

Venomous Snakes and Envenomation in Brunei

5

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Contents

Introduction	104
The Venomous Snake Fauna	105
Elapidae	106
Banded Krait, <i>Bungarus fasciatus</i> (Schneider, 1801)	106
Red-Headed Krait, <i>Bungarus flaviceps</i> (Reinhardt, 1843)	106
Blue Coral Snake, <i>Calliophis bivirgatus</i> (Boie, 1827)	106
Malayan Striped Coral Snake, <i>Calliophis intestinalis</i> (Laurenti, 1768)	106
Equatorial Spitting Cobra, <i>Naja sumatrana</i> (Müller, 1890)	107
King Cobra, <i>Ophiophagus hannah</i> (Cantor, 1836)	107
Beaded Sea Snake, <i>Aipysurus eydouxii</i> (Gray, 1849)	108
Annulated Sea Snake, <i>Hydrophis cyanocinctus</i> Daudin, 1803	108
Lesser Dusky Sea Snake, <i>Hydrophis melanosoma</i> Günther, 1864	108
Ornate Sea Snake, <i>Hydrophis ornatus</i> (Gray, 1842)	108
Spiral Sea Snake, <i>Hydrophis spiralis</i> (Shaw, 1802)	109
Annandale's Sea Snake, <i>Kolpophis annandalei</i> (Laidlaw, 1901)	109
Short Sea Snake, <i>Lapemis curtus</i> Shaw, 1802	109
Yellow-Lipped Sea Krait, <i>Laticauda colubrina</i> (Linnaeus, 1758)	109
Yellow-Bellied Sea Snake, <i>Pelamis platura</i> (Linnaeus, 1766)	110
Viperidae	110
Sumatran Pit Viper, <i>Parias sumatranus</i> (Raffles, 1822)	110
Sabah Green Pit Viper, <i>Popeia sabahi</i> (Regenass and Kramer, 1981)	110
Bornean Pit Viper, <i>Trimeresurus borneensis</i> (Peters, 1871)	110
Bornean Keeled Green Pit Viper, <i>Tropidolaemus subannulatus</i> (Wagler, 1830)	110

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Snake Envenomation and Ophthalmia	111
Conclusions and Future Direction	113
References	114

Abstract

The venomous snakes recorded from Brunei Darussalam are enumerated. A total of 19 species, representing two families (Elapidae, 15 species, and Viperidae, four species), have been recorded in the country. For each species, there is a brief description of biology, localities, and references. Antivenom sera available at RIPAS Hospital are listed and annotated with their potential use. Apart from bites from venomous snakes, the presence of one “spitter,” the equatorial cobra, *Naja sumatrana*, increases the risk of humans to venom ophthalmia. Finally, future directions for research and management of snake envenomation, and for enhancing knowledge of the country’s snakes for conservation and improving health care, are discussed.

Introduction

Brunei Darussalam (total land area: 5,765 km²) lies along the northwest coast of Borneo, where its two disconnected portions are separated by the East Malaysian state of Sarawak. It shows great contrasts, with vast tracts of unbroken lowland dipterocarp forests, peat, and freshwater swamps, on one hand, to a large and rapidly expanding capital city (Bandar Seri Begawan), connected to other urban centers and to the nearby cities of Malaysia via an extensive system of highways, on the other hand. The small human population (2013 estimate: 415,717), coupled with the dependence on oil and gas, has resulted in the lowland forests being left relatively intact. This is in stark contrast to the situation in the nearby states in Borneo.

The relatively pristine forests and matchless biodiversity of Brunei have been the subject of numerous popular and review articles (Das 1994; Eaton and Ibrahim 1995; Slik et al. 2003), and forestry practices have been compared favorably relative to those in neighboring states (Bryan et al. 2013). The herpetofauna, as expected from the pristine nature of forests and the diversity of forest types represented, is exceptional. Comprehensive inventories, though, are available only for a few areas (see Das 1995; Das et al. 2008), and new species records continue to be reported (e.g., Dehling and Das 2006; Keller 2011). Snakes figure prominently in biotic and herpetofaunal inventories. For instance, the early work of Motley and Dillwyn (1853) includes the snake fauna of the island of Labuan, situated off Brunei (Fig. 5.1).

This essay provides an inventory of the venomous snake fauna of Brunei, including both the terrestrial and marine species, based on museum records and the published literature, providing locality records. Notes on emergencies brought

Fig. 5.1 Reproduction of a watercolor showing *Tropidolaemus subannulatus* from Motley and Dillwyn (1855) “Contributions to the natural history of Labuan and adjacent coasts of Borneo”



about by venomous snakes and on conservation measures specific for Brunei Darussalam are provided.

Institutional abbreviations used are as follows: BM = Brunei Museum, Bandar Seri Begawan, Brunei Darussalam; LSUMZ = Museum of Zoology, Louisiana State University, Baton Rouge, Louisiana, USA; and UBD = Zoological Museum, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam.

The Venomous Snake Fauna

Brunei's major venomous snakes fall into two families, the Elapidae (comprising 15 species of cobras, kraits, coral snakes, and sea snakes) and Viperidae (comprising four species of pit vipers). Several venomous representatives of an otherwise nonvenomous family (Colubridae) are also known from Borneo, belonging to the genus *Rhabdophis*. One member of this genus (*R. chrysargos*) is known from Brunei, but shall be not considered further for lack of reports of human envenomation. In general, the snake fauna of the country is a subset of that described from Malaysia (see “► Chap. 3, [Venomous Terrestrial Snakes of Malaysia: Their Identity and Biology](#),” for this volume).

Elapidae

Banded Krait, *Bungarus fasciatus* (Schneider, 1801)

The banded krait is arguably the most common krait in Brunei and known from no less than five localities, including several from within the capital city of Bandar Seri Begawan. This nocturnal species is typically active at night and associated with swamp forests and, within its range, often encountered as roadkills. Although bites are rare, it should be treated as dangerous, its venom being neurotoxic.

Localities in Brunei are listed below:

BM 56.1995 Kampung Melilas, Belait District

BM 36.2001 Jalan Selayun, Brunei-Muara District

BM 117.1985; BM 178.1985 Kampung Anggrek Desa, Brunei-Muara District

BM 185.1989 Makam Sultan Bolkiah, Bandar Seri Begawan, Brunei-Muara District

BM 19.1994 Kampung Tamoi Tengah, Brunei-Muara District

BM 200.1992 Jalan Labu, Temburong District

BM 88.2006 near Tasek Merimbun, Tutong District

Red-Headed Krait, *Bungarus flaviceps* (Reinhardt, 1843)

The red-headed krait is known from a single specimen in Brunei, suggesting its rarity. Also nocturnal, it inhabits lowland dipterocarp forests. Like the previous species, the venom of this krait is believed to be neurotoxic, although bites on humans have not been recorded.

The sole locality in Brunei is:

BM 5.1987 Kampung Bukit Puan, Belait District

Blue Coral Snake, *Calliophis bivirgatus* (Boie, 1827)

The blue coral snake is a strikingly colored venomous snake and may be more common than suggested by data from Brunei (represented by a single specimen). It is nocturnal and associated with lowland forests.

The only Brunei record is:

UBD 431 Batu Apoi Forest Reserve, Temburong District

Malayan Striped Coral Snake, *Calliophis intestinalis* (Laurenti, 1768)

The striped coral snake bears a distinct coloration on the ventral surface, which is brightly banded, and has a red tail venter. A subfossorial feeder of small snakes, it is

known to cause mild envenomation in human adults. A bite from this species was reported at RIPAS Hospital. No further details are available.

The coral snake is known from three sites:

BM 189.1983 near Sungei Tilong, Muara, Brunei-Muara District

UBD 662 Kampung Mata Mata, Brunei-Muara District

UBD 639 Batu Apoi Forest Reserve, Temburong District

Equatorial Spitting Cobra, *Naja sumatrana* (Müller, 1890)

The equatorial or Sumatran cobra is familiar in Brunei, but reports of cobras by laypersons in Brunei tend to turn out to be other species of mostly nonvenomous snakes. The Bornean population is blue-black dorsally in adults, while juveniles bear distinct pale bands. This is a dangerously venomous species, capable of defending itself aggressively via biting and spraying its venom in the direction of the aggressor, causing ophthalmia.

BM 04.1999 Kampung Sabun, Brunei-Muara District

BM 28.1972 Jalan Muara, Brunei-Muara District

BM 13.1981 Kampung Delima, Brunei-Muara District

BM 315.1984 Sungei Jambu, Tungku, Brunei-Muara District

BM 11.1986 McFarm Limited, Brunei-Muara District

BM 23.1986 Jalan Manggis Dua, Brunei-Muara District

BM 114.1986 Berakas, Brunei-Muara District

BM 87.1988 Jalan McArthur, Bandar Seri Begawan, Brunei-Muara District

BM 59.1990 Padang Golf, Mentiri, Brunei-Muara District

BM 09.1996 Lambak Kanan, Brunei-Muara District

BM 4.1999 Kampung Sabun, Brunei-Muara District

UBD 430 Jerudong, Bandar Seri Begawan, Brunei-Muara District

UBD 528 Berakas Army Camp, Brunei-Muara District

UBD 606 Kampung Sungei Damit, Brunei-Muara District

BM 86–87.2006 near Tasek Merimbun, Tutong District

This species has also been recorded from Batu Apoi Forest Reserve, Temburong District, by Rader and Hemens (2002).

King Cobra, *Ophiophagus hannah* (Cantor, 1836)

The king cobra is a large, diurnal, and dangerously venomous snake that, prior to extensive development of Bandar, appears to have been common locally. Currently, it may be mostly associated with hill dipterocarp forests and is ophiophagous in its diet, although monitor lizards are also consumed. The venom of the species is neurotoxic, with massive amounts of venom discharged during a typical bite.

BM 03.1992 Anduki, Belait District
BM 7.1975 Jalan Tutong, Brunei-Muara District
BM 2.1979 Dewan Museum, Bandar Seri Begawan, Brunei-Muara District
BM 224.1991 Kampung Pintu Halim, Bandar Seri Begawan, Brunei-Muara District
BM 6.1998 Kampung Beribi, Gadong, Bandar Seri Begawan, Brunei-Muara District
BM 1984.80 Kota Batu, Bandar Seri Begawan, Brunei-Muara District
LSUMZ 55839 Forest Hill, Jalan Muara, Bandar Seri Begawan, Brunei-Muara District
BM 12.1995 Bukit Udal, Kampung Sungei Damit, Tutong District

Beaded Sea Snake, *Aipysurus eydouxii* (Gray, 1849)

This unusual sea snake is from shallow coastal waters. It has a specialized diet, comprising fish eggs, that may have resulted in the 50–100-fold decrease in venom toxicity compared to related species (Li et al. 2005). The Brunei record is by Elkin (1992) and apparently not backed with voucher specimens or images.

Annulated Sea Snake, *Hydrophis cyanocinctus* Daudin, 1803

The annulated sea snakes inhabit shallow coastal waters and are often stranded on beaches. Its venom has been shown to cause myonecrosis in lab animals. Hemolysis and respiratory and renal failures have been reported from its bites on humans.

The Brunei record is:

BM 11.1992 Belait District, which has also been cited by Elkin (1992)

Lesser Dusky Sea Snake, *Hydrophis melanosoma* Günther, 1864

The lesser dusky sea snake is found off the coast and may also travel some distance upriver. A poorly known species, its venom has not been investigated. The Brunei record is from a published report by Elkin (1992), apparently without voucher specimens or images.

Ornate Sea Snake, *Hydrophis ornatus* (Gray, 1842)

The ornate sea snake inhabits shallow seas with coral reefs and has also been recorded from turbid waters near estuaries. Its venom has not been studied. The Brunei record is from a published report by Elkin (1992), apparently without voucher specimens or images.

Spiral Sea Snake, *Hydrophis spiralis* (Shaw, 1802)

The spiral sea snake is found in deep waters, typically over 10 m deep. Its bite and venom are not well understood at present. The Brunei record (BM 130.1993) is cited by Elkin (1992) and without a precise locality.

Annandale's Sea Snake, *Kolpophis annandalei* (Laidlaw, 1901)

Annandale's or bigheaded sea snake is a poorly known, monotypic sea snake from coastal waters of Southeast Asia, especially in the eastern Indian Ocean. Nothing is known of its venom or envenomation.

The sole record from Brunei and from Borneo is listed below:

UBD 655 Tungku Beach, Brunei-Muara District (cited by Das 1993)

Short Sea Snake, *Lapemis curtus* Shaw, 1802

The short sea snake inhabits shallow seas, such as off coasts with muddy bottoms and also coral reefs. Its venom has neurotoxic properties.

The Brunei record is listed below:

BM 17.1994 Pantai Penaga, Belait District (cited by Elkin 1992: as *Lapemis hardwickii*)

Yellow-Lipped Sea Krait, *Laticauda colubrina* (Linnaeus, 1758)

The sea krait is associated with coral islands and, on Brunei, has been recorded from the rocky islet of Pulau Punyit, where it is known to ascend trees (Booth et al. 1997; Das 1992). This sea snake is more terrestrial than others occurring in Brunei waters, and although its venom is neurotoxic, it does not pose a particular danger to humans.

BM 04.1992 Pantai Kuala Belait, Belait District
BM 17.1973; BM 87.1993 Tungku, Pulau Punyit, Brunei-Muara District
BM 14.1976 Pantai Muara, Brunei-Muara District
BM 50.1992 Pelong Rocks, Brunei-Muara District
UBD 328, 329 Pulau Punyit, Brunei-Muara District

This species has also been reported from Brunei by Elkin (1992).

Yellow-Bellied Sea Snake, *Pelamis platura* (Linnaeus, 1766)

The yellow-bellied sea snake is the most pelagic of all marine snakes, and the two Brunei records (a specimen and a sighting record) are suspected of being stranded specimens. Mild envenomation and deaths have been reported from its bite elsewhere.

The Brunei record is represented by:

BM 314.1984 Bandar Seri Begawan, Brunei-Muara District

This species has also been reported from Brunei by Elkin (1992).

Viperidae**Sumatran Pit Viper, *Parias sumatranus* (Raffles, 1822)**

This large and strikingly patterned pit viper is known from Batu Apoi, Temburong District (Keller 2008). It is arboreal and restricted to the low hills. Its diet comprises small mammals, birds, and frogs, and its venom is neurotoxic.

Sabah Green Pit Viper, *Popeia sabahi* (Regenass and Kramer, 1981)

The Sabah green pit viper is known from the country (Das 2007), based on an unlabelled museum specimen, and is likely to occur in the upper ranges of mountains, such as Gunung Pagon in the Temburong District. It is arboreal and feeds on small mammals. Nothing is known of its venom, which is believed to be neurotoxic.

Bornean Pit Viper, *Trimeresurus borneensis* (Peters, 1871)

This is a terrestrial and semiarboreal (low vegetation) pit viper from hill dipterocarp forests of Borneo. Its venom is believed to be hemotoxic, although no bites have been recorded.

UBD 489, 638, 681, 682 Batu Apoi Forest Reserve, Temburong District

Bornean Keeled Green Pit Viper, *Tropidolaemus subannulatus* (Wagler, 1830)

The Bornean keeled green pit viper was previously confused with Wagler's pit viper, *Tropidolaemus wagleri*, a species now known to be restricted to the Malay

Peninsula, Sumatra, and adjacent islands. This is arguably the most common pit viper in Borneo and associated with lowland dipterocarp forests and other habitats in the plains, especially in the vicinity of water bodies. It is a sit-and-wait predator of small mammals and birds, and its venom is hemotoxic and known to cause pain, bleeding, local swelling, and occasional necrosis, but more serious effects of envenomation, including human mortalities, are unknown.

The records from Brunei include:

BM 02.1992 Penaga, Seria, Belait District
 BM 76.1993 Kampung Melilas, Ulu Belait, Belait District
 BM 257–258.1992 Jalan Labi, Kuala Belait, Belait District
 BM 54.1973 Kota Batu, Brunei-Muara District
 BM 67.1973 Maktab Perguruan Gadong, Brunei-Muara District
 BM 88.1973 Kampung Subok, Brunei-Muara District
 BM 10.1986 Jalan Mudang, Brunei-Muara District
 BM 43.1988 Kampung Pulori, Brunei-Muara District
 UBD 131 Jalan Muara and Jalan Manggis Dua, Brunei-Muara District
 BM 188.1992 Jalan Bukok, Temburong District
 BM 265.1992 Jalan Temada, Temburong District
 BM 95.1993 Pulau Labi, Tutong District

Snake Envenomation and Ophthalmia

The low number of cases involving snakebites in Brunei (from none to about 12 annually, with no recorded mortalities) may be attributed to the low population density that is mostly concentrated in the urban centers.

The Raja Isteri Pengiran Anak Saleha Hospital (RIPAS Hospital; Fig. 5.2), in Brunei's capital, Bandar Seri Begawan, the country's national hospital (established 28 August 1984), has emergency physicians attending to snakebite and ophthalmia cases. Other primary health centers that stock antivenom serum include the Tutong Hospital, Kuala Belait Hospital, and several special clinics. The country imports six Thai-manufactured antivenom serum, including two polyvalent ones, as follows, from the Thai Red Cross Society:

1. Banded krait antivenom (equine, monovalent), manufactured from *Bungarus fasciatus* that is found in Brunei
2. Russell's viper antivenom (equine, monovalent), manufactured from the Thai population of *Daboia siamensis*. This species (and the genus itself) is not found in Brunei or Borneo.
3. Thai cobra antivenom (equine), manufactured from the Thai population of *Naja kaouthia*, a species not found in Brunei or Borneo. This may have some effect in neutralizing the bites of the congeneric *N. sumatrana*.
4. Green pit viper antivenom (equine, monovalent), manufactured from *Cryptelytrops albolabris*, a species (and genus) that is not found in Brunei.

Fig. 5.2 A view of the entrance to the Accident and Emergency Section of Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital at Bandar Seri Begawan (Photo: Joseph K. Charles)



However, the serum is sometimes recommended for the bite of *Popeia sabahi* as well as *Tropidolaemus subannulatus*, being the most likely nonspecific antivenom to use for bites from these species.

5. Hemato antivenom (equine, polyvalent), manufactured from three viper species – *Daboia siamensis*, *Cryptelytrops albolabris*, and *Calloselasma rhodostoma*, none of which is found in Brunei or in Borneo. This antivenom may be used, in the lack of a monovalent serum, for treating bites from vipers in Brunei.
6. Neuro antivenom (equine, polyvalent), manufactured from three species – *Ophiophagus hannah* (venom extracted from the northeastern, central, as well as southern lowland Thai populations; these populations represent independent lineages that are non-conspecific with the species in Brunei), *Bungarus fasciatus*, and *B. candidus* (this last mentioned species is not found in Borneo). Nonetheless, the serum may be indicated in bites from kraits, other than *B. fasciatus* (for which a monovalent serum is available; see above) and coral snakes (*Calliophis* sp.).

Several venomous species are capable of orally ejecting their venom for a distance of over a meter, targeting the eyes of potential or perceived enemies (see Chu et al. 2010). While most famously recorded from African spitting cobras (Ridley 1944), several Asian species of *Naja* are known to spit. Ophthalmia, as a result of snake venom in the eyes of humans and pets such as dogs and cats, if left untreated, can result in severe ocular injury, leading to potential blindness. Venom ophthalmia has been recorded from Borneo and results from interactions with *Naja sumatrana*. Published records are from Sabah (Garrett 1911) and there are two records from Brunei Darussalam. Attributed to *Naja siamensis* (a Thai endemic), based on nonspecialist literature examined by Raja and Kok (2011) and unidentified to species by Siraj and Joshi (2012), treatment for all spitting species of cobras may be similar (copious ocular irrigation and topical antibiotics).

Conclusions and Future Direction

It is essential to emphasize here of the need to develop antivenom specific to different parts of a geographic region, particularly as the snake fauna, from the rapidly accumulating knowledge of systematics and distribution shows, change with distance. In the case of Brunei, imported Thai antivenom sera are manufactured by the Thai Red Cross Society, from species that were once thought to be conspecific. Taxonomic literature from the past two decades has continued to delimit species boundaries, restricting species names one nearly pan-regional, to more localized populations. Within venomous snake populations, phylogenetically close species and even different populations of conspecifics are known to show significant difference in venom chemistry, including action on humans, further emphasizing the need for local antivenom sera for Bornean venomous snakes.

Better distributional data are needed for Brunei herpetofauna, particularly its venomous snakes, and updated maps of their distribution will aid the treatment of snakebites. Confirmed records for a large number of species, especially the sea snakes, are required, via voucher specimens that are lodged at a museum or unequivocal secondary evidence, such as digital images. Also essential is knowledge of their systematics and natural history. For instance, the population of *Naja sumatrana* in Borneo shows a dramatic ontogenetic shift, from a dark-light banded juvenile to a unicolored adult (Fig. 5.3). Such knowledge is essential for species identification, the first step for species inventories, taxonomy, ecological studies, and, especially, snakebite treatment. Public education on snakes, targeting school children and the general public, within the context of biodiversity conservation, has the potential to dispel fear and promote positive perception of snakes. Such activities, which can be through a medium via radio and television, as well as public talks and more formal inputs into academic curriculum, can enhance appreciation of a valuable part of Brunei's biological diversity.

With the forest resource management practices in Brunei Darussalam being highlighted as one of the best in the region, it can be inferred that there is adequate protection for its biota that is restricted to several habitats in the country. This enlightened approach needs to be emulated regionally and globally for more effective protection of tropical biodiversity of Southeast Asia.

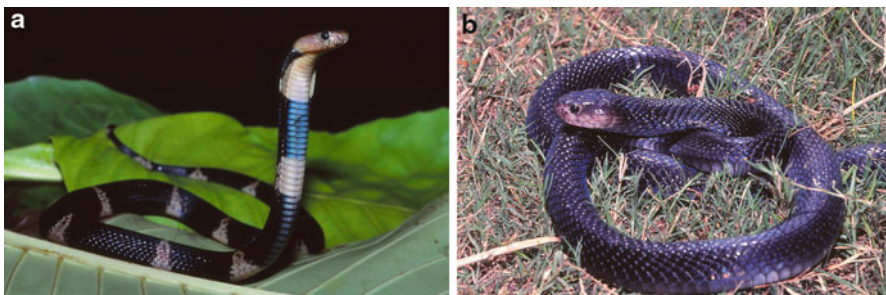


Fig. 5.3 Ontogenetic color change in Bornean *Naja sumatrana*, as shown by a juvenile (a) and an adult (b) (Photo: Indraneil Das)

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