

The red-eared slider
(*Trachemys scripta elegans*)
in Asia: a review

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INTRODUCTION

This chapter reviews what is currently known about the status of red-eared sliders in Asia, as well as the potential impact of this non-indigenous species (NIS) on the native Asian biota. It includes published literature, information from websites, as well as mentioning ongoing research where known.

The red-eared terrapin or slider, *Trachemys scripta elegans* (Wied) is native to the south-eastern United States. Estimates of the annual trade in hatchlings vary from 3–4 million (Platt and Fontenot 1992), 4–7 million (Warwick 1991), 8 million (Williams 1999), to 43.6 million from the USA between 1998 and 2002 and 52 million between 1989 and 1997 (Telecky 2001). The popularity of this species has been influenced by crazes amongst children coinciding with cartoons featuring Teenage Mutant Ninja (Hero in the UK) Turtles. Following on from its popularity in the international pet trade, individuals have been released (as discarded pets or for religious reasons) in many places outside their natural range around the world, including a number of Asian countries. *Trachemys scripta elegans* is in the list of the top 100 of the world’s worst invasive NIS drawn up by the World Conservation Union IUCN (Global Invasive Species Database, <http://www.issg.org/database>) and is considered a major threat to

indigenous aquatic flora and fauna. In 1975, the US Food and Drug Administration banned the domestic sale of terrapins less than four inches (~12 cm) in length (which some children put in their mouths) because they were causing an estimated 300,000 cases of salmonellosis annually (Williams 1999). According to Williams (1999), at that time most of the estimated 8 million hatchlings annually exported to 60 nations were infected with salmonella (ranchered terrapins are fed slaughterhouse offal rich in salmonella). Slider ranching is also an important activity in countries other than the USA. A number of salmonella infections in humans have been traced back to pet terrapins, most of which were *T. s. elegans*. Several authorities believe that they should be considered to be potential vectors of salmonellosis: care should be taken to prevent water in which a pet terrapin has been kept from coming into contact with kitchen utensils or food (Newbery 1984). In people, salmonella causes diarrhoea, fever, and nausea, and can lead to more serious complications such as blood poisoning, meningitis, or death. The most serious cases are found in infants and people with weak immune systems (Salzberg 2000). The importation of red-eared terrapins into New Zealand was banned by the Department of Agriculture due to the potential human health risk (Robb 1980). Conversely, concerns have been raised regarding the depletion of *T. s. elegans* in their natural habitats in southern Louisiana, due to over collection of adults as breeding stock for farms (Warwick *et al.* 1990).

THE GLOBAL SITUATION

Introductions of red-eared sliders due to releases and/or escapes from the pet trade have been reported in Guam (Mariana Islands), Taiwan, Korea, Japan, Malaysia, Singapore, Thailand, Indonesia, Sri Lanka, New Zealand, Israel, Arabia, Bahrain, South Africa, Brazil, Panama, Bermuda, Italy, Spain, Britain, France, Guadeloupe, Guyana, Martinique, Polynesia, and Reunion, as well as in North America outside its natural range (Newbery 1984, Bouskila 1986, Uchida 1989, Ernst 1990, McCoid 1992, Platt and Fontenot 1992, Daniels 1994, da Silva and Blasco 1995, Moll 1995, Ota 1995, Luiselli *et al.* 1997, Servan and Arvy 1997, Chen and Lue 1998, Thomas and Hartnell 2000).

Although the red-eared slider is now found on every continent except Antarctica (Salzberg 2000), the ecological effects of introductions of *T. s. elegans* have been poorly documented (Platt and Fontenot 1992). Most research on its ecology and biology has been in its native temperate regions (e.g. Cagle 1944a, 1944b, 1946, 1950). This species is generally diurnal, feeding mainly in the morning and frequently basking on shores, logs, or while floating, during the rest of the day (Morreale and Gibbons 1986). At night, it sleeps lying on the bottom or resting on the surface near brush piles and hummocks (Ernst and Barbour 1972); however males may move overland at night. Aggressive interactions during basking among four species of emydid terrapins have been

observed (Lindeman 1999). Cagle (1946) correlated basking, feeding, and courtship with temperature. It is thought that the terrapins do not feed beyond the extremes of the temperature range of 10–37 °C and consequently do not grow. Juvenile red-eared sliders are mainly carnivorous, eating tadpoles, insects, snails, and spiders, but adults are opportunistic omnivores, consuming almost any food item available, including small fish, amphibians, water plants, and various molluscs (Newbery 1984, Parmenter and Avery 1990). They feed at any time of the day but usually in the early morning and late afternoon (Newbery 1984).

With its broad ecological tolerances, omnivorous diet, and dispersal ability, there is the potential for establishing breeding populations in many areas of the world but little research has been carried out yet. In some countries, where it has been introduced, red-eared sliders have been said to compete with indigenous species for food and basking spots (Salzberg 2000). There is some preliminary evidence that introduced *T. scripta*, now common in Bermuda, are eating mosquito fish (*Gambusia*) as well as a variety of local snails (Davenport *et al.* 2003). In almost all countries where they have been introduced, there are already indigenous freshwater chelonians.

Before focusing on Asia, we will first briefly examine some of the research on this species in areas where it has been introduced, which are pertinent to the Asian situation.

RESEARCH OUTSIDE ASIA

Although there has been some research carried out on the possible impacts of sliders in Europe, there is however to date no hard evidence of threats to the indigenous species *Emys orbicularis* (Linnaeus), *Mauremys leprosa* (Schweigger), and *Mauremys caspica* (Gmelin), or to freshwater ecosystems. However, in an experimental set-up in France, Cadi and Joli (2003) found sliders outcompeting *E. orbicularis* for basking sites. Again in France, Servan and Arvy (1997) reported that *T. scripta* was widely distributed and reproducing in three regions where the European pond turtle *E. orbicularis* occurred and Cadi *et al.* (2004) confirmed production of both sexes from nests incubated in the wild. A comparison of biological parameters with *E. orbicularis* showed that the red-eared slider was bigger, had a more precocious reproduction, the eggs were larger, the young heavier, and the populations more numerous than those of the European pond turtle (Servan and Arvy 1997). The minimum length of males of the red-eared slider at maturity is less than that of the *E. o. orbicularis*, which explains the precocious maturity of the red-eared slider: two to five years for *T. s. elegans* (Cagle 1950) versus six to 16 years for *E. o. orbicularis* (Servan and Arvy 1997). Morreale and Gibbons (1986) and da Silva and Blasco (1995) suggested that breeding populations of *T. scripta* would become established in south-western Spain, an area of habitats and climate similar to parts of its

native range, and so there is the potential for competition between *T. scripta* and the indigenous species (*M. leprosa* and *E. orbicularis*). In Valencia there is evidence of reproduction; nest sites and hatchlings (Sancho *et al.* 2005, N. F. Ramsay and R. M. O’Riordan 2005, personal observation). In the 1990s, da Silva and Blasco (1995) warned that, if the range of *T. scripta* expands, a displacement of the indigenous species can be expected and that this event would have especially deleterious consequences for *E. orbicularis*, as it is far more endangered and scarce in Estremadura than is *M. leprosa* (da Silva 1993). In 1997, the then 16-member European Union banned the import of red-eared sliders on the grounds that they were having a deleterious effect on the indigenous European pond terrapin (*E. orbicularis*).

In Israel, *T. scripta* is believed to compete with *M. caspica* (Bouskila 1986), while in South Africa it is suspected that *T. scripta* has displaced the native range of *Pelomedusa subrufa* (Lacépède) through competition. Sliders have adapted completely to the seasonal changes. Instead of breeding between March and September (the normal spring and summer months in North America), they breed during the South African equivalent (late August to February). The reproductive success of animals kept in large open pits on the Transvaal high veldt has been very good, suggesting that reproductive success will also be good for those individuals released into the natural environment. In Queensland, Australia, the red-eared slider became a declared Class 1 pest species in 2003 [Queensland Land Protection (Pest and Stock Route Management) Act 2002]. Class 1 pests are those species that have the potential to cause adverse economic, environmental, or social impacts.

IN ASIA

Asia is the world’s most speciose region for tortoises and terrapins as well as having the greatest percentage of threatened species, with more than 75% Critically Endangered, Endangered, or Vulnerable, and 91% on the IUCN Red list (Turtle Conservation Fund 2002). For obvious reasons, research effort and funding has focused on the indigenous species which are both often poorly known and highly endangered due to habitat loss and overcollection, and for aquatic species increasing industrial, agricultural, and domestic pollution of waterbodies. The introduction of NIS, perhaps carrying novel diseases and parasites, as well as being potential competitors, may pose another threat to their already precarious survival. Little research has been carried out in Asia on non-indigenous terrapins, including impacts of red-eared sliders on indigenous species, although there is ongoing research in Singapore (see below).

Commercial farming of species, particularly *Pelodiscus sinensis* (Wiegmann), can lead to other problems. When there is a slump in the market then farms go out of business as in Thailand and Malaysia in 2000 (CITES 2003). It is perhaps not unreasonable to assume that when a farm goes bankrupt unsold animals

are released. Unless there is effective bio-security, farms also act as reservoirs of disease from wastewater, escapes, vermin, etc.

Unlike in the EU, where the import of the red-eared slider was banned in 1997, it is still imported into many Asian countries. Whereas the trade in live freshwater and terrestrial chelonians in Europe and North America is almost entirely driven by the demands of the pet trade, in Asia there are multiple markets. There are the local traditional ones, for food especially the soft-shelled Trionychidae species; medicine, e.g. Three-striped Box Terrapin *Cuora trifasciata* (Bell) can fetch US\$2,000 on the black market, with material from the plastron of this species believed to be a cure for cancer (Guynup 2004); religious reasons (release for karma); and a growing internal pet trade. Demands from all of these potential markets within Asia are rising with a burgeoning middle class and consumer-driven populace.

Singapore

The red-eared slider is the only reptile species legally sold in Singapore in the pet trade, with the numbers imported peaking in 2005 at over 587,852 animals in that year (Lye Fong Keng, Agri-Food and Veterinary Authority, Singapore, 2006, personal communication). Table 1 shows the total numbers of imports and those from the United States of this species in the last few years, with a clear increase after a drop in 2003. A number of other chelonian species have been found illegally for sale in pet shops (ACRES 2005, Goh and O’Riordan 2007). In the wild, in Singapore, at least 11 species of terrapins have been recorded, both indigenous and NIS (Lim and Chou 1990, Lim and Lim 1992, Chou 1995, Teo and Rajathurai 1997). One of the indigenous species, the Mangrove or River Terrapin *Batagur baska* (Gray), is ranked as Critically Endangered by the IUCN and was first on the list of the World’s Top 25 Most Endangered Turtles released by the Turtle Conservation Fund in 2002, while two other species found in Singapore, the Spiny or Spiny Hill Terrapin, *Heosemys spinosa* (Gray), and the Giant Soft-shell Turtle, *Pelochelys cantorii* Gray, are categorized as Endangered. Furthermore, about 5% of Singapore’s reptiles have become extinct over the last 183 years (Brooks *et al.* 2003). By far, the most frequently observed chelonian in Singapore waterbodies is the red-eared slider. However, other NIS have also been found in them, including the Chinese Striped-neck, *Ocadia sinensis* (Gray), the Cooter, *Pseudemys* sp., Chinese Softshell, *P. sinensis*, and the Pig-nosed or Fly river turtle, *Carettochelys insculpta* Ramsay (P.K.A.Ng 2005, personal observation). The Chinese Softshell, *P. sinensis*, is the only species of terrapin permitted for import into Singapore for food. So, as in many parts of Asia, in Singapore there are three separate but sometimes overlapping trades in terrapins; the pet trade; for human consumption; and release for religious reasons. In Singapore, releases of introduced terrapins have gone on for decades (Lim and Lim 1992) for religious reasons, and when red-eared sliders become too large or aggressive to be kept as pets.

Table 1 Numbers and origins of red-eared sliders imported into Singapore (2001–2005).

Year	Numbers from US	Total Numbers
2001	284,000	301,245
2002	266,604	269,904
2003	147,363	149,863
2004	388,236	389,036
2005	522,502	587,852

(Source: Agri-Food and Veterinary Authority, Singapore)

Teo and Rajathurai (1997) mentioned 87 records of sliders in their survey of the nature reserves of Singapore and noted that this species was well established in the reservoirs and lakes of Singapore. They commented that fortunately at that time it had not established itself in forest streams, but it is known that red-eared sliders may move overland (Cagle 1944a) especially if a habitat becomes unsuitable, if there is overcrowding, for mate-seeking, or for securing food, and they may move up to 1.6 km from the nearest water to nest (Cagle 1950). Sulaiman (2002) noted that a major concern for conservationists in Singapore was that sliders may outcompete local species, such as the Spiny Terrapin and the Malayan box terrapin, *Cuora amboinensis* (Daudin). Sliders have been recorded laying eggs in the Botanic Gardens (Teo and Rajathurai 1997) and nesting behaviour has been observed there (T. W. H. Tan 2003, personal communication) and at the Night Safari of Singapore Zoological Gardens (T. M. Leong 2003, personal communication), but it is unknown whether the eggs were viable. In Singapore, there has as yet been no published research to show if *T. s. elegans* and other introduced terrapins are successfully reproducing in the wild and whether there are effects on indigenous species, e.g. if the reproductive period of *T. s. elegans* overlaps with indigenous species, there may be potential competition for nest sites. Sulaiman (2002) noted that a female slider can produce up to a dozen eggs twice a year and may out-breed the Malayan box terrapin that lays two eggs each time.

Since 2002, scientists at the National University of Singapore have been undertaking a comprehensive research programme on the biology of red-eared sliders in Singapore. The aspects under study are: (1) diet and whether there is overlap with indigenous terrapins or other species; (2) surveys of waterbodies for the presence and population size of both indigenous and non-indigenous terrapins; (3) estimates of the population size and structure, in particular for evidence of recruitment (habitat preferences of NIS are being compared with those of indigenous species); (4) the activity patterns of red-eared sliders are being examined and an ethogram determined (the occurrence

of courtship and nesting behaviour are being recorded and the timing of reproduction and egg-laying, the number of eggs produced, and the site of nesting are being examined; interactions with other species, terrapins and others, including aggression, competition for food and basking sites and predation are recorded); (5) the parasite and disease status are also being examined; (6) comparative studies of how red-eared sliders and two “local” species respond to food items, accelerative ability and food capture/handling methods by video-recording and kinematic analysis (c.f. Davenport *et al.* 1992) have been completed (Davenport 2005, personal communication).

The aim at the end of the research programme is to establish if there is an impact by sliders on the indigenous fauna and to provide a programme for long-term monitoring. Data from this research will be of use for resource management by the National Parks Board (the Singapore body responsible for parks and catchment areas) and to educate the public with respect to the potential problems that can result from releasing NIS into the environment.

Thailand

Adult sliders are abundant in all ponds in parks and temples in Bangkok (Jenkins 1995, Cox *et al.* 1998), and have been released into reservoirs and canals and captured in the wild, north of Bangkok (cited in Jenkins 1995). They have also been described as ‘common’ in Lumpini Park in southern Thailand (Ransdale 2001). There is also some commercial production and export of sliders but this is not thought to be significant (CITES 2003).

China

In China, a range of North American species are being farmed largely for local demand with 500,000 sliders being produced over three years. Recent exports of sliders to China from the USA were 4.65 million in 1998, 4.71 million in 1999, and 7.5 million in 2000. China has now stopped the import of sliders less than 10 cm long (CITES 2003). Surveys of some animal markets found sliders for sale in Chengdu and Kunming. At Qingshiqiao, 740 individuals of 11 species were recorded with sliders making up 95% (91% of these were hatchlings), at Huaniao 529 ‘turtles’ were on sale with 98% being sliders (97% hatchlings) (Shi 2000). A small number of sliders were on sale on Hainan Island in 2002 (Shi 2004).

Hong Kong

The presence of sliders in the wild has been recorded by the Hong Kong Reptile and Amphibian Society (www.hkas.com). Surveys of Kau Sai Chau, Sai Kung by Dahmer *et al.* (2001) found a new record for a slider in 2000 compared with a 1993 survey (Lau and Dudgeon 1999).

Malaysia

Sharma (1994) reported that in Peninsular Malaysia *T. scripta* hatchlings are commonly sold in pet shops in Penang, Perak (Ipoh and Taiping), Melaka, Terengganu, and Kuala Lumpur. According to Lim and Das (1999), *T. s. elegans* is widespread in the wild in both rural and suburban areas in Peninsular Malaysia; however, these authors do not mention it occurring in Borneo (see under Indonesia). At the Batu Caves near Kuala Lumpur, adult semi-captive sliders have been seen in ponds (Jenkins 1995). The authors know that some research is currently being undertaken on the sliders in Sabah.

Vietnam

Slider hatchlings have been seen on sale in Hanoi's Dong Xuan Market for the last few years, but have only recently been seen in the waterways. One was first discovered in Hoan Kiem Lake in Hanoi in 1997 by Professor Ha Dinh Duc of Hanoi University and, in 2003, more than a dozen juveniles and two adults were observed (Turtle Conservation Indochina 2003). The red-eared sliders, reportedly shipped in as hatchlings from Thailand, appear to have found their way into the lake as releases for religious reasons. Perhaps a hundred or more turtles are released into the lake by Hanoians each year as part of their tradition. Prof. Ha Dinh Duc noted that the Buddhist tradition of releasing wildlife has resulted in 12 species of turtles thus far being recorded in the lake, including *Indotestudo elongata* (Blyth), *Manouria impressa* (Günther), *Pyxidea mouhotii* (Gray), *O. sinensis*, and *P. sinensis* (Turtle Conservation Indochina 2003). In 2004, Prof. Ha Dinh Duc said that there had been no formal research into the impact of the red-eared slider on Hoan Kiem Lake's indigenous wildlife, but felt it was clear that there would be negative consequences as water levels fall, and called for detailed research into the consequences that NIS would have on genetic diversity and the lake's ecosystem. According to Turtle Conservation Indochina (2003), there is no clear evidence that the red-eared sliders are eaten in Vietnam or shipped to China, although larger individuals are occasionally observed in Ho Chi Minh and Hanoi markets. Red-eared sliders are likely to establish a foothold in Hoan Kiem Lake and possibly other places, as the lake offers suitable nesting, and it is likely that releases will continue to augment existing numbers in the future.

Republic of Korea

There are records of red-eared sliders from a number of areas of Korea. Sliders were originally imported into Korea in the 1970s for Buddhist release ceremonies and later as pets. There has been an estimate of 6.5 million animals imported up until when their import was banned in late 2001 (Soh Ji-young 2003).

Japan

Uchida (1989) wrote of the then current status of non-indigenous terrapins in Japan. More recently, a survey of 802 sites in 46 prefectures, conducted by the Nature Conservation Society of Japan in 2003, found 5,966 'turtles' and 90% of these were NIS, being mostly species common in Taiwan and North and South America. Sliders made up 62% (3,708) of all turtle records (Turtle and Tortoise Newsletter 2004, Templado 2005). There are also records from Okinawa (Ota 1995), while according to Brazil (2005) sliders can be found in every prefecture. The Invasive Alien Species Act was enacted in Japan at the start of June 2005. It prohibits the importation, sale, raising, and release into the wild of 37 NIS. Included in the list is the North American snapping turtle (*Chelydra serpentina* Linnaeus), and pet owners had until 1 December 2005 to register their turtle with the Environmental Ministry. However, the red-eared slider, of which up to a million are imported into Japan each year, is not listed. According to Templado's (2005) article, fear of a mass slider release is one of the reasons why this species was not included in the list.

Indonesia

The Asian Turtle Conservation Network has listed red-eared sliders from Sumatra, Java, Kalimantan (Borneo), Sulawesi, and Irian Jaya (Hendrie and Vazquez 2004). The Irian News reports that the WWF have an additional record for Manokwari in Irian Jaya in 2004 (Irian News 2004).

Taiwan

Lue and Chen (1996) found *T. scripta* to be the second most abundant turtle of all the rivers surveyed in Taiwan. Subsequently, these authors suggested that the wide ecological tolerance and dietary habits of sliders may cause impacts on indigenous chelonians in Taiwan (Chen and Lue 1998). Although the introduction of sliders may unfavourably affect indigenous fauna, only limited data are available regarding the status of its populations, as well as its relationship with indigenous organisms in Taiwan. In the Taipei Botanical Garden, released individuals of the sliders have almost eradicated the vegetation (water lilies) in a pond. The release of non-indigenous freshwater chelonians is banned in Taiwan, but the law is very difficult to enforce and some sliders are released through Buddhist Mercy Ceremonies. Severinghaus and Chi (1999) commented that in Taiwan prayer released birds are usually wild caught, while the turtles and fishes tend to be captive bred NIS, such as *T. scripta* and carp. The import into Taiwan of reptiles as pets is now banned by the government (Chen and Lue 1998).

We have not found any published information on red-eared sliders in India, Cambodia, Lao PDR, or Myanmar. Except for the record of its occurrence mentioned in Servan and Arvy (1997) we have no other data for Sri Lanka.

CONCLUSIONS

There is a growing awareness across much of Asia of the potential problems of NIS as well as of the trade in wild-caught chelonians. There is however a lack of research in most countries on any potential effects, negative or otherwise, of sliders and other non-indigenous chelonians on indigenous species. Indeed, the CITES (2003) report on the trade in chelonians has argued that since *T. scripta* evolved in a region with a diverse range of other terrapin species sharing the habitat, that although opportunistic, it generally does not exclude other species. If there is competition with other terrapins, it is more likely to be in temperate regions where basking becomes more important. The report suggested that it is unlikely that sliders will establish dominant populations in hill or forest streams nor in large rivers and reservoirs, but is more likely to establish in lowland, vegetated, slow-moving, or static waterbodies, e.g. in canals, ponds, and lakes. Luiselli *et al.* (1997) have emphasized that the introduction of NIS should always be strongly discouraged and that severe preventative measures should be adopted by each responsible government to reduce such activities. Releases into the wild can have far-reaching and harmful consequences for natural ecosystems (Newbery 1984) and it is necessary to educate the public about the potential deleterious effects. In Spain, steps are being taken to eliminate sliders (da Silva and Blasco 1995). Several Asian countries have now banned the importation of red-eared sliders and/or have attempted to restrict the trade in wild species. Unlike other tropical regions, there is a sizeable, local (i.e. Asian) demand for chelonians. The cultural significance has to be treated sensitively to avoid complaints of interference with religious beliefs and traditional medicine. This demonstrates the need for local, culturally sensitive educators preferably from the same communities in combination with scientific research. According to Jenkins (1995) and to the Asian Turtle Trade Working Group (2000), keeping chelonians as pets in South-east Asia was much less prevalent than in Europe and North America, but is not uncommon and is increasing. In the European Union, the banning of the sale of *T. s. elegans* has resulted in the importation of another subspecies, *T. s. scripta*, the yellow-bellied slider. It is therefore likely that a similar scenario of releases and escapes will result in another slider in the wild, while there is still not enough research on the potential impact of *T. s. elegans*. The CITES (2003) report commented that only continued monitoring of non-indigenous “freshwater turtle distribution combined with ecological studies of turtle communities in Asia and beyond can provide answers and suggest methods for active management” of non-indigenous freshwater turtle populations.

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REFERENCES

- ACRES. 2005. <http://www.acres.org.sg/Press%20releases/22Jul05.html>. Accessed 18/01/06.
- Asian Turtle Trade Working Group. 2000. Conclusions and recommendations. Pages 148–155 in P. P. van Dijk, B. L. Stuart, and A. G. J. Rhodin, editors. Asian turtle trade: proceedings of a workshop on conservation and Trade of freshwater turtles and tortoises in Asia, Phnom Penh, Cambodia, 1–4 December 1999. Chelonian Research Monographs 2.
- Bouskila, A. 1986. On the danger of the red eared terrapin, *Chrysemys scripta*, in natural habitats in Israel. *Hardun* **3**, 63.
- Brazil, M. 2005. Natural Numbers Game. Wild Watch, Isles of Biodiversity. The Japan Times. <http://search.japantimes.co.jp/print/features/enviro2005/fe20050217mb.htm>. Accessed 18/02/06.
- Brooks, B.W., N. S. Sodhi, and P. K. Ng. 2003. Catastrophic extinctions follow deforestation in Singapore. *Nature* **424**, 420–423.
- Cadi, A., V. Delmas, A.-C. Prévot-Julliard, P. Joly, C. Pieau, and M. Girandot. 2004. Successful reproduction of the introduced slider turtle (*Trachemys scripta elegans*) in the South of France. *Aquatic Conservation: Marine and Freshwater Ecosystems* **14**, 237–246.
- Cadi, A. and P. Joly. 2003. Competition for basking places between the endangered European pond terrapin (*Emys orbicularis galloitalica*) and the introduced red-eared slider (*Trachemys scripta elegans*). *Canadian Journal of Zoology* **81/8**, 1392–1398.
- Cagle, F. R. 1944a. Home range, homing behaviour, and migration in turtles. Museum of Zoology, University of Michigan Miscellaneous Publications **16**, 1–34.
- Cagle, F. R. 1944b. A technique for obtaining turtle eggs for study. *Copeia* **1**, 60.
- Cagle, F. R. 1946. The growth of the slider turtle, *Pseudemys scripta elegans*. *American Midland Naturalists* **36**, 685–729.
- Cagle, F. R. 1950. The life history of *Pseudemys scripta troostii* (Holbrook). *Ecological Monographs* **20**, 31–54.
- Chen, T.-H. and K.-Y. Lue. 1998. Ecological notes on feral populations of *Trachemys scripta elegans* in Northern Taiwan. *Chelonian Conservation and Biology* **3**, 87–90.
- Chou, L. M. 1995. Amphibians and reptiles. Pages 145–150 in S. C. Chin, R. T. Corlett, Y. C. Wee, and S. Y. Geh, editors. Rain Forest in the City: Bukit Timah Nature Reserve, Singapore. Garden's Bulletin Singapore Supplement **3**, 145–150.
- CITES. 2003. Trade in tortoises and freshwater turtles. Development of mid- and long-term conservation measures for tortoises and freshwater turtles. AC19 Doc. 15.2 (Rev. 1).
- Cox, M. J., P. P. van Dijk, J. Nabhitabhata, and K. Thirakhupt. 1998. A photographic guide to the snakes and other reptiles of Peninsular Malaysia, Singapore, and Thailand. New Holland, London, UK, 144 pp.
- da Silva, E. 1993. Distribución de los Emídios *Mauremys leprosa* Schw. (1812) y *Emys orbicularis* L. (1758) de la provincia de Badajoz: factores que pudieran influir en sus áreas de ocupacion. *Doñana Acta Vertebrata* **20**, 260–266.

- da Silva, E. and M. Blasco. 1995. *Trachemys scripta elegans* in Southwestern Spain. *Herpetological Review* **26**, 133–134.
- Dahmer, D. T., H. K. Kwokand, and M. L. Felley. 2001. New reptile and amphibian records for Kau Sai Chau, Sai Kung. *Porcupine* **23**, 1.
- Daniels, T. P. 1994. Red-eared Terrapin at Loch Ardinning, Milngavie (V.C.86). *The Glasgow Naturalist* **22**, 430–431.
- Davenport, J., K. Black, G. Burnell, T. Cross, S. Culloty, S. Ekaratne, B. Furness, M. Mulcahy, and H. Thetmeyer. 2003. *Aquaculture: the ecological issues*. The British Ecological Society, Ecological Issues Series, Blackwell, Oxford, UK, 89 pp.
- Davenport, J., M. Spikes, S. M. Thornton, and B. O. Riley. 1992. Crab-eating in the diamond-back terrapin *Malaclemys terrapin* (Latreille): dealing with dangerous prey. *Journal of the Marine Biological Association of the United Kingdom* **72**, 835–848.
- Ernst, C. H. 1990. Systematics, taxonomy, variation and geographic distribution of the slider turtle. Pages 57–67 in J. W. Gibbons, editor. *Life history and ecology of the slider turtle*. Smithsonian Institution Press, Washington, DC.
- Ernst, C. H. and R. W. Barbour. 1972. *Turtles of the United States*. University Press of Kentucky, Lexington, KY, 347 pp.
- Global Invasive Species Database
<http://www.issg.org/database/species/search.asp?st=sss&sn=&rn=Korea%2C%20Republic%20of&ri=18376&hci=-1&ei=-1&fr=1&sts=sss>. Accessed 20/03/06.
- Goh, T. Y. and R. M. O’Riordan. 2007. Are tortoises and freshwater turtles still traded illegally as pets in Singapore? *Oryx* **41**, 97–100.
- Guynup, S. 2004. Turtle Triage. *Wildlife Conservation*, online edition.
<http://www.wildlifeconservation.org/wcm-home/wcm-article/7191105>. Accessed 20/02/06.
- Hendrie, D. and R. I. Vazquez. 2004. *Tortoises and Freshwater Turtles of Indonesia*. Asian Turtle Conservation Network, PO Box 222, No. 2/C5, Tap the DH Ngoai Thuong, Hanoi, Vietnam. November 27, 2004.
- Irian News. 2004. WWF discovers Red Ear Slider in Manokwari, Indonesian’s Irian Jaya Province. Tuesday May 25, 2004.
- Jenkins, M. D. 1995. *Tortoises and Freshwater Turtles: The trade in Southeast Asia*. Traffic International United Kingdom, 50 pp.
- Lau, M. W. N. and D. Dudgeon. 1999. Composition and distribution of Hong Kong amphibian fauna. *Memoirs of the Hong Kong Natural History Society* **22**, 1–80.
- Lim, K. K. P. and L. M. Chou. 1990. The Herpetofauna of Singapore. Pages 50–59 in L. M. Chou and P. K. L. Ng, editors. *Essays in Zoology*. Department of Zoology, National University of Singapore, Singapore.
- Lim, B. L. and I. Das. 1999. *Turtles of Borneo and Peninsular Malaysia*. Natural History Publications (Borneo) Sdn. Bhd, Kota Kinabalu, Sabah, Malaysia, 151 pp.
- Lim, K. K. P. and F. L. K. Lim. 1992. *A guide to the Amphibians and Reptiles of Singapore*. Singapore Science Centre, Singapore, 160 pp.
- Lindeman, P. V. 1999. Aggressive interactions during basking among four species of emydid turtles. *Journal of Herpetology* **33**, 214–219.
- Lue, K. Y. and T. H. Chen. 1996. The distribution and conservation of fresh water turtles in Taiwan. Council of Agriculture. (In Chinese)

- Luiselli, L., M. Capula, D. Capizzi, E. Philippi, V. TruilloJesus, and C. Anibaldi. 1997. Problems for conservation of pond turtles (*Emys orbicularis*) in central Italy: is the introduced red-eared turtle (*Trachemys scripta*) a serious threat? *Chelonian Conservation and Biology* **2**, 417–419.
- McCoid, M. J. 1992. Geographic distribution: *Trachemys scripta elegans*. *Herpetological Review* **23**, 26.
- Moll, E. O. 1995. The turtle *Trachemys scripta* and the pet trade. *Aliens* **2**, 3.
- Morreale, S. J. and J. W. Gibbons. 1986. Habitat suitability index models: Slider turtle. US Fish and Wildlife Service Biological Report 82 (10.125), 14 pp.
- Newbery, R. 1984. The American red-eared terrapin in South Africa. *African Wildlife* **38**, 186–189.
- Ota, H. 1995. A review of introduced reptiles and amphibians of the Ryukyu Archipelago Japan. *Island Studies in Okinawa* **13**, 63–78.
- Parmenter, R. R. and H. W. Avery. 1990. The feeding ecology of the slider turtle. Pages 257–266 in J. W. Gibbons, editor. *Life history and ecology of the slider turtle*. Smithsonian Institution Press, Washington, DC.
- Platt, S. G. and L. W. Fontenot. 1992. The red-eared slider, *Trachemys scripta* (Wied) in South Korea. *Bulletin of the Chicago Herpetological Society* **27**, 113–114.
- Queensland Land Protection (Pest and Stock Route Management) Act 2002.
http://www.nrm.qld.gov.au/about/documents/annual_report/performance/turtle.html
Accessed 22/03/06.
- Ransdale, N. 2001. [www.surfbirds.com/mb/Trip Reports/thailand.html](http://www.surfbirds.com/mb/Trip%20Reports/thailand.html). Accessed 16/03/06.
- Robb, J. 1980. *New Zealand amphibians and reptiles in colour*. Collins, Auckland, New Zealand, 119 pp.
- Salzberg, A. 2000. The cage papers. *Salmonella and reptiles. The Norway rat of the turtle world*. *Reptile and Amphibian Hobbyist* **5**, 84.
- Sancho, V., I. Lacombe, F. Ramia, J. V. Bataller, and A. Forteza. 2005. Reproduction of *Trachemys scripta elegans* in Valencia Region (East Spain). Abstract from the 4th International Symposium on *Emys orbicularis* Valencia, Spain, 6–10 June 2005, p. 10.
- Servan, J. and C. Arvy. 1997. Introduction de la tortue de Floride *Trachemys scripta* en France. Un nouveau compétiteur pour les espèces de tortues d'eau douce européennes. *Bulletin Français de la Pêche et de la Pisciculture* **344–345**, 173–177.
- Severinghaus, L. L. and L. Chi. 1999. Prayer animal release in Taiwan. *Biological Conservation* **89**, 301–304.
- Sharma, D. S. K. 1994. Tortoise and freshwater turtle trade and utilisation in Peninsular Malaysia. TRAFFIC Southeast Asia Field Report No 15 unpublished, 34 pp.
- Shi, H. T. 2000. Results of turtle market surveys in Chengdu and Kunming. *Turtle and Tortoise Newsletter* **6**, 15b–16.
- Shi, H. T. 2004. Observations of wildlife trade in Wenchang City, Hainan Island, China. *Turtle and Tortoise Newsletter* **8**, 12–13.
- Soh Ji-young. 2003. Ministry declares war on destroyers of environment.
<http://times.hankooki.com/1page/nation/200306/kt2003062718025011970.htm>.
Accessed 20/01/2006.
- Sulaiman, S. 2002. American ex-pets pushing out locals. *The Sunday Times* (Singapore). September 29, 30 pp.

- Telecky, T. M. 2001. United States import and export of live turtles and tortoises. *Turtle and Tortoise Newsletter* **4**, 8–13.
- Templado, L. 2005. Alien species push around locals.
http://www.aquaticaliens.org/news_detail.php?News_Id=3. Accessed 10/10/2005.
- Teo, R. C. H. and S. Rajathurai. 1997. Mammals, reptiles and amphibians in the nature reserves of Singapore- Diversity, Abundance and Distribution. Proceedings of the Nature Reserves Survey Seminar. *Garden's Bulletin Singapore* **49**, 353–425.
- Thomas, M. and P. Hartnell. 2000. An occurrence of a red-eared turtle (*Trachemys scripta elegans*) in the Waikato River at Hamilton, New Zealand. *Herpetofauna (Sydney)* **30**, 15–17.
- Turtle & Tortoise Newsletter. 2004. Over 60% of turtles in Japan are foreign species. Issue 8: 32 Dec. 2004/Japan For Sustainability Newsletter and International Wildlife Coalition, 16 December 2003.
- Turtle Conservation Fund. 2002. A Global Action Plan for Conservation of Tortoises and Freshwater Turtles. Strategy and Funding Prospectus 2002–2007. Washington, DC: Conservation International and Chelonian Research Foundation, 30 pp.
- Turtle Conservation Indochina. 2003 Newsletter of the Turtle Conservation and ecology Program (TCEP) 2.
- Uchida, I. 1989 The current status of feral turtles of Japan. *Anima* **205**, 80–85.
- Warwick, C. 1991. Conservation of red-eared terrains *Trachemys scripta elegans*: threats from international pet and culinary markets. *Testudo* **3**, 34–44.
- Warwick, C., C. Steedman, and T. Holford. 1990. Ecological implications of the Red-eared turtle trade. *The Texas Journal of Science* **42**, 419–422.
- Williams, T. 1999. The Terrible Turtle Trade. *Audubon* **101/ 44**, 46–48.