

# • Aquatic Coralsnake •

## (*Micrurus surinamensis*)

Bites, venoms, and venomous snakes of Colombia

G3

MEDICAL IMPORTANCE GROUP 3

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



⚠ Poorly Reliable: Confidence for this species is poor due to the lack of data and information on Colombian populations. Therefore, most of our knowledge comes from a few studies and populations outside the national territory.



⚠ Detail of: Head, body and tail.

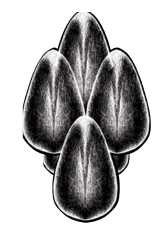
## 1. Envenomation symptoms



Symptoms of envenomation caused by *Micrurus surinamensis* will greatly depend on several factors such as the amount of venom injected by the snake, its size, its age, and the patient's condition [3]. As a rule of thumb, coralsnake bites should be considered as a life-threatening accident, thus taking the victim to the hospital is necessary. The envenomation grade should be considered as mild, moderate or severe, depending on the symptoms [3,4]. An envenomation caused by *M. surinamensis* is considered mild when the victim only exhibit local symptoms such as minor bleeding by the fang marks and numbness feeling in the bitten area that can latter spread nearby (paresthesia) [3,4]. A moderate envenomation will be characterized by acute weakness and fatigue in the muscles (myasthenia) without paralysis [3,4]. Finally, an envenomation is considered severe when there is an intense myasthenia that can evolve into paralysis [3,4].

A single case report has been documented, describing in detail the severe symptoms manifested in a young 18-year old male bitten on the left thumb by an 80 cm *M. surinamensis* at the University of Rural Amazon, Belém, Pará State, Brazil [2]. The bitten occurred in a failed attempt of the man to capture the snake, he was able to immediately remove the snake from its thumb. Although pain is a typical sign in these events, the patient did not complain of pain after the bite [2]. A few minutes later paresthesia appeared, manifested by the patient as numbness in the finger that radiated to the whole arm. Almost 20 minutes later, the patient arrived to the hospital with systemic symptoms, referred as blurry vision, difficulty in speaking (dysarthria), and muscular weakness that evolved into great difficulty walking, and maintaining an upright position [2]. Although the victim's heart rate and blood pressure were stable, symptoms progressed to respiratory distress along with discharge through the nose and mouth [2]. To treat respiratory failure, the patient was immediately transferred to the intensive care unit (ICU), where orotracheal intubation and assisted ventilation were performed for 48 hours [2].

Systemic symptoms can evolve into complications such as bacterial infections (i.e., pneumonia), abnormal amount of air between the lung and the chest wall (pneumothorax), bronchial obstruction, or cardiorespiratory failure [3,4]. Local symptoms are usually minimal and do not lead to severe complications [5,6]. However, edema may occur due to the bite or the use of tourniquets, and the effects of paresthesia and weakness in muscle strength can last up to 3 weeks after the accident [3,4]. Experimental studies with the venom of *M. surinamensis* have shown acute kidney injury development, presented with increase in the urea levels in the blood, however, such clinical manifestation have not been reported in humans [5].



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## 2. Treatments and snakebite care



Given that the venom of *Micrurus surinamensis* is neurotoxic, medical attention must be received as soon as possible in order to reduce the risk of death by respiratory paralysis. Basic first aid includes immobilizing the affected extremity, and cleaning with clear water and soap. The consumption of alcoholic drinks, oils, disinfectants, gasoline, or chemicals, as well as its topical use, must be avoided. Treatment can be difficult and may generate intoxications or additional damages [7]. Tourniquets, incisions, or mouth-suction are discouraged as well, since this can cause ischemia (reduced blood and oxygen flow), edemas, infections, or a second envenoming by ingesting. When moving the patient, a neutral position (lying down or horizontal) is indicated [8]. Full rest and continuous monitoring of respiratory performance are also important because ventilatory support may be required.

Currently, the only effective treatment known against snakebite by *M. surinamensis* is antivenom (antivenine); therefore, traditional practices are discouraged because they delay the time for receiving medical attention [9]. Treatment based on traditional medicine may be based on unknown substances that do not have positive effects on an envenomated bite, thus, worsening the clinical picture of the symptoms; or in the best case it corresponds to placebos (treatments with no therapeutic value) [10]. Several plants could contain potential therapeutic molecules, although their usefulness has not been assessed in clinical trials [10,11,12,13].

Antivenom therapy must be carried out by qualified medical practitioners because side effects like anaphylaxis (extreme allergic reactions) may appear. Thus, hospital facilities are required to prevent and control further complications [7]. The administration of antivenine and dosage must follow the clinical manifestations of the envenomation and the manufacturer's technical sheet according to the available serum brand [7,14]. In Colombia the polyvalent antivenom from the Instituto Nacional de Salud (INS) neutralizes 2 mg of *M. surinamensis* venom per each 10 ml [15]. Polyvalent antivenom from Probiol claims to work against any species of *Micrurus*, although no specific data for the species are provided in its technical sheet, and in a general way it indicates each 10 ml neutralize 1 mg of venom [16]. As a rule of thumb, *Micrurus* envenoming is considered severe (when the symptoms are visible). Recommended dosage for the INS antivenom varies from 5 vials for Andean coralsnake species, to 10 vials for Orinoquian and Amazonian corals [15], in the case of Probiol the dosage should be tripled.

## 3. Snakebite capacity



In its distributional area, *M. surinamensis* is a relatively common species [17] that contributes to its encounter rate being high. Given its semi-aquatic habits, fishermen, kids swimming, or people laundering, or using in any manner the water from effluents of low flowing or small lagoons are prone to accidents with this species. However, coralsnakes usually display deterrent behaviors, so bites are commonly derived from direct and improper handling. In addition, coralsnakes' fangs are small (order of millimeters) and its buccal aperture is narrow (about an angle of 30°), which is a reason why thicker clothes, cowhide gloves and boots are not easily penetrated.

Accidents with this species are not frequent; however, due to its large body size, individuals can inoculate large amounts of venom [17]. Although in Colombia there is an average of ca. of 4700 snakebites per year, and historically about 1.3% are caused by coral snakes (see Chapter 1), specific data for *M. surinamensis* are not available.

## 4. Recognition



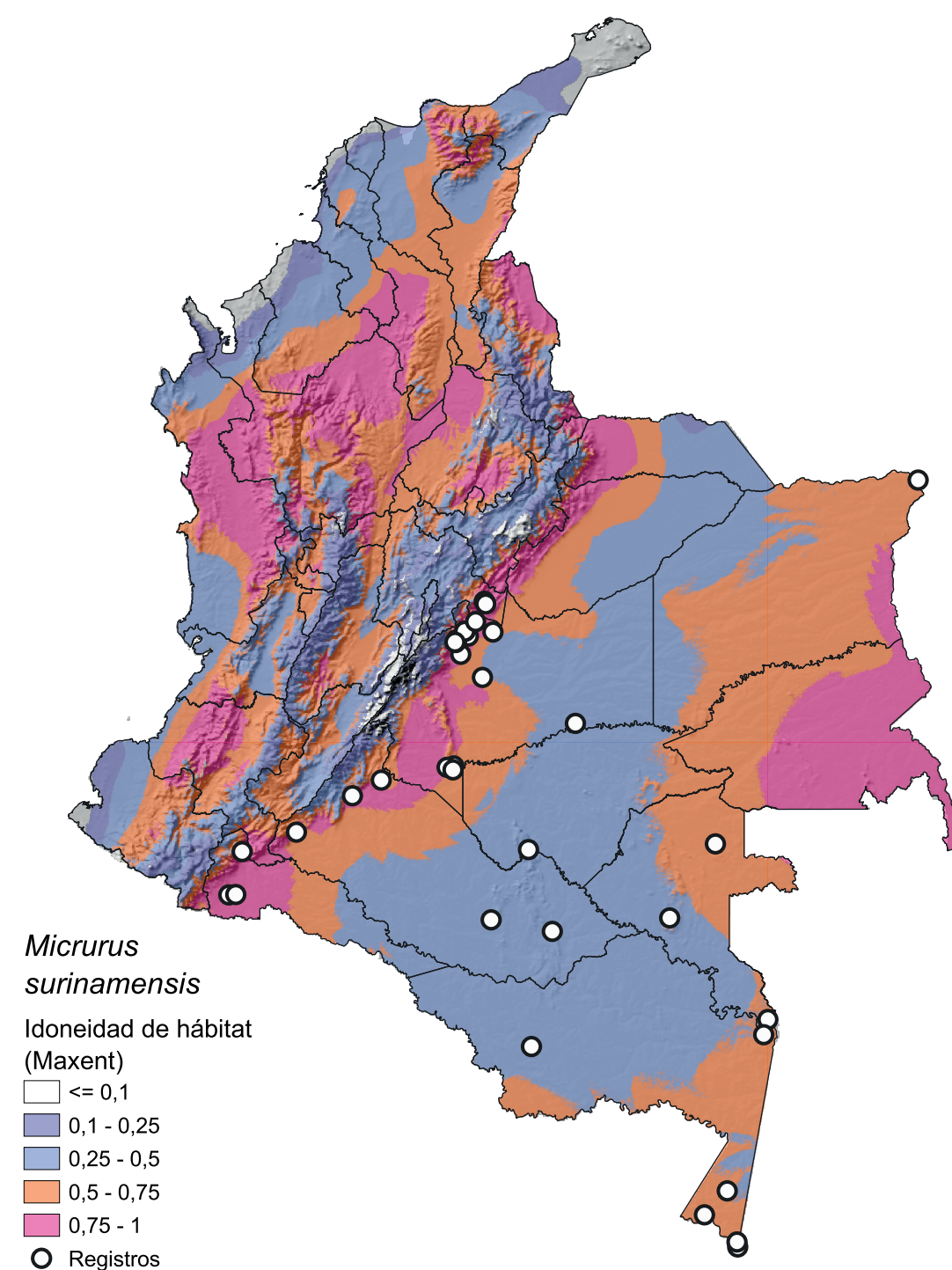
*Micrurus surinamensis* is a unique coralsnake that has several particularities within its overall morphology, such as a flattened head with dorsally positioned eyes and nostrils. These are adaptations for its aquatic habits [18,19]. This fish-eating snake is one of the largest and stoutest coral snakes as it can reach up to 1.4 m in total length [17,18]. It is characterized as a tricolored patterned coralsnake with black rings arranged in triads and separated by two shorter white rings (1-2 dorsal scales), and the central black ring is longer (5-8 dorsal scales) than the others (2-3 dorsal scales). The triads are separated by long red rings (5-8 dorsal scales) with scales that contain black pigments either on the posterior edge of each scale or as irregular scattered spots [19,20]. The first triad is complete, and individuals may contain between 5-8 complete body triads and 1-2 caudal triads [19]. A red cephalic cap covers the head from the tip of the snout to the posterior portion of the parietal scales, where the first body triad begins with a short black ring.

This coralsnake is easily distinguished from all the other congeners, with the exception of *Micrurus nattereri* (previously considered as a subspecies), because the orbit is in contact with only the fourth supralabial, whereas in other species of *Micrurus* the third and fourth supralabial scales are in contact with the eyes [19]. Moreover, having all the red cephalic scales outlined by black borders is also a very distinguishable feature of the species. The color pattern is a useless trait to distinguish between *M. surinamensis* and *M. nattereri*. Nevertheless, both can be distinguished by scale counts such that *M. surinamensis* has 156-174 ventral scales in males (versus 180-195 in *M. nattereri*) and 169-187 ventral scales in females (versus 193-215 in *M. nattereri*) [20]. Given the evolutionary closeness of these last two species, it is likely they would produce very similar envenoming clinical pictures.

## 5. Distribution

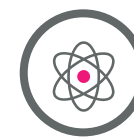


*Micrurus surinamensis* is widely distributed in South America as it is found in the Guianas region (Suriname, Guyana and French Guiana), Ecuador, Peru, Colombia, Venezuela, Bolivia and Brazil [18,20,21]. In Colombia, this species is widely distributed in the southeastern regions of the country in the Orinoquia and Amazonia. Voucher specimens of *M. surinamensis* are known from the departments of Amazonas, Caquetá, Meta, Putumayo, and Vaupés, within an elevation range between 50-576 m a.s.l [21]. Based on ventral and sub-caudal counts, we found that specimens from Guainía and Vichada departments, housed at the Reptile Collection of the Instituto Alexander von Humboldt (IAvH-R 1888, 8339, respectively), belonged to the closely related species *M. nattereri*. The potential area of the distribution of *M. surinamensis* in Colombia is 630,520 km<sup>2</sup>(Figure 1).



**Figure 1.** Geographic distribution of *Micrurus surinamensis* 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



*Micrurus surinamensis* is a common coralsnake in the southern region of the Colombian Amazonia; however, its encounter rate, is rather uncommon within the northern Amazonia and Orinoquia regions [17]. It is a unique species of coralsnake due to its aquatic or semi-aquatic habits, that enables individuals to live in streams, rivers, ponds, and morichales (swamp forest dominated by *Mauritia flexuosa* palm), where they can maintain themselves submerged during prolonged periods, within both forested and open areas [19].

Similar to most coralsnakes, *M. surinamensis* is characterized as being a crepuscular or nocturnal species; however, there are casual and sporadic reports of individuals actively foraging during the daylight [17,22,23]. Although it is considered a docile species, when threatened, individuals may display antipredator behaviors like compressing their body dorsoventrally, coiling the tail while hiding their head under the body or making subtle trashes while striking [22]. Bites are not the primary antipredator behaviors displayed, this behavior only appears as a last resort, when retreat (e.g., runaway) and passive deterrent behaviors (e.g., compress their body dorsoventrally, coil the tail) fail to stop the predatory attack, or the predator stimuli.

This aquatic snake feeds principally on fishes characterized by having an elongated, flattened or depressed body such as species from the genus *Gymnotus*, *Callichthys*, *Sternopygus*, and *Synbrachus* [17,18,24,25]. However, it can also act as an opportunistic species and occasionally may feed on caecilians, lizards, and other snakes [23]. Although there is still a great lack of information regarding the predatory behavior of the species, field observations suggest that individuals capture their prey in the water during night hours and posteriorly move to the stream banks to ingest it, starting via the head [25]. Interestingly, the composition of the venom of *M. surinamensis* differs from that of other congeners as it seems to be principally composed of three-finger toxins (3FTx) that may be specialized in quickly immobilizing their principal prey items (fish ?) (see Chapter 2) [26,27,28].

As in all known coralsnakes, *M. surinamensis* has an oviparous reproductive mode, with females laying between 5-12 eggs per brood [17,22]. Unfortunately, there is still a lack of information regarding the reproductive seasons and the frequency of reproduction among the different populations. Moreover, there seems to be an evident sexual dimorphism as females average larger sizes than males [17]. Currently, there is no information regarding the life expectancy of the species in the wild. However, under captive conditions the average life-span reaches only 7 months,

although individuals may survive up to 1.28 years (see Chapter 8) in captivity. There are reports of individuals infected with endoparasites such as nematodes (*Physaloptera* sp.), pentastomids (*Sebekia oxycephala*) and trematodes (*Opistogonimus lecithonotus*) inside the oral cavity and esophagus [29].

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



Available information indicates that *M. surinamensis* can inhabit different types of water bodies in open or forested areas [30,31,18,22,21]. Sources of information, such as photographs published on web pages (e.g., iNaturalist) and specimens housed in biological collections (Colección de Reptiles del Instituto Alexander von Humboldt IAvH-R-7020, 7024, 7092, 7153, 8339) support the presence of *M. surinamensis* in swampy areas, lagoons, and streams in the vicinity of farms and villages in southeastern Colombia. The high fecundity of this species (5-12 newborns) [22], coupled with the large body size that individuals can reach, and the aquatic habitats close to houses and farms they may inhabit, suggests that *M. surinamensis* is a coralsnake likely to be encountered by people in rural areas.

## 8. Conservation



**Least Concern.** Both from local and global assessments, this species is considered as Least Concern [32,33]. This species is not listed in Resolution 1912/2017 from the Colombian Environmental Ministry and is not considered as an endangered species in CITES. Like all the snakes in Colombia, their main threat is from killing by humans and habitat loss [34]. Currently, there are no specific populational studies on this species nor data of illegal trade. Amazonian forest has been deforested in many areas of northwestern and central Amazon basin which, in addition to the individuals killed by people, could lead to a decrease in local populations.

## 9. Scientific name and common names



The scientific name of *Micrurus surinamensis* is composed of two elements; the first one is the genus and the second is the specific epithet. *Micrurus* is derived from the Greek words “mikros”, meaning small, and “oura”, meaning tail, in reference to their short tail [19]. The name *surinamensis* refers to Suriname, the species' type locality.

Given that this species has semi-aquatic habits and a fish diet, some common names include water or aquatic coralsnake (*coral de agua*) or fish-eating coral snake (*coral comedora de peces*).

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



| ★  |                        |   |
|--|------------------------|---|
| TOXICITY AND BIOLOGICAL ACTIVITY                     | VENOM ACTIVITY PROFILE | GENERAL BIOLOGICAL TRAITS                 |
| <b>LD<sub>50</sub> (µg/mice):</b> 13.53 (5-34.84 µg) | <b>Proteolytic:</b> No | <b>Total Length (cm):</b> ♂ 126.2 ♀ 123.5 |
| <b>MCD (µg/mL):</b> Unknown                          | <b>Neurotoxic:</b> Yes | <b>Weight (g):</b> ♂ Unknown ♀ 600        |
| <b>MDD (µg/mice):</b> Unknown                        | <b>Myotoxic:</b> No    | <b>Reproduction:</b> oviparous            |
| <b>MED (µg/mice):</b> Unknown                        | <b>Hemotoxic:</b> No   | <b>Diet:</b> piscivorous (fishes)         |
| <b>MHD (µg/mice):</b> Unknown                        | -                      | <b>Distribution:</b> Orinoquia-Amazonia   |

### PROTEOME

|                              |                      |                      |                     |
|------------------------------|----------------------|----------------------|---------------------|
| <b>PLA<sub>2</sub>:</b> 4.2% | <b>SVSP:</b> Unknown | <b>SVMP:</b> Unknown | <b>NGF:</b> Unknown |
| <b>CRISP:</b> Unknown        | <b>CTL:</b> Unknown  | <b>DIS:</b> Unknown  | <b>KUN:</b> Unknown |
| <b>BPPs:</b> Unknown         | <b>VEFG:</b> Unknown | <b>3FTx:</b> 95.4%   |                     |
| <b>Crotoxin:</b> No          | <b>Crotamine:</b> No | <b>LAAO:</b> 0.4%    |                     |

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

★ Poorly Reliable: Confidence for this species is poor due to the lack of data and information on Colombian populations. Therefore, most of our knowledge comes from a few studies and populations outside the national territory. LD<sub>50</sub>: median lethal dose; MCD: minimum coagulant dose; MDD: minimum defibrinating dose; DEM: minimum edema-forming dose; DHM: minimum hemolytic dose; PLA<sub>2</sub>: phospholipases A<sub>2</sub>; 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. Venom profiles from an individual of Porto Velho, Rondônia, Brazil [1]. Symptoms manifested by a 18-year male bitten by a snake from Pará State, Brazil [2].

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