Department of **Agriculture and Fisheries**
Biosecurity Queensland

Asian spined toad

Bufo melanostictus

Steve Csurhes

First published 2010
Updated 2016

Queensland Government

Contents

Summary

The Asian spined toad (*Bufo melanostictus*) is closely related to one of Queensland's most infamous pests, the cane toad (Bufo marinus). While the cane toad is native to South America, the Asian spined toad is native to Asia.

Much like the cane toad, the Asian spined toad is highly fecund, producing up to 40,000 eggs per clutch. It is also poisonous, has a generalist diet and is well adapted for life in urban areas.

Asian spined toads are abundant in Bali and Papua New Guinea. Although not currently naturalised in Australia, they are occasionally intercepted within shipping containers, vehicles and other imported goods.

Pest risk assessment suggests that Asian spined toads are highly likely to naturalise in Queensland. Moreover, the species has the potential to become a significant pest, with impact comparable to the cane toad. Habitats at risk include all tropical, coastal areas of northern Queensland.

Preventative measures in the form of border quarantine exclusion, as well as post-border surveillance and early detection are vital to prevent naturalisation.

Identity and taxonomy

Species: *Bufo melanostictus (*Schneider 1799)

Synonyms:

Ansonia kamblei, Bufo tienhoensis, Duttaphrynus melanostictus

In 2006, a review of amphibian taxonomy placed *Bufo melanostictus* in a new genus, *Duttaphrynus* (Frost et al. 2006).

Common names:

Asian spined toad, Southeast Asian toad, Asian common toad, spectacled toad, common Indian toad, black-spined toad, common Sunda toad, black-lipped toad, keeled-nosed toad, South Asian garden toad, black-spectacled toad, house toad, Asiatic toad, Asian eyebrow-ridge toad, Asian black-spotted toad, and Javanese toad.

Family: Bufonidae

Similar species:

B. melanostictus may be confused with *Bufo marinus* (cane toad), though the former is smaller with distinctive black warts (CaneToadsinOz.com 2009). Morphology is highly variable, especially the juveniles. As a result, it is often confused with co-existing species throughout its range (Daniels 2005). Similar species include Indian and other South and Southeast Asian toads such as *Bufo cyphosus*, *Bufo himalayanus*, *Bufo microtympanum*, *Bufo noellerti*, and *Bufo stuarti*. Juvenile *B. melanostictus* are sometimes confused with *Bufo microtympanum* (Daniels 2005).

Bufo is a genus of about 225 species of true toads. It is a cosmopolitan genus with species in all regions of the world except the Arctic, Antarctic, Australia, New Guinea and neighbouring islands. *B. melanostictus* is one of the most widespread species in its genus.

Description

B. melanostictus is a stocky, medium-sized to large toad with a relatively small head and short hind limbs. Snout-vent length of males is between 57–83 mm, and females between 65–85 mm, sometimes exceeding 150 mm. The head has elevated bony ridges, with long dark crests that border the eyelids and run down on either side of the eye. Another thicker crest runs from the eye to the parotoid gland. The parotoid glands are very prominent, oval-shaped and about as long as eye and snout combined.

Colour is highly variable, usually being greyish or reddish brown, but can range from plain brick-red to almost black. The most common colour pattern is one of pale yellow-brown marked boldly with dark or reddish-brown streaks and spots. In juveniles, the throat has a blackish band that runs between the chin and breast. The back is covered with round warts of varying sizes, often surrounded by darker pigment and capped with tiny dark spines. There are pimple-like warts on the sole and toes. The juveniles lack warts and often have a very inconspicuous eardrum. The underside is largely whitish with fine black spots. Males have a subgular vocal sac, and breeding males have a bright yellow-orange throat region and develop cornified pads on the inner side of the first and second fingers. Tadpoles are black and small, up to 15 mm long (Daniels 2005; Forestry Department Sarawak 2008; Khan 2000; NationMaster.com 2005).

Figure 1. Dorsal view of *Bufo melanostictus* displaying the prominent black warts and reddish-brown streaks (Photo: L Shyamal. Image from Wikimedia Commons under *Creative Commons Attribution 2.5 License*).

Biology

Life history

Larvae metamorphosis:	25–30 days
Length of larval stage:	34–90 days
Number of eggs:	40,000 per clutch
Oviposition frequency:	can possibly breed twice per year, most likely once per year
Sexual maturity:	can mature as small as 23 g body size
Sexual activity:	unknown
Life span:	4-10+ years in captivity

(Bartlett & Griswold 2001; Daniels 2005; Jørgensen et al. 1986)

Breeding depends on rainfall and temperature. In areas with seasonal monsoon rains, breeding often peaks at the start of the wet season. Where climate is more stable, breeding can occur throughout the year (Jørgensen et al. 1986; Mathew 1999).

Ovulation follows a pattern related to the lunar cycle, with most females ovulating just before or after the full moon. The female ovaries can occupy 30% of the gross body weight, a trait that facilitates high fecundity (Whitten et al. 1997).

B. melanostictus breeds opportunistically in various bodies of freshwater including gutters, puddles and even cement cisterns in parks (Saidapur & Girish 2001). Males congregate at breeding sites where they call to females. The call is a *'creo-o-o'; cro-ro-ro-ro-ro-ro'* that is repeated in choruses rather monotonously. The calling males may be heard throughout the night during rain and sometimes on overcast days (Daniels 2005).

There is intense competition between males for females. Often a number of males will cling to a female. The female lays a long string of black eggs which are fertilised externally by the male. The eggs are enclosed in a double gelatinous capsule and laid in a double jelly string around submerged vegetation (Khan 2000). The eggs develop into larvae in 24–48 hours, depending on water temperature.

The tadpoles are small, black and congregate into schools. Both kinship and density affect larval duration and size at metamorphosis. Tadpoles reared with siblings metamorphose more quickly than those reared with non-siblings, and tadpoles reared with siblings and in lower densities have a larger mean body mass (Saidapur & Girish 2001). Tadpoles are scavengers feeding on almost anything. Time to metamorphosis varies between habitats and ranges from 34–90 days. Young toadlets actively feed during the night and day, often on soft-bodied ants (Daniels 2005).

Diet

B. melanostictus has a broad, opportunistic diet. It hunts exclusively on the ground, often consuming a wide variety of invertebrates. Arthropods are often the dominant food type, especially ants and termites. Other prey include invertebrates in the orders Opisthoptera, Dermaptera, Orthoptera, Hemiptera, Lepidoptera, Coleoptera, Heteroptera, Hymenoptera, Dictyoptera, Diptera, Chilopoda, Diplopoda, Aranida, and Mollusca. Even insects with noxious protective and offensive mechanisms such as scorpions, centipedes and millipedes are frequently taken. Most food items are between 5–20 mm in size (Berry & Bullock 1962; Mathew 1999). Tadpoles eat mainly phytoplankton (Sinha et al. 2001).

Predators and diseases

Tadpoles are prey for water snakes and carnivorous tadpoles of species such as *Hoplobatrachus tigerinus* (Daniels 2005; Saidapur et al. 2009).

Adult *B. melanostictus* are prey for checkered keelback snakes (*Xenochrophis piscator*) and crows (Kanade 2006). Larger toads probably poison a range of predators (Daniels 2005).

B. melanostictus can carry a number of parasites including microfilarial worms, nematodes (*Oxysomatium* sp. and *Rhabdias* sp.) and trematodes (*Mesocoelium burti*) (Rahman et al. 2008).

Preferred habitat

B. melanostictus is a nocturnal terrestrial species found across temperate, subtropical and tropical habitats from sea level to 2000 m. The species can be described as a "habitat generalist" but tends to prefer disturbed lowland habitats such as disturbed forests, forest margins, riparian areas and human-dominated agricultural and urban areas. It is uncommon in closed forest.

Adults shelter during the day under rocks, leaf-litter, logs and man-made structures such as drains, rubbish piles and even houses. At night, they often gather to feed around street lamps.

Breeding occurs in still and slow-flowing rivers as well as temporary and permanent ponds and pools. They can breed close to the sea with tadpoles tolerating brackish water up to 1% salinity (Daniels 2005; Forestry Department Sarawak 2008; Strahan 1957; van Dijk et al. 2004; Wildlife Singapore undated).

Global distribution

B. melanostictus is abundant and widespread across Asia. Its native distribution extends from north Pakistan through Nepal, Bangladesh, India, Sri Lanka, southern China (including Taiwan, Hong Kong and Macau), Myanmar, Lao People's Democratic Republic, Vietnam, Thailand and Cambodia to Malaysia, Singapore, and Indonesia (Sumatra, Java, Borneo, Anambas Islands and Natuna Islands).

It has naturalised in parts of Indonesia (Bali, Sulawesi, Ambon, Manokwari, Maluku), New Guinea (West Papua and Papua New Guinea) and the Andaman and Nicobar Islands in the Indian Ocean (Lever 2003; van Dijk et al. 2004). *B. melanostictus* has recently been discovered in East Timor (CaneToadsinOz.com 2009).

Distribution in Australia

B. melanostictus has not yet established in Australia. Individuals have been intercepted at Australian airports and sea ports from flights and ships coming from Asia. They are usually found in international vessels, shipping containers, machinery and personal effects such as bags, shoes, boxes and cartons. When detected, they are destroyed by AQIS officers (AQIS 2008; AQIS 2009).

Conservation status

Bufo melanostictus is listed on the IUCN Red List as 'Least Concern' due to its wide distribution, tolerance of a broad range of habitats, and large population. It is an abundant species throughout its range that is probably increasing in many areas (van Dijk et al. 2004).

Bufo melanostictus is not listed on a CITES appendix.

Threat to human safety

B. melanostictus does not pose a direct threat to human safety, but is toxic (much like *B. marinus*). Adults secrete a milky toxin that has a pungent odour. The skin excretions contain several bioactive compounds with lethal, hypotensive, hypertensive, neurotoxic, cardiotoxic, haemolytic and sleep inducing factors (Das et al. 2000). When handled by people, the toad can cause itching in the nostrils, eyes and exposed skin (Daniels 2005). In some Asian countries, toads are used as a food source, however the consumption of *B. melanostictus* skin and eggs can cause serious illness or even death (Keomany et al. 2007).

History as a pest overseas

B. melanostictus was first detected in Bali in 1958 and subsequently spread through Indonesia to Papua/New Guinea. Most recently it was discovered in East Timor where it was initially mistaken for *B. marinus* (CaneToadsinOz.com 2009). In Papua, *B. melanostictus* was first noticed around 1980, and it is not known whether its introduction was accidental or deliberate. The toad is confined to the narrow coastal plain east of the Arfak Mountains. Here it is considered to be 'exceedingly abundant' and since introduction has achieved an explosive population increase, similar to establishment patterns exhibited by *B. marinus* (Lever 2003). Their ecological impact in Papua is unknown. However, in other parts of Indonesia, they are displacing *Bufo biporcatus*— a smaller, less active species (Iskandar 2004).

In East Timor they are suspected to cause serious ecological problems, comparable to the impact of *B. marinus* in Australia. To date, no quantitative assessment has been carried out to measure their impacts in East Timor (AQIS 2009; CaneToadsinOz.com, 2009). In Indonesia, some authors have commented that "nothing can hinder its expansion" (Church 1960; Whitten et al. 1997).

Potential distribution and impact in Queensland

Bufo melanostictus is not currently present in Australia.

Since climate is a primary factor that determines a species' distribution, climate-modelling software (PC CLIMATE) was used to predict the area of Australia where climate is suitable for *B. melanostictus* (Figure 2).

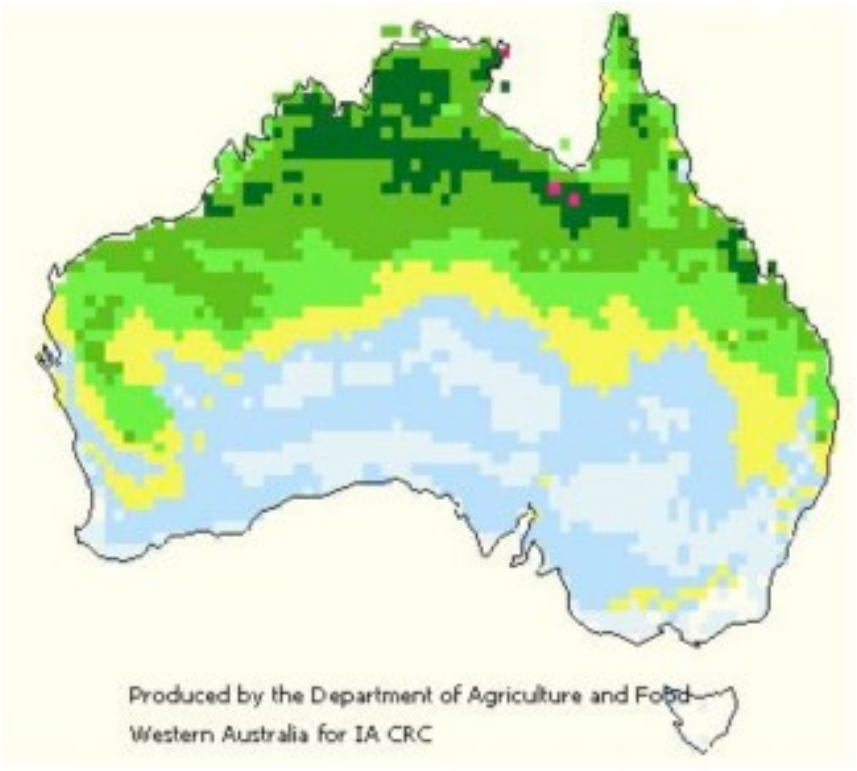

Figure 2. Potential distribution of *Bufo melanostictus* in Australia (pink and dark green areas indicate where climate is most suitable for the species; mid green, light green and yellow indicate areas where climate is moderately suitable; blue and light blue where climate has low suitability; and white where climate is unsuitable). Map courtesy of Department of Agriculture and Food, Western Australia.

Based purely on an assessment of climatic suitability, *B. melanostictus* is likely to survive over large areas of Queensland, with coastal and northern areas being most suitable. It is important to note, however, that other habitat attributes, such as the availability of food and predator abundance, will influence range and abundance.

The closely related species *Bufo marinus* is a well-established significant pest across northern and eastern Queensland. *B. melanostictus* shares very similar attributes such as relatively large size, broad habitat tolerances, high fecundity and a generalist diet. Hence, it seems reasonable to predict that if *B. melanostictus* naturalised in Queensland, its ecological impact would be comparable to *B. marinus*.

Climate-match, a broad natural range and a history as a pest elsewhere are perhaps the most reliable predictors of invasion success (for a full review of attributes that confer invasion success see Hayes and Barry 2008). *B. melanostictus* has all three attributes and, as such, should be considered to pose a high risk.

The 'Bomford numerical risk assessment'

A numerical risk assessment system developed by Bomford (2008) is widely applied in Australia to assess the level of risk posed by vertebrates. This approach enables numerical ranking and prioritisation of large numbers of species. Firstly, a species' potential distribution is predicted using climate-modelling computer programs. The remaining steps involve allocation of scores for a number of attributes relevant to a species' pest status including biology, costs to the economy, the environment and society, and management efficacy.

Using the Bomford system, Asian spined toads were assessed as a 'serious' threat species (refer to attachment).

Additional Bomford models confirm establishment risk as 'serious'.

References

AQIS (2009) *Bulletin–April/May 2009*. http://www.daff.gov.au/aqis/about/reports-pubs/aqis-bulletin/2009/april-may#toad

AQIS (2008) *Bulletin–January/February 2008*. http://www.daff.gov.au/__data/assets/pdf_file/0011/593363/bulletin-janfeb08.pdf

Bartlett, RD & Griswold, B (2001) *Reptiles, amphibians, and invertebrates: an identification and care guide*. Barron's Educational Series.

Berry, PY & Bullock, JA (1962) 'The Food of the Common Malayan Toad, *Bufo melanostictus* Schneider', *Copeia*, 4: 736–741.

Bomford, M (2008) *Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand: validating and refining risk assessment models*. Invasive Animals Cooperative Research Centre, Canberra.

Bomford, M, Kraus, F, Braysher, M, Walter, L, Brown, L (2005) *Risk assessment model for the import and keeping of exotic reptiles and amphibians*. http://www.feral.org.au/feral_documents/RepAmphRisk.pdf

CaneToadsinOz.com (2009) *Cane Toads in Timor–Not!* http://www.canetoadsinoz.com/canetoadsintimor.html

Church, G (1960) 'The Invasion of Bali by *Bufo melanostictus*', *Herpetologica*, 16(1): 15–21.

Daniels, RJR (2005) *Amphibians of peninsular India*. Universities Press (India).

Das, M, Mallick, BN, Dasgupta, SC, Gomes, A (2000) 'A sleep inducing factor from common Indian toad (*Bufo melanostictus*, Schneider) skin extract', *Toxicon*, 38: 1267–1281.

Forestry Department Sarawak (2008) *Common Sunda Toad*. http://www.forestry.sarawak.gov.my/forweb/wildlife/fauna/amphib/bufo.htm

Frost, DR, Grant, T, Faivovich, J, Bain, RH, Haas, A, Haddad, CFB, De Sá, RO, Channing, A, Wilkinson, M, Donnellan, SC, Raxworthy, CJ, Campbell, JA, Blotto, BL, Moler, P, Drewes, RC, Nussbaum, RA, Lynch, JD, Green, DM, Wheeler, WC (2006) 'The Amphibian Tree of Life', *Bulletin of the American Museum of Natural History*, 297: 1–370.

Hayes, KR and Barry, SC (2008). Are there any consistent predictors of invasion success ? *Biological Invasions* 10: 483–506.

Iskandar, D (2004) *Ingerophrynus biporcatus–IUCN Red List of Threatened Species*. http://www.iucnredlist.org/details/54588/0/full

IUCN (2008) *Range map–Duttaphrynus melanostictus*. http://www.iucnredlist.org/details/54707/0/rangemap

Jørgensen, CB, Shakuntala, K, Vijayakumar, S (1986) 'Body size, reproduction and growth in a tropical toad, Bufo melanostictus, with a comparison of ovarian cycles in tropical and temperate zone anurans', *Oikos*, 46: 379–389.

Kanade, A (2006) 'Down-*toad*-den: A Series of Unfortunate Events', *Hornbill*, Jan-Mar: 30–31. http://www.seas.upenn.edu/~kanade/downtoadden.pdf

Keomany, S, Mayxay, M, Souvannasing, P, Vilayhong, C, Stuart, BL, Srour, L, Newton, PN (2007) 'Toad poisoning in Laos', *The American Society of Tropical Medicine and Hygiene*, 77(5): 850–853.

Khan, MS (2000) *Amphibiaweb–Bufo melanostictus*. http://amphibiaweb.org/cgi/amphib_query?query_src=aw_lists_genera_&where-genus=Bufo&where-species=melanostictus

Lever, C (2003) *Naturalized Reptiles and Amphibians of the World*. Oxford University Press.

Mathew, M (1999) *Studies on some aspects of the biology and ecology of common Indian toad–Bufo melanostictus Schneider (Class Amphibia; Order Anura)–PhD Thesis*. http://www.mgutheses.org/page/?q=T%200581&search=&page=&rad=#184

NationMaster.com (2005) *Encyclopedia–Bufo melanostictus*. http://www.nationmaster.com/encyclopedia/Bufo-melanostictus

Oldroyd, BP & Wongsiri, S (2006) *Asian honey bees: biology, conservation, and human interactions*. Harvard University Press.

Pokhrel, S, Thapa, RB, Neupane, FP, Shrestha, SM (2006) 'Absconding behaviour and management of *Apis cerana* F. honeybee in Chitwan, Nepal', *Journal of the Institute of Agriculture and Animal Science*, 27: 77–86.

Rahman, WA, Tan, A, Sufina, I (2008) 'On the parasitic fauna of two species of anurans collected from Sungai Pinang, Penang Island, Malaysia', *Tropical Biomedicine*, 25(2): 160–165.

Saidapur, SK, Veeranagoudar, DK, Hiragond, NC, Shanbhag, BA (2009) 'Mechanism of predator-prey detection and behavioural responses in some anuran tadpoles', *Chemoecology*, 19: 21–28.

Saidapur, SK & Girish, S (2001) 'Growth and Metamorphosis of *Bufo melanostictus* Tadpoles: Effects of Kinship and Density', *Journal of Herpetology*, 35(2): 249–254.

Sinha, B, Chakravorty, P, Borah, MM, Bordoloi, S (2001) 'Qualitative analysis of food spectrum of five species of anuran tadpoles from Arunachal Pradesh, India', *Zoos' Print Journal*, 16(6): 514–515.

Strahan, R (1957) 'The Effect of Salinity on the Survival of Larvae of *Bufo melanostictus* Schneider', *Copeia*, 2: 146–147.

van Dijk, PP, Iskandar, D, Lau, MWN, Huiqing, G, Baorong, G, Kuangyang, L, Wenhao, C, Zhigang, Y, Chan, B, Dutta, S, Inger, R, Manamendra-Arachchi, K, Khan, MS (2004) *Duttaphyrynus melanostictus–IUCN Red List*. http://www.iucnredlist.org/details/54707/0

Whitten, T, Whitten, AJ, Soeriaatmadja, RE, Afiff, SA (1997) *The ecology of Java and Bali*. Oxford University Press.

Wikipedia (2009) *Bufo*. http://en.wikipedia.org/wiki/Bufo

Wildlife Singapore (undated) *Asian Toad Bufo melanostictus*. http://www.wildsingapore.per.sg/discovery/factsheet/toadasiatic.htm

Attachment

Using the Bomford (2008) system, Asian spined toads in Queensland were ranked as a 'serious' threat species.

Australian Bird and Mammal Model

Species		***Bufo melanostictus* (Asian spined toad)**
Date of assessment		16/07/2009
Literature search type and date		See references
Factor	**Score**	
A1. Risk to people from individual escapees (0–2)	2	Asian spined toads are capable of causing fatalities or serious injury to people.
A2. Risk to public safety from individual captive animals (0–2)	1	Moderate risk that toxins of captive animals pose a public safety risk.
Stage A. Public Safety Risk Rank = Sum of A 1 to 2. (0–4)	**3**	**Highly dangerous**
B1. Climate Match (1–6)	4	High climate match in Australia. CMS = 1183. From climate map produced by Department of Agriculture and Food, Western Australia, using PC Climate software.
B2. Exotic population Established Overseas (0–4)	4	Asian spined toads have established on larger islands: Bali, East Timor, and Papua.
B3. Overseas Range Size (0–2)	1	Overseas range size of 6.6 million square kilometres (Bomford et al. 2005).
B4. Taxonomic Class (0–1)	1	Amphibian
B5. Diet (0–1)	1	Generalist diet of invertebrates including arthropods, ants, termites, beetles, mollusc, spiders, scorpions, centipedes & millipedes.
B6. Habitat (0–1)	1	Asian spined toads are able to survive and breed in human-disturbed and manmade environments.
B7. Migratory (0-1)	1	Non-migratory.
B. Probability escaped or released individuals will establish a free-living population = Sum of B 1 to 7. (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)	0	Approximately 6.6 million square kilometres (Bomford et al. 2005).
C3. Diet and feeding (0–3)	0	Not a mammal.

C4. Competition with native fauna for tree hollows (0–2)	0	Asian spined toads are not known to use tree hollows.
C5. Overseas environmental pest status (0–3)	2	Moderate environmental pest in Bali, East Timor and Papua.
C6. Climate match to areas with susceptible native species or communities (0–5)	5	The species 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	Asian spined toads are known to predate on honey bee hives (Oldroyd & Wongsiri 2006; Pokhrel et al. 2006)
C8. Climate match to susceptible primary production (0–5)	1	Total commodity damage score = 5 (see Table 1).
C9. Spread disease (1–2)	1	Amphibian
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. People have died after consuming Asian spined toads or their eggs, and their poison can cause irritation.
C. Probability an exotic species would become a pest (for birds, mammals, reptiles and amphibians) = Sum of C 1 to 11. (1–37)	**14**	**Moderate 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	**3**	**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	**13**	**Serious 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		
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	**14**	**Moderate pest risk**
VPC Threat Category		**Serious**

ESTABLISHMENT RISK RANKS

Australian Reptile and Amphibian Model

SPECIES:	*Bufo melanostictus* (Asian spined toad)
DATE OF ASSESSMENT:	04/09/2009
LITERATURE SEARCH TYPE AND DATE:	see references

Factor	Score	
A. Climate Match Risk Score	27.2	CMRS = 100 (759/2785). From climate map produced by Department of Agriculture and Food, Western Australia, using PC Climate software.
B. Exotic Elsewhere Risk Score	30	Established breeding self-sustaining populations on Bali, East Timor and Papua.
C. Taxonomic Family Risk Score	20	Family: Bufonidae
≤22 = low establishment risk; 23-60 = moderate establishment risk; 61–115 = serious establishment risk; ≥116 = extreme establishment risk		
Establishment Risk Rank	**77.2**	**Serious Establishment Risk**

Bird and Mammal Model adapted for reptiles and amphibians

SPECIES:	*Bufo melanostictus* (Asian spined toad)
DATE OF ASSESSMENT:	04/09/2009
LITERATURE SEARCH TYPE AND DATE:	See references

Factor	Score	
A. Climate Match Score (1–6)	4	CMS = 1183. From climate map produced by Department of Agriculture and Food, Western Australia, using PC Climate software.
B. Exotic Population Established Overseas Score (0–4)	4	Asian spined toads have established on larger islands: Bali, East Timor, and Papua.
C. Overseas Range Size Score (0–2)	1	Approximately 6.6 million square kilometres (Bomford et al. 2005).
≤4 = low establishment risk; 5–7 = moderate establishment risk; 8–9 = serious establishment risk; 10–12 = extreme establishment risk		
Establishment Risk Rank	**9**	**Serious Establishment Risk**

Table 1. Calculating Total Commodity Damage Score

Industry	Commodity Value Index[1] (CVI)	Potential Commodity Impact Score (PCIS, 0–3)	Climate Match to Commodity Score (CMCS, 0–5)	Commodity Damage Score (CDS, columns 2 x 3 x 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	0	Not estimated	0
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	2	5	5
Total Commodity Damage Score (TCDS)	—	—	—	**5**