Pest risk assessment

Red-eared slider turtle (*Trachemys scripta* subsp. *elegans*)

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This publication has been compiled by Steve Csurhes, Caitlin Davies and Clare Hankamer of Biosecurity Queensland, The Department of Primary Industries.

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Summary

The red-eared slider turtle (*Trachemys scripta* ssp. *elegans*) is a small freshwater turtle native to the Mississippi Valley in the southern United States.

Tens of millions of red-eared sliders have been sold worldwide as pets. As a result, the species has naturalised in numerous countries. While perhaps most abundant in heavily modified waterways, there is considerable evidence that red-eared sliders can negatively affect locally native turtle species. The International Union for Conservation of Nature (IUCN) has listed the red-eared slider among 100 examples of the 'world's worst invasive species'. Pet turtles can also transmit salmonella to people, especially children.

Despite strong restrictions on possession and sale in Queensland, small, naturalised populations of red-eared sliders have been detected in coastal south-eastern Queensland. These populations have been reduced to very low levels via a concerted eradication campaign. The continued dumping of unwanted pets means that surveillance and control will be ongoing.

Based on the evidence presented in this risk assessment, it seems reasonable to suggest red-eared sliders are a 'high-risk' species in Queensland. The species has a range of attributes considered to confer significant pest potential, including:

- a history as a major pest overseas
- well-adapted to climates experienced over much of Queensland
- a broad natural geographic range
- a generalist diet
- high fecundity.

This study suggests there is sufficient evidence to conclude red-eared sliders pose a significant threat to native freshwater turtle species and human health, and that current restrictions on possession and sale are justified.

Identity and taxonomy

Species identity: *Trachemys scripta* subspecies *elegans*

Synonyms: *Chrysemys scripta elegans*, *Chrysemys scripta*, *Emys elegans*, *Emys holbrooki*, *Emys sanguinolenta*, *Pseudemys scripta*, *Pseudemys scripta elegans*, *Testudo scripta*, *Trachemys lineata*

Common names: Red-eared slider turtle

Family: Emydidae

Currently, the red-eared slider turtle is considered a subspecies of *Trachemys scripta* ('common slider' or 'slider'). However, its taxonomy is unclear. In the past, it has been placed in three different genera—*Chrysemys*, *Pseudemys* and *Trachemys* (Gibbons 1990). While the various genera are subject to ongoing review, *T. scripta* is currently split into three subspecies—*T.s. elegans* (red-eared slider), *T.s. scripta* (yellow-bellied slider) and *T.s. troostii* (Cumberland slider) (Seidel 2002).

Hybrids of red-eared sliders and yellow-bellied sliders have been reported in the southern United States (Somma *et al*. 2009a), hybrids of red-eared sliders and *T. taylorii* in Mexico (Seidel 2002), and hybrids of red-eared sliders and native terrapins in the Bahamas (Ardastra Gardens, Zoo and Conservation Center 2010). There is potential for hybridisation with other congeners, notably *T. decussata angusta* (Cayman Islands) (Lever 2003; GISD 2009), *Trachemys decorata* and *Trachemys stejnegeri vicina* (Caribbean) (Powell *et al*. 2000), and *Trachemys gaigeae* (New Mexico) (Seidel *et al*. 1999; Stuart 2000). Hybridisation is common in closely related freshwater turtle species, and intergeneric and interclade hybrids exist (Parham *et al*. 2001; Iverson *et al*. 2007; Brophy *et al.* 2006).

Description

Red-eared sliders are a medium-sized freshwater turtle, generally 125–200 mm long but can grow up to 350 mm long (Image 1). Females are usually larger than males (plastron length 150–195 mm, compared to 90–100 mm for males) (Ernst & Barbour 1972). The carapace and skin is olive to brown with yellow stripes or spots. While specimens in captivity tend to have clean shells, the shells of wild specimens are usually covered by a layer of algae, obscuring their distinctive colours and patterns.

Image 1. Red-eared slider turtle.

Key diagnostic features include:

- a red stripe behind each eye (Figure 1)
- an ability to withdraw its neck straight back into its shell (Australian turtle species withdraw their necks sideways)
- long claws and a dome-shaped shell (native turtles have shorter claws and a flattened shell).

Occasionally, the distinctive red stripe is missing or expressed only as a red patch on the top of the head (Frisby 2010). Older males can also become melanistic and difficult to identify (Zipcode Zoo 2010).

Similar native turtle species include:

- *Chelodina longicollis*—common snake-necked turtle, eastern long-necked rurtle or stinker, which emits an offensive smell when disturbed (occurs in eastern Australia from northern Queensland to southern Australia)
- *Chelodina oblonga*—oblong turtle (occurs in south-western Western Australia)
- *Myuchelys latisternum*—saw-shelled turtle (occurs in Cape York to northern New South Wales)
- *Emydura macquarii macquarii*—Murray River turtle (occurs in south-eastern Australia from Nepean River, New South Wales, to Pine Rivers, southern Queensland) (Department of Agriculture and Food 2009).

The pet trade has developed two colour morphs of red-eared sliders—a pastel (lighter colour with varying amounts of red and yellow) and an albino (bright yellow as a juvenile with colour fading as the turtle ages) (Frisby 2010).

The two other subspecies—*T.s. scripta* (yellow-bellied slider) and *T.s. troostii* (Cumberland slider)—are similar to red-eared sliders but have a yellow band behind each eye. The Cumberland slider also has a wider post-orbital stripe that is never entirely one colour; more usually yellow and orange fading to a darker orange-red away from the eye (Wikipedia 2010a; Bringsøe 2006). It can appear similar to the yellow-bellied slider, but has fewer wider

stripes on its head, neck and legs (Ernst *et al*. 1994). For more details refer to Bringsøe (2006) and Ernst *et al*. (1994).

Biology and ecology

Red-eared slider turtles are active during the day (diurnal), resting on the bottom or floating on the surface at night (Department of Agriculture and Food 2009). They can remain submerged for a considerable time.

Adult red-eared sliders tend to be herbivores, whereas juveniles tend to be more omnivorous. Both prey on molluscs and invertebrates opportunistically—notably snails, insects and their larvae, worms, shrimp and crayfish. They are known to eat fish, frogs' eggs and tadpoles, and water snakes. They eat a variety of aquatic plants and algae, including a number of noxious aquatic weeds such as water hyacinth (Ernst et al. 1994; Brown et al. 1995; Feldman 2005). While capable of eating small vertebrates—including small reptiles, amphibians, mammals, fish and birds (Scalera 2006)—fish and birds are very rarely part of their diet (Feldman 2005).

Like most aquatic turtles, red-eared sliders have fixed tongues and must eat their food in the water (Wikipedia 2010b).

Reproduction and dispersal

Sexual maturity is reached at 2–5 years of age (Dundee & Rossman 1989). Maximum life-span is generally in the order of 20–30 years, although only 1% of hatchlings reach this age (Feldman 2005). Some references claim maximum age can be up to 75 years (Dundee & Rossman 1989; Department of Food and Agriculture 2009).

Red-eared sliders can wander up to 9 km from water to find suitable habitat, search for a mate or lay eggs (Department of Agriculture and Food 2009). Nests are dug well above water level, usually within 500 m of water, but sometimes up to 1.6 km away (Bringsøe 2006; Department of Agriculture and Food 2009). Soil moisture is important for nesting and maintenance of egg moisture content. Under laboratory conditions, vermiculite with a water potential of -1500 kpa (0.09 g water: 1 g vermiculite) was the driest condition at which the majority of eggs hatched successfully (Tucker & Paukstis 2000).

Females can produce viable eggs for up to 5 years after mating (O'Keefe 2005), although fertility drops to 20% or less after the first year (Feldman 2005). Females can lay up to 3 clutches (approximately 75 eggs) per season, compared to a maximum of 30 eggs (typically 10–15 eggs) per season for Australian native turtles (Cann 1998; Goode & Russell 1968; O'Keefe 2005; Zipcode Zoo 2010). However, there is evidence that up to 6 clutches per year of 2–30 eggs each can be produced at times (Scalera 2006). Eggs are white, 23–44 mm long and weigh 6–15 g (Bringsøe 2006; Dundee & Rossman 1989).

Red-eared sliders exhibit temperature-dependent sex determination, similar to other turtle species. A temperature of 22.5 ˚C is the lowest constant incubation temperature needed to produce viable hatchlings. However, most emerge deformed or neurologically impaired at this temperature (Ewert & Nelson 1991). Constant incubation temperature must be greater than 28.3 ˚C to produce females (Cadi *et al*. 2004), and to produce all females the temperature must be greater than 30.6 ˚C for 4 hours per day during the middle (third) phase of development (Feldman 2005).

Time to hatching is approximately 68–70 days. Newborn hatchlings are 20–35 mm long (Dundee & Rossman 1989). Hatchling mortality rates are high. Predators include crows, rats and snakes.

Origin and distribution

Red-eared sliders are native to the Mississippi Valley in the southern United States, including Illinois, Missouri, Kansas, Oklahoma, Arkansas, Tennessee, Mississippi, Louisiana, Texas, Kentucky, Ohio and West Virginia (Department of Agriculture and Food 2009; Somma *et al*. 2009a).

Naturalised populations exist in every continent except Antarctica, including Asia, Australia, Austria, Bahamas, Bahrain, Belgium, Belize, Bermuda, Brazil, British Virgin Islands, Cambodia, Canada, Cayman Islands, Chile, China, Colombia, Costa Rica, Czech Republic, Cyprus, Denmark, Dominican Republic, El Salvador, Estonia, Europe, Faroe Islands, Finland, France, French Polynesia, French West Indies (Grande-Terre, Basse-Terre), Gambia, Germany, Gibraltar, Greece, Greenland, Guadeloupe, Guam, Guatemala, Guyana, Hong Kong, Honduras, Hungary, Iceland, Indonesia, Israel, Italy,

Japan, Korea, Democratic People's Republic of Korea, Republic of Latvia, Lithuania, Malaysia, Martinique, Mexico, Micronesia, Federated States of Micronesia, New Caledonia, New Zealand, Nicaragua, Northern Mariana Islands, Norway, Panama, Philippines, Poland, Puerto Rico, Reunion, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, United Kingdom, United States, Venezuela and Vietnam (GISD 2009; Reptile Database 2010) (Figure 1).

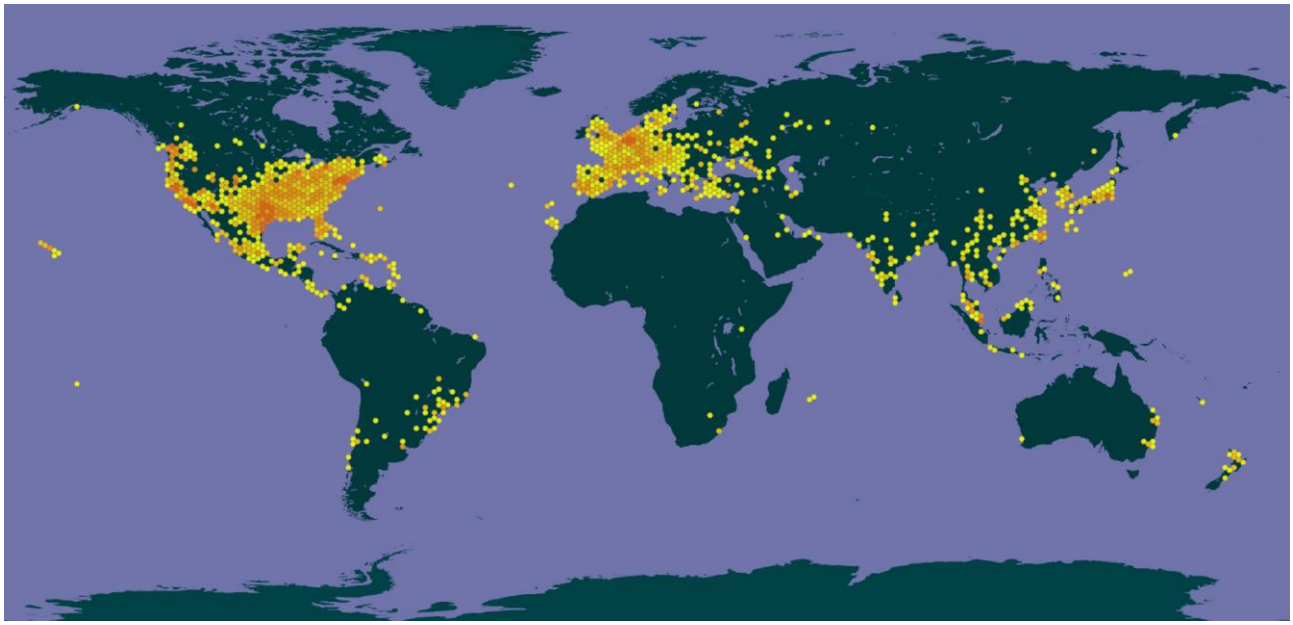

Figure 1. Global distribution of red-eared slider turtle (Source: GBIF 2025).

Status in Australia

Red-eared sliders have naturalised in Queensland and New South Wales. Individual specimens have been detected in the wild in the Australian Capital Territory, Victoria and Western Australia (GISD 2009; Massam et al. 2010). The species has been intercepted at the border at least 67 times from 1999 to 2010 (Henderson and Bomford 2011). Red-eared slider turtles have also been detected in illegal keeping across Australia.

Status in Queensland

T. scripta, including its subspecies, was banned from possession and sale in Queensland in 1985.

While long-suspected to exist in the illegal pet trade, the first naturalised population of red-eared sliders was detected in Queensland in 2004, in a small number of private dams in the Pine Rivers Shire just north of Brisbane. An ongoing eradication campaign, combined with a public awareness campaign, subsequently resulted in the detection of several other naturalised populations, to the north and south of Brisbane. In 2022, red-eared slider turtles were detected at Robina on the Gold Coast. Current efforts are focused on detecting very small numbers of wild specimens and preventing release/dumping of additional animals.

Preferred habitat

Preferred habitats include a range of still or slow-moving freshwater ponds and lakes (rarely in flowing water). Red-eared sliders readily tolerate artificial ponds and lakes and often thrive in dams that have been polluted by excessive organic matter. They can tolerate brackish marshes, human-made canals and ponds in city parks. Tolerance of pollution levels including radioactive, thermal, chemical and organic pollution is higher than in other vertebrates (Gibbons 1990). While occasionally seen in salt water, these are animals washed downriver by stormwater.

Preferred climate is perhaps best described as temperate. However, the species is very adaptable and readily tolerates subtropical and tropical areas, generally where temperatures are between 10 ˚C and 37 ˚C (Ramsay *et al.* 2007). In the northern parts of its native range, survival is limited by winter temperature, in particular depth of soil freezing (Packard *et al*. 1997). In cold climates, hatchlings can overwinter in their nests. Adults can survive severe winters (-10 ˚C for extended periods) by hibernation—or more correctly brumation, at the bottom of shallow lakes or ponds and less commonly under banks, in hollow tree stumps or under rocks (Wikipedia 2010b; Department of Agriculture and Food 2009). Animals brumate when air temperatures fall below 10 ˚C or when water temperature falls below 13 ˚C. They become active when necessary for food or water, or to bask if temperatures increase (Wikipedia 2010b).

Red-eared sliders have been detected in New Zealand but do not appear to be breeding, due to the cold climate (Feldman 2005).

History as a pest elsewhere

The IUCN has listed the red-eared slider among 100 examples of the world's worst invasive species (Lowe et al. 2000). Red-eared sliders have naturalised on every continent except Antarctica and on numerous islands. The Global Invasive Species Database (2009) lists it as a pest in Australia, Bermuda, Brazil, British Virgin Islands,

Canada, Cayman Islands, Dominican Republic, France, Germany, Israel, Ruyuku Islands (Japan), Latvia, Poland, Puerto Rico, Singapore, South Africa, Spain, Taiwan and Thailand. In Spain, it is considered one of the most harmful invasive species (GEIB 2006). Despite being native to parts of the United States, it has spread to most states, including Hawaii (Somma *et al*. 2009b). It was introduced into most countries via the pet trade (GISD 2009; WWF 2010)

Import into New Zealand was banned in 1965. Import into the European Union was banned in 1997 (Bringsøe 2006; Feldman 2005).

There is considerable evidence that red-eared sliders have negative impacts on native turtles and aquatic ecosystems in general. For example, in Singapore, red-eared sliders (now the most commonly observed aquatic turtle in the country) appear to be posing a significant threat to the survival of critically endangered river terrapins (*Batagur baska*) (Blog.nus 2010). Elsewhere, the genetic integrity of rare and threatened *Trachemys* species, such as *Trachemys gaigeae* (Mexican plateau slider) could be at risk, due to hybridisation with red-eared sliders (IUCN 2010; Seidel *et al*. 1999; Stuart 2000).

Disease risk

There is evidence of red-eared slider turtles transmitting pathogens to other turtle species throughout its introduced range (Héritier *et al.* 2017). There is potential that the species may introduce exotic pathogens that may be a threat to native turtle species.

Red-eared slider turtles transmitting platyhelminth parasites to captive populations of European pond turtle, *Emys orbicularis* in France (Verneau *et al.* 2011).

An outbreak of spirorchiidiasis in *E. orbicularis* in Northwestern Spain is believed to have resulted from a spill-over event from red-eared slider turtles (Iglesias *et al.* 2015).

It has been speculated that the invasive red-eared slider turtle has introduced pathogens that are responsible for the decline in western pond turtle *Emys marmorata* populations in California, USA (Silbernagel *et al.* 2013).

Red-eared slider turtles can act as a reservoir for infectious diseases such as sea turtle egg fusariosis (Martínez-Ríos *et al.* 2022). This fungal pathogen causes low hatching success and mass mortalities in nesting areas of sea turtles (Gleason *et al.* 2020). There is potential that red-eared slider turtles may facilitate the distribution of this disease and negatively impact native sea turtles.

Uses

The red-eared slider is the world's most commonly traded live reptile, mainly for use as a pet (Telecky 2001; TRAFFIC 1998; Warwick *et al*. 1990; WWF 2010). The United States currently exports 8 million red-eared sliders per annum (WWF 2010), with 52 million exported from 1989–1997. Demand was fuelled in the late 1980s by the children's television characters, the 'Teenage Mutant Ninja Turtles' (Somma *et al*. 2009a). In 1996, red-eared sliders comprised 88% of total trade in reptiles (TRAFFIC 1998). The sheer volume of trade in sliders has facilitated the species' rapid naturalisation across temperate and subtropical countries of the world (Spinks *et al*. 2003).

Red-eared sliders are popular pets due to low price, small size and easy maintenance. However, they can live for up to 50 years in captivity and, when mature, can inflict painful bites. These traits result in large numbers being dumped into the wild (GISD 2009; Luiselli *et al.* 1997).

In the Philippines, China and Malaysia, red-eared sliders are farmed for food (Matthews 2008; Somma *et al*. 2009a; TRAFFIC 2008). Import of turtles into California for their meat was banned in 2010 (USA Today 2010).

In China, slider shells are used in traditional medicine (TRAFFIC 2008).

Millions of red-eared sliders have been released into the wild in Asia for Buddhist 'mercy ceremonies' (Feldman 2005). In Vietnam, they have been released into the wild (along with other animals) during the seventh month of the lunar calendar to pray for good luck.

Pest potential in Queensland

Climate-matching software called 'Climatch' (Bureau of Rural Sciences 2009) was applied to predict areas of Queensland where climate is similar to that experienced across the native and naturalised range of the red-eared slider. Much of southern Queensland and parts of coastal eastern Queensland appear highly suitable (Figure 2).

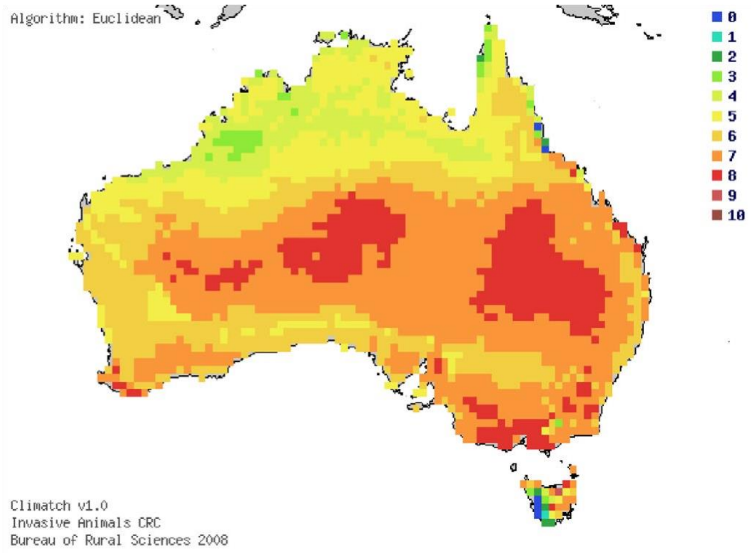

Figure 2. Area of Australia where climate appears suitable for survival of red-eared slider turtles—red and dark orange indicate areas where climate is highly suitable; light orange and yellow indicate areas where climate is marginally suitable; green and blue indicate areas where climate is considered unsuitable for this species.

While the potential impacts of invasive species are generally difficult to predict with precision, information on the impacts of red-eared sliders overseas provides a reasonable insight into the most likely impacts in Queensland. Potential impacts could include the following:

Negative impact on native turtle species

Red-eared sliders have several attributes that seem to confer a competitive advantage over locally native turtle species—they mature at a younger age, are more aggressive, have higher fecundity and have a larger adult body size. A range of studies provide evidence that red-eared sliders can compete successfully with native turtles for food, nesting sites and basking sites (Frank & McCoy 1995; Williams 1999; Salzberg 2000; Cadi & Joly 2003; Polo-Cavia *et al*. 2010; Lindeman 1999; Spinks *et al*. 2003; Cann 1998; Goode & Russell 1968; Scalera 2006). For example, Cadi and Joly (2003) found that the endangered European pond turtle (*Emys obicularis galloitalica*) shifted its basking activity to lower quality sites when faced with the more aggressive red-eared slider.

There are 32 species of native freshwater turtles in Australia (Georges & Thomson 2010), including several species classified as rare and threatened in Queensland. If red-eared sliders become abundant across their full potential range in Queensland, they could compete for food resources with locally native turtle species. However, the exact impacts, and the degree to which red-eared sliders might invade less disturbed wetland ecosystems, are difficult to predict.

Hybridisation occurs frequently in turtles, including intrageneric hybridisation (Brophy *et al*. 2006; Parham *et al*. 2001; Iverson *et al*. 2007). Indeed, there has been some debate over new species identifications in the family Geoemydidae and whether they are in fact hybrids produced from turtle farms in China, where multiple species have been housed together (Parham *et al*. 2001). As yet there is no evidence of interfamilial hybridisation (Brophy *et al.* 2006) and this seems unlikely. All Australian native turtles belong to the family Chelidae (except *Carettochelys insculpta,* which belongs to the Carettochelyidae). Hence, hybridisation is unlikely to be an issue. It must be noted that *T.s. elegans* and *T.s. scripta* could hybridise in the wild leading to possibly more vigorous genotypes.

Negative impact on prey items

Since red-eared sliders are omnivorous (particularly juveniles), they could have an impact on a range of aquatic prey items, including rare amphibians (O'Keefe 2005; Lever 2003).

Negative impact on aquatic ecosystems generally

Evidence from the United Kingdom suggests red-eared sliders are a threat to nesting waterbirds, taking over nests for basking sites and damaging and preying on eggs and hatchlings (Department of Agriculture and Food 2009). However, the full ecological impact of red-eared sliders is unknown (Ramsay *et al*. 2007; Bringsøe 2006).

Negative impact on human health

In a controlled study in Connecticut, pet turtles were reported to cause 25% of human salmonellosis cases. Similar results were recorded in another study in New Jersey in 1970–1971 (23% turtle-associated cases, compared to 6% in the control group) (Lamm *et al*. 1972). Turtles were responsible for an average of 14% of cases per year between 1970 and 1976 (Cohen *et al*. 1980). Fatalities in children have been reported (Rosenstein *et al*. 1965; Center for Disease Control 2007). In the state of Washington, a ban on pet turtles enforced in 1968 proved effective in reducing the number of salmonellosis cases, and recommendations were made to enforce the ban across all states (Lamm *et al*. 1972). To prevent further outbreaks of salmonella in children, there was a United States–wide ban on the sale of turtles with a carapace length less than 4 inches (the size considered small enough to be placed in a child's mouth) (JAMA 2008; Williams 1999). Although this prohibition dramatically reduced the number of cases (Cohen *et al*. 1980), baby turtles are still available from pet shops and flea markets in the United States. Multi-state outbreaks were reported in 2007–2008, associated with children handling salmonella-infected turtles.

Salmonella can also be transferred to humans when drinking water has been contaminated by turtles (Newberry 1984; Bomford 2008). Use of antibiotics at United States turtle hatcheries has led to more antibiotic-resistant strains of salmonella (Ernst *et al.* 1994).

Negative impact on animal health

Red-eared sliders are often reared in septic conditions. Hence, the risk of spreading diseases and parasites (apart from salmonella) from captive-bred specimens into wild reptile populations is significant (Feldman 2005; Somma *et al.* 2009a; O'Keefe 2005; Scalera 2006). In the state of Washington, populations of the native turtle *Actinemys marmorata* were seriously impacted by a respiratory infection in 1990 and *T. scripta* was the likely vector (Hays *et al*.

1999). There is evidence that a malaria-like blood parasite was transferred to two species of native turtles from infected *T.s. elegans* in the Lane Cove River, Sydney (Department of Agriculture and Food 2009).

Based on the evidence presented in this assessment, it seems reasonable to suggest red-eared sliders are a 'high-risk' species in Queensland. The species has a range of attributes considered to confer significant pest potential, including:

- a history as a major pest overseas
- climatic suitability to large parts of Queensland
- a broad natural geographic range
- a generalist diet
- high fecundity.

Risk assessments in other states also conclude that red-eared sliders are 'high-risk' species. Bomford (2008) predicted a 'serious' risk of establishment of *T.s. scripta* based on a high climate-match score, evidence of pest status elsewhere and a high establishment score. Similarly, Massam et al. (2010) ranked the species as a 'high priority' for management in Australia, to prevent the establishment of additional populations and to eradicate existing populations, and recommended the species be added to a national 'alert list'.

Pest potential of related taxa

As a consequence of restrictions on sale and possession of red-eared sliders in some countries, closely related species are being sold as alternatives. The yellow-bellied slider (*T.s. scripta*) and the Cumberland slider (*T.s. troostii*) are now replacing the red-eared slider in the European pet trade, and may pose similar threats to the European pond turtle (*Emys orbicularis*) (Bringsøe 2006). Naturalised populations of yellow-bellied sliders have been detected outside the species' native range in California, Colorado, New York, New Jersey, Pennsylvania, Michigan, Virginia, North Carolina, South Carolina, Wisconsin and perhaps Massachusetts (Somma et al. 2009b), and elsewhere overseas (Ramsay *et al*. 2007). Hybrids of these subspecies have been recorded in northern Spain (Valdeón *et al*. 2010).

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