**Score Sheet**

<table>
<thead>
<tr>
<th>SPECIES: African Clawed Frog (<em>Xenopus laevis</em>)</th>
<th>Species Description – 8-15 cm, males are smaller than females. The head and body is depressed and flattened; the small, lidless round eyes are located on top of the head. The skin is smooth and slippery, and the hind feet are large and webbed, and are well adapted for swimming. The three inner toes of the hind feet have small black claws on them (frogs of the genus <em>Xenopus</em> are the only frogs with clawed toes). The forefeet are much smaller, are not webbed, and are used to push food into the mouth. Variable in colour, the back with a dark, irregularly spotted pattern on a yellow to grey-brown background. Spots are variable in size and shape. They are sometimes almost totally grey-black. The underside is an off-white colour, with brown spots (Hey 1949, Deuchar 1975, Mattison 1982, Obst et al 1988, Passmore and Carruthers 1995, Tinsley and Kobel 1996, Chantasirivisal 2005, Reed 2005, Somma 2005, Global Invasive Species Database 2006).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other common names include: African Clawed Toad, Smooth Clawed Toad, Common Plantanna</td>
<td>General Information – Used to be important as a laboratory animal. During the 1940s young female frogs were used in pregnancy tests. They react to the hormones contained in urine from pregnant women by spawning spontaneously within 6-10 hours after having a urine sample injected into the dorsal lymph sac (Obst et al 1988, Matthews and Brand 2004). The frog remains an important subject for biological research, as it produces large numbers of eggs and its transparent embryos allow for easy observation of developmental changes (Matthews and Brand 2004). <em>Xenopus laevis</em> was the first vertebrate animal to be cloned, and recent years have seen their continued use with the advent of further developments in genetic technologies (Reed 2005).</td>
</tr>
<tr>
<td>Subspecies:</td>
<td>Longevity – Maximum longevity is 30.3 years, although life-span is usually much shorter (HAGR Human Ageing Genomic Resources 2006).</td>
</tr>
<tr>
<td>X. l. laevis</td>
<td>Status –</td>
</tr>
<tr>
<td>X. l. petersii</td>
<td>1. Red List Category – Least Concern (LC)</td>
</tr>
<tr>
<td>X. l. poweri</td>
<td>Rationale: Listed as ‘Least Concern’ on the IUCN Red List of Threatened Species. Listed as LC in view of its very wide distribution, its tolerance of a broad range of habitats, its presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Tinsley et al 2004).</td>
</tr>
<tr>
<td>X. l. victorianus</td>
<td>2. CITES listed Protection States: Not Listed (CITES 2007).</td>
</tr>
<tr>
<td>X. l. bunyoniensis</td>
<td>The Risk Assessment Model</td>
</tr>
<tr>
<td>(Passmore and Carruthers 1995)</td>
<td>Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 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 <a href="http://www.daff.gov.au/brs/land/feral-animals/management/risk">http://www.daff.gov.au/brs/land/feral-animals/management/risk</a>. This model used the Apple Mac application CLIMATE (Pheloung 1996) for climate matching.</td>
</tr>
<tr>
<td>DATE OF ASSESSMENT: 13/06/2008</td>
<td>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</td>
</tr>
<tr>
<td>Bird and Mammal Model Used: (Bomford 2008) using PC CLIMATE (Brown et al 2006, Bureau of Rural Sciences 2006)</td>
<td>---</td>
</tr>
</tbody>
</table>

African Clawed Frog (*Xenopus laevis*) risk assessments for Australia. Amanda Page, Win Kirkpatrick and Marion Massam, July 2008, Department of Agriculture and Food, Western Australia.
The most recent publication (Bomford 2008) includes updated 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 04/01/2008

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SCORE</th>
</tr>
</thead>
</table>

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) 5 Climate Match Score = 2634 Very high climate match with Australia [See above for information on climate matching.]

Climate data from 652 locations (see species’ worldwide distribution map) were used to calculate the CMS. Overseas distribution south and central Africa, with introduced populations occurring in Europe, North America, South America, and Ascension Island (Lever 2006) (see B2 and B3 for details).

B2. Exotic population established overseas (0–4) 4 Exotic population established on an island larger than 50 000 km² or anywhere on a continent

During the 1940s, the African Clawed Frog was shipped around the world for use in human pregnancy tests. Laboratories began rearing the frogs in large numbers to meet the high demand, and because they proved so easy to
African Clawed Frog (Xenopus laevis) risk assessments for Australia. Amanda Page, Win Kirkpatrick and Marion Massam, July 2008, Department of Agriculture and Food, Western Australia.

keep in captivity. A flourishing pet trade developed in the 1950s and 1960s. In the late 1950s, new technologies for pregnancy diagnosis were developed, and many laboratories simply released their frogs into the wild. Laboratory escapes as well as intentional releases of unwanted pets were, and continue to be modes of introduction (Matthews and Brand 2004, Peek 2006).

British Isles – The first discovery of feral African Clawed Frogs was on the Isle of Wight, following deliberate releases in 1967. The frogs bred successfully for a number of years, however none have been recorded recently, and African Clawed Frogs may now be extinct on the island (Tinsley and McCoid 1996, Beebee and Griffiths 2000, Arnold 2002, Lever 2006). (No CLIMATE points available).

Two large populations of African Clawed Frogs of unknown origin were discovered in 1979 in South Wales. These are distributed across a watershed about 1 km apart so may have arisen as a result of a single introduction (Tinsley and McCoid 1996, Measey 1998, Measey and Tinsley 1998, Beebee and Griffiths 2000, Arnold 2002, Lever 2006).

African Clawed Frogs were reportedly established in some ornamental ponds in Kent, south-east England, in 1987, and in a pond in south-east London in the early 1990s. Adults and large numbers of larvae were present up to the early 1990s, but none have been seen at either of these localities recently. Fish predation may have eliminated these colonies. There are also occasionally reports of adult toads being captured in south-west England as a result of fishing operations, but whether breeding has occurred there is not known (Tinsley and McCoid 1996, Beebee and Griffiths 2000, Lever 2006).

France – A population has established in the department of Deux-Sevres. It is thought to have originated from a single release of animals from a breeding centre in the region at the beginning of the 1980s (Fouquet and Measey 2006). (No CLIMATE locations available).

Germany; the Netherlands – There is evidence that African Clawed Frogs have been released and survived for lengthy periods in a number of European mainland countries, including Germany (Hamburg) and the Netherlands. In the Netherlands, about 100 tadpoles were collected in 1979 in a canalised ditch near Utrecht, and a single large adult was collected in 1974 near Gorichem (Tinsley and McCoid 1996, Somma 2005, Lever 2006).

Italy – In June 2004, the African Clawed Frog was observed for the first time in Italy, in the drainage area of the “Fiume Iato”, a river originating in the “Monti di Palermo” area (Sicily, southern Italy). From June to October, field surveys were carried out in Fiume Iato, in the “Lago Poma” reservoir and in 13 agricultural ponds in the reservoir watershed. At each site, the presence of African Clawed Frogs was confirmed. Tadpoles, juvenile frogs, and several adult specimens of different size were found in the river above the reservoir, in the reservoir itself, and in most of the surveyed agricultural ponds. The capture of a large number of individuals belonging to different age-classes confirms the occurrence of a viable population of African Clawed Frogs in Sicily. It is thought that the invasion occurred around 1999 (Lillo et al 2005).

United States – Feral African Clawed Frogs have been found in Colorado, Florida, Massachusetts, North Carolina, Nevada, New Mexico, North Carolina, Texas, Utah, Virginia, Wisconsin, and Wyoming, but have not established breeding populations that have persisted over time. Arizona and California are the only states in which apparently permanent populations are known (Lannoo 2005, Somma 2005).

In Arizona, the African Clawed Frog was introduced in the 1960s into artificial ponds at the Arthur Pack desert golf course in Tucson, where surveys in 1988-91 revealed the existence of large populations (Tinsley and McCoid 1996, Lannoo 2005, Somma 2005, Lever 2006).

The African Clawed Frog was first found in California in 1968, near Westminster, Orange County, although it is likely that the African Clawed Frog existed in California waters before this time. The frog also occurs at Muntz lake, near Palmdale, Los Angeles County. Large breeding populations also exist in the West Mount Helix and Lower Sweetwater River drainages, San Diego County (Bury and Luckenbach 1976, McCoid and Fritts 1980, McCoid and Fritts 1993, Tinsley and McCoid 1996, Fisher 2005, Lannoo 2005, Somma 2005).

The North Carolina and Wisconsin frogs have not persisted, largely due to winter and temperature extremes. The
Virginia population, first noted in 1982 at the Gulf Branch Nature Center, Arlington, was extirpated by the late 1980s (Lannoo 2005).

**Mexico** – Large populations of African Clawed Frogs exist in the Tijuana River, Baja California, on the US-Mexico border. The frogs probably spread through intersecting irrigation channels from California (Somma 2005, Lever 2006).

**Chile** – The African Clawed Frog was introduced to Chile in 1973, when an unknown number of frogs were dumped into a single lagoon (Caren) near Santiago’s international airport. Since then, the frogs have spread, probably assisted by humans, to other lagoons in and around Santiago, and to the Casablanca Valley (Tinsley and McCoid 1996, Jaksic 1998, Lobos and Jaksic 2005, Lever 2006).

**Ascension Island** – African Clawed Frogs have been present on the island since at least 1944. It is likely that it was introduced to Ascension Island from South Africa during WWII, when the species was in high demand for diagnostic purposes (Loveridge 1959, Tinsley and McCoid 1996, Somma 2005, Lever 2006).

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**B3. Overseas range size score (0–2)**

Scoring: 0 – 1 = 0; 1 – 70 = 1; ≥70 = 2

1. Overseas range size between 1-70 million km², estimated at 9.93 million km². Includes current and past 1000 years, natural and introduced range.


The species has been introduced to parts of Europe, North America, South America, and Ascension Island (see B2 for details).

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**EstABLISHMENT RISK SCORE**

**SUM OF SCORE A (B1) + SCORE B (B2) + SCORE C (B3) (1-12)**

10

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**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)**


**B5. Diet score (0–1)**

1. Generalist with a broad diet of many food types

- African Clawed Frogs eat underwater, pushing large items into their mouth by a scrabbling action of the forefeet. Adults are primarily consumers of slow-moving aquatic invertebrates, although few studies have been undertaken of diets in the wild. Diet consists of a wide range of animals including zooplankton, crustaceans, molluscs and insects. Terrestrial invertebrates, aquatic vertebrates including fish and other frogs are occasionally consumed. The species will also scavenge on dead frogs, fish, birds, and small mammals. In bodies of water where there are limited prey, adults will cannibalise young (Deuchar 1975, Measey 1998, Beebee and Griffiths 2000, Lobos and Measey 2002, Chantasirivisal 2005, Lannoo 2005, Lobos and Jaksic 2005, Gutsche and Elepfandt 2006).

- Clawed frog larvae are mid-water suspension feeders. Food items include phytoplankton, especially unicellular algae and diatoms, protozoans, and bacteria. (Lannoo 2005, Global Invasive Species Database 2006).

- Adult African Clawed Frogs can survive up to a year without food (Chantasirivisal 2005).

**B6. Habitat score - undisturbed or disturbed habitat (0–1)**

1. Can live in disturbed habitats

- The African Clawed Frog is a highly adaptable species, with a wide salinity (up to 40% seawater), pH (5-9) and temperature (2-35°C) tolerance (Munsey 1972, Matthews and Brand 2004, Global Invasive Species Database 2006). It occupies almost every kind of water body, including rivers, lakes, swamps, dams and man-made irrigation ditches (Tinsley and Kobel 1996, Willigan 2001). Large populations are often found in organically enriched impoundments like sewage maturation ponds, where individuals are often seen breaking the surface as they take air (Passmore and Carruthers 1995).
Many introduced African Clawed Frog populations are in disturbed or human-made bodies of water, such as drainage ditches, flood control channels, golf course ponds, man-made lakes, irrigation canals, cattle tanks, and sewage plant effluent ponds (Willigan 2001, Lannoo 2005).

In Chile, African Clawed Frogs are found at higher densities in artificial water bodies (ponds, dams and irrigation canals) than in natural lagoons, streams or rivers. A survey conducted in central Chile found that 80% of African Clawed Frogs were found in artificial water bodies, compared with 20% in natural water bodies (Lobos and Jaksic 2005).

There are several reports of African Clawed Frogs moving overland during torrential rain (Lobos and Jaksic 2005). In Africa, African Clawed Frogs have been known to migrate to newly-filled seasonal rain pools for breeding. Feral African Clawed Frogs in Wales migrated 0.2 km in late spring to a spawning site. Such migrations have not been observed in feral US populations (Lannoo 2005).

### ESTABLISHMENT RISK SCORE

<table>
<thead>
<tr>
<th>Score A. Climate Match Risk Score Degree (Sum of species’ 4 scores for Euclidian match classes 7 - 10)</th>
<th>78</th>
<th>CMRS = 100(2183/2785)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score B. Has the species established an exotic population in another country? (0–30)</td>
<td>30</td>
<td>The species has established a breeding self-sustaining exotic population in another country (Lever 2006) (see B2 for details).</td>
</tr>
<tr>
<td>Score C. Taxonomic Family risk score (0–30)</td>
<td>15</td>
<td>High risk family (Bomford 2006)</td>
</tr>
</tbody>
</table>

**Family - Pipidae (Gray, 1825) (ITIS Integrated Taxonomic Information System 2007, Catalogue of Life 2008)**

### 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
- \( \leq 4 = \text{Low Establishment Risk} \; ; \; 5-7 = \text{Moderate Establishment Risk} \; ; \; 8-9 = \text{Serious Establishment Risk} \; ; \; 10-16 = \text{Extreme} \)

| Score | 10 | EXTREME |
12 = EXTREME ESTABLISHMENT RISK

<table>
<thead>
<tr>
<th>Model B: Using the seven factors/questions from stage B of the Australian Bird and Mammal Model (Bomford 2008) pp 20</th>
<th>14</th>
<th>EXTREME</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 6 = LOW ESTABLISHMENT RISK; 7-11 = MODERATE ESTABLISHMENT RISK; 12-13 = SERIOUS ESTABLISHMENT RISK; ≥ 14 = EXTREME ESTABLISHMENT RISK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Australian Reptile and Amphibian Model (Bomford 2008, pp 51-53)</th>
<th>123</th>
<th>EXTREME</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 22 = LOW ESTABLISHMENT RISK; 23-60 = MODERATE ESTABLISHMENT RISK; 61-115 = SERIOUS ESTABLISHMENT RISK; ≥ 116 = EXTREME ESTABLISHMENT RISK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HIGHEST ESTABLISHMENT RISK RANK**
(When establishment risk ranks differ between the models, the highest ranked outcome is used (Bomford 2008).)

**EXTREME – ENDORSED BY VPC**

<table>
<thead>
<tr>
<th>Median number of references for Establishment Risk for all amphibians assessed by (Massam et al 2010) (n=11)</th>
<th>15</th>
</tr>
</thead>
</table>

| Total number of references for this species | 35 – more than the median number of amphibian references were used for this assessment, indicating a decreased level of uncertainty. |
World Distribution – African Clawed Frog (*Xenopus laevis*), includes current and past 1000 years; including natural populations (black) and introduced populations (red).

Each black or 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.
Map 1. Climate match between the world distribution of African Clawed Frog (*Xenopus laevis*) and Australia for five match classes.

<table>
<thead>
<tr>
<th>Colour on Map</th>
<th>Level of Match from Highest (10) to Lowest (6)</th>
<th>No. Grid Squares on Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>10 HIGH MATCH</td>
<td>1</td>
</tr>
<tr>
<td>Pink</td>
<td>9 HIGH MATCH</td>
<td>96</td>
</tr>
<tr>
<td>Dark Green</td>
<td>8 MOD MATCH</td>
<td>791</td>
</tr>
<tr>
<td>Mid Green</td>
<td>7 MOD MATCH</td>
<td>1295</td>
</tr>
<tr>
<td>Lime Green</td>
<td>6 LOW MATCH</td>
<td>451</td>
</tr>
</tbody>
</table>

CMS = 2634
Map 2. Climate match between the world distribution of African Clawed Frog (*Xenopus laevis*) and Australia for eight match classes.

<table>
<thead>
<tr>
<th>Colour on Map</th>
<th>Level of Match from Highest (10) to Lowest (3)</th>
<th>No. Grid Squares on Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>10 HIGH MATCH</td>
<td>1</td>
</tr>
<tr>
<td>Pink</td>
<td>9 HIGH MATCH</td>
<td>96</td>
</tr>
<tr>
<td>Dark Green</td>
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</tr>
<tr>
<td>Mid Green</td>
<td>7 MOD MATCH</td>
<td>1295</td>
</tr>
<tr>
<td>Lime Green</td>
<td>6 MOD MATCH</td>
<td>451</td>
</tr>
<tr>
<td>Yellow</td>
<td>5 MOD MATCH</td>
<td>104</td>
</tr>
<tr>
<td>Blue</td>
<td>4 LOW MATCH</td>
<td>33</td>
</tr>
<tr>
<td>Light blue</td>
<td>3 LOW MATCH</td>
<td>7</td>
</tr>
</tbody>
</table>
References


