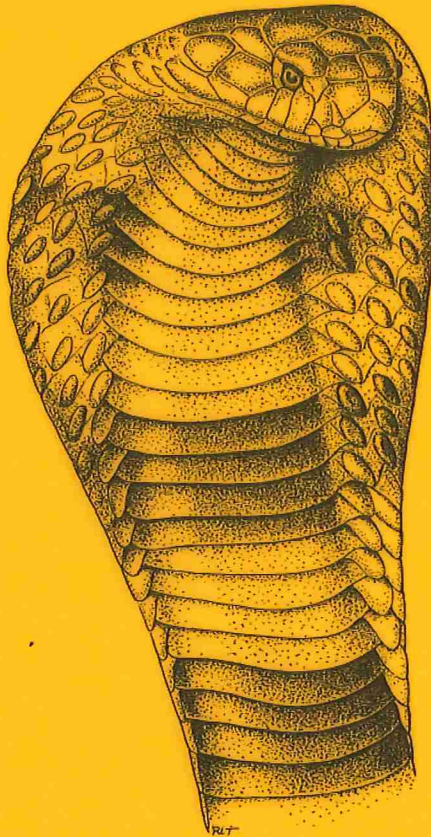


# VENOMOUS SNAKES: A SAFETY GUIDE FOR REPTILE KEEPERS

WILLIAM ALTIMARI



SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

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VENOMOUS SNAKES:  
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# VENOMOUS SNAKES: A SAFETY GUIDE FOR REPTILE KEEPERS

WILLIAM ALTIMARI

## INTRODUCTION

This paper is a safety primer for keepers working with venomous snakes in herpetological collections. Recent research has shown that venomous bites have occurred among reptile keepers in North American zoos at the rate of approximately one per year for the past quarter-century (Card and Roberts 1996). Furthermore, it is possible that this count is low and that some envenomations went unreported to the survey. This author believes that this rate of keeper envenomation can be lessened with a greater awareness on the part of keepers of the habits and potentialities of the snakes in their charge. Publications dealing with the care of venomous snakes generally offer a broad and brief overview of some of the practical concerns that might arise when dealing with these animals. As far as the author knows, there has heretofore been no guide to the broad range of species one might encounter on a daily basis in an international collection of venomous serpents. In addition to advice on working with sixty different species of snakes, included in this primer is information, when known, on the toxicity of their venoms. In more than two decades of involvement with venomous snakes, the author has been surprised on more than one occasion to learn how many zoo professionals, including veteran keepers, have only a very vague notion of the lethality of their charges, in terms of both the potential of their venoms and of the behavioral quirks that render working with these snakes problematic. It is hoped that the information in this paper will help remedy that. Venom yields presented here are the *maximum* published yields that the author has been able to obtain from a variety of sources (Branch 1988; Broadley and Cock 1975, 1989; Brown 1973; Daniel 1983; Ernst 1992; Glenn and Straight 1982; Klauber 1956; Lowe, Schwalbe and Johnson 1986; Minton, Dowling and Russell 1965; Minton and Minton 1980; Spawls and Branch 1995; Sutherland 1981). These sources, as well as those for lethal doses, are listed in this section as a group, since to cite a source with each individual entry would make this paper far too difficult to read. This booklet is a practical handbook for working zoo and museum herpetologists, and its clarity and user-friendliness would be seriously compromised by parenthetical references next to each numerical entry on yields and doses.

It should be noted that maximum yields are often several times greater than average yields. However, persons working with venomous snakes should always operate from the perspective of a worst-case scenario. Likewise, sizes given are maximum known sizes. Because sensitivity to snake venoms can vary significantly among individuals, remarks on symptoms and lethality should be regarded as applying only in a general sense and are based upon the results of published experiments with mice and rats as well as on case histories of human envenomations. Estimates of lethal doses for human adults are from Minton and Minton (1980), Spawls and Branch (1995), Tamiya (1975), and Vick *et al.* (1975). The author emphasizes that extrapolations from experiments with rodents are merely conjecture and should be regarded with caution.

Remarks on the temperaments and behavior of all animals in this paper are based on the author's personal experience. Some herpetologists might argue that the temperaments of venomous snakes vary so widely that no broad observations on their behavior can be made. The author rejects this notion as dangerous. The fact that one encounters a calm and sedate Egyptian Cobra does not disprove the fact that most of them are nervous. The exception does not disprove the rule. A keeper, particularly a novice, must be informed by more experienced keepers of the general run of behavior of the venomous snakes in his or her charge. For an experienced keeper to neglect to do so, because of concerns about variability or uncertainty of behavior, is dangerous in the extreme. Variability of specific behaviors does not refute likelihood of specific behaviors. However, it should be borne in mind that the statements in this paper regarding behavior are *not* generalizations from the author's experience but, rather, a description of it. Unique and startling incidents with venomous snakes occur with some frequency, so it is always wise for the keeper, veteran as well as novice, to err on the side of caution. It was decided to include no snakes about which the author did not have first-hand knowledge. Though this eliminates potentially valuable information, it also eliminates unverified anecdotes and hearsay accounts of dubious accuracy. Other professionals are encouraged to continue this work with additional supplements drawn from their own experience.

## EQUIPMENT

*Hooks.* Snake hooks come in a wide range of sizes, configurations, and materials, from homemade ones of commonly found materials to hooks manufactured from expensive, lightweight metals. Even a snake that readily balances itself on a hook will be difficult to work if the hook is ill-fitting in the keeper's hand. Thus, every keeper who works in a venomous snake section should have access to a hook with which he or she is comfortable. The



author's favorites are hooks with hollow aluminum shafts, long and thin rubber grips, and hook material of titanium or aluminum. They are lightweight, tarnish resistant, easily disinfected, and durable enough to last for decades, if not a lifetime. For lifting heavy-bodied snakes (e.g., *Bitis arietans*, *Bitis gabonica*, *Crotalus adamanteus*), flat-bladed hooks two to three centimeters wide are recommended, as they will not press as deeply as rounded hooks into the underside of the snake. The lifting parts of the hooks should be curved rather than L-shaped, thus preventing the snake from sliding down the shaft toward the keeper should the animal be inadvertently lifted higher than the level of the keeper's hand. However, an L-shaped hook can be useful as the second hook when moving an arboreal snake, since this type of hook tends to be easier to manipulate gently around a snake's prehensile tail.

*Tongs.* Snake tongs are essential in capturing wild snakes, but their use in a herpetological collection is very limited because of two serious shortcomings. First, in unskilled or nervous hands they can easily injure a snake. Second, most snakes are much more likely to thrash wildly and injure their spines and internal organs and to bite the tool and injure their mouths when being grasped by tongs than when being lifted by hooks. Tongs are best used for feeding and otherwise servicing an enclosure, and should be used to grasp a snake only in an emergency when nothing else will suffice or is available. Tongs are not an acceptable substitute for lack of skill with a snake hook.

*Shields.* Shields are useful tools in servicing an enclosure. A small transparent plastic shield placed in front of a hide box can be used to keep the snake inside it out of mischief while the cage is being serviced. A large transparent plastic shield can be employed to keep a snake at the far side of an exhibit during servicing, while still allowing the snake to be seen should it decide to go around the shield.

*Snake Cans.* The safest and most secure snake holding cans are galvanized metal garbage cans with a handle on the lid and a bail on the can which can be raised to secure the lid. For many decades these were the snake cans of choice, but now they have often been replaced—though not superseded—by hard rubber trash cans. Though these latter cans are able to survive years of rough handling, their lid fastening devices make them a poor choice for the safety conscious. They are sometimes difficult to close, almost always cumbersome and dangerous to open, and their hidden locking clasps prone to warping and breakage. On the other hand, the lids of the metal cans can be put in place and removed with a hook from a safe distance, and their locking device is both positive and immediately visible. With proper care, these cans will last many years.

*Face Shields.* A plastic face shield is a necessity when working with *Spitting Cobras*. Goggles may be used in an emergency, but a full face shield

will ensure that an open sore or abraded skin on the keeper's face will not be contacted by squirted venom, and the shield will also prevent the keeper's inhalation of dried venom.

*Tubes.* The use of clear acrylic tubes for the mechanical restraint of venomous snakes is the safest and most effective means of immobilizing these animals without an anesthetic. Pioneered at the Dallas Zoo and refined at the Oklahoma City Zoo, it has been described at length elsewhere and will not be elaborated upon here (Murphy 1971; Walczak 1991). Briefly, it consists of placing the snake in a trash can with several centimeters of water and encouraging it to climb up the tube. The keeper should grip the tube along the side near the top and be very careful not to allow any part of the hand to cross the top opening of the tube. When the snake's head is approximately halfway up, the tube is pressed gently downward against the body of the snake, thereby immobilizing it. The snake is then grasped at the point where it enters the tube while several fingers of the same hand also grasp the tube. The animal, now secured within the tube, is then removed from the can. In the case of a snake with a relatively large body but with a small head (e.g., *Crotalus tigris*), a second and narrower tube can be inserted at the top end over the head of the snake. In this way the snake cannot turn its head around in the tube and try to crawl back toward the keeper's hand. As with most methods of working safely with venomous snakes, the tubing method's greatest strength is its simplicity. The author is not aware of any cases of envenomation resulting from the use of this excellent technique.

### GENERAL GUIDELINES

- When one is working with venomous snakes, another keeper qualified to assist should always be within sight or call.
- A keeper should never even consider working with venomous snakes when he or she is tired, ill, or taking medication which might impair alertness.
- A keeper should never work with venomous snakes when there is the slightest potential for a power failure. This can be caused by a thunderstorm, an ice storm, high winds, flooding, etc. It can also be caused by underground excavation near power lines, as well as an electrician at work inadvertently cutting the power to the facility. Even if there is an emergency generator, there is usually some lag time before it starts. The author is aware of two instances in which a keeper had a venomous snake on a hook when the lights went out.
- A hook should always be at hand when a venomous snake cage is opened, thus avoiding the necessity of searching for one should the snake attempt to escape from its enclosure.

- The keeper should always ensure that there is a clear line of retreat should a particularly aggressive snake propel itself out of its enclosure or leap off a hook onto the floor. A venomous snake should never be allowed to interpose itself between the keeper and the only exit.
- When a snake is to be lifted with a hook, the hook should be placed beneath the snake slightly *forward* of midbody. Though sometimes a snake will recoil, most snakes lifted anywhere near midbody have a tendency to begin to move forward when they feel themselves being lifted. By placing the hook slightly anterior to the snake's midpoint, the keeper helps ensure that the hook will be at the center of the snake by the time the animal clears the substrate. Encouraging a snake to do what one wants is far more effective than attempting to coerce it.
- Research has shown that a high number of keeper envenomations result from the use of hooks that are too short for the length of the snake (Card and Roberts 1996). The use of feeding tongs which are too short, as well as the feeding of snakes without using tongs at all, are also significant causes of snakebite among keepers. The history of snakebite among zoo professionals has shown that keepers are much less likely to be bitten when removing a snake than they are when performing some activity in an enclosure with a snake inside it (Card and Roberts 1996). Therefore, if there is any doubt whatsoever about the wisdom of servicing an enclosure with the snake inside it, the snake should definitely be removed.
- Lids and doors should be opened with a long-handled implement if the size and position of the snake and the size of the enclosure indicate that the snake could reach the area of the opening or beyond if it strikes.
- If an exhibit enclosure has a solid door with no window, the keeper should *always check from the front* the position of the head of the snake or snakes before opening the enclosure. A fish-eye peek hole in the door is often inadequate for this purpose and should not be relied upon.
- If a keeper is servicing an enclosure with a venomous snake inside it, the keeper should not allow the snake out of his or her line of vision, regardless of how long it takes to service the enclosure. If the enclosure requires extensive servicing and the snake cannot be kept in view during the procedure, the snake should be removed.
- As a general rule, it should be assumed that a snake can, with a strike, reach a distance of at least one-half to three quarters of its body length. This could conceivably even be exceeded if the snake succeeds in launching its entire body forward with the strike (e.g., *Calloselasma rhodostoma*). A cobra will generally not strike farther than the length of its *raised fore body* (though, of course, it need not hood and raise its body at all in order to bite), although after a strike it could move its body forward and then strike again from a shorter distance.

- It is preferred that holding cages with screen tops be fitted with a double screen with a space between screen layers, thus preventing a bite to a hand or arm carelessly laid across the top. Also, the author is aware of three instances in which crotalids struck at top screens with such force that venom was ejected onto the keepers. In one instance, venom entered the keeper's eyes and hospital care was required. A double screen alone will not prevent this, but it will somewhat mitigate the danger by decreasing the amount of venom exiting the cage.
- Before returning a snake to a holding cage with a sliding lid, the keeper should re-insert the lid into its guides and close it about halfway. When the snake is returned to the cage, its head can be directed with the hook to the covered part of the cage, thus allowing the keeper to slide the lid closed with greater safety to both the keeper and the snake. If the lid will slide easily in its guides, the hook, rather than the hand, should be used to slide it closed.
- Ideally, an area housing venomous snakes should not have equipment, other than snake cans, stored on the floor where an escaped snake can easily conceal itself.

## SNAKES IN HERPETOLOGICAL COLLECTIONS

### Family Elapidae

Cobras, mambas, and kraits comprise the majority of elapids in most herpetological collections. The author's experience with Australian elapids is confined to a single species, so the present discussion will deal primarily with the genera *Naja*, *Ophiophagus*, *Dendroaspis*, and *Bungarus*.

It was once considered unsafe to move cobras with hooks in the manner one uses to move vipers. Generally, three other methods were used with cobras. First, the snake was encouraged to enter a lockable shift box which was then closed and moved easily and safely. Second, if there happened to be a shift door between two cages, the slide was pulled and the animal was encouraged to move into the adjacent cage, the slide closed, and the original cage was serviced. Last, the forebody of the snake was lifted with a hook and the tail of the animal was gently grasped with the other hand and the snake directed to where the keeper wanted it to go.

The lockable shift box and the use of a shift cage remain excellent methods of moving King Cobras, mambas, and very nervous and aggressive Spitting and Forest Cobras. On the other hand, "tailing"—the combined use of a hook and the restraint of the tail—is, in the author's view, unnecessary and dangerous. Experience has shown that most cobras (genus *Naja*) can be moved with a hook in the manner of other venomous snakes. They may hood and hiss while they are on the hook, but on the hook they usually remain.

Lateral or dorsal/ventral compression of the snake with the hand can elicit a defensive strike. This is why snakes, both venomous and non-venomous, often bite tongues. Seizing a snake is the easiest way to get it to bite. Though one might derive a certain ego enhancement from handling a cobra, this temptation should be avoided.

Kraits (genus *Bungarus*) are generally docile and can usually be moved with traditional hooking methods, though they can sometimes be aggressive in the early morning and at night. Mambas (genus *Dendroaspis*) tend to be quite variable in temperament among the different species, but shifting is the preferred method of moving these snakes. Adult King Cobras (*Ophiophagus hannah*) should always be shifted, without exception. It is also advisable to keep a long-handled broom at the rear of a King Cobra enclosure. Should an aggressive snake escape into the keeper alley and raise its forebody to strike, the broom can be placed against the underside of the snake's neck, in the manner of using a yoke when working with ostriches, to keep the animal at bay until assistance arrives or until the snake can be directed back into its cage.

*Acanthopis antarcticus* (Common Death Adder)

Habits and size—terrestrial, diurnal and nocturnal, 90 cm.

Venom yield—236 mg; lethal dose 10–15 mg.

Envenomation—local pain; death from respiratory paralysis.

Temperament—very aggressive, with an extremely fast strike; will bite anything within reach of its jaws; will attempt to throw itself off hook while simultaneously striking (a rare behavior in captive venomous snakes); *must be treated with extreme caution.*

*Aspidelaps scutatus* (Shieldnose Cobra)

Habits and size—fossorial, nocturnal, 75 cm.

Venom yield—50 mg; lethal dose probably ~50 mg.

Envenomation—local pain and swelling; death from respiratory paralysis

Temperament—extremely nervous and highly strung; very prone to hiss and strike, but often strikes with mouth closed; tendency to slide quickly off hook; can be balanced on hook, but must be lifted quickly and neatly and without hesitation.

*Bungarus fasciatus* (Banded Krait)

Habits and size—terrestrial, nocturnal, 2.25 m.

Venom yield—114 mg; lethal dose unknown, but probably < 10 mg.

Envenomation—generalized pain spasms; death from respiratory paralysis.

Temperament—very shy and unlikely to bite during the day, except in a feeding reaction, but can be very aggressive at night and in the early morning; good balancer.

*Bungarus multicinctus* (Many-banded Krait)

Habits and size—terrestrial, nocturnal, 1.84 m.

Venom yield—11 mg (actual maximum is probably higher); lethal dose unknown, but probably <10 mg.

Envenomation—generalized pain and paralysis; death from respiratory paralysis.

Temperament—very shy and unlikely to bite except during a feeding reaction, but can be very aggressive at night and in the early morning; good balancer.

*Dendroaspis angusticeps* (Eastern Green Mamba)

Habits and size—arboreal, diurnal, 2.5 m.

Venom yield—100 mg; lethal dose 15 mg.

Envenomation—local pain, swelling, gangrene; death from respiratory paralysis.

Temperament—relatively docile; should be shifted, but very docile snakes can be moved with a hook, though this is not recommended.

*Laticauda colubrina* (Yellow-lipped Sea Snake)

Habits and size—aquatic (marine), primarily nocturnal, 1.35 m.

Venom yield—5 mg; lethal dose 17.5 mg.

Envenomation—N/A; fatalities rare or unknown due to docile nature and low venom yield.

Temperament—docile and shy, though there is at least one report of aggressive behavior of this snake when out of water; poor balancer.

*Laticauda semifasciata* (Erabu Sea Snake)

Habits and size—aquatic (marine), primarily nocturnal, 1 m.

Venom yield—5 mg; lethal dose 33.6 mg.

Envenomation—N/A; fatalities rare or unknown.

Temperament—considered docile by native fishermen, but captive specimens can be nervous and virtually impossible to work on a hook, so the use of tongs should be considered in this rare instance.

*Micruroides euryxanthus* (Western Coral Snake)

Habits and size—fossorial, diurnal and nocturnal, 60 cm.

Venom yield—6 mg; lethal dose N/A.

Envenomation—local pain; no fatalities known but venom probably could cause respiratory paralysis.

Temperament—very nervous but not prone to bite, except in a feeding reaction; tendency to slide quickly off hook; very poor balancer, though long-term captives sometimes become workable with a hook.

*Micrurus fulvius* (Eastern Coral Snake)

Habits and size—terrestrial, diurnal, 1.2 m.

Venom yield—20 mg; lethal dose 4–5 mg.

Envenomation—local pain; death from respiratory paralysis.

Temperament—very nervous but usually not prone to bite unless freshly caught from the wild; tendency to slide quickly off hook; very poor balancer, though long-term captives occasionally become fair balancers.

*Naja haje* (Egyptian Cobra)

Habits and size—terrestrial, diurnal and nocturnal, 2.5 m.

Venom yield—300 mg; lethal dose 25–35 mg.

Envenomation—intense local pain and swelling, necrosis; death from respiratory paralysis.

Temperament—nervous; because of large size and uncertain temperament, snake should be moved by shifting.

*Naja kaouthia* (Monocled Cobra)

Habits and size—terrestrial, nocturnal, 2.25 m.

Venom yield—263 mg; lethal dose 15–20 mg.

Envenomation—local pain and swelling, extensive necrosis; death from respiratory paralysis.

Temperament—nervous; good balancer.

*Naja nigricollis* (Blackneck Spitting Cobra)

Habits and size—primarily terrestrial, primarily nocturnal, 2 m.

Venom yield—350 mg; lethal dose 40–50 mg.

Envenomation—severe local pain and swelling, extensive necrosis; possible neurological complications; death from pulmonary edema.

Temperament—nervous; more likely to “spit” than bite; face shield a necessity; shifting is preferred in order to prevent venom from being squirted onto the keeper and the work area.

*Naja nivea* (Cape Cobra)

Habits and size—primarily terrestrial, diurnal, 1.7 m.

Venom yield—250 mg; lethal dose 15–20 mg.

Envenomation—local pain and swelling; death from cardiac arrest or respiratory paralysis.

Temperament—nervous; usually easy to balance on a hook, though temperaments vary.

*Naja oxiana* (Central Asian Cobra)

Habits and size—terrestrial, probably nocturnal, 1.9 m.

Venom yield—372 mg; lethal dose N/A.

Envenomation—death from respiratory paralysis.

Temperament—nervous; good balancer.

*Naja pallida* (Red Spitting Cobra)

Habits and size—primarily terrestrial, primarily nocturnal, 1.5 m.

Venom yield—N/A; lethal dose N/A, but probably similar to *Naja mossambica* (40–50 mg).

Envenomation—severe local pain and swelling; extensive necrosis; fatalities uncertain but venom could possibly cause respiratory paralysis.

Temperament—will “spit” readily; more likely to bite than some Spitting Cobras and will seize hook, tongs, or any other tool within reach; face shield a necessity; shifting to adjoining cage is preferred method of moving this snake.

*Ophiophagus hannah* (King Cobra)

Habits and size—terrestrial, diurnal, 6 m.

Venom yield—450 mg; lethal dose 25–35 mg.

Envenomation—severe local pain and swelling; occasional necrosis; possible hemorrhagic effects; death from cardiac arrest or respiratory paralysis.

Temperament—usually fairly docile except when hungry, when a feeding reaction might cause an inadvertent attack; because of size, shifting should be the sole method of moving this animal; probably the most intelligent of all snakes; the author’s experience, as well as that of other herpetologists, indicates that adult king cobras are capable of visually distinguishing among different people and sometimes develop an aversion, with corresponding aggressiveness, toward specific individuals; *must be treated with extreme caution.*



*Walterinnesia aegyptia* (Black Desert Cobra)

Habits and size—terrestrial, nocturnal, 1.35 m.

Venom yield—20 mg; lethal dose N/A.

Envenomation—local pain and swelling; death from respiratory paralysis.

Temperament—moderately nervous; good balancer.

## Family Viperidae

Vipers and pit vipers vary so widely in size, shape, and temperament that only a few generalizations can be made.

Heavy-bodied snakes, though sluggish, have very quick head and neck movements, and their short strike is extremely fast. It should not be underestimated.

Arboreal snakes should always be worked with two hooks at hand. If the snake begins to climb the first hook, the second hook can be used to dislodge it. Alternatively, the keeper can lay down the hook and then use the second hook to pick up the snake. A third method is to use both hooks simultaneously when moving the snake. The animal is hooked at mid-body, and the second hook is gently placed against the tail. A prehensile-tailed snake will usually grasp the second hook with its tail. This two-hook method greatly increases their sense of security during a transfer.

*Agkistrodon bilineatus* (Cantil)

Habits and size—terrestrial, diurnal, > 1.3 m.

Venom yield—N/A; lethal dose N/A.

Envenomation—local pain and swelling, extensive necrosis; fatalities rare; possible death by hemorrhage.

Temperament—extremely irritable and prone to strike without warning; often a poor balancer with pronounced tendency to slide off hook.

*Agkistrodon contortrix* (Copperhead)

Habits and size—terrestrial and semi-aquatic, diurnal and nocturnal, 1.34 m  
(*Agkistrodon c. mokasen*).

Venom yield—75 mg; lethal dose ~100 mg.

Envenomation—local pain and swelling; fatalities extremely rare; possible death from hemorrhage.

Temperament—moderately nervous; good balancer.

*Agkistrodon piscivorus* (Cottonmouth)

Habits and size—terrestrial and semi-aquatic, diurnal and nocturnal, 1.88 m.  
Venom yield—170 mg; lethal dose ~100 mg.  
Envenomation—local pain and swelling, extensive necrosis; fatalities rare, but possible death from hemorrhage.  
Temperament—unpredictable; may strike at sudden movement; good balancer despite size.

*Bitis arietans* (Puff Adder)

Habits and size—terrestrial, nocturnal, 1.9 m.  
Venom yield—350 mg; lethal dose 90–100 mg.  
Envenomation—local pain and swelling; necrosis; death from hemorrhage.  
Temperament—moderately nervous; fairly good balancer, but two hooks are required for large specimens to prevent spinal injury.

*Bitis gabonica* (Gaboon Viper)

Habits and size—terrestrial, nocturnal, >2 m.  
Venom yield—2400 mg; lethal dose N/A, but possibly less than that of *Bitis arietans*.  
Envenomation—local pain and swelling, necrosis; death from hemorrhage.  
Temperament—variable; can strike extremely quickly at anything within reach of jaws, but usually hisses rather than bites; fairly good balancer, but two hooks are required for large specimens to prevent spinal injury.

*Bitis nasicornis* (Rhinoceros Viper)

Habits and size—terrestrial, nocturnal, 1.2 m.  
Venom yield—N/A; lethal dose N/A, but probably more than that of *Bitis gabonica*.  
Envenomation—local pain and swelling, necrosis; few recorded bites but probably death from hemorrhage.  
Temperament—can be irritable; fairly good balancer, but two hooks are required for large specimens to prevent spinal injury.

*Bothriechis schlegelii* (Eyelash Palm Viper)

Habits and size—arboreal, 80 cm.  
Venom yield—20 mg; lethal dose ~15 mg.  
Envenomation—local pain and swelling; extensive necrosis; fatalities rare or unknown, but possible death from hemorrhage.  
Temperament—variable; sometimes highly strung and prone to bite; prehensile-tailed, so two hooks are required.

*Bothrops alternatus* (Urutu)

Habits and size—terrestrial, nocturnal, 2 m.  
Venom yield—100 mg; lethal dose 15–20 mg.  
Envenomation—local pain and swelling; extensive necrosis; fatalities rare, but possible death from hemorrhage.  
Temperament—nervous; will sometimes lunge violently when touched; good balancer once on hook.

*Bothrops andianus* (Andean Lancehead)

Habits and size—terrestrial, max. size N/A.  
Venom yield—N/A; lethal dose N/A.  
Envenomation—N/A, but symptoms probably similar to those from *B. atrox*.  
Temperament—will strike readily with little provocation; very difficult on a hook; heavy adults should be shifted, if possible.

*Bothrops atrox* (Common Lancehead, Barba Amarilla)

Habits and size—terrestrial, nocturnal, > 2.4 m.  
Venom yield—238 mg; lethal dose N/A.  
Envenomation—local pain and swelling; extensive necrosis; death from hemorrhage.  
Temperament—can be nervous and unpredictable; some individuals highly aggressive; can be moderately good balancer, but shifting is preferred method of moving for all but the most docile snakes.

*Bothrops caribbaeus* (St. Lucia Lancehead)

Habits and size—terrestrial, nocturnal, >2 m.  
Venom yield—N/A; lethal dose N/A.  
Envenomation—intense local pain and swelling; extensive necrosis; death from hemorrhage.  
Temperament—nervous, especially when touched; tends to climb hook, so two hooks should be available when moving this snake.

*Bothrops (Atropoides) nummifer* (Jumping Pit Viper)

Habits and size—terrestrial, max. size N/A.  
Venom yield—130 mg; lethal dose N/A.  
Envenomation—N/A, but probable pain, swelling, and necrosis; fatalities rare or unknown.  
Temperament—variable; capable of long strike; good balancer despite size.

*Calloselasma rhodostoma* (Malayan Pit Viper)

Habits and size—terrestrial, primarily nocturnal, >1 m.

Venom yield—60 mg; lethal dose 30–35 mg.

Envenomation—local pain and swelling; necrosis; death from hemorrhage.

Temperament—irritable and prone to strike without warning; marked tendency to slide forward several inches with each strike, thus quickly shortening the distance between itself and the keeper; good balancer; its tendency to stay coiled when moved allows it to be lifted by having the hook placed in the center of the coil and then being raised as if one were picking up a doughnut with a hook.

*Cerastes cerastes* (Egyptian Horned Viper)

Habits and size—terrestrial, nocturnal, 85 cm.

Venom yield—70 mg; lethal dose 40–50 mg.

Envenomation—local pain and swelling; necrosis; fatalities rare, but possible death from hemorrhage.

Temperament—nervous; excellent peripheral vision and will strike extremely quickly at any movement; good balancer.

*Cerastes gasperettii* (Gasperetti's Viper)

Habits and size—terrestrial, nocturnal, 85 cm.

Venom yield—N/A; lethal dose N/A.

Envenomation—local pain and swelling; fatalities rare or unknown.

Temperament—moderately nervous; poor balancer; two hooks aid in moving this snake.

*Crotalus adamanteus* (Eastern Diamondback Rattlesnake)

Habits and size—terrestrial, crepuscular and nocturnal, 2.5 m.

Venom yield—864 mg; lethal dose 40–50 mg.

Envenomation—local pain and swelling, extensive necrosis; death from hemorrhage and vascular collapse.

Temperament—varies, but tends to be nervous; good balancer despite large size; two hooks are required for large specimens to prevent spinal injury.

*Crotalus atrox* (Western Diamondback Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 2.13 m.

Venom yield—1145 mg; lethal dose 60–70 mg.

Envenomation—intense local pain and swelling, necrosis; death from hemorrhage.

Temperament—moderately to extremely nervous; poor to good balancer, depending on individual; two hooks are required for large specimens to prevent spinal injury.

*Crotalus basiliscus* (Mexican West Coast Rattlesnake)

Habits and size—terrestrial, nocturnal, 2 m.

Venom yield—297 mg (average); lethal dose N/A.

Envenomation—N/A.

Temperament—moderately nervous; fair balancer.

*Crotalus catalinensis* (Santa Catalina Island Rattlesnake)

Habits and size—terrestrial and arboreal, 73 cm.

Venom yield—32.6 mg; lethal dose N/A.

Envenomation—N/A.

Temperament—can be nervous and difficult on a hook.

*Crotalus cerastes* (Sidewinder)

Habits and size—terrestrial; diurnal, nocturnal, and crepuscular; 82 cm.

Venom yield—67 mg; lethal dose 30–35 mg.

Envenomation—local pain and swelling, necrosis; fatalities rare; probably death from hemorrhage.

Temperament—moderately nervous, fair to good balancer.

*Crotalus durissus* (Neotropical Rattlesnake)

Habits and size—terrestrial, 1.8 m.

Venom yield—300 mg; lethal dose 10 mg.

Envenomation—local pain and swelling; death from renal failure or respiratory paralysis (*C. d. terrificus*).

Temperament—nervous and prone to bite, especially when hungry; can be difficult to work on a hook because of size and temperament; two hooks are required for large specimens to prevent spinal injury; *because of temperament and venom composition and yield, one of the most dangerous of all snakes and must be treated with extreme caution.*

*Crotalus horridus* (Timber Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 1.89 m.

Venom yield—229 mg; lethal dose 40–50 mg.

Envenomation—local pain and swelling; death from hemorrhage or heart failure.

Temperament—nervous; good balancer.

*Crotalus lepidus* (Rock Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 85 cm.

Venom yield—129 mg; lethal dose N/A.

Envenomation—local pain and swelling; fatalities unknown, but possible death from hemorrhage.

Temperament—nervous; good balancer.

*Crotalus mitchellii* (Speckled Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 1.32 m.

Venom yield—350 mg; lethal dose N/A.

Envenomation—local pain and swelling; fatalities rare; possible death from hemorrhage.

Temperament—nervous and prone to strike without warning; good balancer.

*Crotalus molossus* (Blacktail Rattlesnake)

Habits and size—terrestrial and arboreal, diurnal and nocturnal, 1.26 m.

Venom yield—540 mg; lethal dose N/A, but probably similar to *C. atrox*.

Envenomation—local pain and swelling; death from hemorrhage.

Temperament—probably the most docile of all rattlesnakes, though freshly caught specimens can be very aggressive and unpredictable; good balancer once acclimated.

*Crotalus pricei* (Twin-spotted Rattlesnake)

Habits and size—terrestrial, diurnal, 66 cm.

Venom yield—8 mg (average); lethal dose N/A.

Envenomation—local pain and swelling; fatalities rare or unknown; danger from hemorrhage.

Temperament—nervous; good balancer.

*Crotalus ruber* (Red Diamond Rattlesnake)

Habits and size—terrestrial, nocturnal, 1.6 m.  
Venom yield—707 mg; lethal dose N/A.  
Envenomation—local pain and swelling; death from hemorrhage.  
Temperament—fairly docile; good balancer.

*Crotalus scutulatus* (Mojave Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 1.29 m.  
Venom yield—150 mg; lethal dose 10–15 mg.  
Envenomation—local pain and swelling, with potentially neurotoxic effects if snake is from population having “Mojave toxin;” death from shock, renal failure or respiratory paralysis.  
Temperament—variable; can be very nervous, with strong tendency to slide off hook; some snakes will also attempt to strike from hook.

*Crotalus tigris* (Tiger Rattlesnake)

Habits and size—terrestrial, diurnal and nocturnal, 90 cm.  
Venom yield—17 mg; lethal dose N/A.  
Envenomation—local pain and swelling; fatalities rare or unknown; possible death from hemorrhage.  
Temperament—moderately nervous; good balancer.

*Crotalus vegrandis* (Uracoan Rattlesnake)

Habits and size—terrestrial; max. size N/A.  
Venom yield—N/A; lethal dose N/A.  
Envenomation—local pain and swelling; death from renal failure or respiratory paralysis (considered by some to be a subspecies of *C. durissus*).  
Temperament—moderately nervous; good balancer despite size.

*Crotalus viridis* (Western Rattlesnake)

Habits and size—terrestrial and arboreal; diurnal and nocturnal, 1.62 m.  
Venom yield—390 mg; lethal dose N/A.  
Envenomation—local pain and swelling; death from hemorrhage or heart failure combined with respiratory complications.  
Temperament—varies widely, but tends to be more nervous than most species of *Crotalus* and can be difficult on a hook.

*Crotalus willardi* (Ridgenose Rattlesnake)

Habits and size—terrestrial, diurnal, 60 cm.  
Venom yield—37 mg; lethal dose N/A.  
Envenomation—N/A; bites rare, fatalities unknown.  
Temperament—variable; good balancer.

*Echis carinatus* (Saw-scaled Viper)

Habits and size—terrestrial, nocturnal, 64 cm.  
Venom yield—72 mg; lethal dose 3–5 mg.  
Envenomation—local pain, swelling, necrosis; spontaneous hemorrhage from mucus membranes; death from central nervous system hemorrhage.  
Temperament—extremely highly strung and prone to bite; shield should never be used when servicing enclosure—snake should always be removed; *the irascible temperament of this snake, coupled with the extreme sensitivity of humans to its venom, makes it one of the most dangerous snakes in a collection; must always be treated with extreme caution.*

*Sistrurus catenatus* (Massasauga)

Habits and size—terrestrial; diurnal, crepuscular, and nocturnal; 1 m.  
Venom yield—35 mg; lethal dose 20–25 mg.  
Envenomation—local pain and swelling; death from hemorrhage.  
Temperament—nervous; poor balancer; two hooks used simultaneously will aid in moving.

*Sistrurus miliarius* (Pigmy Rattlesnake)

Habits and size—terrestrial, diurnal, 80 cm.  
Venom yield—35 mg; lethal dose 30 mg or more.  
Envenomation—local pain and swelling; fatalities rare, but possible death from hemorrhage.  
Temperament—nervous; poor balancer; two hooks used simultaneously will aid in moving.

*Trimeresurus purpureomaculatus* (Mangrove Viper)

Habits and size—terrestrial and nocturnal, 1 m.  
Venom yield—N/A; lethal dose N/A.  
Envenomation—local pain and swelling; necrosis; fatalities rare.  
Temperament—nervous; will strike repeatedly with little provocation; prehensile-tailed, so two hooks should be used when moving this snake.



*Trimeresurus stejnegeri* (Chinese Green Tree Viper)

Habits and size—arboreal, 90 cm.

Venom yield—N/A; lethal dose N/A.

Envenomation—local pain and swelling; fatalities rare; death from hemorrhage.

Temperament—calmer than some members of this genus; prehensile-tailed, so two hooks should be used when moving this snake.

*Tropidolaemus wagleri* (Wagler's Palm Viper)

Habits and size—arboreal, 1.3 m.

Venom yield—90 mg; lethal dose 70 mg or more.

Envenomation—local pain and swelling; experiments with mice indicate neurological complications; fatalities rare or unknown.

Temperament—unpredictable; prehensile-tailed, so two hooks should be used when moving this snake.

*Vipera ammodytes* (Sand Viper)

Habits and size—primarily terrestrial, primarily nocturnal, 90 cm.

Venom yield—N/A; lethal dose N/A.

Envenomation—local pain and swelling; severe abdominal pain; occasional necrosis; fatalities rare; possible death from pulmonary edema or hemorrhage.

Temperament—usually docile, but can be irritable and strike unexpectedly; good balancer.

*Vipera aspis* (Asp Viper)

Habits and size—60 cm.

Venom yield—N/A; lethal dose N/A.

Envenomation—local pain and swelling; severe abdominal pain; occasional necrosis; possible neurological complications; possible death from pulmonary edema or hemorrhage.

Temperament—usually unaggressive; good balancer.

*Vipera lebentina* (Bluntnose Viper)

Habits and size—terrestrial, nocturnal, 1.67 m.

Venom yield—100 mg; lethal dose 15–20 mg.

Envenomation—intense local pain and swelling; generalized ache; death from hemorrhage.

Temperament—generally sluggish, but can strike unexpectedly; good balancer.

*Vipera (Daboia) palaestinae* (Palestine Viper)

Habits and size—terrestrial and arboreal, nocturnal, 1.3 m.

Venom yield—90 to 120 mg; lethal dose 25–30 mg.

Envenomation—intense local pain and swelling; death from hemorrhage.

Temperament—will strike readily in a feeding reaction or when annoyed; good balancer.

**VENOMS**

The toxicology of snake venoms is an ongoing science subject to continual revision. It is not necessary for a snake keeper to have a comprehensive understanding of the current state of knowledge in this discipline. For data on the efficacy of various antivenins, as well as information on sources of supply, the reader is referred to the most recent volumes on this subject (Gopalakrishnakone and Chou 1990; Meier and White 1995). However, a general awareness of the capabilities of venom toxins can itself have a therapeutic effect on the behavior of those otherwise tempted to be reckless or cavalier.

Long gone are the days when snake venoms were simply categorized as “neurotoxic” or “hemotoxic.” It is now known that this was a false dichotomy and that these venoms are far more complex than previously believed (Russell 1980; Broadley and Cock 1975, 1989). The venoms of some crotalids and viperids (e.g., *Crotalus durissus terrificus*, *Crotalus scutulatus*, *Bitis atropos*) can exhibit a preponderance of neurotoxic effects, and the cytolytins in the venoms of several elapids (e.g., *Naja kaouthia*, *Ophiophagus hannah*, *Naja nigricollis*, *Naja pallida*, *Naja atra*) can produce painful and permanent tissue damage. Even the prompt and judicious administration of antivenin cannot guarantee the prevention of neurological complications in the former cases or crippling and potentially career-ending structural damage in the latter. Furthermore, the recovery from an envenomation is very much dependent on the skills of the attending physicians. As many zoo herpetologists know, these skills vary alarmingly.

Furthermore, reptile keepers must realize that if they are envenomated, the bite is likely to be on a part of the body that can lead to the most serious complications. Research on the causes and outcomes of envenomations has shown that “it is important for individuals handling snakes to realize that they risk envenomation to the upper extremities, trunk, and head, areas that are likely to result in permanent disfigurement and dysfunction” and “they are also at increased risk for lethal envenomation” since bites on the upper body seem more likely to be fatal than bites on the lower extremities (Dart *et al.* 1992). Research has indicated that “antivenom must be given within the

initial 20 to 60 minutes post-envenomation”—which is virtually impossible with modern medical protocols—“*to be effective in preventing local necrosis*” [italics added](Hardy 1992). Furthermore, “injury that occurs before antivenom can be administered is probably not reversible. Thus, it is certainly possible to receive optimal medical treatment and still have permanent disability” (Dart *et al.* 1992).

Of course, no institution should house any venomous species without current and adequate antivenin stocks on hand. Though this seems obvious, the author is aware of instances where these requirements were not met. In cases where no antivenin exists for a particular species that is known or believed to be potentially lethal, its maintenance in any collection is fraught with both ethical and legal complications. It is the author’s view that the keeping of such snakes, except in a venom laboratory or pharmaceutical facility engaged in producing antivenin, is unjustified.

A refrigerator full of antivenin can, paradoxically, become the source of complacency and carelessness on the part of the keepers it is supposed to assist. So accustomed are we to the wonders of modern pharmacology that we tend to forget that antivenins are still experimental drugs, not magic bullets. It is far better never to need to crack one of those vials, than to roll the dice and hope for the best. Every snakebite is serious, and with no envenomation is there a free ride, except to the hospital.

## CONCLUSIONS

The physical skills necessary to work safely with venomous snakes are relatively simple, though it is certainly true that some keepers never acquire them. Working safely with a venomous snake requires grace and finesse coupled with an economy of movement in which maximum effect—in this case the safe moving of the animal—is accomplished with minimal effort. Hooks should be held lightly rather than tightly, and abrupt or unnecessary movements on the part of the keeper should be avoided. Furthermore, venomous snakes should not be overmanaged, which is to say that they should be moved as little as necessary and as gently and delicately as possible.

That said, it is the author’s view that most of the skills necessary to work with venomous snakes are not physical techniques but mental attributes. Presence of mind, a calm temperament, and coolness under pressure are the most valuable qualities that one can bring to this endeavor. It is unlikely that these qualities can be acquired, but it is certainly true that, when already present, they can be enhanced by careful training.

If one would like to sum up everything with a single rule, it would be this: *Never take an unnecessary risk.* There are two reasons for this. Firstly, if one does and is bitten, severe suffering and even death can be the result. Secondly,

if one does and is not bitten, one is emboldened to continue this behavior and to take even greater risks, however unconsciously, in the future, thus greatly increasing the likelihood of a serious accident at some time down the line. The life of no snake, nor the pressure of any deadline, is worth the pain or death of a person. If a task cannot be performed safely today, then it should be postponed until time or assistance or different circumstances will permit the safe resolution of the problem.

One final thought is in order. Legendary herpetologist V. F. M. FitzSimons wrote, concerning cobras, "They are all exceedingly quick-moving, active and agile and also inquisitive, insolent and intelligent" (Broadley 1983). This acute observation neatly encapsulates the thrill and the dilemma of working with venomous snakes. While it is true that some venomous snakes are among the most beautiful reptiles in the world, there are other beautiful reptiles. It is the terrible power that these snakes possess which draws otherwise sensible people to seek to interact with them. There is surely no discredit in acknowledging the truth of this and in deriving pleasure from it.

On the other hand, there is not, nor can there ever be, any honor in being bitten by a venomous snake. Though some have been known to brag about having endured such experiences, this is the height of folly. A scar or a mutilated limb is not a badge of courage but a symbol of human error. Wise indeed are the keepers who recognize this.

Remember the cobra. Venom and insolence comprise an awesome elixir. It must be approached with delicacy and care. It is not a mix with which one should ever dare to trifle.

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