

CONCEPTS

Recognizing Dangerous Snakes in the United States and Canada: A Novel 3-Step Identification Method

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The rapid and accurate recognition of dangerously venomous snakes following bites is crucial to making appropriate decisions regarding first aid, evacuation, and treatment. Past recommendations for identification of dangerous North American pit vipers have often required subjective determinations of head shape or relied on traits shared with some nondangerous species (elliptical pupils and undivided subcaudal scales). Heat-sensitive facial pits are diagnostic but require close examination of the dangerous head, and cephalic traits are useless when working with a decapitated carcass. Exclusive of cephalic traits, pit vipers north of Mexico can be recognized by the combination of keeled middorsal scales and undivided subcaudal scales. The order of colored rings is usually suggested to identify coral snakes in the United States, yet extension of the colored rings across the ventral scales must be added as an essential identifying factor to ensure elimination of all harmless look-alikes. A novel 3-step flow chart is presented that allows dangerous snakes in the United States and Canada to be recognized quickly and dependably without relying on cephalic traits. This process cannot be used in other countries, however, due to greater variability of these characteristics in snakes from other parts of the world. Finally, close examination of potentially venomous snakes is extraordinarily dangerous and steps to safeguard those making such observations are discussed.

Key words: snake bites, snake identification, North American venomous snakes, vipers, pit vipers, coral snakes

Introduction

The ability of emergency medical personnel, as well as outdoor enthusiasts themselves, to quickly and reliably recognize snakes capable of producing medically significant injuries is essential to selecting the best course of action following a bite. Does the injury produced by a particular snake require that planned activities be abandoned and emergency evacuation be initiated, or does it simply require routine superficial wound care? When the dead animal (or a piece of it) is presented to paramedics or emergency department staff, are they prepared to safely and reliably assess the danger represented? Such assessments not only facilitate rapid intervention for envenomated patients but, when a nondangerous species is involved, can prevent unnecessary emergency evacuation and antivenom therapy,¹ both of which can be hazardous and expensive.

Even when a carcass has been decapitated, keeled middorsal scales and undivided subcaudal (under the tail) scales—or adjacent red and yellow rings that extend across the ventral scales—will provide rapid dependable recognition of North American pit vipers and coral snakes, respectively.

The Need for an Improved Method

Pit vipers are widely distributed in the United States and Canada. Rattlesnakes (genera *Crotalus* and *Sistrurus* of the family Viperidae, subfamily Crotalinae) populate much of the southern margin of Canada as well as almost all of the contiguous United States. Copperheads and cottonmouths (genus *Agkistrodon*) are found throughout much of the eastern and south-central United States. The family Elapidae is represented by 2 coral snake genera (*Micrurus* and *Micruroides*) in the southern United States. Maine, Alaska, and most of Canada (north of about 52° north latitude) are devoid of dangerous native snakes.²

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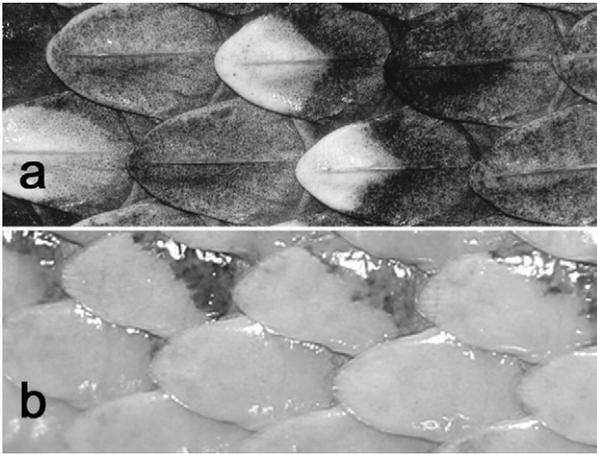


Figure 1. Keeled dorsal scales (a). Smooth dorsal scales (b). Examine the scales near the dorsal midline and ignore scale shape and color; look only for the tiny longitudinal ridge that forms the keel.

Triangular heads, elliptical pupils, and undivided subcaudal scales have historically been suggested as traits for use by lay persons to recognize pit vipers in the United States.^{1,3–7} However, each of these traits is either subjective, shared with certain harmless species, or both. The definitive characteristic of pit vipers is the heat-sensitive facial pit; however, detection of these small structures requires close examination of the face, which is dangerous, even after the head has been severed (see Discussion). In any case, cephalic characteristics are not helpful when working with a decapitated carcass—a common method for killing snakes.

The order of colored rings (“red on yellow, kill a fellow; red on black, venom lack”) is commonly suggested to identify coral snakes in the United States,^{1,4–7} yet that trait alone does not eliminate certain harmless look-alikes (eg, *Chionactis palarostris* of the family Colubridae).⁸

Concept Development

The middorsal scales of native viperids are invariably keeled² (Figure 1A), a trait shared with many nondangerous taxa.^{8,9} All native viperids also bear a single row of subcaudal scales, contrasting with the double row of subcaudals (Figure 2) found in all but 3 species of harmless native snakes.^{2,8,10} Significantly, the 3 harmless species bearing undivided subcaudal scales (*Rhinocheilus lecontei*, family Colubridae, and the dwarf boas *Charina bottae* and *Charina trivirgata*, family Boidae) lack keeled dorsal scales, having smooth dorsal scales (Figure 1B) instead.^{8,10} Therefore, the combination of keeled middorsal scales and undivided subcaudal scales is diagnostic for native pit vipers north of Mexico.

Although the aforementioned rule is also valid for rattlesnakes, they can be quickly and reliably recognized by the presence of a rattle. Neonates bear a single “birth button.” In one species of the genus *Sistrurus*, the rattle is noticeably reduced in size.^{2,9,11} As rattlesnakes age, the older distal rattle segments routinely become brittle and eventually break away. The proximal segment, however, contains living tissue and is invariably retained. In the exceedingly rare event of a genetic deformity or traumatic amputation of the distal tail and rattle, the characteristics described herein will properly identify a rattlesnake as a pit viper. No rattlesnake bears a gracefully tapered and pointed tail.^{2,11} It is worth noting that even the so-called “rattleless” rattlesnake (*Crotalus catalinensis*) of Isla Santa Catalina in Mexico’s Sea of Cortez is not truly rattleless; it produces rattle segments just like other rattlesnakes; it is unique only in that the older segments are lost each time a new one is added.^{2,11}

Native coral snakes are brightly colored serpents, ringed in red, black, and yellow (or white, especially in the Arizona form).^{2,8,9} North American coral snakes can be recognized by the combination of every other ring being yellow (or white) with rings completely encircling the body, including across the ventral scales (Figure 3). Most harmless native tricolored snakes are distinguished by every other ring being black (Figure 4), separating the yellow (or white) and red rings.^{8,9} In harmless species with dorsal colors that resemble coral snakes, the belly is colored differently than the dorsum (Figures 5 and 6) due to the failure of the red coloration to cross the ventral scales.⁸

Figure 2. Undivided (above) compared to divided (below) subcaudal (under the tail) scales. The relatively large anal plate (a) separates the ventral (belly) scales at left from the subcaudal scales at right. The determination of divided or undivided must be based on the majority of the subcaudal scales on the proximal two-thirds of the tail, as a few aberrant scales are common proximally, and subcaudal scales near the distal tip are usually divided in all taxa.



Figure 3. The tricolored rings extend all the way around the coral snakes, including across the belly, as in this Texas Coral Snake (*Micrurus tener*). Compare to Figures 5 and 6.

These morphological characteristics are combined in a flow chart (Figure 7) that allows dangerously venomous snakes to be easily recognized based on 3 objective determinations of noncephalic traits for either coral snakes or pit vipers.

Discussion

The only species likely to be confused in the flow chart is the Long-nosed Snake (*Rhinocheilus lecontei*, Figure 6) at question one, but it will key out correctly regardless of the choice at the first step. The flow chart does not identify snakes to species. Specific identification is both significantly more complex and unnecessary for the initial decisions in response to a snakebite. For the past 60 years, FDA-approved antivenoms have consisted of a



Figure 4. Several harmless tricolored snakes are native to the United States. Every other ring is black in most of the coral snake mimics, such as this kingsnake (*Lampropeltis triangulum*).



Figure 5. Although this harmless Shovel-nosed Snake (*Chionactis palarostris*) resembles a coral snake dorsally, the red bands do not extend across the belly. Compare to Figure 3.

specific product for Eastern and Texas Coral Snakes (*Micrurus*) and 2 polyvalent antivenoms approved for use against all native pit vipers (genera *Crotalus*, *Sistrurus*, and *Agkistrodon*). Therefore, a determination of coral snake or pit viper is sufficient even for selection of the correct antivenom. It is worth noting that no antivenom is produced for the generally innocuous Arizona Coral Snake (*Micruroides*).

OTHER “VENOMOUS” SNAKES

Some North American snakes belonging to families other than Viperidae and Elapidae are well known for



Figure 6. The harmless Long-nosed Snake (*Rhinocheilus lecontei*) is the species most likely to cause confusion at question one of the flow chart, as some may consider it to be tri-colored. Regardless of which choice is made at question one, the result will be correct: it is eliminated as a coral snake by its predominantly white belly and as a pit viper by its smooth middorsal scales.

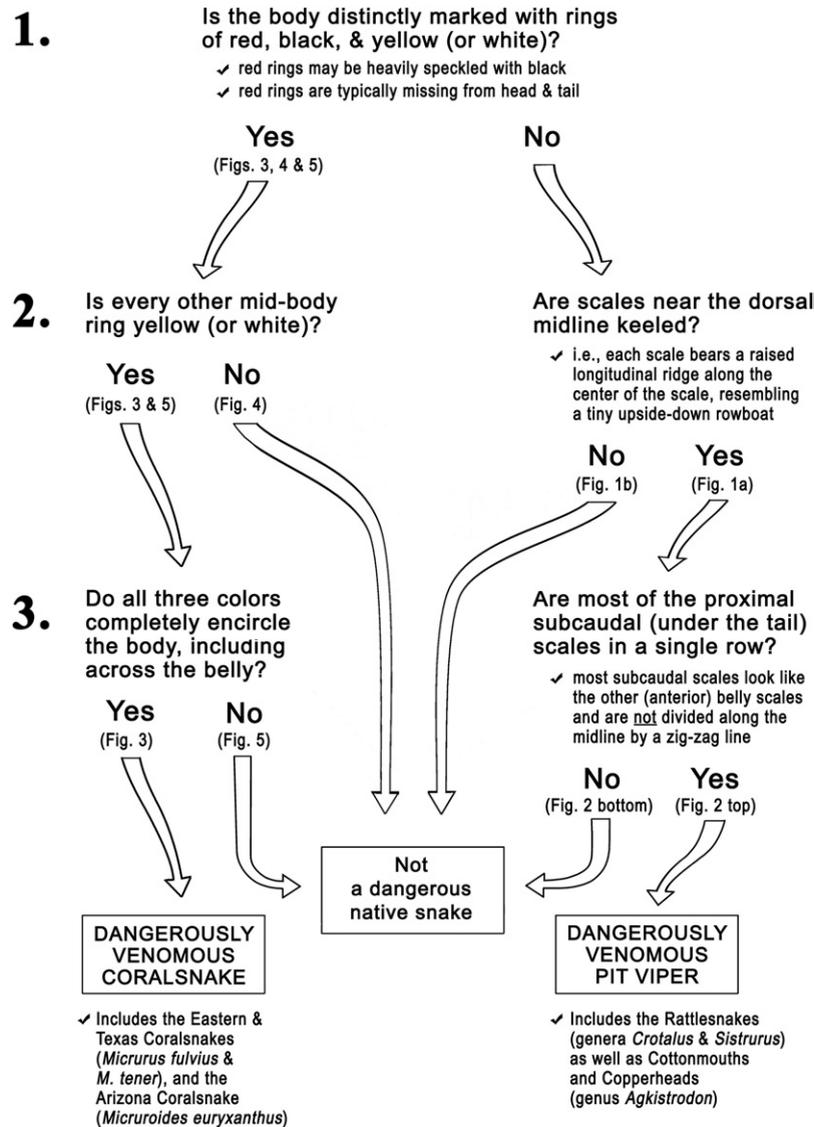


Figure 7. Flow chart depicting the 3-step process using objective noncephalic characteristics to determine if a native snake in the United States or Canada is dangerously venomous.

producing toxic oral secretions and for having elongated, grooved teeth in the rear of the mouth for chewing these toxins into their small prey. Bites by these so-called “rear-fanged” snakes, such as lyre and night snakes (*Trimorphodon* and *Hypsiglena*, respectively), may produce relatively minor effects (most commonly pain, swelling, and bruising) in humans but are non-life-threatening.¹ Similarly, there are occasional reports of mild toxicity produced by the bites of other “non-venomous” snakes.^{12,13} Recent findings by molecular biologists suggest that many extant snakes and lizards may have evolved from venomous ancestors and retain genes capable of expressing various toxic enzymes and other peptides,¹⁴ although the vast ma-

jority remain harmless to creatures larger than frogs and lizards. It has also been suggested that rattlesnake venoms are undergoing rapid evolution in response to interactions with humans, but that assertion is widely discounted by evolutionary biologists.¹⁵

One additional dangerously venomous snake is technically native to the United States yet otherwise omitted here because it has been reported on only a handful of occasions and has produced no recorded bites in the United States. The Yellow-bellied Sea Snake (*Pelamys platurus* of the family Elapidae) is closely related to coral snakes and cobras, is a common animal in coastal waters along the Pacific side of Central America, and has been sighted occasionally in the ocean off of southern

California.⁸ It is entirely pelagic but may wash up on beaches or get tangled in offshore fishing equipment. These snakes are easily identified by their bold yellow and black markings and flattened oar-like tails.

IMPORTANT SAFETY WARNINGS

This process requires close examination of potentially deadly animals. Headless carcasses are safe to handle. However, freshly killed snakes and even severed heads may bite reflexively and inject venom when handled.¹¹ Therefore, severed heads and carcasses with heads still attached should never be manipulated with the hands, even while wearing gloves.

In the event that a live snake is presented for identification, the danger of another person being bitten is high. Snakes presented in cardboard boxes, buckets, and other improvised containers are particularly dangerous and should generally be kept out of ambulances and emergency rooms, as snakes are well-known escape artists. Attempts by inexperienced personnel to open such containers, transfer live snakes from one container to another, or examine them under such circumstances, are likely to result in additional people being bitten. Cloth bags are favorite containers of herpetologists but are extremely dangerous when used by nonexperts. These precautions cannot be overemphasized.

Following a bite, it may be tempting to kill and decapitate a snake to facilitate its close examination; however, intentional interaction with snakes produces a high percentage of the annual snakebites in the United States^{1,6} and the risk must be carefully weighed against the potential benefit. Aroused snakes, especially pit vipers, can be very quick and unpredictable and close approach (within the length of the snake), even momentarily, clearly risks another bite.

The proliferation of camera phones and the ability to easily transmit digital photographs makes it possible to rapidly identify snakes by transmitting a digital photo to an expert. In most cases, detailed close-ups are not necessary; a well-focused full-body image will usually suffice. Nonetheless, photography of a live snake is dangerous and must be accomplished while remaining farther away from it than the length of the snake. And the hazard of opening a container housing a live snake, even for a photograph, likely outweighs the immediate need to identify it.

GEOGRAPHIC LIMITATION

It is crucial that this key not be used outside of the United States and Canada. Latin America is home to pit vipers with divided subcaudal scales (eg, *Bothrops asper* and *Bothrops atrox*), as well as greater than 50 additional species of coral snakes, most of which violate the identification rules described herein.² Afro-Eurasia and Australian serpents are even more

diverse. This identification method should not be relied upon following bites by captive snakes, as some hobbyists keep deadly exotic species and may not know or admit the animal's true identity.

Finally, escaped exotic snakes must be considered, although reports of innocent persons (ie, other than the owners/keepers) being bitten by escaped nonnative venomous snakes are almost nonexistent. Nonetheless, signs and symptoms of potential envenomation should never be ignored, regardless of the appearance or tentative identification of the biting snake.

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