

Dialogues on the Tao* of *Lachesis*

* Tao: “the way” in literal translation. Taoism is an ancient Chinese school of thought that advocates open mind to all possibilities, in the same way that “the uncarved block” presents itself to the sculptor.

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Introduction

Deep in the Atlantic rainforest in Brazil, at the Serra Grande Center (SG), a series of chicken wire, outdoor enclosures with various natural vegetation, artificial burrows/retreats and exposure to the natural elements has provided Dr. Rodrigo Souza with the opportunity to successfully raise and breed *Lachesis muta rhombeata*. Although seemingly “primitive” (from now on PH, for Primitive Herpetoculture) by today’s highly technological standards of captive care, it behooves us to consider looking outside the box in terms of proper captive care of sensitive species like *Lachesis*.

The three authors come from very different backgrounds with respect to geography, husbandry philosophy, and facilities. Looking at the ways of Taoism, however, despite our very different backgrounds, we have been able to achieve success in working with *Lachesis*. It is our intention to not only show some of our methods in working with bushmasters, but to also provide a template for working with other species and incorporating field studies and observations with captive care.

Rob Carmichael serves as Curator of the Wildlife Discovery Center (WDC) in Lake Forest, Illinois, where the bushmaster is displayed in a semi-naturalistic exhibit utilizing both modern-day herpetoculture methods and the integration of observations made from the more “primitive” way.

Dr. Earl Turner comes from a zoo background in the Texas area where he has kept and bred various *Lachesis* by utilizing modern day advances in technology under controlled, indoor conditions (Turner, 1997, 1998).

So what method is best? The (apparently) “primitive,” *au naturale* (but not naive) way, or utilizing today’s technology to re-create natural conditions in a controlled, indoor setting? BOTH! We will be sharing our experiences, our failures, our passion and our sincere desire to share everything we consider relevant to help others avoid the many problems we’ve faced while dealing with the *Lachesis* clan, with special emphasis on *Lachesis muta rhombeata*, *L. m. muta* and *L. stenophrys*.

The maintaining of the subspecific status in this paper is not a personal stand for or against anyone. It means in Rod’s case that he is specifically referring to *Lachesis* from the Atlantic rainforest, from the Brazilian east (Atlantic) coast. It’s necessary however to remember that many authorities are not very enthusiastic about subspecies in herpetology, because often it seems that they were established based on superficial attention to one or a very few characteristics—and at least sometimes, if we look at another character we would establish different sub-

species. For *Lachesis*, so far the clearly demarcated taxa, which we call species, are *L. acrochorda*, *L. melanocephala*, *L. muta* and *L. stenophrys*. Subdividing *L. muta* into *L. m. muta* and *L. m. rhombeata* is in taxonomic limbo and under major controversy (Ripa, 2000–2006; Fernandes et al., 2004). The present edition of the *International Code of Zoological Nomenclature* (Fourth Edition, ISBN 053301-006-4), however, does maintain trinomial nomenclature (subspecies).

The feeding challenge

Whoever wishes to be successful in maintaining these pit-vipers in captivity must begin by understanding the unique feeding habits and the natural eco-biology involved. Well fed, healthy, stress-free animals are step one towards longevity and any reproductive attempts.

One of the inhabitants of the remaining 7% of the original Atlantic rainforest, a little brown rice rat (*Oryzomys* sp.), known locally as the “paca” mouse, is a bushmaster’s favorite in the wild. The average weight of these wild rodents and of four other rodent species that Rod has captured in prime *Lachesis* territory is around 90 g (~3 oz) or less. That makes us think that in nature *Lachesis* is very active (at night) and is constantly moving around searching for “light” meals (90 g), and most likely feeds more than once a week. The fit and strong individuals we’ve all met in the wild are the living proof of it. Heavier prey items are offered to them in shady Serra Grande—every eight days if it’s “cold” (20–24°C / 68–75.2°F), or every fifteen days if it’s sunny (24–28°C / 75.2–82.4°F). Bushmasters are extremely selective when it comes to feeding, and unlike in the sympatric *Bothrops* genus, even animals in the 2.4 m (~8 ft) total length (TL) range will not usually try to strike-hold any prey weighing over 220 g (~8 oz). As a comparison so that we may comprehend how specialized these animals are, a large Brazilian *Bothrops* like *B. jararacussu* (1.8 m or ~6 ft TL) can easily ingest a 400 g (~14 oz) rat or guinea pig.

One of the wonderful benefits of today’s internet is the ability to network and converse with other professionals. After a brief discussion via email with the other two authors, the keepers at WDC realized that they were offering prey too large for a *Lachesis muta* that had just arrived at their facility. After many unsuccessful offerings, they decided to offer an adult mouse to the 5-ft male *L. muta*. Needless to say, they had a happy ending.

Bushmasters will strike-hold in the shoulder area any living prey (mostly mammals, occasionally birds) weighing up to 120 g (~4 oz), basically what the snake will find in nature, and will

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usually strike-release and conduct chemosensory search and trail-following (a hard and frequently unsuccessful task in the flooded rainforest) if the prey weighs over 120 g. Large prey reaction to strike-hold could be dangerous to the snake: 220 g (~8 oz) is the heaviest prey item we suggest one should offer to adult individuals. Ideal prey size in Serra Grande was learned the hard way, through mistakes that have resulted in regurgitation and esophagus injury, that sometimes led to death. Once again, we can take some of these in situ and field observations and translate them into our own captive management programs in dealing with *Lachesis*. By taking note of the mistakes made in the past, we can make improvements in order to prevent future problems, that usually start with the offering of oversized rats, in a hot enclosure (more than 28°C or 82.4°F). Knowledge is power, and this knowledge about bushmasters' feeding preferences in the Atlantic rainforest was achieved by interviewing native people (mostly hunters and woodsmen), and by placing mousetraps in different crops. This was the starting point of Nucleo Serra Grande 7 years ago, when we started efforts to control the slaughter perpetrated against these snakes (by safely removing individuals found in roads, crops or residential areas), labeled as "Vulnerable" by the International Union for the Conservation of Nature.

The picture below shows the true bushmaster strike-hold approach, always in the shoulder area, with venom injected directly in heart and lungs, causing "instant" death. These observations, strike-hold or trail following (chemosensory search) according to size of the prey, confirm those of Chiszar et al. (1989) and Boyer et al. (1995).

A very special need

A cool temperature by tropical standards of 16.6°C (61.8°F) has been recorded in Serra Grande, which is in prime natural *Lachesis* territory, within the Atlantic rainforest, 150 m above sea level, with humidity levels always around 85–99%. In the fake armadillo burrows offered to the snakes, the temperature has reached 14°C (57.2°F); it is reasonable to affirm that the averages within the well preserved rainforest are around 21–25°C (69.8–77°F) all year long. Thus, temperature is a critical component of proper *Lachesis* care and we recommend a thermal gradient to allow these snakes to cool down as needed.



True strike-hold: fangs in the heart and lungs + lifting prey above the ground.

The length that these snakes may reach is a very controversial issue. They are the largest venomous snakes of the Americas (second in the world only to king cobras). Bushmasters beyond 300 cm TL are rare, and Ditmars' (1910) *L. stenophrys* at 350–360 cm TL remains as the longest specimen.

In 1957 a DC-3/C-47 delivered a large box flown from Colombia to the U.S. by the Tarpon Zoo of Tarpon Springs, Florida. When it was opened, all that could be heard were words of astonishment by Fred Penman, Trudie Jerkins and Dr. Earl Turner, as out crawled the biggest bushmaster they all have seen to this day. Immediately a string was laid as closely as possible next to this snake. After the operation was completed a few times, the string measurement was 12 ft, 1 in. Allowing for several factors, they all agreed that the snake was (at least) 11 ft, 3 in, give or take an inch. At approximately 342.9 cm TL, this snake is probably among the three longest bushmasters ever (reliably) measured.

So, with such a huge digestive tube and the low temperatures (and low metabolism rates) of the natural habitat, small prey preference may be taken as an evolutionary adaptation (Ripa, 2000–2006) to cold environment (slow digestion). Oversized food items could turn into putrid gas bombs inside the animal, halfway into the intestine (incomplete digestion), often killing the snake if it's too late for vomiting it. The proteolytic action of the *Lachesis* venom is not remarkably strong and it does not help digestion as much as *Bothrops* venom does, for instance. For this reason, bushmasters are never seen basking in the sun after eating, thus accelerating general metabolism, something that *Bothrops* always does. If the average temperature in the enclosure is above 28°C (82.4°F), keepers will probably experience a high rate of regurgitation and its hazards to the health of the animals. Captive observations indicate the same behavior as our *Lachesis muta* and *L. stenophrys* exhibit tendencies towards the cooler end of their exhibits even after feeding, although they will bask under a low level heat source on occasion.

Notes on husbandry

The (PH) offering of live prey in Serra Grande means to Rod that snakes will have to exercise through the obstacles of the outdoor enclosures, and preserve hunting skills and tactics, and that will apparently contribute to better overall health. Obesity is a well known problem for the captive. Sometimes specimens of some collections are so lethargic even at nighttime that they seem "depressed." The prey offered consists of 2-month-old Wistar rats, born and raised in Serra Grande with the best rodent food available, deparasitized with ivermectin every 6 months, drinking from the pure water collected from the daily thunderstorms, and supplemented with extra doses of vitamins. It's well known however, that after 90 days frozen, thawed frozen prey items will not be a vehicle for any parasites, and that's a price-less peace of mind for keepers.

We have never seen a serious injury inflicted by live rodents offered to the snakes in Serra Grande. One snake was stabbed in the eye when the two of them strike-held a single mouse at the same time: keeper error. At Serra Grande we are talking about 40 m² enclosures, for 4–5 individuals maximum loaded with places for the rodents to hide. For public exhibits at the WDC,



Results of bushmaster necropsies. The image on the left shows healthy looking pulmonary tissue, and a normal looking heart. The righthand image shows a heavily parasitized lung, with an abnormal amount of fluid. These are pentastomid parasites (*Porocephalus* sp.) (see Gárate et al., 2007); some are almost 2 in long when adults. They are found in wild caught animals. The pulmonary cycle of these worms will make the snake stay uncoiled, eventually with an abnormally open mouth. Routine deparasitization is essential to keep things under control: the parasite load must not be too high when you treat the snake. If hundreds of large individuals like these *Porocephalus* die inside the lung during treatment, their decaying will induce a fatal pneumonitis, which is a “foreign body” type of inflammatory reaction to the fluids created in the decomposing process, and that will lead to poor oxygenation and pneumonia due to bacterial attack in an already weakened snake. It must be said however, that it is not clear at this point if any anthelmintic drug is effective against hematophagous pentastomids once they get installed in the lung. Ivermectin may be helpful, and so is endoscopic removal of individuals, dead or alive.

we typically keep one bushmaster per enclosure. In a controlled, indoor setting, the practice of feeding frozen thawed prey works well but it is critically important to use long tongs to introduce prey. An errant feeding strike can be catastrophic if you are in the line of attack. Always offer food at an angle to help prevent an accident. Sometimes snakes will just eat dead mice offered to them without injecting venom (and helping digestion substantially), and that’s also to be avoided for complete absorption of the nutrients. If you go MH, be sure to set the microwave for the correct strike-inducing temperature: prey offered should have a body temperature of around 95°F (35°C).

Practitioners of MH often condemn PH for (1) keeping colonies in (2) open serpentariums, mostly because of the difficulties with parasite control, administering medication, and keeping track of feeding frequency on an individual basis. Another concern is an eventual loss of sex drive in communally kept animals. And all these are genuine worries for keepers worldwide.

MH considers individual enclosures where snakes lie on newspapers as the ideal way to achieve longevity records. The rationale behind it is a sense of total control. Dr. Turner and Rob Carmichael keep off-display bushmasters on newspaper and Dr. Turner has achieved breeding success taking this simple approach towards their care. Rod is not a critic of the method at all: fungus free, easy to clean, keeping excessive moisture away from the animals. In Serra Grande babies lie on newspapers for their entire first year, although space is an issue for the well being of large animals like *Lachesis*.

Serra Grande seems to have learned from both MH and PH over the years, and in the daily routine the best of each is put into practice. Vivaria of up to 40 m² for a colony of 2 males and 3 females amidst the Atlantic rainforest mean ethical confinement to Rod. In such spacious areas, not overexposing individ-

uals to each other, libido is not affected. Such vivaria where animals actually exercise, hunt, bathe in the rain and bask in the early morning sun, would be inappropriate without the possibility of parasite control (MH). The communally kept animals will go to an intensive care unit at least once a year, during the rainy season (April–May) for a routine prophylactic isolation. Probing, deworming, nutritional supplementation and overall evaluation takes place in the ICU, where the snakes remain isolated in individual 2 × 1 m nylon camping tents. Meanwhile the floor of the original vivarium where the colony is kept is being replaced and actually carbonized with “blue flame” torches in an attempt to control eventual larvae and organic waste that would cause transdermal infection (*Strongyloides* spp., *Rhabdias* spp., etc). Native ants are taken as the greatest helpers (scavengers) in the daily, constant and never-ending clean-up task. Since there are only screens between snakes and forest, those little and welcome friends are always in and out of the vivaria at night. It took a long time to understand their importance and turn walls into screens especially to permit this “cooperation.” Ticks, mostly of the genus *Amblyoma*, around Serra Grande are also under control (at this moment) partly because of the ants. But yes, the highly effective fipronil spray is used every once in a while: one-minute operation, spray and let go. Fecal samples have revealed that so far Serra Grande is on the right track as far as parasite control is concerned. PH can be a true headache and virtually an impossible task, specially in outdoor enclosures if parasite control is neglected.

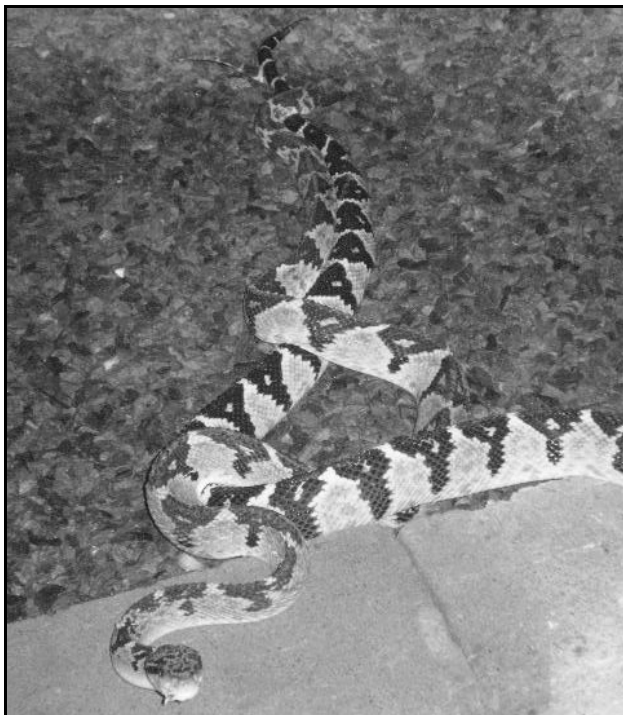
If individual enclosures (MH) are the choice because “it’s more in line with the natural behavior of *Lachesis*,” it has to be questioned if anyone one has enough field observation time to affirm that. The animal is getting to be so rare in a vast and sometimes inaccessible rainforest territory, that its more accurate to admit not enough data to evaluate the matter. In the case of Serra Grande we are talking about an 8 × 5 m enclosure (exten-

sive method) loaded with Atlantic rainforest vegetation and places to hide, a 2.2 colony will still pile up in one single spot, regardless of ten other “hot spots” available in the same area, under the same conditions of temperature and humidity. And that happens during all seasons. In these vast artificial set-ups, however, the potential for harm to the snake or the keeper is greater, but these were where for the first time in Brazil, sexual activity for the genus has been consistently recorded.

Alternation (routinely and on demand) of three husbandry methods (extensive/outdoor, semi-extensive/indoor room, and intensive/nylon tent) according to time of the year and individual conditions follows from the same reasoning that is behind WDC’s off-display efforts: these creatures are too precious to afford a single loss.

Obviously, if you take this information and apply it to a zoological institution like the Wildlife Discovery Center, it would be impractical to dedicate an entire building for a public display of bushmasters (although that would be very cool and having a large Atlantic rainforest habitat featuring a group of *L. m. rhombeata* would be visionary!). The WDC has space limitations but always puts the needs of the animals first and foremost. In 2006 the WDC contracted Habitat Systems, Ltd. to construct an exhibit measuring 10 ft wide × 3 ft deep × 4 ft high. This exhibit holds one large female *Lachesis m. muta*, and features real tree limbs and hollows to provide secure hiding areas. The substrate consists of a deep layer of peat, soil, leaf mulch, cypress mulch, sand (very little) and forest humus. A layer of dead leaves is sprinkled over the surface to allow the snake to nestle in, provide security and allow for natural ambush behavior (particularly when resting against a large dead tree limb). A large water pan is always kept filled with fresh water.

Upon advice from Dr. Turner, it was decided to keep the



The first known image of an actual mating of Atlantic bushmasters, taken in the semi-extensive indoor system at Serra Grande in 2007.

substrate fairly dry in WDC, but maintain moderate to high ambient humidity levels. Captive *Lachesis* oftentimes succumb to an illness commonly referred to as “red belly disease,” a deadly fungal and bacterial dermatitis. Upon microscopic examination on pieces of infected scales, the snakes actually develop a type of septicemia (blood poisoning). It can be credited as mismanagement of the snake. It occurs when a bushmaster is kept too moist. Any cypress mulch or other substrate should be totally dry if utilized for *Lachesis*. Many medications have been used—to no avail. Dr. Turner has utilized the drug Naxcel which should be given either subcutaneously or in the lateral muscle. A total of 10 injections should be given: 1 per day alternating in the lateral muscle. This treatment is credited with saving two *Lachesis stenophrys* that were received by Dr. Turner in extremely poor condition. Both snakes regained their health after receiving the treatment using Naxcel. The dosage for Naxcel is .25 cc per 10 lbs of body weight.

Naxcel comes in 1 g bottles and the shelf life after being opened is very short. So after the treatment is concluded freeze the remainder and it will retain its potency. This will save bushmasters from a fatal disease caused by stress and a cage substrate which is too moist. So how could “Primitive Herpetoculture” deal with the “red belly” issue, in outdoor enclosures? Here again the three authors are in an agreement, for in the outdoor vivaria in Serra Grande there is a rocky bottom that prevents snakes from direct contact with the muddy forest ground, and these enclosures are placed on slopes so as to achieve natural drainage of water. Also there can be no better ventilation than in those chicken wire enclosures. The animals are truly stress free, and the proof of it is the absence of scraped snouts: they don’t seem to realize that they are confined and are not looking for escape routes, and besides, none is being force fed.

A snake continually sitting on a moist surface in a captive setting can develop all kinds of problems. So, we will heavily mist the cage every 2–3 days and allow it to dry slowly. We use hand held misters rather than expensive and elaborate misting systems, so that the snakes get used to daily interaction with keepers. Stress management is the most critical component of successful public exhibition of *Lachesis* (assuming that the environment is appropriate). A happy bushmaster lies in a coiled position except when foraging for prey. At night, they begin to forage and become very alert—do NOT attempt to muck with bushmasters at night! Any signs of stress related myopathy results in the animal being taken off exhibit right away—our bushmasters are much too precious to take any chances. The WDC exhibit utilizes Pro Product Radiant Heat Panels attached to thermostat to provide both a basking area as well as proper ambient temperatures including a slight night drop. The three authors agree with the offering of a drier substrate to the snakes. Even in outdoor enclosures in Serra Grande a layer of rocks is above the natural jungle soil, to aid in fungus and parasite control.

Notes on Reproduction

Serra Grande listened to folk knowledge and common sense, as well as paying attention to science and previous experiences

while testing what is today the only successful breeding center for *Lachesis* in Brasil. The process led to questions as why should money be spent in egg incubators if the Atlantic rainforest has been doing it (incubating eggs) for maybe 300–800 thousand years (disjunction Amazon-Atlantic rainforests, according to Zamudio and Greene, 1997). This is a true MH vs PH argument that has happened in the past. In Serra Grande the eggs were kept in the forest under major protection, but exposed to natural the temperatures and humidity. In the end, at an average temperature of 25°C / 77°F (very cool by tropical standards), the success ratio in 2007 in Serra Grande would have been 100% if a small fly attack didn't induce the loss of 2 out of 16 eggs, from two different pairings (Souza, 2007).

In Atlantic rainforest of the Brazilian east coast, among wild caught animals, females are much more common than males. A 1 (male): 5 (female) ratio is not a very wild guess. If the continual destruction of habitat (93%) for the last 500 years (and global warming) has brought historical series of higher temperatures to the remaining forest surroundings it is hard to affirm, but one thing seems to occur under controlled conditions: the higher the temperature, the majority of neonates are female, correspondingly, the lower the incubation temperature, the majority of hatchlings are male, and that seems to point towards the possibility that temperature actually influences gender in this genus.

Somma (2003) confirms what all those who breed bushmasters know by experience: there is parental care among reptiles towards eggs for sure, and eventually towards neonates. We cannot at this point confirm even any short term care for neonates in bushmasters, in Serra Grande the one attempt to leave the eggs with the female ended up with the total loss of fourteen eggs (insect attack). A special enclosure is being designed the get safely back to the experiment, and maybe find out something beyond the well known brooding behavior such as effective neonate care. The functions of brooding in thermo- and hydro-regulation are often overshadowed by the defensive function. If there is one occasion to be extra careful while around bushmasters, it is egg removal. All native people in the Atlantic rainforest have stories to tell about “attacks” from male and female that were protecting the nest. Three times in Serra Grande, male and female bushmasters were found (and photographed) guarding the eggs, a behavior yet to be confirmed by further observation, and not observed other than in *rhombeata*.

The natural arrival of a series of cold fronts in the Atlantic rainforest takes place early in the second half of the year, and the combination of sudden temperature drops and rise in humidity levels is what triggers the sexual behavior: males with unusually high tongue-flick rates indicate the beginning of new mating opportunities. And this will project egg laying during the dry season, when flooding is less likely to occur. So this is another key issue for the breeding of bushmasters under controlled situations: the possibility of simulating a cold front in the enclosure, with a sudden temperature drop and rise in humidity. Notice that the words “breeding season” have been intentionally avoided. Animals of very different ages can be found in a 12-month span in the Atlantic rainforest, and maybe as Mother Nature's response to population decline, there might

be various fertile periods (and not one breeding season) in the bushmaster's biological clock. “Off season” mating has been photographed. Cold fronts generated in the Antarctic may hit Brazil all year long, and maybe these “barometric opportunities” are not being taken for granted anymore.

The perfect formula to *not* achieve bushmaster reproduction in captivity is: unfit (too young, too old, suffering from malnutrition or stressed) animals + very little space + too much disturbance. The vigorous male combat observed may trigger some hormonal responses needed for sexual activity, and this alone calls for a spacious area for the group. Real “wart skin” (teens are smoother) individuals, in the 6 ft (1.80 m) TL range and around 8 lbs (4 kg) of weight (minimum) are the natural candidates, those we can call “adults.” One of our greatest references, Boyer from Dallas Zoo, went from water to wine after moving his animals from 0.75 × 2.25 × 0.5 m high boxes to a 3.6 × 2.3 × 2.4 m high room. In Serra Grande the semi-extensive method consists of large rooms, 6 × 4 m, not exposed to weather (cement walls and roof) but within the Atlantic rainforest and the natural parameters of temperature and humidity of *Lachesis* territory. This is nothing new and was inspired by the big adapted fridge of the Dallas Zoo, and their most successful and pioneer breeding program—*Lachesis* needs space.

Avoiding neck injury

Boyer et al. (1989) begin their groundbreaking paper with the following sentence: “The longevity record of the Bushmaster *Lachesis muta* in captivity has been unimpressive; its large size and apparently calm disposition belie its delicate constitution.” The cornerstone of the handling of these animals is to avoid any contact with the fragile neck region. It's just too much muscle for a not so strong osteo-tendinous frame, and if not properly immobilized, the animal will twist in its own axis, provoking self-inflicted irreversible medullary damage and death.

It is unrealistic however to assume that *Lachesis* will never have to be restrained in the traditional way. After a 40-day fast it's time to consider force feeding before its too late. A medium size rat (100 g or 3.52 oz) should be soaked in egg yolk and very

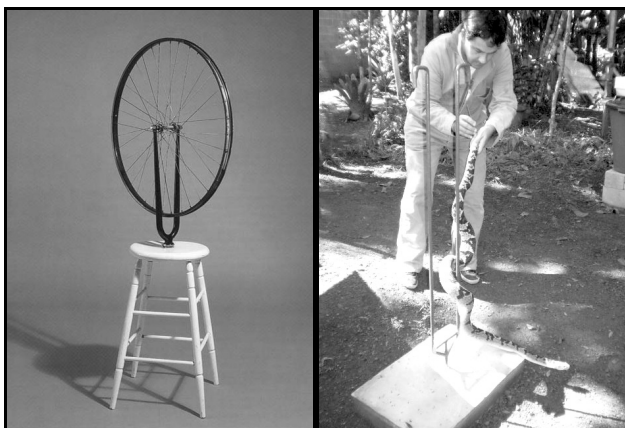


The reproduction of the Atlantic bushmaster for the first time in captivity: we credit the good success ratio to the cool (75°F average) temperatures of the incubator, the Atlantic rainforest (see Souza, 2007a).

cautiously placed in the mouth of the snake for venom injection and then slightly forced down the throat. Be sure to keep the forceps out of the way of the fangs so as not to break them. Be sure also to have two or three helpers for the procedure, ready to avoid the “neck twist” that will be attempted for sure. The procedure (force feeding) will give you time to try to figure out what the problem (refusing to eat) is: Oversized prey items? Heavy parasitism: *Strongyloides*, coccidia, *Ascaris*, *Trichomonas*, cestodes, pentastomids? Maladaptation syndrome (stress + parasites)? Exposure to wrong temperatures? A second reason for force feeding is to utilize the feed animal as a vehicle for routine deparasitization every six months. The medications are placed inside the food animal and provided to the snake utilizing the method mentioned above. The infested snakes in the highly successful *Lachesis* program of the Dallas Zoo were treated with mebendazole 20-25 mg/kg, metronidazole 200 mg/kg, ivermectin 200 µg/kg and niclosamide 150 mg/kg (Boyer et al., 1989). Their results settle the gossip that blames reproductive failures on ivermectin.

Necessity frequently leads to creativity, and Serra Grande has crafted low tech and very cheap tools (Souza, 2006), for their own specific needs and beliefs concerning bushmasters, and a good example of such tools is the “Duchamp” or “Bushamp,” to safely probe or medicate large bushmasters (or any other “high-striker”) without assistance and without restraining the neck region. Tubes are also part of the arsenal in Serra Grande, but again not to take any chances, the neck region has radically been avoided over there, with the exception of those two situations: force feeding for nutrition, and force feeding for routine deparasitization.

The surrealist masterpiece *Bicycle Wheel* of Marcel Duchamp (check below) was the inspiration to develop this simple device. Over the years Rod reports to have ended up doing a lot of solo (a huge mistake) procedures such as probing, tick removal, minor wound medication, etc., in 7-ft-plus individuals facing the eventual hazards of a free neck region, but the “Duchamp” (or “Bushamp”) proved itself efficient and safe for the very experienced handler, and virtually harmless for the snake. Remember, this is necessary in Serra Grande. Back in the U.S. we typically use various tubes for proper restraint but the methods utilized by Rod might provide some new techniques for mild restraints during examination that keeps stress at a



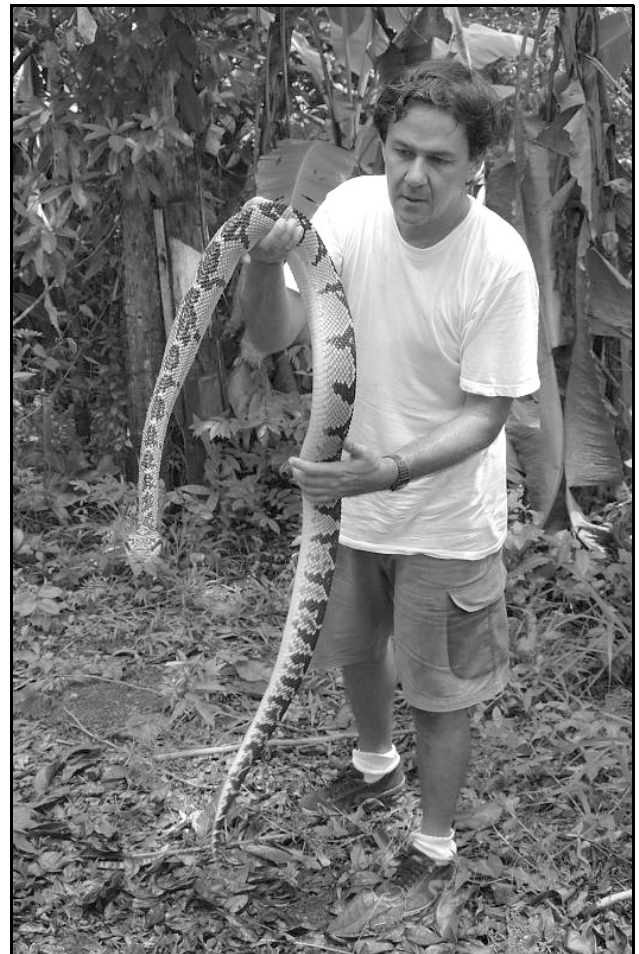
The Duchamp (1913) and the “Bushamp” (2007).

minimum on the snake. The WDC is going to experiment with the Duchamp method.

The images speak for themselves: remove the wheel from the Duchamp (1913) and add a heavy (80 pounds) concrete bottom to it and you’ll have the “Bushamp” (2007).

The width between the steel bars is calculated according to the animals you deal with; 5 inches will be just fine in most cases. The height of the steel bars is also important (from 3 to 4 ft) so as to avoid a sudden release. Control the forward motion of the animal by gently holding/letting go the grip on the tail, and also move yourself around the device so as to keep the medium third of the animal tangled, avoiding a strike and backwards motion. In this specific case (photo) Rod is probing alone a 7-ft male, a 30-second procedure.

Still out of necessity, again to avoid neck injury and the terrible “shock state,” where just by being treated roughly, but with no anatomic damage, the snake simply dies in front of your eyes, some bushmaster keepers have over the years attempted to improve the condemned practice of free handling. If one feels the need to use the method and is experienced enough to deal with it, just keep in mind that if you happen see the two loreal pits at once while free handling the animal, you’re already a target. And one should also be aware that suddenly dropping the animal, even from a height as low as two feet, may be fatal to it, because of rupture of internal tissues and internal bleeding.



Free handling golden rule (obvious): if you see both loreal pits, you’re already a target.

Staying alive

All those dealing with dangerous wildlife must remember that in nature there are individual differences and circumstances. One must never believe that “the genus” behaves in such and such a way: one individual may all of a sudden act differently. Overconfidence is what may really kill us, and we all better watch out full time for our own egos, as much as we do for concentration, distance and anticipation. One should be mostly concerned with space in the working area, for a fair chase or even a sequence of very high strikes are true possibilities: don’t corner or allow yourself to be cornered by adult bushmasters.

One of the greatest pieces of advice we could get came from Pearn et al. (1994): “The 28 herpetologists interviewed had sustained 119 bites by potentially dangerous species, and hundreds of clinically insignificant bites. The experienced herpetologists sustained a life-threatening bite every 10 years (median). Herpetologists working with highly venomous snakes are at high risk. Prevention involves recognizing the risk; possessing a first-aid certificate; applying standard first-aid if a bite is sustained; carrying a mobile telephone; and not working alone.” © 1994. *The Medical Journal of Australia*—reproduced with permission.

Shortly stated, if you are dealing with *Lachesis* your main concern should be your own safety since they come well equipped to kill you in one hour or less after a bite, and may completely knock you out in 10–20 minutes, even with very low volume of poison injected in your body. We do not advise any delay on your way to a nearby hospital, previously selected and whose staff (previously contacted preferably) is ready for such an emergency. Take as a rule: if the bite site is really painful and bleeding, chances are you’ve got “a bad one” and will quickly need antivenin.

For a full account of what to expect after a *Lachesis* bite, see Souza et al. (2007). In this article one may also realize the importance of the biochemical properties of *Lachesis* poison to the pharmacological world.

For an account in which quick antivenin was not available, one may refer to Mellor and Arvin (1996), who describe a previously healthy adult male, bitten right above the knee, striving for survival throughout three months of agony and pain, facing surgeries, infection and the amputation of one entire leg at pelvic level. An airlift and a five-day hospitalization may cost you over \$150,000 in the U.S. Health insurance plans are a must for herpetologists.

Conclusion

We have mentioned already that 93% of the original Atlantic rainforest is gone. In the southern part of Bahia state, satellite photographs of a federal agency for cocoa research (CEPLAC) reveal that the remaining 7% of the forest is being devastated at a constant pace of 1% a year. That happens due to the so-called

“little ant” deforestation: a small scale clear-cutting procedure, multi-focal and extremely hard to detect and prevent. Little by little all *Lachesis* territory turns into cattle territory, roads, villages, mega-resorts etc. And also, just by seeing a magnificent and apparently well preserved forest, you can’t call it *Lachesis* territory: Huge expanses of the remaining rainforest (Maraú/Bahia area for instance), that provide the shade needed by the cocoa (“cacau”) trees, have been heavily sprayed (mostly in the ’80s) with the deadly and worldwide banned pesticide BHC (to “protect” cocoa and the chocolate industry) thus breaking the food chain in the forest, and so, the magnificent trees are all there, but not the rats, nor the snakes or lizards—nothing.

Without the forest, and so 1) without the humidity that will that will prevent eggs from dehydrating, and without the shade that will lower temperatures, and 2) facing a cultural association with the devil, fueling the ongoing slaughter, and 3) after major, criminal interferences in the food chain, what else can we expect for the future of the Atlantic bushmaster in the wild? Here also lies the importance for our captive breeding programs, maybe to “start it all over again” in the future, providing individuals for reintroduction in selected areas, and for other successful breeding programs.

As the three of us began our conversations on writing this article for CHS we struggled because there is so much we want to share, so much we still have to learn, and so much that we want the readers to know in terms of the plight of Brazil’s Atlantic rainforest region and the need for aggressive conservation management plans to be in place not only to save the bushmaster but to save many species of wildlife. The habitat situation for the Central American species is not all that different. The Amazon forest still shelters and protects *Lachesis acrochorda* and *L. muta muta* (or *L. muta*). But how safe is the forest herself nowadays, and for how long? To save a species you must save its habitat and in order to save the habitat you must have a buy-in from those folks who live in that region. Pragmatic and idealistic issues are at the heart of saving this land and there must be a middle ground reached so that people can live and the bushmaster can continue to be an integral part of the natural heritage and biodiversity of this region. Working with *Lachesis* utilizing both primitive and modern day herpetocultural methods is an endeavor of love and probably the only method by which the true “Lords of the Rainforest” will be saved from an uncertain future in nature.

Again here the Tao of *Lachesis*, or the multiple ways to achieve a goal, without the limitations of “an expert’s mind” where few possibilities exist, and where prejudice may reduce opportunities for learning.

As the sculptors of the “uncarved block,” we must tell the story and bring awareness to the *Lachesis* plight. It would be a shame to think about a world without the largest pitviper known to humans. It’s written on the tombstone of extinction: “Too few cared.”

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