Department of **Agriculture and Fisheries**
Biosecurity Queensland

Invasive animal risk assessment

Cobra (all species)

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Contents

Summary

The common name 'cobra' applies to 30 species in 7 genera within the family Elapidae, all of which can produce a hood when threatened. All cobra species are venomous. As a group, cobras have an extensive distribution over large parts of Africa, Asia, Malaysia and Indonesia.

Cobras range in size, but average-sized adults are around 2 metres long. The largest is the 'king cobra' (*Ophiophagus hannah*), the largest venomous snake in the world.

Cobras inhabit a variety of habitats including forest, grassland, desert and cultivated areas. Most species have a broad diet including small mammals, birds, fish, amphibians and other reptiles.

To date, only one species (*Naja kaouthia*) has naturalised outside its native range (on Okinawajima, an island near Japan). However, this study suggests that many other species have the potential to naturalise in Queensland, if offered the opportunity. As a group, cobras have several attributes considered to confer pest potential: *viz*. (1) they are generalist predators that would have little difficulty finding sufficient food, if released into the wild; (2) they can survive in a diverse range of habitats, with some species being highly commensal (inhabiting areas close to houses); (3) most species are well adapted to tropical and subtropical climates, comparable to Queensland's climates; (4) all species are venomous and dangerous to people; and (5) some species have extensive natural distributions, an attribute often associated with invasive vertebrates.

If cobras ever naturalised in Queensland they could have significant and irreversible impacts on native wildlife. Moreover, certain species could cause significant human mortality, especially in our coastal wet tropics. Being generally free of their natural pests and diseases, cobras have the potential to become overabundant in suitable habitats in Queensland, much like the brown tree snake has become overabundant following its accidental release in Guam (Micronesia). The brown tree snake, a mildly venomous snake, is responsible for around one-third of total hospital admissions in Guam and has pushed a range of locally native bird species to extinction.

Introduction

Identity and taxonomy

Taxa identity: about 30 species in 7 genera (*Aspidelaps*, *Boulengerina*, *Hemachatus*, *Naja, Ophiophagus*, *Pseudohaje*, *Walterinnesia*) within the family Elapidae

Common names: cobra, hooded snakes

Taxonomy

The common name 'cobra' is applied to about 30 species of snakes in 7 genera (*Aspidelaps*, *Boulengerina*, *Hemachatus*, *Naja*, *Ophiophagus*, *Pseudohaje* and *Walterinnesia*) within the family Elapidae. The taxonomy of some species is unclear. The term 'cobra' is abbreviated from the Portuguese 'cobra de capello', which means 'snake with hood'. Hence, 'cobra' refers to any species within the family Elapidae that can produce a hood when threatened. The genus *Naja* represents the typical cobras, which are perhaps what are commonly thought of as the archetypal cobras. *Naja* comprises approximately 25 species and is the most widespread. *Hemachatus* and *Ophiophagus* are also well known as cobras, as they represent what are commonly referred to as 'spitting' and 'king' cobras, respectively.

Description

Cobras generally possess long and slender bodies with smooth scales. Their heads are typically covered with large shields (scales) and their eyes have round pupils. These traits are common to the family Elapidae.

Cobra species vary in size. Typically, *Naja* species reach 2 m. The king cobras, which are the largest cobras, and the world's largest venomous snake, reach an average of 4 m, but can reach 5.5 m.

Like all elapids, cobras have hollow fangs at the front of the maxilla (proteroglyphous). In some species, such as the spitting cobras, the fangs are modified to spit venom. All Elapids are venomous and many deadly.

Diet

Diet varies depending on species. *Naja* species tend to prefer small mammals (often rodents), whereas *Boulengerina* species prefer fish and *Ophiophagus* species prefer other snakes.

A

B

C

Figure 1. Cobra species:

A. Indian cobra (*Naja naja*)—photo by Kamalnv (made available on Wikimedia and reproduced under the terms of GNU Free Documentation License)

B. King cobra (*Ophiophagus hannah*)—photo by Kumar (made available on Wikimedia and reproduced under the terms of GNU Free Documentation License)

C. Spitting cobra (*Hemachatus hemachatus*)—photo by Rinkhals (made available on Wikimedia and reproduced under the terms of GNU Free Documentation License)

Reproduction

Typically, cobras breed in spring and all species lay eggs (oviparous), except for *Hemachatus hemachatus* that has live young (ovoviviparous, where the eggs are hatched inside the mother's body). Uniquely, the king cobra builds a nest and protects the eggs prior to hatching. Egg production generally ranges between 2 and 20 per clutch.

Predators and diseases

Within their native range, the 30 species of cobra are subject to predation from about 30 species of mongoose, their principal predators.

Origin and distribution

Cobras as a group inhabit most areas of Africa, Asia, Malaysia and Indonesia (Table 1). The Indian cobra (*Naja naja*) has the most extensive range, across large areas of Africa and Asia.

Table 1. Distribution and habitat preferences of cobra genera

Genus	Taxon author	Species	Common name	Geographic range	Habitat
Aspidelaps	Fitzinger, 1843	2	Shieldnose cobra	South Africa (Cape Province, Transvaal), Namibia, southern Angola, Botswana, Zimbabwe, Mozambique	Fossorial (subterranean)
Boulengerina	Dollo, 1886	1	Water cobra	Cameroon, Gabon, Democratic Republic of the Congo, Congo, Central African Republic, Tanzania, Equatorial Guinea, Rwanda, Burundi, Zambia	Typically aquatic, inhabiting rivers, streams, lakes, swamps Also found in lowland forests
Hemachatus	Fleming, 1822	1	Spitting cobra (Rinkhals)	South Africa, Zimbabwe, Lesotho, Swaziland	Prefers grassland
Naja	Laurenti, 1768	25	Cobra	Africa, Asia	Various including forests, savannah, semi-desert, cultivated areas, populated areas
Ophiophagus	Günther, 1864	1	King cobra	Bangladesh, Myanmar, Cambodia, China, India, Andaman Islands, Indonesia, Laos, Thailand, Vietnam, west Malaysia, Philippines	Forest
Pseudohaje	Günther, 1858	2	Forest cobra	Angola, Burundi, Cameroon, Central African Republic, Democratic Republic of the Congo, Congo, Gabon, Ghana, Kenya, Nigeria, Rwanda, Uganda, Sierra Leone, Liberia, Ivory Coast, Togo, Nigeria	Forest (arboreal)
Walterinnesia	Lataste, 1887	2	Black desert cobra	Egypt, Israel, Lebanon, Syria, Jordan, Iraq, Iran, Kuwait, Saudi Arabia, Turkey	Desert

Status in Australia and Queensland

Currently there are no wild populations of cobra in Australia or Queensland. However, cobras are kept under permit in high-security premises such as zoos, reptile parks or facilities involved in the production of antivenin or research.

The importation of exotic animals into Australia is restricted by the *Environmental Protection and Biodiversity Conservation Act 1999*, which includes a list of plants and animals permitted to be imported as live specimens (the 'Live Import List'). Species are listed in two categories: i) importation permitted without permit, and ii) importation requiring a permit. Conditions may also be placed on the specimen's importation. Any species not included on the 'Live Import List' requires an application for its addition to the list, for consideration by the Minister for the Environment, Heritage and the Arts.

Six cobra species are listed on the 'Live Import List': *Naja haje* (banded Egyptian cobra), *Naja melanoleuca* (forest cobra), *Naja naja* (Indian cobra), *Naja nigricollis* (black-necked spitting cobra), *Naja nivea* (cape cobra) and *Ophiophagus hannah* (king cobra). All six species require an import permit and conditions apply to their import and keeping. Conditions for the import of these species are presented in Table 2. The species represented on the list cover less than 20% of the cobra species worldwide, and thus any importation of a species that is not listed would require an application for its addition to the 'Live Import List.'

Table 2. Cobra species included on Australia's 'Live Import List' under the *Environmental Protection and Biodiversity Conservation Act 1999*

Taxon	**Common name**	**Cites appendix**	**Conditions for import**
Naja haje	Banded Egyptian cobra		Commercial venom production and eligible non-commercial purpose only, excluding household pets and travelling exhibitions High-security facilities only
Naja melanoleuca	Forest cobra		Commercial venom production and eligible non-commercial purpose only, excluding household pets and travelling exhibitions High-security facilities only
Naja naja	Indian cobra	II	Commercial venom production and eligible non-commercial purpose only, excluding household pets and travelling exhibitions High-security facilities only
Naja nigricollis	Black-necked spitting cobra		Commercial venom production and research purposes only High-security facilities only
Naja nivea	Cape cobra		Commercial venom production and research purposes only High-security facilities only
Ophiophagus hannah	King cobra	II	Commercial venom production and eligible non-commercial purpose only, excluding household pets and travelling exhibitions High-security facilities only

While the import of cobra species is restricted by law, a certain number are suspected to have been illegally smuggled into the country. Such animals are believed to be kept in private collections by snake enthusiasts. In 2000 and 2001, a range of illegally imported venomous snakes were detected. These included three puff adders (Viperidae), four rattlesnakes (Viperidae), four vipers (Viperidae) and nine spitting cobras (Elapidae) (Keith Larner, Department of Sustainability and Environment, Victoria. pers. comm.). The majority of these specimens were detected while passing through the postal system.

These detections highlight the risk of cobra species being introduced into Australia, and the subsequent risk of escape, theft and release into the wild.

Preferred habitat

Cobra species inhabit a range of habitats including forest, grassland, desert and cultivated areas (Table 1). Some species are adapted to specific habitats (such as the forest or water cobras), while others are generalists occupying a broad range of habitats (e.g. Indian cobra).

History as a pest elsewhere

To date, only one species (*Naja kaouthia*) has naturalised outside its native range (on Okinawajima, an island near Japan) (Lever 2003). However, there is no published information on its impacts.

Cobras are not typically considered to be pests within their native range. However, they are often feared and unwanted due to the threat they pose to human life.

A number of cobra species colonise cultivated areas where they hunt rats and mice. As a result, interaction with people is common. The threat to human safety tends to be greatest for children and people who live long distances from medical help.

Uses

In their native range, certain cobra species are credited for controlling rodents in crops (Advani 1987). However, as stated above, the presence of cobras in cultivated areas increases the likelihood of a lethal or harmful encounter with people.

Cobra venom is collected to produce antivenin. Venom composition varies between cobra species, so antivenin produced for one species may not be effective for other species.

Venom from the king cobra has painkilling properties (Pu et al. 1995) and Cobra Venom Factor (CVF) has helped prevent rejection of organs after transplants in experiments (Kobayashi et al. 1997).

Pest potential in Queensland

The pest potential of cobras can be expected to vary, depending on species. Some of the more widespread 'ecological generalist' species (such as various species of *Naja*) appear to pose an extreme risk, in terms of potential to form wild populations following accidental or deliberate release in Queensland, and in terms of potential impact. Moreover, *Naja* species have a range of attributes considered to confer high pest risk: *viz*. (1) these species are generalist predators that would have little difficulty finding sufficient food, if released into the wild; (2) they can survive in a diverse range of habitats, with some species being highly commensal (inhabiting areas close to houses); (3) these species are well adapted to tropical and subtropical climates, comparable to Queensland's climates; (4) all species are venomous and dangerous to people; and (5) some species have extensive natural distributions. These attributes are commonly associated with highly invasive vertebrates and are discussed in more detail below.

Climate match

Collectively, cobras have an extensive distribution in both tropical and subtropical regions throughout Africa, India, Malaysia and Indonesia, in arid and humid habitats. Using the climate-match software 'Climatch' (Bureau of Rural Sciences 2009), a prediction of the areas of Australia where climate appears suitable for cobras is presented in Figure 2. The degree of 'climate match' for the cobra group is very high, with the majority of Queensland showing a climate match score between 7 and 9.

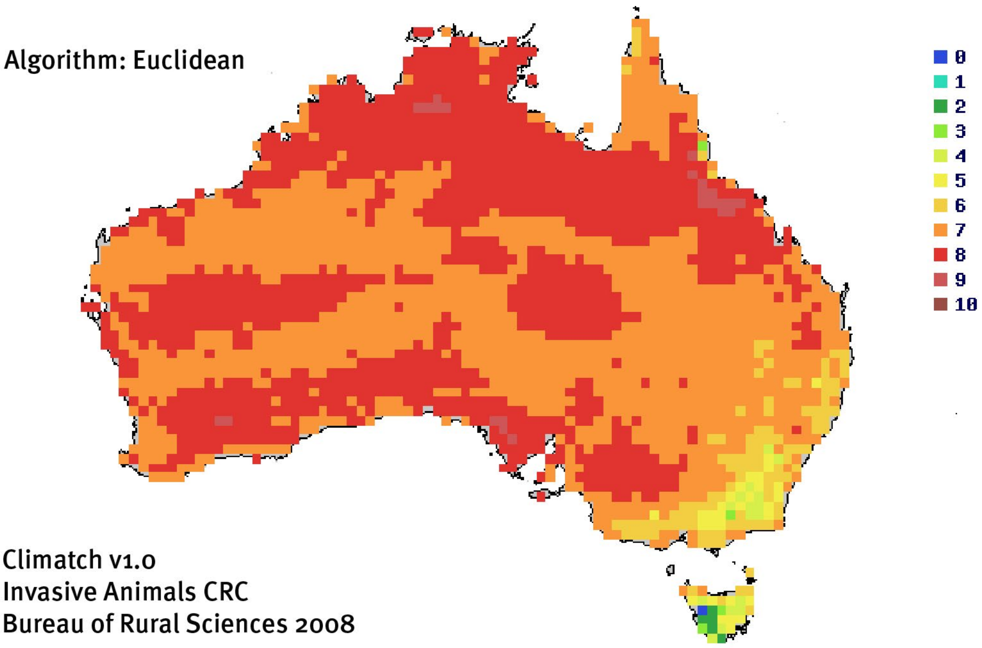

Figure 2. Areas of Australia where climate is comparable to climate types experienced across the native range of cobra species (red and orange indicate highly suitable climates, yellow is marginally suitable and green and blue unsuitable)

Habitat suitability

The *Naja* species of cobra inhabit a diverse range of habitats, including forest, grassland, cultivated land and semi-arid dessert. All these habitats are present in Queensland and a number of species would have little difficulty finding suitable habitat.

Broad natural geographic range

A number of cobra species have extensive ranges across Africa and Asia, highlighting their ability to survive in diverse habitats. Together with climate match, broad natural geographic range is among the most reliable predictors of invasion success.

Generalist diet

While some species have more specialised diets than others, most cobra species have opportunistic diets covering a broad range of prey items. A significant proportion of cobra species would have little difficulty finding suitable food if established in favourable habitat in Queensland.

Venom production

All cobras produce venom and although not as potent as some of Queensland's native snakes, they are nonetheless dangerous and still represent a significant threat to public safety.

Disease

Cobras, along with other snakes and reptiles, are potential hosts for foreign pests and diseases, which threaten native and domestic animals. For example, some reptiles can carry ticks that spread the bacterium *Cowdria ruminantium*, which, although not lethal to reptiles, can kill grazing animals.

Numerical risk analysis

Using a numerical risk assessment model published by Bomford (2008), cobra species (as a group) pose an 'extreme' risk in Queensland (see Attachment 1).

If cobras ever naturalised in Queensland they could have significant and irreversible impacts on native wildlife. In addition, certain species could cause significant human mortality, especially in our coastal wet tropics. Being generally free of their natural pests and diseases, cobras have the potential to become overabundant in suitable habitats in Queensland, much like the brown tree snake has become overabundant following its accidental release in Guam (Micronesia). The brown tree snake, a mildly venomous snake, is responsible for around one-third of total hospital admissions in Guam and has pushed a range of locally native bird species to extinction.

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Attachment 1

Using the Bomford (2008) system, *Naja* spp. were ranked as having an 'extreme establishment risk' in Queensland.

Table 1. Australian bird and mammal model

Species:		**Naja spp.**
Date of assessment:		**7 January 2010**
Literature search type and date:		**See references**
Factor	**Score**	
A1. Risk to people from individual escapees (0–2)	2	*Naja* spp. are capable of causing fatalities or serious injury to people
A2. Risk to public safety from individual captive animals (0–2)	2	There is a high risk that toxins of captive animals pose a public safety risk
Stage A. Public safety risk rank = sum of A1 to A2 (0–4)	**4**	**Highly dangerous**
B1. Climate match (1–6)	6	Extreme climate match in Australia (CMS = 2729)
B2. Exotic population established overseas (0–4)	2	*Naja kaouthia* has naturalised on the small Japanese island of Okinawajima (Lever 2003)
B3. Overseas range size (0–2)	1	Overseas range size approximately 50 million square kilometres (assumption based on size of Africa and distribution in Asia)
B4. Taxonomic class (0–1)	1	Reptile
B5. Diet (0–1)	1	Generalist diet of small mammals, birds, amphibians, reptiles, eggs and occasionally invertebrates
B6. Habitat (0–1)	1	*Naja* spp. are able to survive and breed in human-disturbed and human-made environments
B7. Migratory (0–1)	1	Non-migratory
B. Probability escaped or released individuals will establish a free-living population = sum of B1 to B7 (1–16)	**13**	**Serious establishment risk**
C1. Taxonomic group (0–4)	0	Other group
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2)	2	Approximately 50 million square kilometres (assumption based on size of Africa and distribution in Asia)
C3. Diet and feeding (0–3)	0	Not a mammal
C4. Competition with native fauna for tree hollows (0–2)	2	*Naja* spp. may use tree hollows, for example N. *naja* lays its eggs in tree hollows (Animal Diversity Web 2001)
C5. Overseas environmental pest status (0–3)	1	*Naja kaouthia* has naturalised outside of its native range and is likely to be a minor environmental pest

Factor	Score	
C6. Climate match to areas with susceptible native species or communities (0–5)	5	The genus has more than 20 grid squares within the highest two climate match classes, and has more than 100 grid squares within the four highest climate match classes, that overlap the distribution of any susceptible native species or communities
C7. Overseas primary production pest status (0–3)	1	*Naja* spp. are known to eat poultry and eggs
C8. Climate match to susceptible primary production (0–5)	2	Total commodity damage score = 20 (see Table 4)
C9. Spread disease (1–2)	1	Reptile
C10. Harm to property (0–3)	0	$0
C11. Harm to people (0–5)	4	Injuries or harm severe or fatal but few people at risk—*Naja* spp. venom can be fatal
C. Probability an exotic species would become a pest (for birds, mammals, reptiles and amphibians) = sum of C1 to C11 (1–37)	18	Serious pest risk
A. Risk to public safety posed by captive or released individuals A = 0 = not dangerous; A = 1 = moderately dangerous; A ≥ 2 = highly dangerous	4	Highly dangerous
B. Risk of establishing a wild population For birds and mammals: B < 6 = low establishment risk; B = 7–11 = moderate establishment risk; B = 12–13 = serious establishment risk; B > 14 = extreme establishment risk For reptiles and amphibians: B < 3 = low establishment risk; B = 3–4 = moderate establishment risk; B = 5–6 = high establishment risk; B > 6 = extreme establishment risk	13	Serious establishment risk
C. Risk of becoming a pest following establishment C < 9 = low pest risk; C = 9–14 = moderate pest risk; C = 15–19 = serious pest risk; C > 19 = extreme pest risk	18	Serious pest risk
Vertebrate Pests Committee threat category		**Extreme**

Table 2. Australian reptile and amphibian model

Species:		**Naja spp.**
Date of assessment:		**28 August 2009**
Literature search type and date:		**See references**
Factor	**Score**	
A. Climate match risk score	94	CMRS = 100 (2620/2785)—from climate map produced by Department of Agriculture and Food, Western Australia, using PC climate software
B. Exotic elsewhere risk score	15	*Naja kaouthia* has been introduced into another country (Okinawajima) and records exist of it in the wild, but it is uncertain if a breeding, self-sustaining exotic population has established
C. Taxonomic family risk score	10	Family Elapidae
≤22 = low establishment risk; 23–60 = moderate establishment risk; 61–115 = serious establishment risk; ≥116 = extreme establishment risk		
Establishment risk rank	**119**	**Extreme**

Table 3. Bird and mammal model adapted for reptiles and amphibians

Species:		***Naja* spp.**
Date of assessment:		**7 January 2010**
Literature search type and date:		**See references**
Factor	**Score**	
A. Climate match score (1–6)	6	CMS = 2729
B. Exotic population established overseas score (0–4)	2	*Naja kaouthia* has naturalised on the small Japanese island of Okinawajima (Lever 2003)
C. Overseas range size score (0–2)	1	Approximately 50 million square kilometres (assumption based on size of Africa and distribution in Asia)
≤4 = low establishment risk; 5–7 = moderate establishment risk; 8–9 = serious establishment risk; 10–12 = extreme establishment risk		
Establishment risk rank	**9**	**Serious**

Table 4. Calculating total commodity damage score

Industry	Commodity value index*	Potential commodity impact score (0–3)	Climate match to commodity score (0–5)	Commodity damage score (columns 2 × 3 × 4)
Cattle (includes dairy and beef)	11	0	Not estimated	0
Timber (includes native and plantation forests)	10	0	Not estimated	0
Cereal grain (includes wheat, barley sorghum etc.)	8	0	Not estimated	0
Sheep (includes wool and sheep meat)	5	0	Not estimated	0
Fruit (includes wine grapes)	4	0	Not estimated	0
Vegetables	3	0	Not estimated	0
Poultry and eggs	2	2	5	20
Aquaculture (includes coastal mariculture)	2	0	Not estimated	0
Oilseeds (includes canola, sunflower etc.)	1	0	Not estimated	0
Grain legumes (includes soybeans)	1	0	Not estimated	0
Sugarcane	1	0	Not estimated	0
Cotton	1	0	Not estimated	0
Other crops and horticulture (includes nuts, tobacco and flowers)	1	0	Not estimated	0
Pigs	1	0	Not estimated	0
Other livestock (includes goats, deer, camels, rabbits)	0.5	0	Not estimated	0
Bees (includes honey, beeswax and pollination)	0.5	0	Not estimated	0
Total commodity damage score				**20**

* The commodity value index is an index of the value of the annual production value of a commodity. For a full explanation refer to Bomford (2008).