RISK ASSESSMENT FOR EXOTIC REPTILES AND AMPHIBIANS INTRODUCED TO AUSTRALIA – Pond Slider (*Trachemys scripta*) (Schoepff, 1792)

Class *Reptilia*; Order Testudines; Family Emydidae (Rafinesque, 1815); Genus *Trachemys* (Agassiz, 1857); (The Reptile Database 2007)

Department of Agriculture and Food
GOVERNMENT OF WESTERN AUSTRALIA

Score Sheet

SPECIES: Pond Slider (*Trachemys scripta*)

Other common names include: Red-eared Slider, Common Slider

Historically, the species has been referred to in refereed literature under three generic names; *Pseudemys*, *Chrysemys* and *Trachemys* (Gibbons 1990).

In North America, there are three described subspecies each with their own distinct colour pattern; *T. scripta scripta*, *T. s. elegans* and *T. s. troostii* (Ernst et al 1994, Iverson et al 2000, Seidel 2002) as In (Somma et al 2007).

Twelve subspecies of *T. scripta* are listed by the reptile database (The Reptile Database 2007):

T. scripta scripta (SCHOEPFF 1792)

T. scripta cataspila (GÜNTHER 1885)

T. scripta chichiriviche (PRITCHARD & TREBBAU 1984)

T. scripta elegans (WIED 1838)

T. scripta emolli LEGLER 1990

T. scripta grayi (BOCOURT 1868)

T. scripta hiltoni (CARR 1942)

T. scripta ornata (GRAY 1831)

T. scripta taylori (LEGLER 1960)

T. scripta troostii (HOLBROOK 1836)

T. scripta venusta (GRAY 1855)

T. scripta yaquia (LEGLER & WEBB 1979**)**

Emydidae is the largest and most diverse family of living turtles with two subfamilies generally recognised: *Batagurinae* or Old World pond turtles, and *Emydinae* or New World pond turtles. Emydinae are separated into two generic complexes: **Clemmys** complex that includes the genera *Clemmys*, *Emybooidea*, *Emys* and *Terrapene*; ***Chrysemys*** complex that includes the freshwater genera *Chrysemys*, *Deirochelys*, *Graptemys*, *Pseudemys*, *Trachemys* and the brackish water genera *Malaclemys*. (Ernst 1990)

Trachemys was originally separated from the genera *Chrysemys* and *Pseudemys* but subsequently all three have been considered, on occasion, to be congerneric and placed in the genus *Chrysemys* however, recent work agrees with slider turtles being separated on their own in *Trachemys* (Ernst 1990). Taxonomy of the genera *Trachemys* is subject to ongoing review. The genus has the largest distribution of turtles in the New World with 26 extant forms (Seidel 2002); most are recognised as subspecies of the mega-species *Trachemys scripta* (Ernst 1990).

Trachemys scripta

This assessment has been performed at the species level however, much of the information on introduced populations concerns two subspecies *T. s. scripta* and *T. s. elegans.* These subspecies have been exported from the United States in massive numbers throughout the world and as a consequence *T. s. elegans* and to a lesser degree *T. s. scripta* have established populations in numerous countries.

Species Description as from USA government factsheet - a medium sized freshwater turtle (carapace length 125-289 mm. Although subspecies are variable they have a prominent patch or patches of red, orange or yellow post-orbital on each side of the head (Ernst and Barbour 1989), The three North American subspecies (Ernst et al 1994) have different colour patterns; in all subspecies these distinctive patterns may be obscured in older, melanistic (darker) males (Somma et al 2007).

Trachemys scripta scripta (Schoepff, 1792) yellow-bellied slider has a large yellow patch behind the eye that is most evident in juveniles and females. Broad vertical bands (when viewed from the side) are often present on the carapace, the yellow plastron (lower shell) typically has round dusky smudges or none at all, and narrow yellow stripes mark the front surface of the forelegs (Ernst et al 1994, Conant and T. 1998). Occurs in southeastern Virginia to northern Florida (Ernst and Barbour 1989).

Trachemys s. elegans (Wied-Neuwied, 1838), the red-eared slider, has a unique, broad red or orange (rarely yellow) stripe behind each eye. Younger individuals have numerous dark, eyelike spots on the yellow plastron) (Ernst et al 1994, Conant and T. 1998). *T. s. elegans* considered to be the most common and has been introduced to numerous localities worldwide (Salzberg 2000) as in Somma *et. al* 2007. Occurs in Mississippi Valley from Illinois to the Gulf of Mexico (Ernst and Barbour 1989).

Trachemys s. troostii (Holbrook, 1836), the Cumberland slider, is similar to the red-eared slider, but has a narrower yellow stripe behind each eye, and fewer, wider stripes on the legs, neck, and head (Ernst et al 1994, Conant and T. 1998). Occurs in upper parts of the Cumberland and Tennessee rivers from southeastern Kentucky to northeastern Alabama (Ernst and Barbour 1989).

General Information - In the southern part of its natural range *T. scripta* can be active year-round but in the north sliders must hibernate during winter (some individuals emerge on warm days), they become inactive at water temperatures below 10 degrees Celsius (although some have been observed swimming under ice). Clutch size 2 – 23

		eggs, up to 5 clutches per year, [length of incubation usually within 60 – 80 days but determined by temperature, (Ernst et al 1994)] successful hatching usually requires temperature above 20 degrees Celsius. Sliders can spend considerable time under water, especially during hibernation. They are primarily diurnal and at night sleep by resting on the bottom or floating at the surface and forage for food during the day (preferring shallow water less than 3 m); the habit of basking during the day is well developed even in hatchlings. Movement between water bodies can be in response to feeding, reproduction, basking, in search of more favourable sites, or droughts and seasonal fluctuations in water level; longest recorded movement greater than 5 km. (Ernst et al 1994) Sliders spend time basking and will pile up several deep at prime basking sites (Ernst and Barbour 1989). *Trachemys* is predominately freshwater but may enter brackish coastal waters (Ernst 1990). Tolerance to salty conditions is uncertain with little specific information available in the literature and opinions differ among researchers. There is anecdotal evidence in Australia of a low salt tolerance (pers. comm. Scott O'Keeffe) however, in the Chesapeake Bay area in the USA an upper limit appeared to be 10 ppt (Gibbons 1990, National Exotic Marine and Estuarine Species Information 2008). Dr Tony Tucker (Manager Marine Sea Turtle Research Project at MOTE Marine Laboratory, Sarasota, Florida) suggests most observations of Red-eared sliders are animals washed into brackish or salt-water areas after storms, and prolonged exposure to salt will kill the turtles; max. salt tolerance of 10 bats/1000 (pers. comm. Scott O'Keeffe, 2008). **Longevity** - the species is long-lived - survives in captivity for up to 40 years (Slavens and Slavens 2006), believed to live 50 – 75 years (Dundee and Rossman 1989); most don't live past 30 years (Dewey and Kuhrt 2002). **Status** - IUCN Red Listed, Lower Risk and Near Threatened (Tortoise & Freshwater Turtle Specialist Group 1996). Listed on the List of 100 of the World's Worst Invasive Alien Species, 1 of only 2 reptiles listed (other Brown Tree Snake) (Global Invasive Species Database 2005). Importation of *T. scripta* banned by European Union in 2005 (Official Journal of the European Union 2005).
DATE OF ASSESSMENT: 15/11/2007 **Bird and Mammal Model Used: (Bomford 2008) using PC CLIMATE (Brown et al 2006, Bureau of Rural Sciences 2006)**		**The Risk Assessment Model** 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 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 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 14/11/2007		
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)	6	*Climate Match Score = 2768 Extreme climate match with Australia* Climate data from 2730 locations (see species' worldwide distribution map) were used to calculate the CMS; natural distribution of *Trachemys scripta* is southeastern North America to Venezuela, with introduced populations occurring worldwide (see questions B2 and B3). [See above information on climate matching.]
B2. Exotic population established overseas (0–4)	4	*Exotic population established on island larger than 50 000 km^2 or anywhere on a continent* The most commonly traded reptile in the pet industry with commercial production of the species on ranches in the US, particularly in Louisiana (Warwick et al 1990). Many pets, once reaching adult size, can inflict painful bites, are more difficult to keep and are released into the wild (Chen and Lue 1998, Cox et al 1998, Ficetola et al 2002, Cadi et al 2004, Dykes 2007, Ramsay et al 2007). Large numbers of sliders are released into the wild in Asian countries as part of Buddhist cultural practices (Ramsay et al 2007) [A slider was reportedly seized at Brisbane airport being carried into Australia for this purpose (pers comm. Scott O'Keeffe 2008).] *T. s. scripta* and *T. s. elegans*. have established outside their natural distribution and introduced populations now occur worldwide (Ramsay et al 2007). Many of these populations are self-sustaining through natural breeding. However, in some countries or localities that have very cold winters such as England and New Zealand breeding may not occur and populations are sustained at reasonably high numbers because of the longevity of the species [50

years plus (Dundee and Rossman 1989)] and recruitment from deliberate release by people of unwanted pets or by pets escaping. (Thomas and Hartnell 2000) (Holman 1994, Cadi et al 2004) (Williams 1999, Kovacs et al 2004) (Lever 2006).

1. **United States:**

The species has established in many states beyond the Midwestern states where it occurs naturally. Introduced populations established in Maine, New York, New Jersey, Massachusetts, Connecticut, Pennsylvania, Virginia, North Carolina, South Carolina, Florida, Indiana, Wisconsin, Texas, Arizona, Oregon, southern Ohio, Maryland, Washington, and Michigan (small isolated breeding populations in southern Michigan are able to survive winters) with origins from multiple introductions of released pets, but some archaeological evidence of *T. scripta* possibly being a relic species from ancient times (Holman 1994) (Ernst et al 1994, Conant and Collins 1998, Somma et al 2007, National Exotic Marine and Estuarine Species Information 2008). Large population established in ponds of the United States National Arboretum in Washington DC (Ernst 1990).

Iowa - red-eared turtles (*T. scripta*) continue to be found in scattered ponds, usually rural, throughout the state (Christiansen 2001).

California with populations well established and breeding reported (Spinks et al 2003).

Pennsylvania – widespread in the southeast with well established breeding populations (Urban and Morgan 2005).

Florida, occurs naturally in northwest Florida but introduced populations occur in Dade County, Lake Conway – Orlando and southern Pinellas County (Hutchison 1992); populations noted in southern Florida 1996 (King and Krakauer 1966) but establishment not reported until much later (Wilson and Porras 1983).

2. **Canada**:

At two localities in Ontario (Harding 1997).

3. **Mexico:**

Recorded in Mexico in Baja California (Stebbans 1985) however, possibly not *T. scripta* but the indigenous *T. nebulosa* (Seidel 2002).

4. **Bermuda** widely distributed on the island (Lever 2006).

5. **South America:**

Chile: Reported as an invasive species of concern in Chile; imported commercially in large numbers for the pet trade (Iriarte et al 2005); feral specimen collected in El Toyo on the Maipo River (Nunez et al 2002).

Reportedly introduced to **Brazil** and **Panama** (Moll 1995) and **Guyana** (Lever 2006)..

6. **West Indies and Caribbean Sea**:

Bahama and **Cayman Islands** (Alderton 1988).

In the **Lesser Antilles** on Guadeloupe (Schwartz and Thomas 1975, Censky and Kaiser 1999).

British Virgin Islands – a breeding population established in a manmade pond (built in 1980s), adults observed soon after construction of the pond and hatchlings first recorded in 1998; eradication efforts failed (Perry et al 2007).

Trinidad - Possible presence of feral populations as captive adults kept under semi-natural conditions and hatchlings are widely available in pet shops (Murphy 1997).

7. **Europe:**

Imported into Europe in huge numbers for the pet trade and now widely distributed in wetlands (Cadi and Joly 2004):

		▪ Hungary (Kovacs et al 2004, Balázs and Györffy 2006) ▪ Austria (Kaltenegger 2006) ▪ Sweden (Nilson and Andren 1986) (Bringsøe 2006) ▪ Czechoslovakia (Chemelik and Korinek 1994) ▪ Spain (Luiselli et al 1997, Bertolero and Canicio 2000, Cordero Rivera and Ayres Fernandez 2004) ▪ Italy (Ferri and Soccini 2003) (Ficetola et al 2002) ▪ France – widely distributed and found in lakes, ponds and rivers of all major hydro graphic basins, breeding has been recorded at Toulouse, Tours and Ales (Arvy and Servan 1998, Cadi et al 2004, Cavitte et al 2007) ▪ Greece - reported from the mainland (Athens) and Crete - Zakynthos and Kos (Bruekers et al 2006) ▪ Germany, where breeding occurs (Ernst et al 1994, Pieh and Laufer 2006) (Bringsøe 2006) ▪ Belgium (Hermanns and Nizet 1998) ▪ United Kingdom – found in many locations in ponds, lakes, reservoirs; also on Jersey in Channel Islands and in Cardiff, South Wales; breeding in UK currently unconfirmed (Beebee and Griffiths 2000) ▪ Cyprus (King and Burke 1989) ▪ European countries where the species is found in the wild but no self-sustaining populations established include: Denmark, western Russia, Finland, Lithuania, Poland (Bringsøe 2006). **8. <u>Middle East</u>** ▪ Israel (Bouskila 1986, King and Burke 1989) ▪ Bahrain (Leviton et al 1992) **9. <u>Pacific Islands:</u>** On the islands of **Guam** (well established) and the **Mariana Islands** (established) (McCoid 1993, Ernst et al 1994, McCoid and Kleberg 1995). **Hawaii** – collected from water bodies on Hawaii, Kauai and Oahu islands (Hawaiian Ecosystems at Risk project (HEAR) 2007), (Lever 2006) and Palau (Miles 2007). **French Polynesia** – widely distributed (Servan and Arvy 1997). **Micronesia** – Eastern Caroline Islands, one specimen recorded for Pohnpei by deliberate or inadvertent human-assisted transport, not established (Buden et al 2001). **10. <u>Indian Ocean</u>** Reunion island in the **Mascarene Islands** (Servan and Arvy 1997). **11. <u>South Africa</u>**: Release of unwanted pets that were imported into the country with tropical fish now occupy ponds and streams near Pretoria, Johannesburg, Silverton and Durban (Lamar 1997, Branch 1998, Salzberg 2000). **12. <u>Asia</u>**: The most conspicuous turtle in Southeast Asia due to its habit of basking in the open; widely kept as a pet (imported from the US) and released into city parks, temple ponds and national parks; breeding widespread under Asian tropic

		conditions and the species is expected to spread widely throughout the region; populations recorded for **Thailand**, **Malaysia**, **Vietnam**, **Korea**, **Japan**, **Indonesia**, **Taiwan**, and **China** (unconfirmed but the species is widely traded and farmed) (Jenkins 1995, Cox et al 1998, Lever 2006, Global Invasive Species Database 2007, Ramsay et al 2007). Present on **Hong Kong** (Hong Kong Reptile & Amphibian Society 2008). **Japan** – Okinawajima in the Okinawa islands in southern Ryukyu Archipelago; Amarni-Oshima islands, and Ishigakijima and Iroinotejima in the Yaeyamo Archipelago (Ito et al 2000, Lever 2003, Kanto et al 2005, Yasukawa 2005, Sato 2006). **Korea** – recorded at Pusan (Platt and Fontenot 1992, Lever 2003). Recorded from a number of areas in Korea where they were first imported in 1970 for Buddhist release ceremonies and later for pets; importation was banned in 2001(Ramsay et al 2007). **Taiwan** – species can be found in various water bodies including rivers, ponds, lakes and artificial reservoirs and at some sites they are as abundant as native turtles; gravid females, nests and hatchlings have been found indicating establishment in Taiwan (Chen and Lue 1998). **Singapore** (Lamar 1997), present in many freshwater bodies with densities high in some areas such as Botanical Gardens, Bedok Reservoir and Bukit Batok Town Park (Goh and O'Riordan 2007). **13. <u>New Zealand</u>** (Global Invasive Species Database 2007) Found in waterways especially along the Waikato River (Dykes 2007); sightings in the wild around Huntly that is situated on either side of Waikato River 93 kilometres south of Auckland (Hudson and Thornton 1994). Reports of red-eared sliders in the wild in NZ, believed to be all released or escaped captives; conditions in Hamilton area of the North Island would allow sliders to successfully live long term however, for breeding to occur lengthy warm conditions are necessary for sex-determination of eggs. These conditions would be possible in micro-habits along rivers but occurrences limited and therefore establishment of breeding populations unlikely (Thomas and Hartnell 2000). [No reports of breeding in the wild in NZ found at the time of this assessment.] **14. <u>Australia:</u>** **Queensland** – Two breeding population of red-eared sliders, one in the Pine Rivers area and another in the Caboolture Shire and sightings in other locations in southeast Queensland (Townsend 2005, Queensland Department of Natural Resources and Water 2007a, b). Breeding population in Yeramba Lagoon, southern Sydney area of **New South Wales** (Burgin 2006), and gravid female found in late 2007 at Wolli Creek reserve, Sydney (pers. comm. Geoffrey Ross, Wildlife Management Officer, Central Branch, Parks & Wildlife Division, Department of Environment & Climate Change 2007). **Victoria** – *T. scripta* discovered in Melbourne, Victoria (Edwards 2007). Single animals have also been removed from urban areas in Western Australia (DAFWA Unpublished reports) (Limpus 2006)
B3. Overseas range size score (0–2) < 1 = 0; 1 – 70 = 1; >70 = 2	1	*Overseas range between 1-70 million km^2 , estimated at 10.8 million km^2 . Includes current and past 1000 years, natural and introduced range.* In the US *T. scripta* ranges from southeastern Virginia south-westward to northern Florida, north through Kentucky and Tennessee to southern Ohio, northern Indiana, Illinois, and southestern Iowa, and west to Kansas, Oklahoma, and New Mexico; continuing through Mexico and Central America to Colombia and Venezuela (Ernst and Barbour 1989, Ernst 1990, Ernst et al 1994). Widely introduced outside its natural range, see question B2 for full description of the species introduced range.
ESTABLISHMENT RISK SCORE	**11**	

SUM OF SCORE A (B1) + SCORE B (B2) + SCORE C (B3) (1-12)		
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 2007).
B5. Diet score (0–1)	1	*Generalist with a broad diet of many food types* The species is omnivorous, and a wide range of food is consumed; including plant material, snails, fish, dipteran larvae and pupae and terrestrial insects (Chen and Lue 1998). Prey items reported in Louisiana include crawfish, other smaller crustaceans, insects and small vertebrates (Gulf States Marine Fisheries Commission 1999). The juveniles require more animal food for greater growth which is linked to a higher survivorship (Pan et al 2004, Bouchard and Bjorndal 2006). However, another study found juvenile *T. scripta* faecal content comprised >70% plant matter, while adult males and females had equal proportions of plant and animal matter in their faeces; the data indicated that dietary shifts occur (Dreslik 1999). Stomach contents of adult females collected from two ponds in France showed diet was omnivorous and included fish, vegetable material, insects and terrestrial ants as well as plastic, stones and paper (Prevot-Julliard et al 2007). In Queensland, digestive tracts of some captured animals contained large quantities of grass. Food items include water insects, snails, tadpoles, crayfish, fish, crustaceans and molluscs: plants eaten include arrowhead (*Sagittaria latifolia*), water lilies, water hyacinths and duck weed, carrion is also eaten (Smither 2004). Adults are omnivorous showing no preference for either plant or animal food, they will take almost any food item available; foods recorded include duckweed, algae, assorted emergent herbaceous plants, tadpoles, small fish, insects (adults and larvae) crayfish, shrimp, amphipods, various molluscs (mostly snails) (Ernst and Barbour 1989). Food can be taken while the turtle is on land but is consumed in the water to aid swallowing (Smither 2000).
B6. Habitat score - undisturbed or disturbed habitat (0–1)	1	*Can live in human-disturbed habitats* The species is highly adaptable and tolerates brackish water (see earlier note on salt tolerance), it can live in man-made canals, irrigation ditches and city ponds and lakes (Somma et al 2007). They prefer soft bottomed (i.e. muddy) quiet bodies of water such as slow moving rivers, streams, swamps, ponds, creeks, also stock tanks. They spend a significant amount of time just floating (assisted by their inflatable throat) and basking on the shore close to the water's edge, on logs or rocks (Smither 2004). Occupies most freshwater habitats preferring quiet waters with soft bottoms, abundant aquatic plants and suitable basking sites (Ernst et al 1994). They use objects floating or projecting over water to bask upon and may climb bushes to heights of a metre (Minton 1972). Noted that sliders can live in waters contaminated with radioactive material, variety of chemical pollutants, water with high organic load, and thermally polluted water (Gibbons 1990). *T. scripta* living in a lake receiving thermal effluent from a coal-fired power plant had higher reproductive potential and higher rate of population increase than *T. scripta* living in natural lakes (Thornhill 1982). The species can survive European winters by hibernating, some with severe winters with extended periods of minus ten degrees (Cadi and Joly 2003).
B7. Non-migratory behaviour (0–1)	1	*Non-migratory or facultative migrant in its native range* Both extrapopulational (long-range) and intrapopulational movement occur and are usually associated with breeding (females searching for nest sites, males seeking mates), hatchling movement from nest to aquatic habitat, individuals seeking favourable sites to hide or periods of dormancy, away from adverse conditions, in search of seasonal resources (tropical *T scripta* in response to rainfall patterns but this type of movement not common), to hibernation sites. This type of movement is not seasonal on an annual bases therefore is not classed as migratory movement: all activity is diurnal (Gibbons et al 1990, Somma et al 2007).

Establishment Risk Score **Sum of B1-7 (1-16)**	**15**	
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)*	92	*CMRS = 100(2553/2785)* The natural distribution of *Trachemys scripta* is southeastern North America to Venezuela, with introduced populations occurring worldwide (Gibbons 1990) (see Score C of Bird and Mammal Model for details).
Score B. *Has the species established an exotic population in another country? (0–30)*	30	*Species has established a breeding self-sustaining exotic population in another country* *T. s. scripta* and *T. s. elegans*. have established outside their natural distribution and introduced populations now occur worldwide (Ramsay et al 2007). Many of these populations are self sustaining through natural breeding however, in some countries or localities that have very cold winters such as England and New Zealand breeding may not occur and populations are sustained at reasonably high numbers because of the longevity of the species [50 years plus (Dundee and Rossman 1989)] and recruitment from deliberate release by people of unwanted pets or by pets escaping. (Thomas and Hartnell 2000) (Holman 1994, Cadi et al 2004) (Williams 1999, Kovacs et al 2004) (Lever 2006) (see Score B of Bird and Mammal Model for details).
Score C. *Taxonomic Family risk score (0–30)*	15	*High risk family (Bomford 2006)* Family Emydidae (The Reptile Database 2007) The largest and most diverse family of living turtles with two subfamilies generally recognised: Batagurinae or Old World pond turtles, and Emydinae or New World pond turtles. Emydinae are separated into two generic complexes: Clemmys complex that includes the genera Clemmys, Emybooidea, Emys and Terrapene; Chrysemys complex that includes the freshwater genera Chrysemys, Deirochelys, Graptemys, Pseudemys, Trachemys and the brackish water genera Malaclemys. (Ernst 1990).
Establishment Risk Score **Sum of Score A + Score B + Score C (0 – ≥116)**	**137**	
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.*	0	*Animal posing a lower risk of harm to people (will not make unprovoked attacks causing injury requiring medical attention, and which, even if cornered or handled, are unlikely to cause injury requiring hospitalisation)* Although can bite and scratch, escaped captive-kept sliders are unlikely to cause an injury requiring hospitalisation. Large animals when handled are capable of giving a painful and injurious bite; an aggressive turtle, large males (from the wild) snap vigorously when captured (Minton 1972); can be aggressive and will often bite and scratch when handled (Ernst et al 1994).
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)*	0	*Nil or low risk (highly unlikely or not possible).*

PUBLIC SAFETY RISK SCORE SUM OF A1 + A2 (0-4)	0	

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.*	✓	*Moderate environmental pest in any country or region [score = 2, using scoring from Australian Bird and Mammal Model Q C5 (0-3)].* Listed among the '100 of the World's Worst Invaders' by the Global Invasive Species Database. Species selected for the list according to two criteria: their serious impact on biological diversity and/or human activities, and their illustration of important issues surrounding biological invasion: "Slider turtles (*Trachemys scripta elegans*) are popular pets and as a result have become established in many parts of the world, where it is thought that they compete with native aquatic turtles. They are omnivorous and will eat insects, crayfish, shrimp, worms, snails, amphibians and small fish as well as aquatic plants. Red-eared sliders are found both in fresh and brackish waters including coastal marsh ponds" (Global Invasive Species Database 2007). Competition between *T. scripta* and native *Emys orbicularis* likely in France as *T. scripta* is bigger, is sexually mature earlier, occurs in high densities in small areas and diet is more varied and overlaps that of *E. orbicularis'* diet spectrum and there is a wide overlap of their respective ecological niches (Arvy and Servan 1998). Many European countries have introduced populations of *T. scripta* living in the wild, breeding has been recorded in some countries (France, Spain, Italy) however, even when no breeding occurs, populations can be maintained at high densities due to regular introduction into the wild and the longevity [captive record of 40 years (Slavens and Slavens 2006)] of the species and pose a threat to indigenous turtles (Cadi and Joly 2003). Competition with native turtles - In mixed groups introduced red-eared sliders out-competed the native European turtle *E. orbicularis* for preferred basking places; the availability of basking sites for *Emys* was reduced because the species was reluctant to use a site already occupied by *T. scripta*, suggesting remote identification of the occupant and active avoidance of any contact with it (Cadi and Joly 2003). Communities warned of the danger of introductions of red-eared sliders to local ecosystems and advised capture and removal of the species from wetlands in southern Europe (Cadi et al 2004). Illegal release of red-eared sliders endangers native European pond turtles and their behaviour. Competition for European pond turtles by introduced red-eared sliders in France (Servan and Arvy 1997). (European Community) *Emys orbicularis* is classified as endangered by the European Community and Near Threatened globally by IUCN (2002) (Cadi and Joly 2004, Kovacs et al 2004). In France, weight variation and survival were compared using control groups and mixed groups between groups of introduced red-eared sliders and the endangered indigenous turtle, *E. orbicularis*. During three years of monitoring *E. orbicularis* had higher weight loss and mortality in the mixed groups. The better basking sites were taken by the sliders and competition between turtles can be for food, nesting sites and basking sites (Cadi and Joly 2004). Major conservation problems for the most endangered reptile in Galicia (Northwest Spain) *E. orbicularis* includes introduction of the exotic competitor *T. scripta* and the predator black-bass fish (*Micropterus*

salmoides) (Cordero Rivera and Ayres Fernandez 2004) (Luiselli et al 1997).

One report following a survey of feral populations of red-eared sliders on Kos, Greece considered they would be unlikely to be a significant threat to indigenous species (Bruekers et al 2006).

In California Marin Water Districts - nonnative slider species out-compete native species for food, take the best basking spots and may introduce new diseases into the local turtle population (Fimrite 2004) .

England – introduced red-eared sliders use water birds' nests (such as grebes) as basking sites causing damage and destruction of nest, eggs or hatchlings; and they also predate on native invertebrates (Folger 2001, Pendlebury 2004).

Important competitor for the European pond turtle (*E. orbicularis*) where populations of introduced red-eared sliders also occur, especially competition for valued basking sites (Ficetola et al 2002, Balázs and Györffy 2006, Ficetola and De Bernardi 2006).

Importation of *T. s. elegans* now banned by the European Union because of concerns of the negative effects of released pets on native turtle *E. orbicularis* (Williams 1999): Importation of *T. scripta* banned in the EU since 1997 however, many still kept as pets. Due to their rapid growth to a difficult-to-manage size as well as being large biting adults, unwanted animals are released into the wild (Prevot-Julliard et al 2007).

In Pennsylvania, US concern that introduced red-eared sliders (their presence mainly attributed to release by people) are having a negative effect on a listed threatened native turtle, the Redbellied Turtle (*Pseudemys rubriventris*), and other native turtles (Urban and Morgan 2005).

May compete with native turtles for trophic resources and nesting areas (Gulf States Marine Fisheries Commission 1999).

In California in waterways on the University of California competition recorded between introduced *T. scripta* and native *Emys marmorata* for basking sites due to the larger size of *T. scripta*, also risk of the introduction of disease to native turtle populations from the release of pet sliders; *T. scripta* outnumbered populations of *E. marmorata* population (Spinks et al 2003).

Introduced red-eared slider *T. s. elegans* in Florida, US may intergrade with the allopatric yellow-bellied slider *(T. s. scripta*) that is native along the eastern coast of the US from northern Florida to southestern Virginia (Hutchison 1992), impacts on the genetic structure of populations are occurring in Virginia due to introgressive hybridisation between *T. s. scripta* and the introduced *T. s. elegans* (Mitchell and Pague 1990) (Williams 1999).

Red-eared sliders may wander far from water and colonise newly available habitat, dispersal aided by manmade canals and irrigation ditches (Cox et al 1998) In (Somma et al 2007).

Report of a predatory attack by three *T. scripta elegans* on an adult Mississippi Map Turtle (*Graptemys pseudogeographica kohni*) (Hilgenhof 1996).

T. scripta second most abundant freshwater turtle in Taiwan and there is concern about their impact on native turtles and aquatic plants, essential that more studies and monitoring are carried out (Chen and Lue 1998).

Released pet turtles spread disease and parasites into the environment that may have a negative impact on indigenous wild turtles (Stuart 2000, Fimrite 2004).

Anecdotal evidence from the Queensland Red-eared Slider Turtle Eradication Program - in some ponds where REST?? were present at very high densities, there were no native turtles or fish of any kind present, while similar water bodies nearby without sliders, did support these animals (pers comm. Scott O'Keeffe 11/02/2008).

		Does not use tree hollows [score = 0 using scoring from Australian Bird and Mammal Model Q C4 (0, 2)]. *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 during this assessment. *Low risk (injuries, harm or annoyance likely to be minor and few people exposed) of harm or annoyance to the public posed by a wild population [score = 2, using scoring from Australian Bird and Mammal Model Q C11 (0-5)].* **Zoonoses:** The species could become a reservoir or vector for disease that affect people. Transmission of salmonella infection and subsequent sepsis of a child from a pet slider (Clegg and Heath 1975, Kaibu et al 2006, Nagano et al 2006). Transmission of salmonella to humans from turtles (sale of small turtles has been banned in US since 1975) (Bergmire-Sweat et al 2008), and other reptiles (Chiodini and Sundberg 1981, Ward 2000). Red-eared sliders tested positive for known pathogens for chelonians (Soccini 2004). Transmission of Salmonellosis to people from drinking water contaminated by sliders (Newbery 1984, De Moor and Bruton 1988). Importation of the species into New Zealand was banned due to human health risks (Robb 1980).
*2. Has close relatives with similar behavioural and ecological strategies that have had adverse impacts elsewhere **		Other members of the genus *Trachemys* have established exotic populations, however no reports that these species have had adverse impacts (Lever 2006).
3. Is dietary generalist	✓	The species is omnivorous, and a wide range of food is consumed; including plant material, snails, fish, dipteran larvae and pupae and terrestrial insects (Chen and Lue 1998) (see Score B5 for details).
*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 **	✓	*T. s. scripta* and *T. s. elegans*. have established outside their natural distribution and introduced populations now occur worldwide (Ramsay et al 2007). Many of these populations are self sustaining through natural breeding however, in some countries or localities that have very cold winters such as England and New Zealand breeding may not occur and populations are sustained at reasonably high numbers because of the longevity of the species [50 years plus (Dundee and Rossman 1989)]
*6. Harbours or transmits diseases or parasites that are present in Australia **	✓	Red-eared sliders tested positive for known pathogens for chelonians (Soccini 2004). Transmission of Salmonellosis to people from drinking water contaminated by sliders (Newbery 1984, De Moor and Bruton 1988). Importation of the species into New Zealand was banned due to human health risks (Robb 1980).
7. Has close relatives among Australia's endemic reptiles and amphibians		No Australian turtles in the Family Emydidae or genus *Trachemys* (Catalogue of Life 2008; Cogger 2000).
*8. Is known to have spread rapidly following their release into new environments **	✓	Species is known to spread rapidly following release into new environments, see Score B2 for details.
9. Is predatory	✓	The species is omnivorous, and a wide range of food is consumed; including plant material, snails, fish, dipteran larvae and pupae and terrestrial insects (Chen and Lue 1998). Prey items reported in Louisiana include crawfish, other smaller crustaceans, insects and small vertebrates (Gulf States Marine Fisheries Commission 1999). The juveniles require more animal food for greater growth which is linked to a higher survivorship (Pan et al

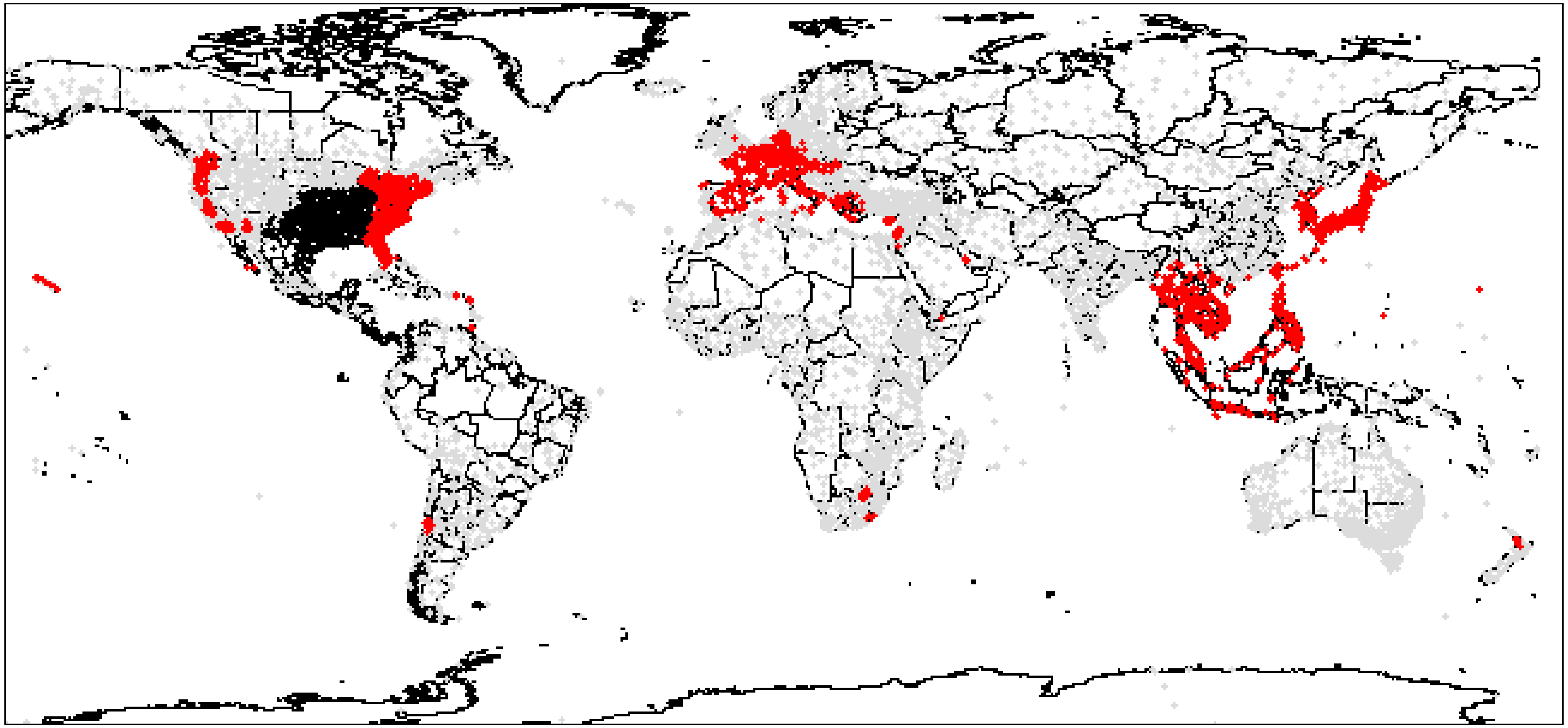
		2004, Bouchard and Bjorndal 2006). However, another study found juvenile *T. scripta* faecal content comprised >70% plant matter, while adult males and females had equal proportions of plant and animal matter in their faeces; the data indicated that dietary shifts occur (Dreslik 1999). Stomach contents of adult females collected from two ponds in France showed diet was omnivorous and included fish, vegetable material, insects and terrestrial ants as well as plastic, stones and paper (Prevot-Julliard et al 2007). In Queensland, digestive tracts of some captured animals contained large quantities of grass. Food items include water insects, snails, tadpoles, crayfish, fish, crustaceans and molluscs: plants eaten include arrowhead (*Sagittaria latifolia*), water lilies, water hyacinths and duck weed, carrion is also eaten (Smither 2004). Adults are omnivorous showing no preference for either plant or animal food, they will take almost any food item available; foods recorded include duckweed, algae, assorted emergent herbaceous plants, tadpoles, small fish, insects (adults and larvae) crayfish, shrimp, amphipods, various molluscs (mostly snails) (Ernst and Barbour 1989). Food can be taken while the turtle is on land but is consumed in the water to aid swallowing (Smither 2000).
Factors	**1,**3,**5,**6,8,9	
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**	*The species has no grid squares within the highest six climate match classes that overlap the distribution of any susceptible native species or ecological communities* *The species has more than 20 grid squares within the highest two climate match classless and/or has more than 100 grid squares within the highest four climate match classes, that overlap the distribution of any susceptible species or communities,* ***AND*** *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 are of the highest six climate match classes for the exotic species being assessed [species status listed in bold]. [score = 5, using scoring from Australian Bird and Mammal Model Q C6 (0-5)].* Due to the extreme climate match with Australia, most native freshwater turtles (Cann 1998) could potentially be at risk from any established populations of *T. scripta*. Negative effects would most likely be caused by competition for food, preferred habitats, especially basking sites as native turtles bask out of the water; additionally there is limited knowledge on the behaviour and diet of many native turtles. *Emydura* spp at high risk from competition, such as the Brisbane River Turtle (*E. macquarii signata*) and Krefft's Turtle (*E. krefftii*) (Cann 1998). The **critically endangered** Western Swamp Tortoise *(Pseudemydura umbrina*) that has a very small distribution within a populated area would be very vulnerable to populations of introduced sliders; other species at risk include the Gulf Snapping Turtle (*Elseya lavarackorum*) **endangered**, Mary River Turtle (*Elusor macrurus*) **endangered**, Bell's Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle (*Elseya belli*) **vulnerable** and the Brisbane River Turtle (*Emydura macquarii signata*) **vulnerable** (Dept of the Environment Water Heritage and the Arts 2007).
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.*	1	*Score = 10 (Bomford 2008) [score = 1, using scoring from Australian Bird and Mammal Model Q C8 (0-5)].* See Commodity Scores Table – species has attributes making it capable of damaging aquaculture.

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	**11**	EXTREME
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	**15**	EXTREME
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	**137**	EXTREME
HIGHEST ESTABLISHMENT RISK RANK (When establishment risk ranks differ between the models, the highest ranked outcome is used, (Bomford 2008).	-	**EXTREME – ENDORSED BY VPC**
PUBLIC SAFETY RISK RANK AUSTRALIAN BIRD & MAMMAL MODEL, STAGE A (BOMFORD 2008, PP 17) A = 0 = NOT DANGEROUS; A = 1 = MODERATELY DANGEROUS; A ≥ 2 = HIGHLY DANGEROUS	**0**	NOT 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

		82 – more than the median number of reptile references were used for this aspect of the assessment, indicating a decreased level of uncertainty. 2 - less than the median number of reptile references were used for this aspect of the assessment, indicating an increased 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)**		**EXTREME – 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,**5**,6,8,9	
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)**	**1**	
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) Total number of references for this species		20 110 – more than the median number of reptile references were used for this assessment, indicating a decreased level of uncertainty.

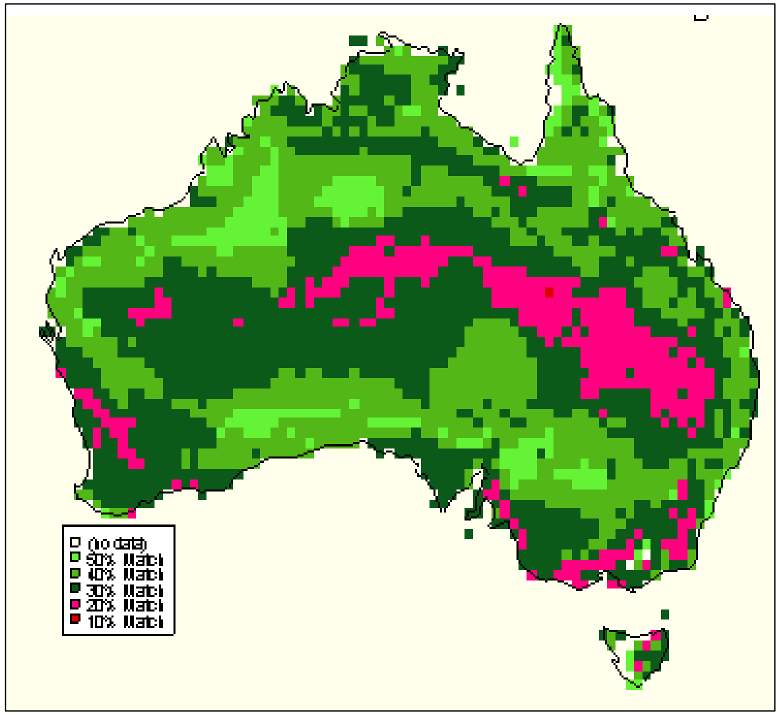
WORLDWIDE DISTRIBUTION – Pond Slider (*Trachemys scripta*) including natural populations (black) and introduced populations (red).

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.



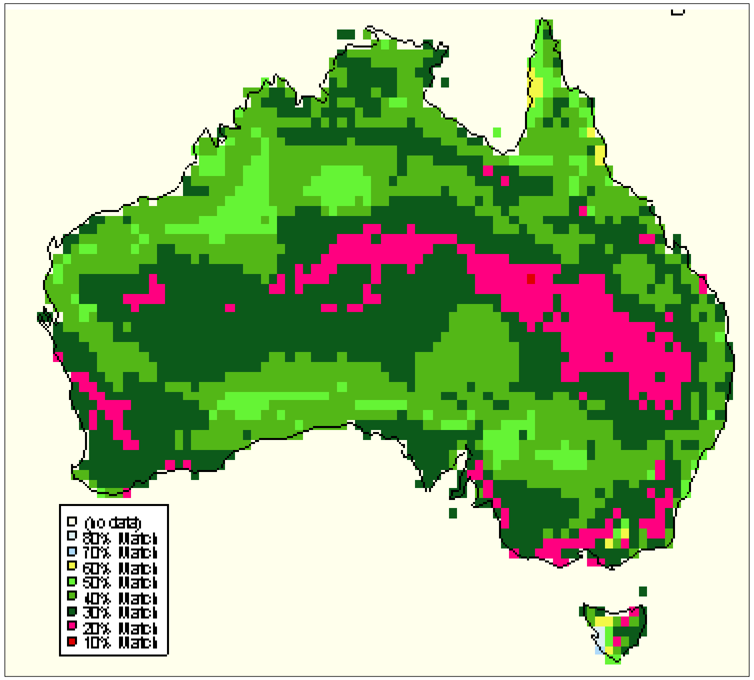
Map 1. Climate match between the world distribution of Pond Slider (*Trachemys scripta*) and Australia for five match classes.

Colour on Map	Level of Match from Highest (10) to Lowest (6)	No. Grid Squares on Map
Red	10 HIGH MATCH	1
Pink	9 HIGH MATCH	317
Dark Green	8 MOD MATCH	1235
Mid Green	7 MOD MATCH	1000
Lime Green	6 LOW MATCH	215
		CMS= 2768



Map 2. Climate match between the world distribution of Pond Slider (*Trachemys scripta*) 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	1
Pink	9 HIGH MATCH	317
Dark Green	8 HIGH MATCH	1235
Mid Green	7 MOD MATCH	1000
Lime Green	6 MOD MATCH	215
Yellow	5 MOD MATCH	14
Blue	4 LOW MATCH	1
Light blue	3 LOW MATCH	2



Pond Slider *(Trachemys scripta)* 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)
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
Sheep (includes wool and sheep meat)	5	0	0	0
Fruit (includes wine grapes)	4	0	0	0
Vegetables	3	0	0	0
Poultry and eggs	2	0	0	0
Aquaculture (includes coastal mariculture)	**2**	**1**	**5**	**10**
Oilseeds (includes canola, sunflower etc)	1	0	0	0
Grain legumes (includes soybeans)	1	0	0	0
Sugarcane	1	0	0	0
Cotton	1	0	0	0
Other crops and horticulture (includes nuts, tobacco and flowers)		0	0	0
Pigs	1	0	0	0
Other livestock (includes goats, deer, camels, rabbits)	0.5	0	0	0
Bees (includes honey, beeswax and pollination)	0.5	0	0	0
Total Commodity Damage Score (TCDS)				**10**

[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.]*

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Vertebrate Pests Committee Threat Categories (Natural Resource Management Standing Committee 2004)

VPC Threat Category

A species' VPC Threat Category is determined from the various combinations of its three risk ranks; (A) Public safety risk rank, (B) Establishment risk rank, (C) Pest risk rank.

B. Establishment Risk Rank[1]	C. Pest Risk Rank[1]	A. Public Safety Risk Rank	Threat Category
Extreme	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	Serious	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	Moderate	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	Low	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Serious	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Serious	Serious	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Serious	Moderate	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Serious	Low	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Moderate	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Moderate	Serious	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Moderate	Moderate	Highly Dangerous	**Serious**
Moderate	Moderate	Moderately Dangerous or Not Dangerous	**Moderate**
Moderate	Low	Highly Dangerous	**Serious**
Moderate	Low	Moderately Dangerous or Not Dangerous	**Moderate**
Low	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Low	Serious	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Low	Moderate	Highly Dangerous	**Serious**
Low	Moderate	Moderately Dangerous or Not Dangerous	**Moderate**
Low	Low	Highly Dangerous	**Serious**
Low	Low	Moderately Dangerous	**Moderate**
Low	Low	Not Dangerous	**Low**

[1] 'Establishment Risk' is referred to as the 'Establishment Likelihood' and 'Pest Risk' is referred to as the 'Establishment Consequences' by the Natural Resource Management Standing Committee (2004).