

# • Amazonian Bushmaster •

(*Lachesis muta*)

Bites, venoms, and venomous snakes of Colombia

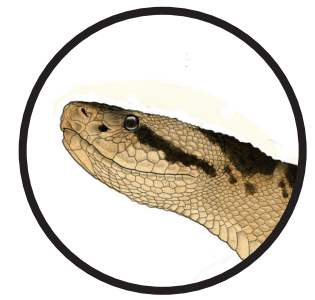
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MEDICAL IMPORTANCE GROUP 3

Snakes that **bite rarely**, but are **capable of causing serious and life-threatening envenoming**.



⚠ Reliable: The information gathered on this species is robust and supported by multiple published scientific studies, including those on Colombian populations. However, there are still aspects of its basic biology, venom, epidemiology, and clinical symptoms that need to be further studied.



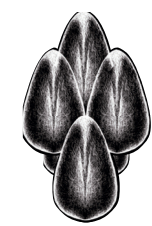
⚠ Detail of: Head, body and tail.

## 1. Envenomation symptoms



Envenomation by *Lachesis* snake species generates highly conserved symptoms among the four species of the genus so far reported, exhibiting few variations among them [1]. Moreover, these symptoms are very similar to those observed in envenomation caused by *Bothrops* species such as: local pain, edema, hemorrhage, ecchymosis, dermonecrosis and myonecrosis. Nevertheless, envenomation caused by *Lachesis* snake species is characterized by showing cardiovascular collapse, alteration of the autonomic nervous system that manifests with profuse sweating, producing "vagal symptomatology" within 15-20 minutes after the bite, abdominal colic, nausea, vomiting, watery diarrhea, diastolic and systolic hypotension, sinus bradycardia, hematuria, uncoordinated gait and intermittent consciousness; all these symptoms known as "*Lachesis* syndrome" [2-5].

Mild lachesic envenoming exhibits pain, absence or slight edema, absence or slight hemorrhages, and absence of vagal manifestations (e.g., hypotension, bradycardia, diarrhea, pale skin, lightheadedness, blurred vision). During moderate envenoming evident edema shows up, as well as a discrete nasal and gingival hemorrhagic manifestations, but vagal manifestations are absent. Finally, during lachesic envenoming severe patients show severe edema and profuse hemorrhage vagal manifestations such as diarrhea, bradycardia, hypotension or shock, renal failure and multi-systemic failure [3,6]. Despite the similarity in the symptoms of *Lachesis* and *Bothrops* species, envenomation caused by *Lachesis* species can be distinguished by the presence of vagal syndrome [4].



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## 2. Treatments and snakebite care



Snakebites by *Lachesis* species should always be considered medically critical. Although *Lachesis muta* accounts for few annual envenomations in Colombia, when they occur, the patient must be immobilized and physical activity minimized to prevent the systemic dissemination of venom. Immediate transport to a hospital is essential.

About 30% of lachesic accidents are usually mild. However, all patients should be treated with the maximum recommended dose of antivenom (10 vials) due to the high snakebite capacity of these snakes that are capable of inoculate a large amount of venom [2,4]. The antivenom therapy for combating envenomation inflicted by *Lachesis muta* must follow the clinical manifestations of snakebites. In cases of mild envenomation 4-6 vials; moderate 7-9 vials, and severe 10 or more [7,8,39]. However, the required dosage is subject to the clinical judgment of the treating physician. It should also be noted that antivenoms manufactured in other Latin American countries, including Brazil, Peru, and Costa Rica, are effective against envenomations by Colombian populations of *Lachesis muta* [7].

## 3. Snakebite capacity



According to data from the Colombian Public Health Surveillance System (SIVIGILA, Spanish acronym) for the period 2010-2020, *Lachesis muta* was responsible for 45 snakebites in Colombia, averaging approximately 2.25 cases annually. Three of these envenomations were fatal. Together, *Lachesis muta* and *L. acrochorda*, they caused a total of 256 snakebites during last decade, of which 138 (53.9%) had mild effects, 72 (28.1%) moderate and 46 (17.9%) severe. For both species, antivenom was used in 82% of the cases, resulting in 6.67% of fatal cases for *L. muta*. This data diverges from the findings of Otero-Patiño [2], which state that bushmaster bites constitute nearly 2% of Colombia's annual snakebites, with approximately 60% of these cases progressing to severe envenomation and 10% proving fatal.

When compared to viperid genera such as *Bothrops*, *Porthidium*, *Bothrocophias*, and *Bothriechis*, snakes of the genus *Lachesis* account for a low incidence of snakebites in Colombia. This low incidence is attributable, in part, to the bushmaster's preference for primary and secondary forest habitats, which are often distant from human settlements. Furthermore, *Lachesis* species are typically non-aggressive and elusive in nature [3,8]. Nevertheless, the few envenomations that do occur are considered severe, largely due to the substantial venom yields—ranging from 200 to 411 mg—that these snakes can inoculate [3].

## 4. Recognition



The Amazonian Bushmaster (*Lachesis muta*) is likely the longest venomous snake in the Americas. While adults typically measure under 2.5 m, individuals of up to 3.5 m have been reported [8]. This species can be distinguished from other pitvipers by several key characteristics: irregular spotting on the dorsal surface of the head, a spine-tipped tail, and prominent, knob-like keels on the dorsal scales. Its coloration also exhibits geographic variation, with western Amazonian populations being darker, northeastern populations (in Venezuela, the Guianas, and Trinidad and Tobago) being lighter, and Atlantic Forest individuals exhibiting a pinkish hue. Additional diagnostic traits include a distinctive black postocular stripe and an iris that ranges in color from black and brown to red-brown to wine-red.

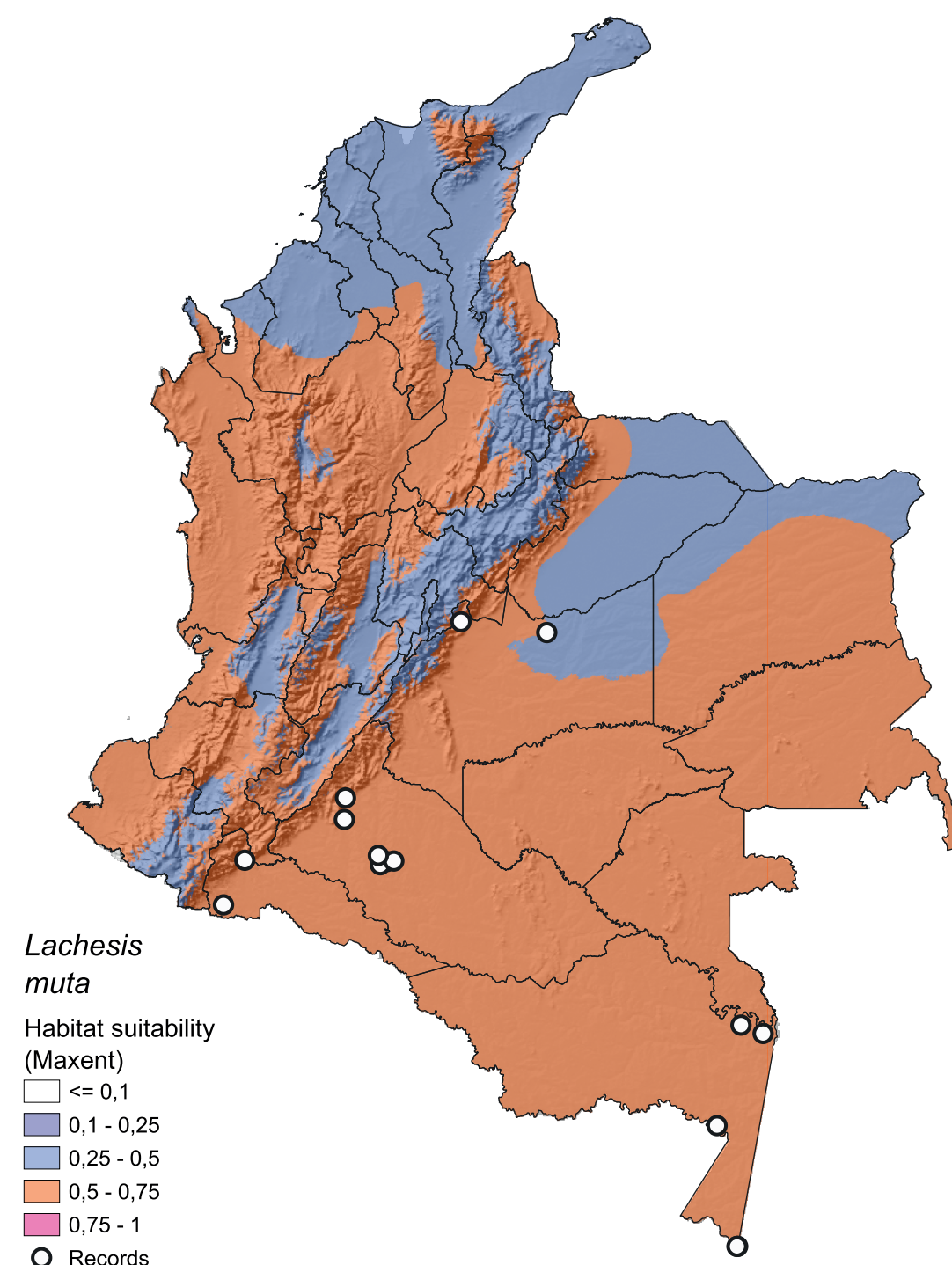
The body's background color varies from light tan and yellow to pink or orange, overlain with 25-35 more or less regular diamond dorsal patterns. From lateral view, these diamonds appear as inverted triangles thickest laterally. They may be fused or separated by one or two vertebral row scales and are typically bordered by a row of scales lighter than the background. Within the diamond, the scales may match the background color, be lighter, darker, or entirely absent. In neonates and juveniles, the diamond patterns may be complete, or incomplete and the tail tends to be reddish in color.

The cephalic scales are smooth to tuberculated. Dorsal body scales are keeled and arranged in 31-38 rows, with the vertebral and paravertebral scales being strongly tuberculated, forming a prominent vertebral keel. Sexual dimorphism is evident in scale counts: males possess 213-231 ventrals and 44-51 subcaudals, while females have 220-236 ventrals and 41-49 subcaudals. Typically, the subcaudal scales are paired, terminating distally in 4-5 rows of small spiniform scales and a large caudal spine at the tip of the tail. However, in some specimens the firsts subcaudal scales may be single [8,9].

## 5. Distribution

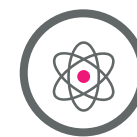


*Lachesis muta* is native of South America distributed across foothills of the eastern Andes, in the Amazon, Esequibo of Guayana, and southern Orinoco River basins, from sea level up to 1800m above sea level [8,10]. In its geographic distribution, it has been recorded in Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, Venezuela and Trinidad and Tobago in the Caribbean [8,11]. In Colombia, *L. muta* has been reported in the departments of Amazonas, Caquetá, Putumayo and Meta [11–13]. The potential area of the distribution of *Lachesis muta* in Colombia is 383,587 km<sup>2</sup> (Figure 1).



**Figure 1.** Geographic distribution of *Lachesis muta* in Colombia and its habitat suitability model. Based on bioclimatic variables, the habitat suitability model predicts the species' potential distribution in Colombia, identifying zones with suitable or unsuitable environmental conditions for its occurrence across the country. Values close to 1 indicate optimal environmental conditions (high probability of presence), while values close to 0 indicate unsuitable conditions (absence likely).

## 6. Natural history



Rare. Data on the population abundance of *Lachesis muta* is scarce in the literature. Furthermore, the likelihood of encountering this species is known to depend on local environmental conditions [8]. For instance, in southern Orinoco River, Venezuela, Barrio-Amorós et al. [14] reported finding only three individuals over three months of sampling. In contrast, within the Turimiquire massif (also in Venezuela), the same sampling effort yielded 12.3 individuals, indicating a higher density than in the Atlantic Forest, where only one individual was reported per 32.5 hours of search effort [8]. Conversely, an 18-month snake inventory in northern Bahia, Brazil, failed to detect any individuals in the field, with a single specimen recorded only from museum collections [15].

Although rigorous population studies are still lacking, these reports suggest that *L. muta* can be sighted with relative frequency in some primary forests, while in other parts of its range, it is considered rare. Consequently, the species is generally regarded as uncommon across its overall distribution [8]. A significant knowledge gap exists regarding the natural history of *L. muta* in Colombia, as it has not been the subject of any local scientific research.

*Lachesis muta* is a nocturnal, terrestrial species that primarily inhabits forest floors with abundant leaf litter. It can also be found, though less frequently, in secondary forests or adjacent open areas [8,9]. There are also documented reports of this species within cocoa plantations [15]. During the day *L. muta* individuals are typically in a torpor state, even though during the breeding season the males adopt an aggressive attitude and remain in a combative posture with each other, even during daylight hours. Individuals of this species often stay under fallen trees or in burrows built by mammals, mainly agoutis (*Dasyprocta* spp.), pacas (*Agouti paca*), spiny rats (*Proechimys* spp.), and armadillos of the genera *Dasyopus* y *Priodontes*, or in rocky cavities [9].

This snake mainly feeds small and medium-sized mammals that are usually between 200–525 g [16], including rodents (rats, mice, spiny rats, squirrels, porcupines) and marsupials, of the taxa *Akodon*, *Oryzomys*, *Proechimys*, *Sciurus*, *Coendu melanurus* y *Monodelphis brevicaudata* [9]. To capture their prey, they employ ambush as a strategy (sit-and-wait), while this is a species that can be considered very active compared to other pitvipers such as *Bothrops* species, and *Crotalus durissus*, and that feeds frequently due to the relatively small size of their prey [16].

*Lachesis muta* is an oviparous species and represents the only confirmed clade of New World pitvipers to exhibit both egg-laying and parental care [9,21]. The average clutch size is estimated to be 6–11 eggs [9], though considerable variation exists. Records from captive breeding report clutches of 6 to 20 eggs [10,16,22, 23], while data from wild specimens indicate a range of 3 to 14 eggs [20]. Currently, no positive correlation between female body size and clutch size or egg dimensions has been demonstrated.

The four nominal species of *Lachesis* have similar gestation and incubation periods. Reported values (in days) are *L. acrochorda*: gestation (g)= 110, incubation (i)= 93 [24]; *L. stenophrys*: g= 100–115, i= 60–90 [9,25–28]; *L. melanocephala*: g= 101, i= 66–75 [26]; *L. muta*: g= 70–100, i= 60–79 [9,10,17,22, 23]. It is critical to note that these data originate from captive individuals, where varying incubation protocols involving temperature and moisture—factors fundamental to embryonic development—can significantly affect incubation duration [21]. Combining gestation and incubation, females may spend up to seven months without feeding.

The reproductive phenology of *L. muta* appears to vary geographically. Some sources propose an absence of distinct seasonal reproduction, citing records of eggs, neonates, and gravid females throughout the year without a clear modal pattern [17,18]. These sources also suggest that sexual activity is stimulated by cold fronts and storms [17,18]. In contrast, studies of Brazilian populations in the Atlantic and Amazon Forests demonstrate marked seasonality, with copulations occurring from April to September—the driest and coldest season in the Amazon—and oviposition from November to February. Neonate emergence then takes place between January and April, coinciding with the onset of the rainy season [19,20].

This apparent contradiction reflects the limited consolidated knowledge of its reproductive biology. Furthermore, truly a seasonal reproduction is rare in tropical snakes [40], suggesting that the reported continuous reproduction in this species is likely an artifact of insufficient data rather than a genuinely atypical reproductive strategy.

Neonates measure 40–54.2 cm in total length. Males reach sexual maturity at approximately 122–129 cm in total length, while females mature at about 112–164 cm, typically within 1–2 years. Under human care, individuals have been known to live for up to 16 years and potentially longer [41]

Given its wide distribution, it is likely that *L. muta* employs different reproductive strategies in response to local environmental conditions. This plasticity may be facilitated by the female's ability to store sperm, allowing for fertilization at the most suitable time for offspring survival [19], although this hypothesis has not yet been formally assessed.

## 7. See it in the wild, rural or peri-urban areas



Given that individuals of *Lachesis muta* typically inhabit places far from human settlements and due to their elusive and cryptic behavior, encounters with humans are unlikely. To increase the probability of encountering these snakes it is necessary to visit the primary and secondary forests where they live, although in some regions they have occasionally been sighted in crops and open areas [8,15]. The expansion of agricultural frontiers and the consequent deforestation in the distribution area of this species increase the chances of encounters with humans. Evidently, human communities in rural areas are the most prone to suffer snakebites involving this species, especially those who carry out agricultural work [2,30,31].

## 8. Conservation



**Not Evaluated (NE).** The conservation status of *Lachesis muta* has not been formally evaluated on the IUCN Red List of Threatened Species [32]. Similarly, it is not listed under Resolución 1912 de 2017 by the Ministerio de Ambiente y Desarrollo Sostenible de Colombia for threatened wild species. However, it was assessed in the Libro Rojo de Reptiles de Colombia as Least Concern (LC).

A population from the Atlantic Forest in Ceará, Brazil—previously considered a separate subspecies, *Lachesis muta rhombeata*—was categorized as Vulnerable (VU) by the IUCN [33]. It is important to note that this subspecific classification is no longer considered taxonomically valid [34,35]. Despite the "Least Concern" designation in Colombia, Barrio-Amorós et al. [8] argue that *L. muta* should be considered Near Threatened (NT) globally. They contend that despite its wide distribution, it is a naturally scarce species facing imminent threat from accelerated habitat loss.

Regarding direct threats in Colombia, Lynch et al. [36] identified and ranked five primary factors affecting snake populations, from least to most impactful: (1) Illegal wildlife trafficking; (2) Mortality from vehicular traffic; (3) Mortality caused by farmers and farm workers; (4) Mortality associated with habitat loss and destruction. Considering the ecological traits of *L. muta*—including its low population density and specific forest habitat requirements—it is highly vulnerable to threats 3 and 4. While this threat framework was developed for Colombian snakes in general, it underscores the significant pressures facing *L. muta*. The precise impact of each threat factor on its populations within Colombia, however, remains to be quantitatively assessed.

## 9. Scientific name and common names



The name of the genus derives from the Greek "*Lachesis*" (Λάχεσις): the Apportioner, one of the Moirai, the three Greek goddesses who determine the destiny of human life [9,37]; the specific epithet comes from the Latin "*mutus*" (=mute), probably as a reference to the apparent similarity with the rattlesnakes of the genus *Crotalus*, to which it was originally assigned by Linnaeus [38], but being silent because it has no rattle [8]. The vernacular name in English for snakes of *Lachesis* genus is "busmaster". Because of its wide geographic distribution, *L. muta* has an extensive list of common names, of which the following can be highlighted for some regions: Apaga fogo, pico de jaca (Bahia, Brazil) surucucú (Amazonian Brazil); surucucú de fogo (northeastern Brazil); surucutinga/surucucutinga (central Brazil); pucarara, cascabel púa (Bolivia); verrugoso, diamante, macaurel, mapaná rayo, martiguaja, montuno, pudridora, riega (Colombia); yamunga (shuar), motolo (kichua), yamung/a (shuar), genenenka (huaroani) (Ecuador); maitre de la brousse, urukuku (French Guiana); conocooshe, counacouchi, patiesak (Guyana); shushupe, cuanira, dueño del monte, macapé, monare (Peru); bosmeester, kapisisneki, maka sneki, makkaslang (Surinam); mapepire z'annana, mapepire zanana, pine-apple mapepire, mapepire ananas, pineapple snake (Trinidad and Tobago); cuaima, cuaima piña, cuaima concha de piña, daya (Venezuela) [8].

**Table 1. Summary of important biological, venom, epidemiological and medical traits.**



TOXICITY AND BIOLOGICAL ACTIVITY	VENOM ACTIVITY PROFILE	GENERAL BIOLOGICAL TRAITS
<b>LD<sub>50</sub> (µg/mice):</b> 123.8 (100.73–150.4 µg)	<b>Proteolytic:</b> Yes	<b>Total Length (cm):</b> ♂ 180.5 (45–250) ♀ 197.2 (45–350)
<b>MCD (µg/mL):</b> 5.22 (±8.85 µg)	<b>Neurotoxic:</b> No	<b>Weight (g):</b> ♂ 1940 (10–4052) ♀ 2687 (12–4452)
<b>MDD (µg/mice):</b> 0.63 µg	<b>Myotoxic:</b> Yes	<b>Reproduction:</b> oviparous
<b>MED (µg/mice):</b> Unknown	<b>Hemotoxic:</b> Yes	<b>Diet:</b> Mammals, mainly small rodents and marsupials
<b>MHD (µg/mice):</b> 0.51 (±0.09 µg)	-	<b>Distribution:</b> East of the Andes, around the entire Amazon Basin, Essequibo and south of the Orinoco, in Amazon rainforest ecoregion up to 1800 m of elevation.

#### PROTEOME

<b>PLA<sub>2</sub>:</b> 8.7%	<b>SVSP:</b> 31.2%	<b>SVMP:</b> 12.5%	<b>NGF:</b> No
<b>CRISP:</b> 1.8%	<b>CTL:</b> 7.9%	<b>DIS:</b> None	<b>KUN:</b> No
<b>BPPs:</b> 14.7%	<b>VEFG:</b> 0.6%	<b>3FTx:</b> None	<b>PI-SVMP:</b> 19.4%
<b>Crotoxin:</b> No	<b>Crotamine:</b> No	<b>LAAO:</b> 2.7%	

MAIN ENVENOMATION SYMPTOMS		RISK	GRADE OF ENVENOMATION
<b>Hemorrhage:</b> Yes	<b>Ecchymosis:</b> Yes	<b>Bites per year:</b> 2.25	<b>Mild:</b> 53.9%
<b>Nausea:</b> Yes	<b>Hematemesis:</b> Yes		
<b>Hypotension:</b> Yes	<b>Blisters:</b> Yes	<b>Bites per 1,000 people yearly:</b> Unknown	<b>Moderate:</b> 28.1%
<b>Edema:</b> Yes	<b>Vomiting:</b> Yes		
<b>Coagulopathy:</b> Yes	<b>Diarrhea:</b> Yes	<b>Sequelae caused per year:</b> Unknown	<b>Severe:</b> 17.1%
<b>Sialorrhea:</b> No	<b>Local Pain:</b> Yes		
<b>Hematuria:</b> Yes	<b>Necrosis:</b> Yes	<b>Deaths caused per year:</b> 0.15	
<b>Renal failure:</b> Yes			

★★★ Reliable: The information gathered on this species is robust and supported by multiple published scientific studies, including those on Colombian populations. However, there are still aspects of its basic biology, venom, epidemiology, and clinical symptoms that need to be further studied. LD50: median lethal dose; MCD: minimum coagulant dose; MDD: minimum defibrinating dose; DEM: minimum edema-forming dose; DHM: minimum hemolytic dose; PLA2: phospholipases A2; SVSP: serine proteases, SVMP: metalloproteinases; NGF: nerve growth factor; CRISP: cysteine-rich secretory protein; CTL: C-type lectin/lectin-like, DIS: disintegrins, KUN: Kunitz peptides; BPPs: bradykinin-potentiating peptides; VEGF: vascular endothelial growth factor; 3FTx: three-finger toxins; LAAO: L-amino acid oxidases

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