RISK ASSESSMENTS FOR EXOTIC REPTILES AND AMPHIBIANS INTRODUCED TO AUSTRALIA – Rhinoceros Viper (*Bitis nasicornis*) (Shaw, 1792)

Class - Reptilia, Order - Squamata, Family - Viperidae (Oppel, 1811), Genus - *Bitis* (Gray, 1842); (ITIS Integrated Taxonomic Information System 2007, The Reptile Database 2007a, Catalogue of Life 2008)

GOVERNMENT OF WESTERN AUSTRALIA

Department of Agriculture and Food

Score Sheet

<table>
<tr>
<td>SPECIES: Rhinoceros Viper (Bitis nasicornis)

Other common names include: Rhinoceros Horned Viper; River Jack, Nose-horned Viper

Synonyms:

Coluber nasicornis

Vipera nasicornis

Cerastes nasicornis

Clotho nasicornis

Vipera hexacera

Echidna nasicornis

(The Reptile Database 2007a).</td>
<td></td>
<td>Species Description – A large, stout, heavily-bodied snake. Average adult length 60-90 cm, maximum length 120 cm. Tail is very short; shorter in females than males. A small, flattened, triangular-shaped head, which is very distinct from the relatively narrow neck. The eyes are set well forward; the iris is green or gold, with black flecks. Above each nostril are two to three long horn-like scales. The body scales are rough and heavily keeled. One of the world's most brilliantly coloured and patterned snakes – the head is bluish-green above, with a dark arrow-shaped mark pointing forward between the eyes; the body ground colour varies through shades of blue, pink, purple and green; the complex colour pattern on the body includes a series of yellow-edged, blue blotches down the back, each with a yellow line down the centre; on the flanks is a series of dark crimson triangles, narrowly bordered with blue or green; many lateral scales are white-tipped; the belly is dirty white to dull green in colour, and is extensively mottled in black and grey. Colouration varies among individuals, and despite their brilliance, the colours are disruptive and provide the Rhinoceros Viper with excellent camouflage among the fallen leaves and dappled light on the forest floor. Hatchlings are 18-25 cm length and coloured and patterned as the adults (Isemonger 1962, Mehrtens 1987, US Department of the Navy 1991, Rogers 2000).

General Information – A nocturnal species, the Rhinoceros Viper is partially aquatic, and has been found in shallow pools. It is also a good climber, and often basks in shrubs and trees (Mehrtens 1987, Spawls and Branch 1995).

Because of its habitat preference for an area near water, it is often called the 'River Jack' (Rogers 2000).

The average litter size is 25-30, although records exist indicating over 40 young being born (Mehrtens 1987).

Longevity – Maximum recorded longevity is 9.4 years (HAGR Human Ageing Genomic Resources 2006).

Status –

1. Red List Category – Not Listed (IUCN 2008).

2. CITES listed Protection Status – Not Listed (CITES 2007).</td>
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<td>DATE OF ASSESSMENT: 27/05/2008

Bird and Mammal Model Used: (Bomford 2008) using PC CLIMATE (Brown et al 2006, Bureau of Rural Sciences 2006)</td>
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<td>The Risk Assessment Model

Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, Bomford 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2006, 2008). Developed by Dr Mary Bomford of the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model was originally published in 'Risk Assessment for the Import and Keeping of Exotic Vertebrates in Australia' (Bomford 2003) available online http://www.daff.gov.au/brs/land/feral-animals/management/risk . This model used the Apple Mac application CLIMATE (Pheloung 1996) for climate matching.

The risk assessment model was revised and recalibrated 'Risk Assessment for the Establishment of Exotic Vertebrates in Australia: Recalibrated and Refinement of Models'(Bomford 2006) and the climate application changed to PC CLIMATE software (Bureau of Rural Sciences 2006), available online at http://affashop.gov.au/product.asp?prodid=13506. The most recent publication (Bomford 2008) includes updated</td>
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		instructions for using the exotic vertebrate risk assessment models and an additional model for freshwater fish. A bird and mammal model for New Zealand has also been included. **Which models are being used for the assessments:** Birds and mammals have been assessed using the Australian Bird and Mammal Model (Bomford 2008), pp 16-28, including both versions of stage B, models 1 (4 factors) and 2 (7 factors). All reptiles and amphibians were assessed using three models; the Australian Bird and Mammal Model (Bomford 2008), including Model A, using 3 factors from stage B (pp 54-55), and Model B, using 7 factors from stage B (pp 20), and the Australian Reptile and Amphibian Model (Bomford 2008), p 51-53. The rational for using additional models for reptiles and amphibians is to compare establishment risk ranks of the three models for a precautionary approach. If the models produce different outcomes for the establishment potential of any reptile or amphibian, the highest ranked outcome should be used (Bomford 2008). **Climate Matching Using PC CLIMATE** Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located in the species' world distribution and in Australia. Worldwide, data (source; worlddata_all.txt CLIMATE database) from approximately 8000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution. Data from approximately 762 Australian locations is used for analysis. To represent the climate match visually, the map of Australia has been divided into 2875 grid squares, each measured in 0.5 degrees in both longitude and latitude. CLIMATE calculates a match for each Australian grid by comparing it with all of the meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. These levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. For a grid square on the Australian map to score highly, it must match closely all 16 climatic variables of at least one meteorological station in the species' distribution for each level of climate match. [The score for each grid is based on the minimum Euclidian distance in the 16- dimensional variable space between it and all stations in the species' distribution. Each variable is normalized by dividing it by its worldwide standard deviation.]
LITERATURE SEARCH TYPE AND DATE: NCBI, CAB Direct, MEDLINE, Science Direct, Web of Knowledge (Zoological Records, Biological Abstracts), SCIRUS, Google Search and Google Scholar 07/12/2007		

FACTOR	SCORE	
PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATION		
Model A: Using the first three factors/questions from stage B of the Australian Bird and Mammal Model (Bomford 2008) pp 54-55)		
B1. Degree of climate match between species' overseas range and Australia (1–6)	1	*Climate Match Score = 53 Very low climate match with Australia* [See above for information on climate matching.] Climate data from 168 locations (see species' worldwide distribution map) were used to calculate the CMS. Overseas distribution west and central Africa (The Reptile Database 2007) (see B3 for details).
B2. Exotic population established overseas (0–4)	0	*No exotic population ever established* No reports found (Lever 2006).
B3. Overseas range size score (0–2)	1	*Overseas range size between 1-70 million km^2, estimated at 3.4 million km^2. Includes current and past 1000 years, natural and introduced range.*

< 1 = 0; 1 – 70 = 1; >70 = 2		Range from Liberia and southern Guinea, eastwards along the southern coast of northern Africa, through southern Cameroon, Equatorial Guinea, Gabon, Congo, and extreme northern Angola, through the centre of the Democratic Republic of Congo (Zaire), to Burundi, Rwanda, southern Uganda, and western Kenya (Mehrtens 1987, US Department of the Navy 1991, Spawls and Branch 1995, McDiarmid et al 1999, The Reptile Database 2007a). Also occurs on the island of Bioko (off the west coast of Equatorial Guinea) (Spawls and Branch 1995).
ESTABLISHMENT RISK SCORE **SUM OF SCORE A (B1) + SCORE B (B2) + SCORE C (B3) (1-12)**	**2**	
Model B: Using the seven factors/questions from stage B of the Australian Bird and Mammal Model (Bomford 2008) pp 20		
B4. Taxonomic Class (0–1)	1	*Reptile (The Reptile Database 2007a, Catalogue of Life 2008)*.
B5. Diet score (0–1)	1	*Generalist with a broad diet of many food types* The Rhinoceros Viper is an ambush predator, relying on cryptic colouration as camouflage while waiting for suitable prey to come within striking distance, rather than actively foraging. Small mammals, especially rodents and insectivores, make up the majority of the species' prey, although reports of amphibians and even fish being taken (Isemonger 1962, Mehrtens 1987, Spawls and Branch 1995, Rogers 2000).
B6. Habitat score - undisturbed or disturbed habitat (0–1)	1	*Can live in disturbed habitats* The Rhinoceros Viper inhabits the tropical rainforests of Central and Western Africa, often near water or wet swampy environment. It rarely seems to venture into woodland (Mehrtens 1987, US Department of the Navy 1991, Spawls and Branch 1995, Rogers 2000). The species can occur in cocoa plantations in Ghana (Spawls and Branch 1995). In the Nandi country of Kenya it is tolerated by villagers in some areas, even taking up residence in the roofs of huts (Spawls and Branch 1995).
B7. Non-migratory behaviour (0–1)	1	*Non-migratory or facultative migrant in its native range OR unknown* No information found, but probably non-migratory.
ESTABLISHMENT RISK SCORE **SUM OF B1-7 (1-16)**	**6**	
Australian Reptile and Amphibian Model (Bomford 2008, pp 51-53)		
Score A. *Climate Match Risk Score Degree (Sum of species' 4 scores for Euclidian match classes 7 – 10)*	0.2	*CMRS = 100(5/2785)* Overseas distribution west and central Africa (The Reptile Database 2007a) (see B3 for details).
Score B. *Has the species established an exotic population in another country? (0–30)*	0	*The species has not established an exotic population, including species not known to have been introduced anywhere* No reports of establishment (Lever 2006).
Score C. *Taxonomic Family risk score (0–30)*	10	*Moderate risk family (Bomford 2006)* Family - Viperidae (Oppel, 1811) (The Reptile Database 2007b)
ESTABLISHMENT RISK SCORE	**10.2**	

Sum of Score A + Score B + Score C (0 – ≥116)		
PUBLIC SAFETY RISK RANK		
Risks to public safety posed by captive or released individuals (using the questions from stage A of the Australian Bird and Mammal Model (Bomford 2008, pp 17)		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young..*	2	*Animal that sometimes attacks when unprovoked and is capable of causing serious injury (requiring hospitalisation) or fatality* Large snake with long, curved fangs used for injecting highly toxic venom into prey (Mehrtens 1987). The species is slow moving and usually placid, but it can strike quickly and suddenly, both forwards and sideways (Spawls and Branch 1995). The body scales are heavily keeled. The keels are so hard and prominent that they have been known to inflict cuts on snake handlers when the snake struggles (Spawls and Branch 1995). There are few detailed records of Rhinoceros Viper envenomation. Available information suggests severe local effects, including massive swelling that may lead to necrosis (Spawls and Branch 1995, ZOOBASE 2008). The venom of the Rhinoceros Viper is anticoagulant (MacKay et al 1970). Envenomation by captive kept Rhinoceros Viper's is infrequent in captivity, probably due to the snake's calm behaviour. Four bites from captive kept Rhinoceros Viper have been recorded in the US, one fatal (Keyler 2005, Malina and Krecsak 2008). The fatality was a 48-year-old man bitten by the Rhinoceros Viper when the man accidently hit the snake while trying to feed it (Animal Attack Files 2003, Captive Wild Animal Protection Coalition 2003, Keyler 2005). [See Appendix 1 for additional information on incidents and snake bites in general.]
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	1	*Moderate risk (few records and consequences unlikely to be fatal)* Venomous snakes are often incorrectly termed 'poisonous'. The difference is that venom is generally harmless if ingested however, when injected into the body it is toxic, and the tissue around the site of injection as well as other parts of the body will be effected. For this reason, snake venom cannot be used to poison a person by adding it to someone's drink or food; the venom has to go directly into a blood vessel or tissue (Rice and Jones 2007, Venomoussnakes.net 2008), (R. Reed 2008, pers. comm.). Reports exist of irresponsible use of venom obtained from captive snakes, including murder of humans. A marijuana cigarette laced with rattlesnake venom may have been the cause of death of a teenage male in the US. (KMBC.com 2003). In 2007, there was speculation that snake venom may have been used to murder Pakistan cricket coach Bob Woolmer. Further investigation ruled out this possibility (Biswas 2007, Rice and Jones 2007). A number of reports exist of suicide attempts using snake venom (Weston 1986, Morgan et al 2006), (Yadlowski et al 1980), (Knight et al 1977). (See Appendix 1 for details) In Paris, criminal gangs are reportedly using snakes to intimidate their victims and ward off the police. Several gangs were operating with snakes, instead of the more traditional knives. Victims on the streets of Paris claim they have been threatened with a fatal bite if they fail to hand over their valuables (Animal Attack Files 2000). [See Appendix 1 for additional information.] Venom from the Rhinoceros Viper could be used irresponsibly as in the examples listed above.
PUBLIC SAFETY RISK SCORE **Sum of A1 + A2 (0-4)**	**3**	

OTHER INFORMATION TO ASSESS PEST RISKS		
Checklist of factors associated with increased risks of adverse impacts of established species (Bomford 2008, pp 90-91) NB – an asterisk (*) denotes factors that have not been researched to the same degree as other factors, and were generally addressed using standard textbooks only		
FACTOR	**TICK IF YES**	
1. Has adverse impacts elsewhere *Impacts can be economic, environmental or social; impacts can be significant or subtle.*	✓	*Never reported as an environmental pest in any country or region [score = 0, using scoring from Australian Bird and Mammal Model Q C5 (0-3)].* No reports found (MEHRTENS 1987, SPAWLS AND BRANCH 1995). *Can nest or shelter in tree hollows [score = 2, using scoring from Australian Bird and Mammal Model Q C4 (0, 2)].* A terrestrial snake species, the Rhinoceros Viper hides during the day among leaf litter, around fallen trees, under logs, in holes, or among root tangles of big forest trees. It will also climb into thicket, clumps of leaves, or cracks in trees (Isemonger 1962, Spawls and Branch 1995). Due to the species' physiology, it is extremely unlikely the Rhinoceros Viper would shelter in tree hollows more than a couple of meters above the ground (R. Reed 2008, pers. comm.). *No reports of damage to crops or other primary production in any country or region [score = 0, using scoring from Australian Bird and Mammal Model Q C7 (0-3)].* No reports found (Mehrtens 1987, Spawls and Branch 1995). *Moderate risk of harm or annoyance to the public posed by a wild population – Injuries Or Harm moderate but unlikely to be fatal and few people at risk [score = 3, using scoring from Australian Bird and Mammal Model Q C11 (0-5)].* [Scored as moderate risk due to it being considered placid and not aggressive, and few bites recorded; Envenoming by *B. nasicornis* is relatively rare in captivity all over the world (particularly in Europe and the USA), as well as in the wilderness in Africa (Malina and Krecsak 2008). A placid snake, that is not considered aggressive unless provoked or hungry. Although slow-moving, it can strike suddenly either forwards or sideways when agitated; however, are said to be slow to strike, even in defending themselves. Few bites of humans recorded; however, venom highly cytotoxic, and may cause massive swelling & tissue necrosis. Tissue necrosis resulting in amputation has been reported. When approached, it will hiss and puff; the Rhinoceros Viper can produce what may be the loudest hiss of any of the African snakes (Isemonger 1962, Mehrtens 1987, Spawls and Branch 1995, Rogers 2000). Snakes usually avoid direct contact with humans, and bites occur because people unintentionally threaten them or deliberately seek an interaction. Many accidents can be prevented by simple precautions, such as wearing boots and using a flashlight outdoors at night, and almost all snakebites are now treatable with proper medical care. Mortality today results from a lack of hospital facilities, which is the case in many developing countries, or from failure of the victim to seek medical care – one third (3 out of 9) of recent fatalities from rattlesnake bites in Arizona were of persons who refused medical care (Greene 1997).
*2. Has close relatives with similar behavioural and ecological strategies that have had adverse impacts elsewhere **		No reports found (Lever 2006).
3. Is dietary generalist	✓	Small mammals, especially rodents and insectivores, make up the majority of the species' prey, although reports of

		amphibians and even fish being taken (Isemonger 1962, Mehrtens 1987, Spawls and Branch 1995, Rogers 2000).
*4. Stirs up sediments to increase turbidity in aquatic habitats **		No information found (Lever 2006).
*5. Occurs in high densities in their native or introduced range **		No information found to suggest the species occurs in high densities.
*6. Harbours or transmits diseases or parasites that are present in Australia **	✓	Exotic snakes can harbour diseases that could harm native snake species, such as Inclusion Body Disease or Ophidian Paramyxo Virus (Schumacher 2006).
7. Has close relatives among Australia's endemic reptiles and amphibians		No Australian snakes in the family Viperidae or in the genus *Bitis* (Catalogue of Life 2008; Cogger 2000).
*8. Is known to have spread rapidly following their release into new environments **		No information found (Lever 2006).
9. Is predatory	✓	The Rhinoceros Viper is an ambush predator, relying on cryptic colouration as camouflage while waiting for suitable prey to come within striking distance, rather than actively foraging. Small mammals, especially rodents and insectivores, make up the majority of the species' prey, although reports of amphibians and even fish being taken (Isemonger 1962, Mehrtens 1987, Spawls and Branch 1995, Rogers 2000).
Factors	**1**,3,6,9	

Susceptible native Australian species (using question C6 from the Australian Bird and Mammal Model, Bomford 2008, pp 22-23)		
C6. Climate match to areas with susceptible native species or communities (0-5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	**5**	***One or more susceptible native species or ecological communities that are listed as vulnerable or endangered under the Australian Government* Environment Protection and Biodiversity Conservation Act 1999 *has a restricted geographical range that lies with the mapped area of the highest six climate match classes for the exotic species being assessed. [score = 5, using scoring from Australian Bird and Mammal Model Q C6 (0-5)].*** Reference for all vulnerable or endangered species and communities (status noted in bold) (Department of the Environment Water Heritage and the Arts 2007, 2008). Reference for all Australian native mammal species (Strahan 1995). Susceptible Australian native species or natural communities that could be threatened include: **<u>Mammals:</u>** Northern Hopping-mouse (*Notomys aquilo*) **(vulnerable)**, Dayang (*Pseudomys shortridgei*) **(vulnerable)**, Hastings River Mouse (*P. oralis*) **(endangered)**, False Water Rat (*Xeromys myoides*) **(vulnerable)**, Arnhem Rock-rat (*Zyzomys maini*) **(vulnerable)**, Carpentarian Rock-rat (*Z. palatalis*) **(endangered)**. ***AND*** *The species has 1-9 grid squares within the highest four climate match classes that overlap the distribution of any susceptible native species or ecological communities* **<u>Mammals:</u>** Common Planigale (*Planigale maculate*), Red-cheeked Dunnart (*Sminthopsis virginiae*), Northern Brown Bandicoot (*Isoodon macrourus*), Long-nosed Bandicoot (*Perameles nasuta*), Delicate Mouse (*Pseudomys delicatulus*), Eastern Chestnut Mouse (*P. gracilicaudatus*), Water-rat (*Hydromys chrysogaster*), Grassland Melomys (*Melomys burtoni*), Fawn-footed Melomys (*M. cervinipes*), Giant White-tailed Rat (*Uromys caudimaculatus*), Cape

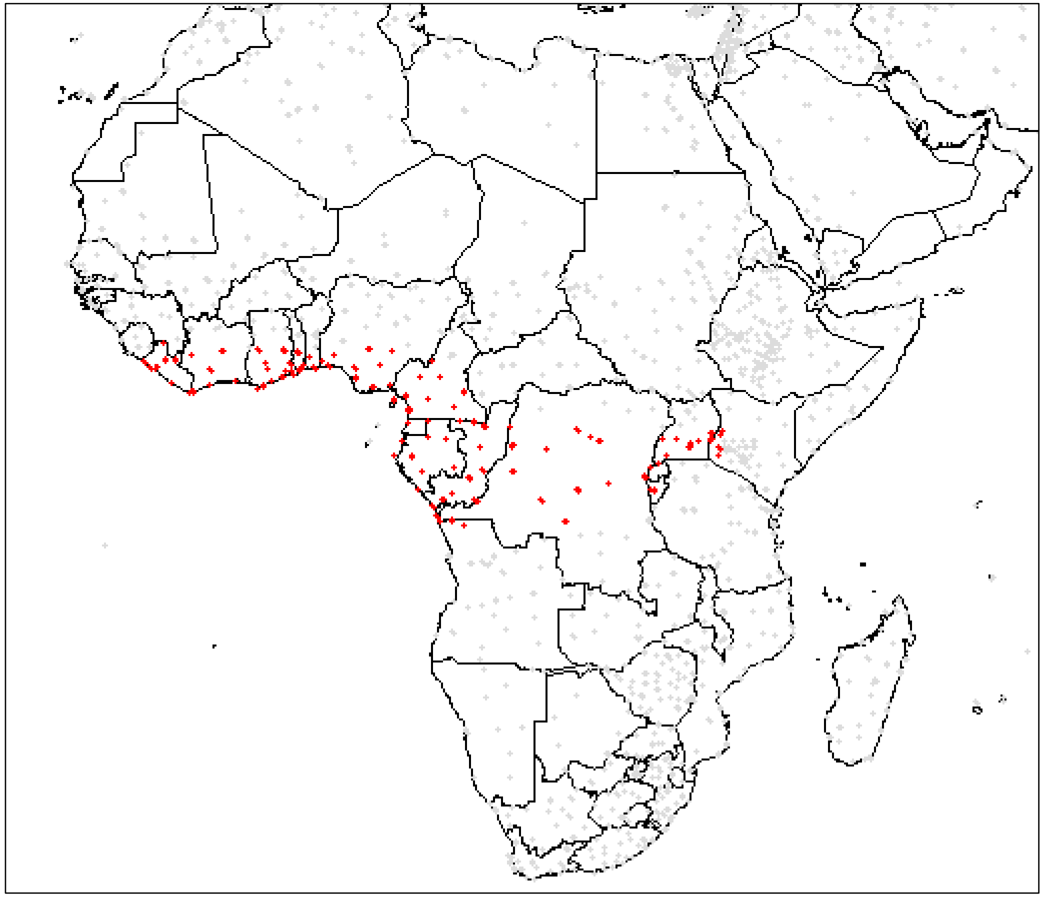
		York Rat (*Rattus leucopus*), Black Rat (*R. rattus*), Canefield Rat (*R. sordidus*), Pale Field-rat (*R. tunneyi*).
Susceptible Australian primary production (using question C8 from the Australian Bird and Mammal model; Bomford 2008 pp 23-25)		
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed elsewhere.*	0	***Score = 0 (Bomford 2003, 2006). [score = 0, using scoring from Australian Bird and Mammal Model Q C8 (0-5)].*** See commodity scores table – species does not have attributes making it capable of damaging any of the primary production commodities.
SUMMARY OF RESULTS		
ESTABLISHMENT RISK RANKS – RISK OF ESTABLISHING A WILD POPULATION		
MODEL A: USING THE FIRST THREE FACTORS/QUESTIONS FROM STAGE B OF THE AUSTRALIAN BIRD AND MAMMAL MODEL (BOMFORD 2008) PP 54-55) ≤ 4 = LOW ESTABLISHMENT RISK; 5-7 = MODERATE ESTABLISHMENT RISK; 8-9 = SERIOUS ESTABLISHMENT RISK; 10-12 = EXTREME ESTABLISHMENT RISK	**2**	**LOW**
MODEL B: USING THE SEVEN FACTORS/QUESTIONS FROM STAGE B OF THE AUSTRALIAN BIRD AND MAMMAL MODEL (BOMFORD 2008) PP 20) ≤ 6 = LOW ESTABLISHMENT RISK; 7-11 = MODERATE ESTABLISHMENT RISK; 12-13 = SERIOUS ESTABLISHMENT RISK; ≥ 14 = EXTREME ESTABLISHMENT RISK	**6**	**LOW**
AUSTRALIAN REPTILE AND AMPHIBIAN MODEL (BOMFORD 2008, PP 51-53) ≤ 22 = LOW ESTABLISHMENT RISK; 23-60 = MODERATE ESTABLISHMENT RISK; 61-115 = SERIOUS ESTABLISHMENT RISK; ≥116 = EXTREME ESTABLISHMENT RISK	**10.2**	**LOW**
HIGHEST ESTABLISHMENT RISK RANK (When establishment risk ranks differ between the models, the highest ranked outcome is used (Bomford 2008).	**-**	**ON HOLD**
PUBLIC SAFETY RISK RANK **AUSTRALIAN BIRD & MAMMAL MODEL, STAGE A (BOMFORD 2008, PP 17)**	**3**	**HIGHLY DANGEROUS**

A = 0 = NOT DANGEROUS; A = 1 = MODERATELY DANGEROUS; A ≥ 2 = HIGHLY DANGEROUS		
Median number of references for Establishment Risk and Public Safety Risk, for all reptiles assessed by (Massam et al 2010) (n=11) Total number of references for this species		15, 2 9 – less than the median number of reptile references were used for this aspect of the assessment, indicating an increased level of uncertainty. 7 - more than the median number of reptile references were used for this aspect of the assessment, indicating a decreased level of uncertainty
DAFWA THREAT CATEGORY - assigned for this study **(Public Safety + ERR) + use of the precautionary approach (when Prelim. Threat Ranking Low or Moderate)**		**SERIOUS – NOT ENDORSED BY VPC**
OTHER INFORMATION TO ASSESS PEST RISKS		
CHECKLIST OF FACTORS ASSOCIATED WITH INCREASED RISKS OF ADVERSE IMPACTS OF ESTABLISHED SPECIES (BOMFORD 2008, PP 90-91) (0-9)	1,3,6,9	
AUSTRALIAN SPECIES POTENTIALLY AT RISK AUSTRALIAN BIRD & MAMMAL MODEL, Q. C6 (BOMFORD 2008, PP 22-23) (0-5)	**5**	
AUSTRALIAN PRIMARY PRODUCTION POTENTIALLY AT RISK AUSTRALIAN BIRD & MAMMAL MODEL, Q. C8 (BOMFORD 2008, PP 23-25) (0-5)	**0**	
ALTERNATIVE THREAT CATEGORY - assigned for this study **(Public Safety + ERR) + arbitrary increase of one rank (based on presence of adverse impact factors 1 or 5, or maximum scoring for predicted effects on Australian species or primary production)**		**EXTREME – NOT ENDORSED BY VPC**
Median number of references for Establishment Risk, Public Safety Risk and Overseas Environmental and Agricultural Adverse Impacts, for all reptiles assessed by (Massam et al 2010) (n=11)		20

Total number of references for this species	16 – less than the median number of reptile references were used for this assessment, indicating an increased level of uncertainty

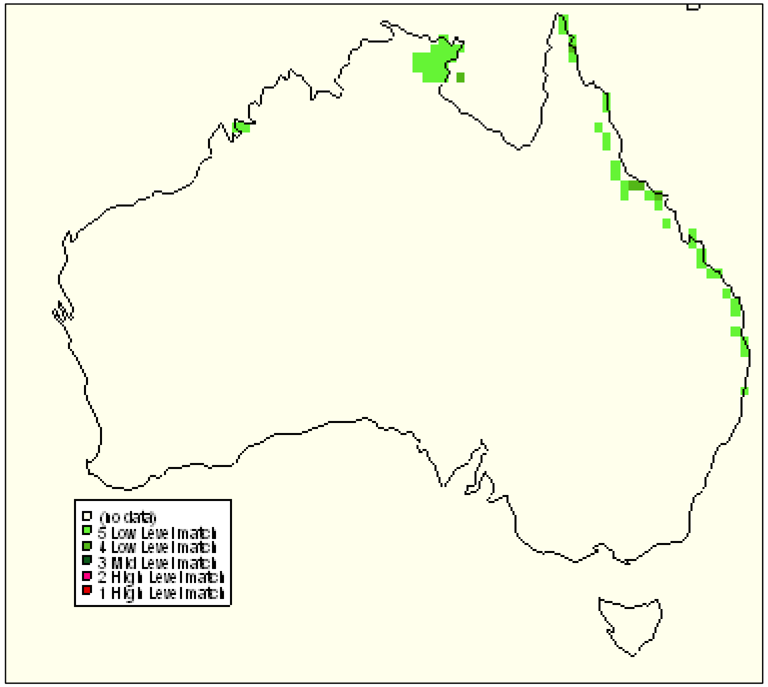
World Distribution – Rhinoceros Viper (*Bitis nasicornis*), includes current and past 1000 years.

Each red dot is a location where meteorological data was sourced for the climate analysis (see B1); faint grey dots are locations available for CLIMATE analysis but are not within the species' distribution therefore not used. There is no introduced range for this species.



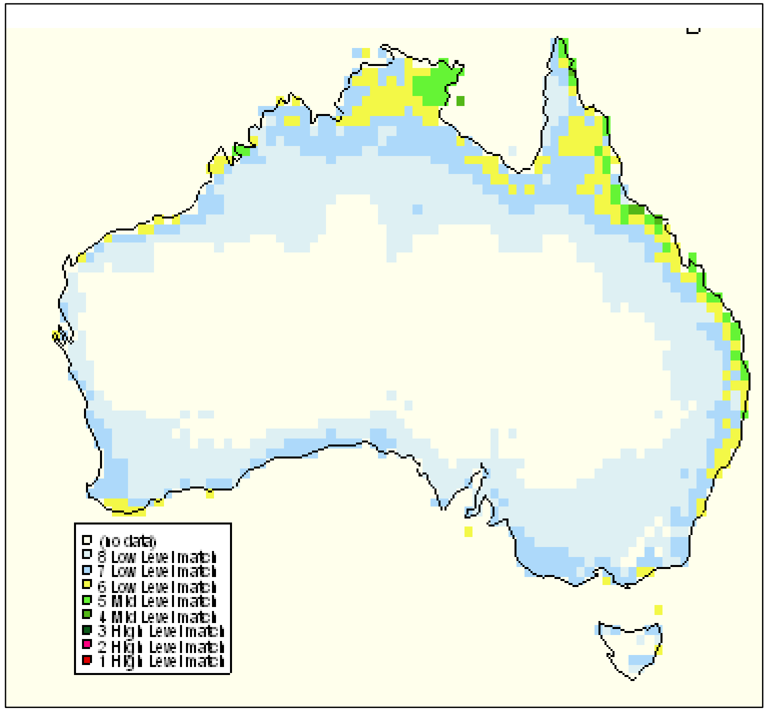
Map 1. Climate match between the world distribution of Rhinoceros Viper (*Bitis nasicornis*) and Australia for five match classes.

Colour on Map	Level of Match from Highest (10) to Lowest (6)	No. Grid Squares on Map
Red	10 HIGH MATCH	0
Pink.	9 HIGH MATCH	0
Dark Green	8 MOD MATCH	0
Mid Green	7 MOD MATCH	5
Lime Green	6 LOW MATCH	48
		CMS = 53



Map 2. Climate match between the world distribution of Rhinoceros Viper *(Bitis nasicornis)* and Australia for eight match classes.

Colour on Map	Level of Match from Highest (10) to Lowest (3)	No. Grid Squares on Map
Red	10 HIGH MATCH	0
Pink	9 HIGH MATCH	0
Dark Green	8 HIGH MATCH	0
Mid Green	7 MOD MATCH	5
Lime Green	6 MOD MATCH	48
Yellow	5 MOD MATCH	158
Blue	4 LOW MATCH	378
Light blue	3 LOW MATCH	853



Rhinoceros Viper *(Bitis nasicornis)* Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 2005-2006 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	Commodity Value Index (based on – 2005-2006 data)	Potential Commodity Impact Score (0-3)	Climate Match to Commodity Score (0–5)	Commodity Damage Score (columns 2 X 3 X 4)
Sheep (includes wool and sheep meat)	5	0	0	10
Cattle (includes dairy and beef)	11	0	0	0
Timber (includes native and plantation forests)	10	0	0	0
Cereal grain (includes wheat, barley sorghum etc)	8	0	0	0
Pigs	1	0	0	3
Poultry and eggs	2	0	0	6
Aquaculture(includes coastal mariculture)	2	0	0	0
Cotton	1	0	0	0
Oilseeds (includes canola, sunflower etc)	1	0	0	0
Grain legumes (includes soybeans)	1	0	0	0
Sugarcane	1	0	0	0
Grapes	0	0	0	0
Other fruit	4	0	0	0
Vegetables	3	0	0	0
Nuts	1	0	0	0
Other livestock (includes goats, deer, camels, rabbits)	0.5	0	0	1
Honey and beeswax	0.5	0	0	0
Other horticulture (includes flowers etc)	1	0	0	0
Total Commodity Damage Score (TCDS)				**0**

[Table 9 Rational

Potential Commodity Impact Score (0-3)

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Appendix 1 – Additional information on venom and harm to humans

Venom is a complex mixture of biologically active peptides representing modified saliva, serving a dual function of rapidly incapacitating or killing prey, as well as acting as a pre-digestant. – venoms may be separated into two basic types: *haemotoxins*, which affect blood and/or tissue, and *neurotoxins*, which affect the nervous system. All venoms contain both types, however one or the other predominates in any given type of venom. All venoms also contain *hyaluronidase*, an enzyme that assures rapid diffusion of the venom. Haemotoxins are generally the dominant component in the venom of vipers. They cause extensive tissue damage, destroy the blood vessels as well as blood cells, and may act as either coagulants or anti-coagulants (Mehrtens 1987, Obst et al 1988, Spawls and Branch 1995, Hadley and Mars 2006, The Reptile Database 2008).

The role of venom in self-defence is secondary. When biting defensively, a snake may not inject venom into the victim, known as a 'dry bite'. If venom is injected, many factors, such as the size of the reptile, the length of time since it last emptied its venom sacs, and the state of its dentition (fangs) will affect the volume of venom injectable (Mehrtens 1987, Spawls and Branch 1995, Hadley and Mars 2006).

Following envenomation, local pain and swelling develop within minutes. There is usually extensive subcutaneous bruising and blood blisters may form rapidly. Painful lymph glands are common. Well-treated cases rarely develop necrosis of the skin, fascia, tendons or muscle, but this may develop from secondary infections in neglected cases, or those abused with tourniquets, deep incisions, or excessive local antivenom injection. Neurotoxic action of the venom is minimal and usually occurs as a secondary consequence of poor blood supply to the brain. Some Puff Adder bites may develop only relatively minor symptoms of swelling, subcutaneous bruising and blood blisters in the vicinity of the bite (Spawls and Branch 1995).

Due to lack of information, and due to similarities between the species, it is often assumed that bites from Rhinoceros Viper will have similar effects as bites from the Gaboon Viper (*Bitis gabonica*). Gaboon Viper bites have a high probability of significant, even lethal envenoming, with both local and systemic effects. Symptoms include moderate to severe swelling of the bitten limb, with marked pain, blistering, bruising, and necrosis. Bleeding can occur due to venom haemmorhagins, especially in the gut (Malina and Krecsak 2008, ZOOBASE 2008).

A case of a bite by a captive Rhinoceros Viper in Hungary has been reported. A 30-year-old male owner of an adult male Rhinoceros Viper was bitten on the finger. He had never been bitten before, and claimed that the snake had always been calm and handled easily, and that special caution was only necessary during the snake's feeding time. The accident happened when the owner pulled the Viper from its cage with a snake-hook. Local symptoms were moderate; there was some swelling, and slight discolouration developed around the fang mark. He experienced slight hypertension, and mild coagulopathy. The use of antivenom was not necessary. This was probably a 'warning' bite from the pet snake, as it only injected a small amount of venom (Malina and Krecsak 2008).

Misuse of venom

Venomous snakes are often incorrectly termed 'poisonous'. The difference is that venom is generally harmless if ingested, however if injected into some tissue it is toxic, and the tissue around the site of injection and other parts of the body will be effected. For this reason, snake venom cannot be used to poison a person by adding it to someone's drink or food; the venom has to go directly into a blood vessel or tissue (Rice and Jones 2007, Venomoussnakes.net 2008), (R. Reed 2008, pers. comm.).

Reports exist of irresponsible use of venom obtained from captive snakes, including murder of humans. A marijuana cigarette laced with rattlesnake venom may be to blame for the death of a teenage male in the US. It was rumoured that the boy may have smoked some marijuana laced with rattlesnake venom the night before his mother found him unresponsive in his bed. Although police could neither confirm nor deny that rumour, there was reason to believe the victim may have been poisoned. The victim's father said that blood tests proved it was the snake venom that killed the boy (KMBC.com 2003).

In 2007, there was speculation that snake venom may have been used to murder Pakistan cricket coach Bob Woolmer. Further investigation ruled out the possibility that snake venom had been used (Biswas 2007, Rice and Jones 2007).

There are also number of reports exist of suicide attempts using snake venom. A 14-year-old male milked the venom from his father's Western Diamondback Rattlesnake (*Crotalus atrox*) by killing it and removing its head, and injected the venom with a syringe into his right antecubital vein. He immediately developed severe pain and vomiting, then hypotension, swollen lips and tongue, and coma. Critical haematological abnormalities, gastrointestinal bleeding, and hematuria developed over 24 hours. Antivenom was administered, and the boy was discharged from hospital after 5 days (Morgan et al 2006).

A 23-year-old man with a history of intravenous drug abuse, had been experiencing personal problems with his girlfriend. He purchased a Diamondback Rattlesnake (*Crotalus adamanteus*) from a friend who raised snakes, milked several millilitres of the venom, then injected it intravenously into his left antecubical fossa. He was admitted to hospital and given antivenom; the man survived (Weston 1986).

A 23-year-old employee of a snake farm was found dead in a wooded area 24 hours after he disappeared. A number of suicide notes were left behind. Two vials, coated on the inside with a white crystalline powder, and a syringe were found near the body. Presumably, the material in the vials was mixed with water and used to fill the syringe for injection. It was suggested that the victim had killed himself by injection of snake venom, because of his knowledge of and access to snake venoms, and the deceased had threatened previously to commit suicide by this means. The vials of powder, residue from the syringe and needle, blood from the victim, and a saline extract of tissue from the injection site were analysed. Conclusive evidence was obtained for the presence of snake venom in the syringe and needle. The exact species of snake was not determined (Yadlowski et al 1980).

A 26-year-old man, who had a history of schizophrenia and had attempted suicide on two prior occasions, was admitted to a mental hospital. Later that evening, the psychiatric registrar was called to see the patient as he was agitated an in a collapsed state. He began talking about having injected himself with insulin. Then, however, he whispered into the doctor's ear "It is snake venom, not insulin". Due to rapid deterioration in his physical condition, he was transferred from the mental hospital to a nearby general hospital, where he was treated as a suspected case of snake venom poisoning. Antivenom for European snakes was given, but he lapsed into a coma and died early the next morning. The home was searched but no notes or toxic substances were found. Intensive enquiries found no evidence of the purchase of commercial snake venom, though the family reported that a year or two prior to the death, they had intercepted correspondence between the deceased and a snake farm, indicating that he had been attempting to buy snakes. Autopsy and laboratory investigation results indicated that venom was present in the injection site tissue, however the snake species was not positively identified. It was suggested that the injected substance contained either a mixture of haemotoxic and neurotoxic venoms, or a venom containing both, such as the Puff Adder (Knight et al 1977).

Snakes usually avoid direct contact with humans, and bites occur because people unintentionally threaten them or deliberately seek an interaction. Many accidents can be prevented by simple precautions, such as wearing boots and using a flashlight outdoors at night, and almost all snakebites are now curable with proper medical care. Mortality today results from a lack of hospital facilities, which is the case in many developing countries, or from failure of the individual that has been bitten to seek medical care – one third (3 out of 9) of recent fatalities from rattlesnake bites in Arizona were to persons who refused medical care (Greene 1997).

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