Chapter 18
Snakes, Snakebites, and Humans

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18.1 Introduction

Indiana Jones is a fictional intrepid archeologist who, in a series of Hollywood movies starting in the early 1980s, faced a variety of perils. He dodged bullets, faced evildoers, and escaped cunning traps set by ancient civilizations to protect assorted treasures. But in *Raiders of the Lost Ark*, he seems to meet his match: "Snakes! Why did it have to be snakes?" he rants, after dropping a torch into a chamber full of nonvenomous snakes, legless lizards, and animatronic ophidians (rest assured, he escapes intact, having achieved his mission and shown us yet again how scary snakes are). Thirty-five years later and reporting the recent scientific discovery (Dinets 2017) that Cuban boas (*Chilabothrus angulifer*) positioning themselves to hunt cave bats take into account where other snakes are located, the mass media report (McKirdy 2017) began with a similar sentiment: "Get ready to update your nightmares." Snakes consistently get a bad rap in the Western world and elsewhere, but this is not a universal viewpoint (Morris and Morris 1965; Pandey et al. 2016). How snakes are perceived is one of three main topics we cover in this chapter. We begin by updating data on snakebites around the world, treating developed countries separately from the developing world because of differences in reliability

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of statistics, prevalence of bites, and efficacy of treatment. We use the same separation in the next section, where we discuss the current knowledge about treatment of snakebite. Finally, we return to public perceptions and folkloristic depictions of snakes around the world.

18.1.1 Current Snake Taxonomy

Taxonomy and phylogeny are rapidly changing, with new taxa being proposed or sunk at a hard-to-follow rate. Not only are species added or removed, but the proposed relationships among them, what families they are put into, and how those are related to one another can change disturbingly frequently. To make matters even more confusing for the noninitiate, there are sometimes strong disagreements among scientists in the field, with some groups using certain names and relationships, while others adhere, just as strongly, to others. Disagreements can last for years, and snake taxonomy is among the less well understood, compared to many other taxa.

Traditionally, most venomous snakes have been placed into two families, Viperidae (Old and New World vipers and pit vipers; approximately 350 species) and Elapidae (cobras, kraits, coral snakes, and sea snakes and their allies – approximately 370 species). These two groupings are consistently upheld in various analyses, although some (e.g., Pincheira-Donoso et al. 2013) retain them as families, whereas others (e.g., Pyron et al. 2011) reduce some of these to subfamilies or provide additional divisions. Atractaspididae (mole vipers, approximately 25 species), recognized by older taxonomies such as Vidal and Hedges (2002), is reduced to subfamily status in Pyron et al. (2011) and absent in Pincheira-Donoso et al. (2013). Consequently, the exact numbers reported are of relatively little value. However, the rough numbers above, based on the frequently updated Reptile Database website (http://www.reptile-database.org/) maintained by Uetz and Hošek, are likely to be qualitatively correct. Similarly, although the names and exact rank of species groupings may change, the broad division into three main groups of venomous snakes has remained stable for quite some time. Finally, there is a rich literature on the toxins of snakes and their effects, and readers interested in additional details should examine a recent contribution, such as Mackessy (2016).

18.2 Snakebites Around the World

There is a common perception that snakebites are a frequent and dangerous phenomenon. For example, an item on WRAL, a news station in North Carolina, USA, was entitled “Snake bites common in N.C.” and opened with the statement “North Carolina leads the nation in the number of people annually bitten by snakes, both venomous and nonvenomous” (Mask 2010). Similarly, a recent CBS news item was entitled “Snakebites are on the rise, and these states are the riskiest” (Rauf 2016).

"More than 1300 U.S. children suffer snakebites each year on average, with one in four attacks occurring in Florida and Texas, a new study reveals," it began. Yet such statements need to be put in perspective. In the USA, where those stories were reported, 71 individuals died from snakebite between 1950 and 1954, or 0.009 per 100,000 people (Parrish 1957). In the late 1970s, the annual number of snakebite fatalities was 9–14 (Russell 1980), and similar numbers have been reported by Chippaux (1998), some two decades later. Current numbers are about five mortalities per year in the nation of roughly 300 million people (National Institute for Occupational Safety and Health 2016). By comparison, over 600 per 100,000 died in the USA in 2014 from heart disease, 40/100,000 from car accidents, 14/100,000 from the flu and pneumonia, and 10/100,000 from firearms (National Center for Health Statistics 2015). Over the decade between 2006 and 2015, over 30 people died in the USA annually, on average, from lightning strike, according to the National Oceanic and Atmospheric Administration (2016). In that context, snakebites appear much less alarming.

Although estimated numbers for some developing countries are much higher (see below), the top 235 causes of death compiled by Lozano et al. (2012) include no animal sources. According to World Health Organization (2017a) statistics, ten causes, ranging from heart disease to road mortality, each were responsible for over one million fatalities in 2015. Over 3000 adolescents died across the world every day in 2015, with road injuries leading the fatalities at almost 10/100,000 (World Health Organization 2017b). Clearly, the obsession of popular culture with ophidians means we are disproportionally worried about snakebites. But that does not mean there is no reason to be concerned. In the mid-1900s, Swaroop and Grab (1954) estimated "the total number of snakebite deaths in the world (excluding China, the USSR, and central European countries)… to be between 30,000 and 40,000 annually." Roughly five million people are now bitten by venomous snakes each year (Kasturiratne et al. 2008; World Health Organization 2015). About half of them are envenomated, and some 100,000–125,000 die (World Health Organization 2015; Groneberg et al. 2016). The modern number is higher, despite improved availability of better treatments, for two likely reasons. First, the world population has grown tremendously, from an estimated 2.5 billion people in 1950 to over 7.6 billion today, with most of the growth occurring in the developing world. Second, current estimates, though still very approximate for some developing nations (e.g., Chippaux 1998), are based on much better data than earlier statistics. Though snakebite is not as big a health concern as heart disease or even road mortality of adolescents, it does cause considerable suffering, at least in some geographical areas and among certain population groups.

18.2.1 Developed Nations

The state of affairs in the USA is emblematic of the rest of the developed world as well, perhaps partially because such a large percentage of the population lives in urban settings and rarely spends time in snake-inhabited locations. In fact, of 1610

animal-caused fatalities recorded in the USA in recent years, some 57% were caused by nonvenomous species, with mammals leading the list and dogs standing out at 17% – much greater than the 3% reported for reptiles (Forrester et al. 2018). In Europe as a whole, Chippaux (1998, 2012) considered snakebites "relatively rare." Incidence of snakebite across the continent ranged from close to zero to about eight per 100,000, with an overall average of about 1/100,000. Mortality averaged 0.0006/100,000 (Chippaux 2012).

In Australia, Isbister et al. (2013), likewise, characterized snakebites as "rare." This evaluation is supported by data documenting 35 fatalities between 2000 and 2016, for an approximate rate of 0.0015/100,000 (Welton and Liew 2017). Deaths between 1992 and 1994 were similar, with 12 deaths reported over the 3-year period (Sutherland and Leonard 1995). In the 1940s, Swaroop and Grab (1954) reported a considerably higher but still globally low rate of 0.07 per 100,000.

In Asia, an in-hospital mortality rate of 0.2% of 1670 in-patients was reported from Japan by Yasunaga et al. (2011) – about 0.005/100,000 in the current decade, compared to 0.57/100,000 in the mid-twentieth century (Sawai 1980) and 0.13 per 100,000 in the 1940s (Swaroop and Grab 1954). Bites were often associated with agricultural or yard-related activities but, unlike in developing countries in the region, usually involved older individuals (Sawai 1998). Low snakebite frequencies were also reported from South Korea and Hong Kong, which had a mortality rate of 0.09/100,000 (Sawai 1980). The only death reported by Moore (1977) from South Korea occurred when a patient left a military facility against medical advice.

In Israel, recent numbers reported by Werner (2016) suggest few bites occur and mortalities are few: four between 1998 and 2009, under 0.05/100,000.

The only African nation identified as "developed" by the CIA (2017) is the Republic of South Africa (which is not included under the "advanced economies" list of the International Monetary Fund (CIA 2017) and is less urbanized than the countries surveyed above). The 1930s data reported by Swaroop and Grab (1954) only include the "European population" and stand at 0.57/100,000. One would assume much higher rates for other racial groups at that time, given much larger population size, greater exposure, and relatively poor medical care. One recent study from one of the more snakebite-prone regions of the country (Darryl et al. 2016) suggests snakebite incidents of roughly 6–90/100,000 and a mortality rate of about 0.28/100,000.

The developed world has a novel snakebite problem that is associated with the growing trade in non-native reptiles (Perry and Farmer 2011). In particular, European and North American hobbyists keep venomous snakes and are at times careless in their husbandry. As a consequence, Warrick et al. (2014) reported 258 envenomations by non-native snakes in North America between 2005 and 2011. Most of those bitten were young, male, and envenomated at their residence. There were few fatalities, however (Warrick et al. 2014). Schaper et al. (2009) and Valenta et al. (2014) report similar incidents from Europe.

18.2.2 Developing World

Information about snakebite frequency and outcome in the developing world is notoriously fragmentary and unreliable (Swaroop and Grab 1954; Chippaux 1998; Kasturiratne et al. 2008). Moreover, some countries, such as Brazil, are much better represented in the publication record than others (Groneberg et al. 2016). Several surveys have attempted to collate such information (Swaroop and Grab 1954; Sawai 1980; Chippaux 1998; Kasturiratne et al. 2008), and we do not intend to duplicate their efforts. Instead, we provide below updated information for each region, as well as recently reported country-specific statistics (Table 18.1) that may not have been included in older work. Although the list represents an extensive literature search, it is not likely to be comprehensive. Most developing nations do not seem to be represented in the recent (2013 or newer) peer-reviewed literature reported in Google Scholar, and we did not seek to locate data that governments may have released in other media.

Table 18.1 Recent estimates of annual snakebite incidence and resulting mortality in developing countries

Country	Bites	Bites/ 100,000	Deaths	Deaths/ 100,000	Source
Africa					
Benin			117		Habib et al. (2015)
Burkina Faso			299		Habib et al. (2015)
Cameroon			263		Habib et al. (2015)
Chad			198		Habib et al. (2015)
Cote d'Ivoire			264		Habib et al. (2015)
Gambia			31		Habib et al. (2015)
Ghana			310		Habib et al. (2015)
Guinea Bissau			24		Habib et al. (2015)
Guinea			159		Habib et al. (2015)
Liberia			37		Habib et al. (2015)
Mali			238		Habib et al. (2015)
Morocco	218	2.65	5.4	0.0–0.2	Chafiq et al. (2016)
Niger			264		Habib et al. (2015)
Nigeria			1927		Habib et al. (2015)
Senegal			192		Habib et al. (2015)
Sierra Leone			92		Habib et al. (2015)
Togo			78		Habib et al. (2015)
Asia					
Bangladesh	15,372	9.8	1709	1.22	Hossain et al. (2016)
India				4.1	Mohapatra et al. (2011)
Iran	5379	4.5–9.1	6.7		Dehghani et al. (2014a)
Iran	2586	6.9	3.5	0.36	Dehghani et al. (2014b)
Malaysia	3658				Ismail (2015)

(continued)

Table 18.1 (continued)

Country	Bites	Bites/ 100,000	Deaths	Deaths/ 100,000	Source
Sri Lanka	>80,000	398	>400	2.3	Ediriweera et al. (2016)
Taiwan	965.5	430*	0.75		Mao and Hung (2015)
Taiwan	929.4	404.9	0.4		Chen et al. (2015)
Americas					
Argentina	808	1.8	0.3	0.24	Dolab et al. (2014)
Belize	50	15.2			Gutiérrez (2014)
Bolivia		8		<4	Chippaux and Postigo 2014
Brazil	27,183				Cupo 2015
Brazil				0.05	Gutiérrez (2013)
Colombia	~4000	6–8.5		0.06–0.26	Otero-Patiño (2014)
Costa Rica				0.02–0.15	Gutiérrez (2013)
Costa Rica	600	12.9			Gutiérrez (2014)
Ecuador				0.05	Gutiérrez (2013)
El Salvador	50	0.8			Gutiérrez (2014)
Guatemala	600	4.2			Gutiérrez (2014)
Honduras	600	7.2			Gutiérrez (2014)
Nicaragua	600	10.5			Gutiérrez (2014)
Panama	2800	79.8			Gutiérrez (2014)
Panama				0.5	Gutiérrez (2013)
Venezuela				0.1-0.2	Gutiérrez (2013)

*Paper reports "4.3 cases per 100,000 person-years"

The countries and regions covered in this section generally suffer higher rates of bites and offer less effective medical treatment. Although antivenom is an effective treatment for snakebites and is readily available in most developed countries, it is often too expensive or simply unavailable in developing nations (World Health Organization 2015). Because many developing countries are located in warm zones, where snakes are more common, people are at greater risk. Moreover, developing countries tend to be poorer, with a greater percentage of the population engaged in activities such as agricultural work that bring them in closer contact with snakes (e.g., Chaves et al. 2015), perhaps with inadequate footwear (Swaroop and Grab 1954). Finally, the typically more fragile economies of developing countries often cannot support effective medical care for many conditions, including snakebite (Williams 2015). Overall, the estimates of snakebite numbers and deaths in developing countries have been fairly stable over time (Kasturiratne et al. 2008). However, the effects of climate change are likely to include increased risk of snakebite in parts of Latin America (Yañez-Arenas et al. 2016) and possibly also elsewhere.

18.2.2.1 Africa

Summarizing early 1900s data, Swaroop and Grab (1954) found it "difficult to make even an approximate estimate" for the continent but provided an overall estimate of "annual total of snakebite deaths is around 400–1,000." By the time of the review of Kasturiratne et al. (2008), African populations have grown considerably. The authors provided separate estimates for northern and sub-Saharan Africa. Some 3000–80,000 snakebite cases occur in northern Africa and the Middle East, with up to 100 fatalities (Chippaux 1998; Kasturiratne et al. 2008). This compares with about 91,000–420,000 bites and 3500–32,000 fatalities in the more populous and wetter sub-Saharan region, with West Africa and East Africa having the second-highest mortality rates in the world (Kasturiratne et al. 2008). Chippaux (1998) provided somewhat higher estimates for bites (roughly one million) and similar numbers for fatalities (about 20,000). Most bites are caused by Old World viperids and elapids.

18.2.2.2 Americas

Of the ~300,000 snakebites that occur in the developing countries of the Americas annually, almost all happen in tropical Latin America. Some 80,000–100,000 envenomations and up to 3500 deaths occur annually (Kasturiratne et al. 2008; Yañez-Arenas et al. 2016). Most bites are caused by crotalids (New World viperids), with fatalities estimated at 540–2300 (Kasturiratne et al. 2008), possibly in excess of 5000 (Chippaux 1998).

18.2.2.3 Asia

Swaroop and Grab (1954) considered Asia to be the region with the highest number of snakebite fatalities. Mortality rates in the mid-twentieth century were approximately 0.9/100,000 for Thailand, 2.7 for Burma (now Myanmar), 0.2 for Malaysia, 0.3 for Taiwan, 4.0 for Sri Lanka, 0.8 for the Philippines, and 2.1 for India (Sawai 1980). Bites were often associated with agricultural activities and typically affect males in their teens or twenties (Sawai 1998). Overall, between nearly 240,000 and 4 million bites occur in Asia each year (Chippaux 1998; Kasturiratne et al. 2008). Bites are caused by both Old World viperids and elapids, with fatalities estimated at 2800–7600 (Kasturiratne et al. 2008) or even as high as 100,000 (Chippaux 1998). South Asia, including India and nearby countries, is consistently reported to have the largest number of fatalities worldwide (Swaroop and Grab 1954; Kasturiratne et al. 2008).

In India, Shukla et al. (2017) recently reported a growing phenomenon we have yet to see described from other countries: intentional, recreational envenomation intended to elicit "euphoria, relaxation and other psychotropic effects." The snakes involved are believed to be elapids, many of which are often lethal. Such use can apparently sometimes rise to the level of addiction (Das et al. 2017).

18.2.2.4 Australasia

In developing parts of the Pacific (as defined by Kasturiratne et al. 2008), such as Papua New Guinea, about 360–4600 bites occur each year, with fatalities estimated at roughly 200–500 (Kasturiratne et al. 2008). As in Australia, bites are predominantly caused by elapids.

18.2.3 Other Dangerous Snakes

Although venomous snakes are responsible for nearly all snake-caused fatalities, attacks by large constrictors can also, albeit rarely, be lethal. Most constrictors are too small to pose any risk, but a few reach large enough size to be dangerous. In the West, most such fatalities are associated with escaped pets. For example, an escaped African rock python (*Python sebae*) "more than 10 feet (approximately 3 meters) long" killed two Canadian children (Smith and Mullen 2013). In the developing world, fatalities are more likely to result from predation in rural circumstances, as was the case for a villager found inside "a 7-meter-long python" (*Malayopython reticulatus*) in Indonesia (Anonymous 2017). In Bangkok, Thailand, the Fire and Rescue Department, which is tasked with removing snakes from homes, has taken away nearly 32,000 individual snakes in 2017 (Paddock and Jirenuwat 2017). Many of these snakes are nonvenomous. "There are only a few cases where snakes come into people's houses and hurt them," an official is quoted as saying, and urban snakes perform important pest control functions (Paddock and Jirenuwat 2017). Thus, the reaction of the public is more often a function of fear and prejudice (see Sect. 18.4), rather than real risk. Unfortunately, the ongoing growth of the urban environment (see Chap. 5) makes such encounters more frequent every year (Paddock and Jirenuwat 2017).

18.3 Clinical Facets of Snakebites

Of the 3700 species of snakes currently named, only about 10% are considered dangerously toxic to humans. Even venomous snakes sometimes inflict so-called dry bites, when no venom is injected. Such an event occurs in at least 20% of pit viper bites and an even greater number in elapids and sea snake bites (Grenvik et al. 2000). Bites without envenomation can sometimes lead to palpitations, dizziness, chest discomfort due to anxiety, and heightened sympathetic response. Two puncture wounds are generally indicative of poisonous snakebites, and nonvenomous snakes may leave an arc of small puncture wounds, but the number of puncture wounds should not be used as a definitive indication of the source of a bite.

All snake venoms are proteins, some with the capacity to cause injury. Hemotoxic venoms, most common in Old and New World viperids, may lead to rupture of red

cells, damage to capillaries and blood vessel cells resulting in extravasation of plasma and cells into adjacent tissues with necrosis, and sometimes derangement of blood clotting systems. This pathology manifests within several minutes, initially as pain and swelling. Neurotoxic envenomation, usually associated with cobras and their relatives, is caused by polypeptide nonenzymatic proteins. Symptoms from these bites may begin with minimal pain and then progress to numbness, palsies, respiratory muscle paralysis, and death. Some snake venoms cause lowering of blood pressure, via several mechanisms. Some pharmaceuticals, such as the angiotensin-converting enzyme inhibitors used for the treatment of hypertension, were inspired by these venoms. The potency of toxin is not always associated with the degree of pain. For example, krait and sea snake bites may be painless, but their venoms are among the most potent in the animal kingdom. Children are more vulnerable to poor outcomes due to their smaller size and volume relative to envenomation.

There are many traditions of treating snakebite, some of which are now known to worsen rather than assist the victim. The application of electric shocks has been a popular intervention in developing countries. This is potentially hazardous, has never been shown to improve outcomes, and is not advised. What can be helpful is having the patient avoid excessive activity, immobilize the bitten extremity, and remove constrictive clothing. If the wound is on the foot, remove shoes; if on the hand, remove jewelry. Administration of alcohol or pain medications in the field is to be avoided. A low-level tourniquet to slow superficial venous and lymphatic flow may be of value, especially if applied by a medical professional. Identifying the type of snake should be attempted if this can be safely done, as it may help select an appropriate antivenin. However, snake capture is ill advised as the snake may bite again, and delivery of care may be delayed. Toxicologists do not advise using ice packs, constrictive tourniquets, or venom extractors (http://azpoison.com/venom/rattlesnakes. Accessed 6/19/17). While mechanical suction has been recommended for decades or longer, this is ineffective in removing significant amounts of venom from the wound site and probably causes focal tissue injury (Hardy 1992).

18.3.1 Developed Nations

Most snakebites in North America occur during the warmer times of the year and at night. Almost all are caused by Crotalidae (New World pit vipers), and 95% of those are caused by diamondback rattlesnakes. Copperhead bites, moderately common in the Eastern USA, have relatively weak venom and rarely lead to complications (Juckett and Hancox 2002). Less than 1% of snakebites in North America result in fatalities (Arizona Poison Control 2017). Over 1000 bites and several deaths per year are reported in Australia. Exotic venomous snakes are a trendy venture in Western countries; the pet owners are among the snakebite victims in these regions. After basic supportive care, the priority for bite management in countries with abundant resources is transfer to the nearest medical facility for definitive therapy and, depending on severity, antivenom.

18.3.2 Developing World

Most bites occur to the lower extremities in resource-limited areas of the world where agricultural workers are active in environments inhabited by snakes. Some cobras and land kraits are known to enter housing at night and bite people sleeping on the floor or ground. There is some seasonality to snakebites with increased incidence during heavy rainfall and floods. Most bites in Africa are due to vipers, puff adders, and spitting cobras (Warrell and Arnett 1976). The morbidity in Africa is difficult to estimate but is likely at least 5% of envenomations, with the puff adder causing the most deaths on that continent (Mallow et al. 2004). Some hunter-gatherer tribes in South America are also at high risk for snakebite.

The Indian subcontinent reports more snakebites than any region in the world, with thousands of annual deaths occurring, mostly in rural areas. Venom of Asian pit vipers is vasculotoxic and may have severe necrolyzing tissue effects. Krait bites often do not cause a local reaction but may cause cramping, abdominal pain, diarrhea, and collapse. Spitting cobra venom may lead to eye injury as well as systemic effects from the toxin. Following an elapid bite, the most common initial signs include vomiting, blurred vision, perioral numbness, headache, and dizziness with cranial nerve palsy resulting in ptosis. Descending paralysis has been observed in Asian patients following cobra bites. The onset of these problems may be within 15 min or delayed for more than 10 h. Depending on the venom load, paralysis of palatal, laryngeal, deglutition, and neck muscles may occur. Airway obstruction and paralysis of the respiratory muscles may ensue and result in respiratory failure (Mehta and Sahdindran 2003).

18.4 Folklore

The association between humans and snakes is an ancient one. In fact, there is evidence of fear of snakes in nonhuman primates (Lee et al. 1963; Kawai and Koda 2016). A powerful representation in many cultural artifacts, from the Mayans and Incas to contemporary art and culture, its presence has been explained by evoking a multitude of authorities, from Genesis to Freud. The views of snakes in human cultures have received extensive attention (e.g., Wake 1888; Morris and Morris 1965; Mundkur 1983), and below we provide a brief summary.

18.4.1 West/Developed World

One of the earliest depictions of snakes is the fertility god, Ningizzida from Sumeria, the first urban civilization centered in southern Mesopotamia, who was associated with vegetation and the underworld. Ningizzida later became the god of healing and is represented by a pair of snakes entwined around a rod. Greek mythology too is

well stocked with snake-inspired gods, starting with the Minoan Snake Goddess (circa 1600 BCE) and including Medusa, a winged female with venomous snakes serving as hair. Of more relevance to us is Asclepius (Aesculapius in Latin), reputed as a healer and, according to some legends, a son of Apollo and therefore a demi-god, especially after the retreat of plague in 420 BCE (Nayernouri 2010). A parallel can be found in the caduceus (a herald, in the shape of two snakes entwined on a short rod, set under a pair of wings and carried by Hermes). The Rod of Asclepius or staff of knowledge (and/or the caduceus of Hermes, the messenger of the gods) serves as the alternate symbol of the medical profession. Associated at once with sin and death as well as rejuvenation and resurrection, the healing symbol can be traced from ancient Middle Eastern cultures (including Hebraic, passing on to Christianity and Islam), whose arrival subsumed many pagan beliefs. It has even been argued that the rod has been replaced by the cross and the serpent by Christ himself (Antoniou et al. 2011).

The source of much of mediaeval natural history is the work of the Roman encyclopedist, Pliny the Elder (23–79 A.D.), entitled *Natural History* (in 37 volumes, the first 10 of which were published in 77 A.D. and the remainder after his death). Information on snakes therein can be imaginative. For example, snakes of India were reported to be large enough to swallow elephants, and some grew to 80 and 140 cubits (1 cubit = 46–56 cm [18–22 inches]) in length (Rackham et al. 1967–1971). In Pliny's defense, early Greek natural history was probably primarily written to entertain a Greek audience. Huge snakes, nonetheless, abound in multiple mythologies (Fig. 18.1).

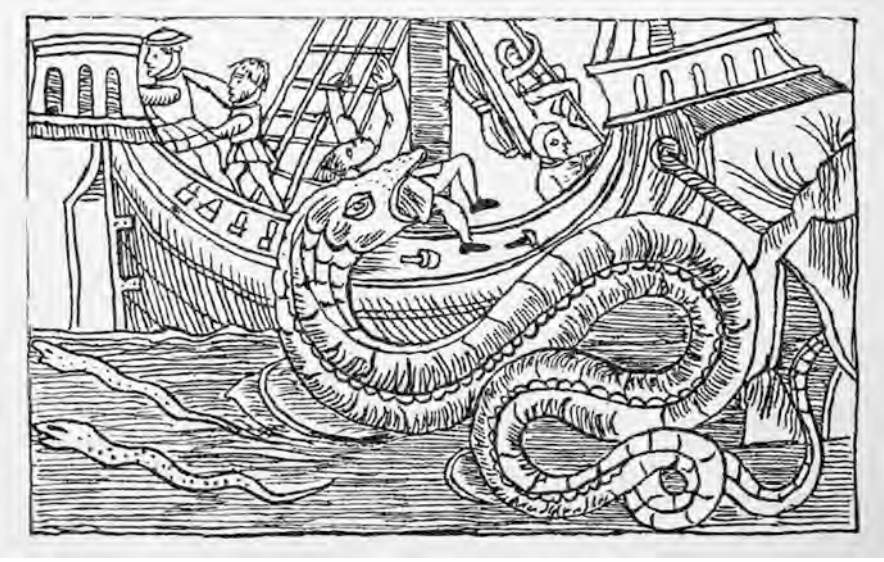

Fig. 18.1 The sea serpent was perhaps the European sailor's ultimate terror in the Middle Ages. The Swedish writer, Olaus Magnus (1490–1557), in his *Historia de Gentibus Septentrionalibus* (published in 1555, from Rome), depicted what an encounter may have looked like in the minds of seafarers

Fig. 18.2 (**a**) The biblical creation story of Adam, Eve, and the snake in the Garden of Eden is depicted on the wall of Abreha Atsbeha (also known as Abreha we Atsbeha), a rock-hewn church in the Tigray Region of northern Ethiopia. (**b**) Surprisingly, the story of Saint George slaying the dragon is depicted throughout Ethiopia, in this case at the Betre Maryam Church on Lake Tana in the Rift Valley

At the core of much of the animus toward snakes in the west, however, is the role of the snake in the creation mythology of the Judeo-Christian-Muslim tradition (Fig. 18.2). With minor variations related to language and sectarian tradition is the story of how the snake helped tempt the first woman into the first sin, resulting in the casting of humanity from paradise, the loss of the snake's legs, and an eternal enmity placed between snakes and humans by God himself. Even the Bahá'í religion, a relatively modern derivation which generally preaches kindness to animals, teaches that "harmful animals, such as the bloodthirsty wolf, the poisonous snake and other injurious animals are excepted, because mercy towards these is cruelty to man, and other animals" (Bahá'í Reference Library 1976).

18.4.2 East/Developing World

Snakes have been object of worship ("ophiolatry") from the earliest time in the Indian subcontinent, and the same reverence can be witnessed in many parts of India to this day. The cobra, in particular, is often associated with Shiva, one of the major

gods in the Hindu pantheon (Smith 1996). Other parts of Asia, especially where Buddhism is practiced, hold the multiheaded cobra in high esteem. After all, wasn't the Buddha sheltered by one such snake while he was meditating? Such behavior among the faithful can be seen in Sri Lanka and Burma and even Japan (Kelsey 1981). Archaeological evidence from the Jomon period (ca. 2000 BC) supports the worship of snakes in ancient Japan, where the ability of snakes to shed their skin was construed as proof of rebirth (Bérczi et al. 2001). Ophiolatric practices can be encountered in many non-Western populations worldwide, on all continents. They are presumably driven by a mixture of fear and wonderment in humans who share landscapes with these animals (Figs. 18.2 and 18.3).

Also important in Asia is trade supplying the culinary business of medicine and nutrition. The "She Gong" (snake soup, Cantonese style), in particular, remains a popular offering in specialty restaurants in Hong Kong, as are snake-based drugs of Chinese traditional medicine (Read 1934). Snakes preserved in "wine" are common in Eastern Asia's many roadside pharmacies (Fig. 18.4; Somaweera and Somaweera 2010).

Apep, the great serpent of the ancient Egyptians, was a powerful adversary of the sun god and was also hostile to humans. In fact, Egyptians may have been the earliest to have employed charms and incantations to keep their dead safe from snakes (Budge 1904). Further south, the San people of southern Africa associate snakes with rainfall and classify them as rain animals (Lewis-Williams and Pierce 2004). The puff adder (*Bitis arietans*) is one such species, associated not only with rainfall and water but also with certain altered states of consciousness.

Overall, although snakes are often feared for their lethal potential in the East, and in many places in the developing world are killed on a regular basis, there is nonetheless a more nuanced view of serpents outside the West.

Fig. 18.3 Image from Hambley (1931. Field Mus. Nat. Hist. Anthropol. Ser. 21), showing temple for python worship in the Kingdom of Dahomey (corresponding to modern-day state of Benin, West Africa)

Fig. 18.4 Bottles of "snake wine" confiscated by customs agents on the island of Guam in the Pacific. The contents included a variety of venomous and nonvenomous snakes, as well as lizard, plants, and other organisms

18.4.3 Eating Snakes

Snakes are eaten in many cultures (Klemens and Thorbjarnarson 1995). However, studies in China (Wang et al. 2014) and elsewhere indicate that snakes can harbor parasites that can sicken people. For example, eating snakes was officially prohibited by the Korean army in the 1980s because of resulting intestinal parasite infections (Huh et al. 1994).

A poorly covered cultural phenomenon is consumption of snakes and/or snake blood by soldiers (Fig. 18.5). Military forces worldwide have used ophiological examples for combat training, fitness, and nutrition for survival (You et al. 2013; Deuster et al. 2013). Since snakes are often perceived as fearsome, associating with them, and especially controlling or killing them, continues to be used as a sign of being fearsome. Although the connection between snakes and violence in popular culture is well established (Morris and Morris 1965, pp. 104–114), only one short note (Werner 1988) appears to have ever focused on public snake eating by military forces, presumably as an intimidation tool.

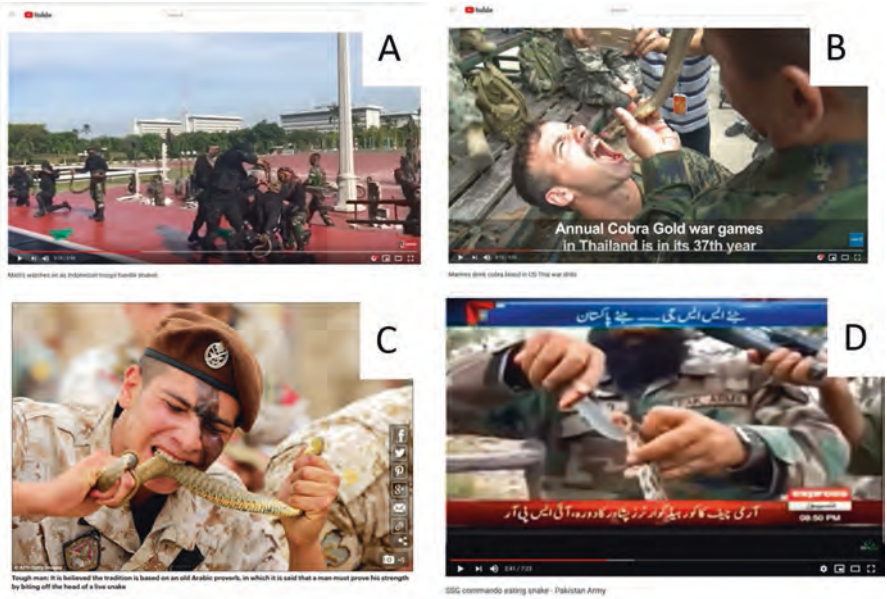

Fig. 18.5 Soldiers using mastery of snakes to prove their fierceness in screen captures of stories from around the globe. (**a**) A video (available at https://www.youtube.com/watch?v=nBJj1hJf5VI) uploaded by the *Times of Oman* shows Indonesian soldiers handling and drinking the blood of cobras in front of US Defense Secretary Jim Mattis in 2018. (**b**) US marines drinking cobra blood in an exercise, part of a video (https://www.youtube.com/watch?v=rvx9scwRQUM) uploaded by the AFP News Agency in 2018. (**c**) A Lebanese commando shown in the Daily Mail (Wyke 2015). (**d**) A Pakistani commando preparing a snake for consumption on a video (https://www.dailymotion.com/video/x2y61cp) originating from *Express News* in Pakistan

18.5 Summary and Conclusions

A brief overview of global perception of snakes shows no fixed pattern of good versus evil in European-based cultures (European, modern Australasia, and North America) against Eastern or those of the rest of the world (South America, Africa, Asia, and Australasia). Ancient cultures in all regions have often treated snakes essentially as of positive influence. However, religious narratives have sometimes resulted in alternative perceptions in their followers, leading to disparate reactions (ranging from fear and loathing to reverence and worship). For example, Pope Francis recently "denounced fake news as evil, comparing it to the snake in the Garden of Eden, and urged journalists to make it their mission to search for the truth" (Anonymous 2018). Traditional lifestyles, typically steeped in religious belief, continue to decline in the face of globalization, and so do many habits and practices that concern conservation, often under the generic phrase "respect of nature." Erosion of such traditions has been associated with failing conservation

action in numerous cases worldwide, and we are aware of one specific to snakes in Japan (see Sasaki et al. 2010). Thus, the study of human-snake associations remains relevant for effective conservation plans for endangered species.

Popular perceptions of snakes as a common source of mortality are not accurate for today's developed world. In Europe, North America, and a few other regions, venomous snakes rarely come in contact with increasingly urbanized people. When bites occur, rapid access to antivenin tremendously reduces mortality rates. In the developing world, however, and particularly in parts of Africa and Asia, rural populations regularly come into contact with a wide variety of venomous snakes, some of them potentially lethal. Regular contact is compounded by less access to medical care in general and to antivenin in particular, resulting in much greater mortality rates. Even in those areas, however, snakebite is a much less frequent cause of health concern compared to many other problems, some traditional and some recent, which do not receive quite as much popular attention.

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