of persons present at the same time. Always have a trained guide of the Project accompany observers and minimize stress on the animal. Ideally, no more than two people should approach simultaneously.
- 2. Respect Research Subjects:** in areas where bushmasters are studied and equipped with tracking devices (such as chips or radio/GPS transmitters), maintain an even greater distance to avoid disrupting their behavior and data collection.
- 3. Maintain a Safe Distance:** to ensure safety for both observers and the animal, keep a significant distance from the bushmaster. These snakes typically remain calm if not provoked or approached too closely. If a bushmaster shows signs of distress, observers should retire slowly and calmly. The recommended safe distance is three to five meters, as bushmasters can strike up to 2 meters (Fig. 11).
- 4. Photography and Videography:** use only natural light for photography and filming. Professional parties may use only soft lights (such as diffusers or warm-filtered continuous LED lights) upon request and approval.
- 5. Engage with Locals:** treat local people with warmth and respect. They often serve as valuable guides and guardians. Acknowledge and reward landowners and guides for their role in preserving the animals and granting access to observe them.
- 6. No Handling:** strictly avoid handling bushmasters. These creatures are sensitive and susceptible to stress. Improper handling could harm them. Additionally, a bushmaster bite can be fatal, and the nearest hospital may be more than 2 hours away. Only trained experts with scientific purposes and proper permits should handle these snakes, and only when necessary.



Figure 11. Photography of wild bushmasters should observe strict protocols, as guarding a prudent distance.

Figure 12. Preliminary home range map of the two males followed with radio signal. Maps elaborated by Andrés Mauricio Forero.



Figure 13. Wild female spotted close to one of the Project males.

on distribution (Dwyer & Pérez 2009; González Maya et al. 2014), captive reproduction (De Plecker & Dwyer 2020), and comprehensive compilations about the species (Campbell & Lamar, 1989; 2004; Fernandes et al. 2004; Savage 2002; Solórzano 2004; Barrio-Amorós et al. 2020; and Solórzano & Sasa 2020), as well as the invalidation of the neotype designation by Entiuspe-Neto (2021). Therefore, everything related to the behavior of this species in the wild is new data.

So, what we know?

After 3 years of anecdotal expeditions (with the legal part stand by) and hundreds of observations in the area, with two adult males bearing radio transmitters and followed for 4 months methodically, acknowledging that it is too soon to deliver any scientific data, we can share some basic but novel observations on the species.

No previous study on natural history of this species has ever appeared. The only contributions have been essentially the formal description (Solórzano & Cerdas, 1986), its elevation to full species status (Zamudio and Greene, 1997), some notes

At the moment, we know that two males have a territory of 15.4 and 3.15 ha (Fig. 12), but they can move up to 200 meters in just a few days. Their peak activity is related to the onset of rainfall, but they likely don't move much during the first two months because they need to recover (especially the females) from being hidden in burrows. Hydration and feeding are necessary for egg production. Currently, we haven't been able to collect direct data on reproduction, so the only published information can be extrapolated from captive settings (De Plecker & Dwyer, 2020). What has surprised us is that both males and females are much more mobile during the dry season

than previously expected. Neither of the two males sought refuge in dens during the whole year of monitoring, and two different females were seen near males during this time. One of these females was spotted twice: once during the dry season near male A4 (Fig. 4) and again inside a burrow that the male guarded from the outside during the rainy season. It's clear that the animals move much more during the wet season, especially after thunderstorms. Perhaps atmospheric pressure and environmental humidity trigger their activity. We observed two males and a female in close proximity to each other on two consecutive nights in September. Animals moving both during night or day were clearly influenced by rainfall.

In total seven animals were detected (only two clear females) in an area of 96 ha. I should not dare to say this yet, but this would mean 0.07 animals/ha. These results may not seem extraordinary, but we are not aware of any other study of density on bushmasters, and we strongly believe is not a bad result! Of course, this is just counting the number of animals we encountered., and is not statistically relevant. Also, this number is very much under the expected number of 1 animal/ha at least in proper habitat. But this is due to different reasons. First, the original density of the species could be much higher in its distribution, until settlers and farmers started to use the forest, clearing for cattle and crops,

and killing all bushmasters seen at sight. Then, this little valley could act as a refuge for the species, as it was not allowed to go hunting, and the occasional encounters with people were not fatal. In any case, we know that snakes are difficultly detectable. In a study in Europe, Bonnet and Nolleau found that, even in good weather, only 30% of vipers would be exposed; but they only found 10%. In a tropical rainforest habitat, with a highly cryptic animal, we can expect a very minimal percentage (1%?). But much more data is needed to better know the real density in different areas.

Shelters. We have a fairly clear understanding that males rely much less on burrows for resting. They are almost always found outside of them throughout the year, often coiled with its extraordinary camouflage. Sometimes they are exposed on the forest floor (Fig. 14, 15), other times under foliage (Fig. 16), and frequently on slopes of up to 50% steepness. Many times they are found near small streams (Fig. 17).

Behavior. These animals are almost strictly nocturnal, spending their days coiled and inactive (Fig. 18.). However, when faced with a nearby human presence (within the 3-meter range recommended by sighting protocols; (Fig. 19)), the animal may start flicking its tongue and slowly adjust itself if left undisturbed. But if the human gets too close and the snake doesn't feel adequately



Figure 14. During the rainy season, adults can be exposed but camouflaged by its own pattern, on the forest floor.



Figure 15. Active during the night, at daytime the animals remain coiled resting.



Figure 16. The cryptic pattern makes them invisible when under foliage.



Figure 17. Adult bushmasters like to be near creeks and very often cross them to find a good spot to wait for their prey.

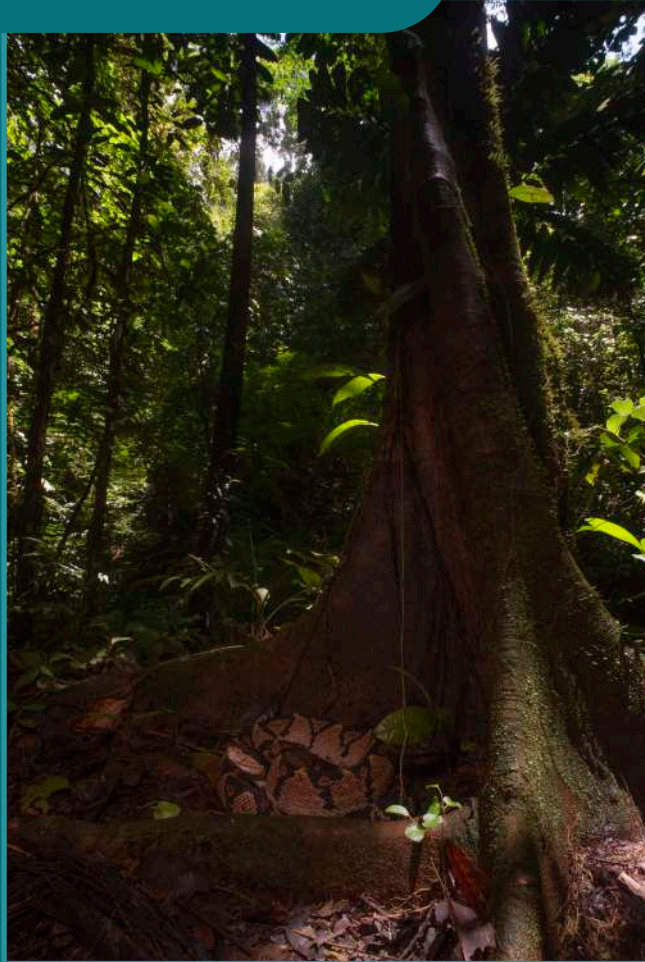


Figure 18. Inactive resting adult male of black-headed bushmaster.



Figure 19. When necessary, investigators can approach carefully to take pictures and data, observing the protocols.

protected, it can react in two ways: 1- It can compulsively agitate its tail, creating a noise similar to a rattlesnake. This serves as a warning (sonic aposematism) to potential predators of its presence. 2- The snake may leap to escape impulsively, which can be mistaken for an attack. In some instances they've been handled for capture or release and those opportunities were taken to photograph and film. Always treated with great care during these moments, they never displayed annoyance or aggression. They often explored their surroundings, seeking places to coil or stopped by streams to drink, allowing photographers to approach without any defense display. Only twice, always during or after rain, have we observed them actively moving during the day. We're uncertain how they would react to the presence of potential prey during daylight. At night, if they're coiled, they can spring into action within seconds within a 1.5-meter radius if they detect prey. We've also seen them actively moving at night. Sometimes we've followed them from a distance, but typically they move a few meters (up to 20 m) before coiling up again. They likely have strategic locations where they rest during their rounds.

What do deceased specimens tell us? On two occasions, we found dead specimens in the wild. In one case, it was an almost complete skeleton missing part of the skull and some vertebrae. In another instance, it was a recently deceased specimen with no apparent signs of human intervention. The specimen was preserved, and a necropsy is pending. In one specimen we've been able to dissect, we detected quite a lot of nematodes (*Porocephalus sp.*) both under the dermis and inside the intestines, in various developmental stages. Another roadkill specimen, preserved for educational purposes in workshops and training, contained rodent hairballs in its intestines.

Feces and sheds. It's not common to find biological material discarded by snakes. Often, we encounter pieces of skin that are completely unidentifiable. While searching for the black-headed bushmaster, we've occasionally found very fresh complete skins - sometimes wet and dirty, other times perfectly collectable. Once, a male (A4) shed its skin twice in less than two months (Fig. 20) during the dry season. We've also been able to identify some *Lachesis* feces relatively close to an animal. The feces can be either fresh and pasty or old, with obvious remnants of mammal hair. Generally, they are found within a radius of at least 10 meters from the animal.



Figure 20. Adult male of *L. melanocephala* close to shed skin (notice the blue tone of the ocular scale).

What we learned and Recommendations

I wanted to convey an initial perspective on what it entails to carry out a project of these characteristics. This is not an official report but a personal appreciation. Once the study is completed, the results will be published in a reputable journal. The conclusion of a project of this magnitude involves many people: scientists (herpetologists, ecologists, toxinologists, veterinarians), educators, local guides, and field experts. Additionally, legal advice is essential to address potential challenges. Typically, a project like this requires external funding, often from conservation-minded individuals who believe in the team's capabilities to achieve its goals. The most critical aspect is maintaining communication between the project team, the local community where it is implemented, and local authorities. Without this, progress is hindered, and failure becomes likely.

However, there are some recommendations we should mention. These apply to any governmental organization, especially when a project has been approved for a five-year period, and bureaucratic processes are not always as efficient as we would expect:

1. Renewal Process: When a project needs renewal, and the paperwork has been submitted and pre-approved, the achievement of its objectives should never be restricted. Particularly when acquiring such rare animals is so challenging; there should be no way to revoke or halt the project while awaiting renewal (unless the project personnel have acted against its goals, endangering themselves or others).

2. Conflict of Interest: Individuals involved in other projects with conflicting interests should never have decision-making power in cases like this. We are aware that one of the members of the competing project (Plato Negro Project) was a SINAC

official. He was the one who dismissed the project's renewal, likely due to personal opinions influenced by direct resource competition.

We have many ideas to make it more relevant and time lasting, but for that we will need not only the complete collaboration of an efficient and diligent SINAC-ACOSA but also the help of many volunteers, visiting scientists, local community, external donors, etc. One of our next main goals is to acquire all the area where the animals inhabit to protect it strictly.

Any help to the Melanocephala Project will be highly appreciated, and will be mentioned in all activities and publications made during it.

Acknowledgements

This project is the result of a long standing passion for bushmasters, for which I must blame many friends: Oswaldo Fuentes, Quetzal Dwyer, Darwin Núñez, etc. But more recently all my activity and interest for them has been embraced by my friend and cofounder of CRWild Cristian Porras Ramírez, without forgetting other colleagues and companions in this endeavor: Víctor Merella, Jovel Cerdas and Jessica Roldán in Rancho Quemado, and the rest of the team, Randal Arguedas, Greivin Corrales, Aarón Gutiérrez, Laura Ruysseveldt and Bryan Minne; also very important to this bushmaster quest is the legal team, Walter Brenes and Valeria Monge. Last but not least, I deeply thank my friend Andres Mauricio Forero for helping with the maps production.

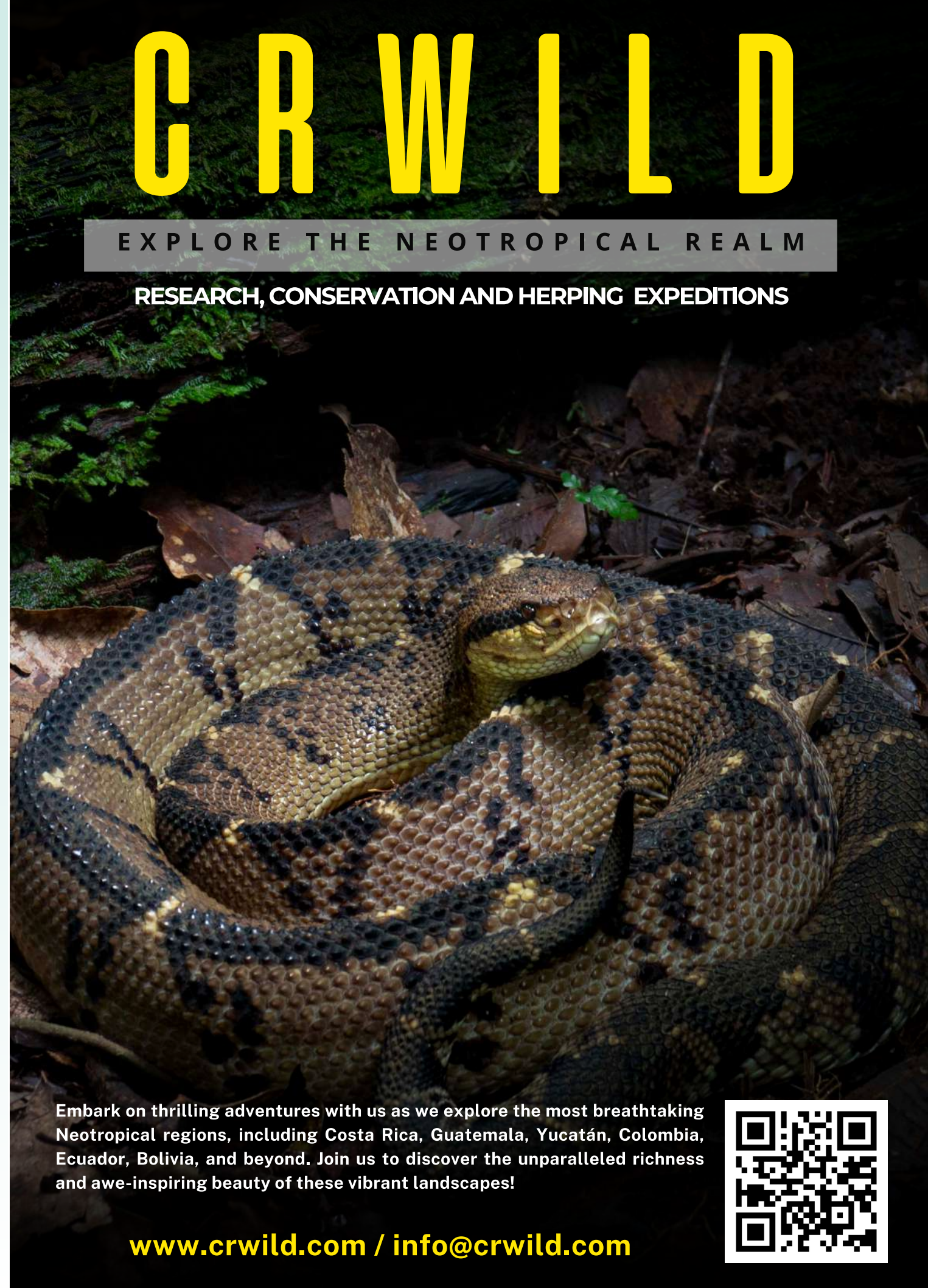
References

1. Barrio-Amorós, C.L. Corrales, G., Rodríguez, S., Culebras, J., Dwyer, Q. & Flores, D.A. 2020. The Bushmasters (*Lachesis* spp.): Queens of the rainforest. An overview of the taxonomy, distribution, natural history, lore, and conservation of the largest vipers in the world. *IRCF Reptiles & Amphibians*, 27(3): 358-381.
2. Campbell, J.A., Lamar, W.W. 1989. *The Venomous Reptiles of Latin America*. Comstock Publishing/Cornell University Press, Ithaca.
3. Campbell, J.A., Lamar, W.W. 2004. *The Venomous Reptiles of the Western Hemisphere. Volume I*. Comstock Publishing Associates, Cornell University Press, Ithaca, New York, USA.
4. De Plecker, R., Dwyer, Q. 2020. First breeding of the black-headed bushmaster (*Lachesis melanocephala*) in Costa Rica. *Herpetological Review*, 51: 57-64.
5. Dwyer, Q., Perez, M. 2009. Geographic distribution: *Lachesis melanocephala*. *Herpetological Review*, 40(1): 114.
6. Entiauspe-Neto, O. M. 2021. Damsel in distress: is the nomenclature of *Lachesis melanocephala* Solórzano & Cerdas, 1986 (Serpentes, Viperidae) in need of rescue? *Bionomina*, 24(1): 51-53.
7. Fernandes, D.S., Franco, F.L., Fernandes, R. 2004. Systematic revision of the genus *Lachesis* Daudin 1803 (Serpentes: Viperidae). *Herpetologica*, 60(2): 245-260.
8. González-Maya, J.F., F. Castañeda, R. González, J. Pacheco & G. Ceballos. 2014. Distribution, range extension, and Conservation of the endemic black-headed bushmaster (*Lachesis melanocephala*) in Costa Rica and Panama. *Herpetological Conservation and Biology* 9: 369-377.
9. Savage, J.M. 2002. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas*. University of Chicago Press.
10. Solorzano, A. 2004. *Serpientes de Costa Rica - Snakes of Costa Rica*. Editorial INBio, Costa Rica.
11. Solórzano, A., Cerdas, L. 1986. A new subspecies of the bushmaster, *Lachesis muta*, from Southeastern Costa Rica. *Journal of Herpetology*, 20(3): 463-466.
12. Solórzano, A., Sasa, M. 2020. Redescription of the snake *Lachesis melanocephala* (Squamata: Viperidae): Designation of a neotype, natural history, and conservation status. *Revista de Biología Tropical*, 68(4), 1384-1400.
13. Zamudio, K.R., Greene, H.W. 1997. Phylogeography of the bushmaster (*Lachesis muta*: Viperidae): implications for neotropical biogeography, systematics, and conservation. *Biol. J. Linnean Soc.*, 62(3): 421-442.

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