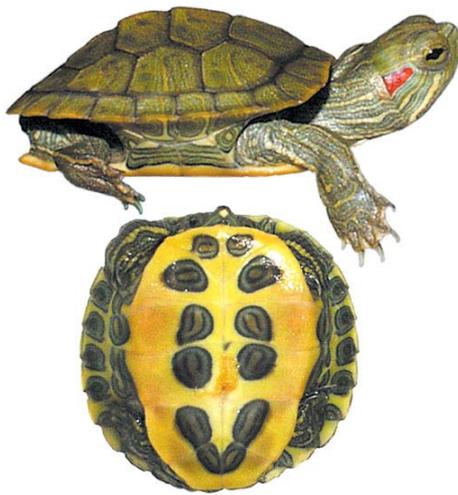


## Red-eared slider turtles (*Trachemys scripta elegans*)

Jenny Burger

Fish 423

7 December 2009



Red-eared slider (1)



Melanistic red-eared slider (2)



Pastel red-eared slider (2)



Albino red-eared slider (2)

## **Diagnostic information**

Red-eared slider turtle is the common name of the invasive species *Trachemys scripta elegans* of the order Testudine, family Emydidae. They are named for the characteristic red postorbital stripes on either side of their heads and innate ability to slide off rocks and logs and into the water. The head, neck, legs, and tail of the slider are olive to brown in color and striped with cream to yellow colored ribbons. These markings on their limbs vary geographically and can come in the form of stripes, reticulations, ovals, etc. Toes are webbed and all bear foreclaws, males having elongated claws compared to females. The carapace is brown to olive with yellow markings that differ depending on the geographic location of the turtle. They have a yellow plastron made up of twelve scutes with distinct markings that range from blotches to intricate patterns. The plastron is slightly broader at the anterior than the posterior. Red-eared sliders have round heads with a protruding snout, a Y-shaped mark on their chin, and a black stripe that runs through their eyes.

Melanism is a common occurrence in older males of the species. It is the ontogenetic darkening of the skin, carapace, and scutes to brown and dark gray or green. The yellow markings on its limbs and head pale and become subdued, leaving the turtle uniform in color. The red stripe behind each eye fades and eventually turns gray. These turtles lack the

characteristics by which the species is identified. There are two other distinct morphs of the red-eared slider; pastel and albino. These morphs are not common in nature, but the turtles are bred to specifically bear these unique colorings. As with melanism, the different morphology of the turtle makes it difficult to identify as a red-eared slider.

## **Life-history and basic ecology**

Red-eared sliders are ectothermic, freshwater aquatic reptiles that spend their time foraging in densely vegetated ponds or basking on logs in the sun. They prefer quiet waters with soft, muddy bottoms, aquatic vegetation, and suitable sites for basking. Basking is important in thermoregulation of body temperature in red-eared sliders. Optimal body temperature is 28°C and is maintained by gaining energy from the sun. Sliders will remain active year round depending on their geographic location. They prefer temperatures ranging from 50 to 90°F, but if the temperature drops below the critical level, the turtles will brumate. Otherwise they are active during the day and sleep during the night, either resting at the bottom or floating on the top of the water. Inside their native range the turtles fill an ecological niche as both a predator and a prey item. They are hardy turtles, and thus outside their native range they fill the same ecological niche with great adaptability.

Turtles are known for their longevity in life, and red-eared sliders follow suit. The average life

span of a red-eared slider is 20-50 years, although generally less for turtles kept as pets. The majority of their growth occurs in early years of life and they do not continue to grow throughout their lifespan. Adult turtles will grow to be 250-300mm in females and 200-250mm in males. Males reach sexual maturity when they are between 90 and 110mm in carapace length, or have distinctively elongated claws. There is a positive correlation between body size and secondary sexual characteristics (claw length) in male sliders. Size is of greater importance in terms of determining sexual maturity than is the age of the male turtle. However, males generally reach sexual maturity between three and five years of age. In females, just the opposite is true; age is more important in determining sexual maturity than is body size. Females may reach sexual maturity at a body size of anywhere from 160 to 200mm, as they are generally larger than males. Age of sexual

maturity of females is typically 5 to 7 years in the wild.

Courtship and mating of mature red-eared sliders occurs in the spring, between March and July. Because females can retain viable sperm for at least a year, mating may occur several weeks or months prior to ovulation in the spring. Red-eared sliders have a particular courtship pattern that is distinctive to their subspecies due to the elongated foreclaws of the males. The courtship occurs in the water with the male swimming backwards in front of the female and facing her. He extends his forelegs with the “palms” facing out and flutters his foreclaws in her face. Once he wins her over, and fertilization occurs, the female may spend additional time basking and change her diet slightly in order to provide for her developing eggs.

During the months of May through June, the female will dig out her nest and lay her eggs.

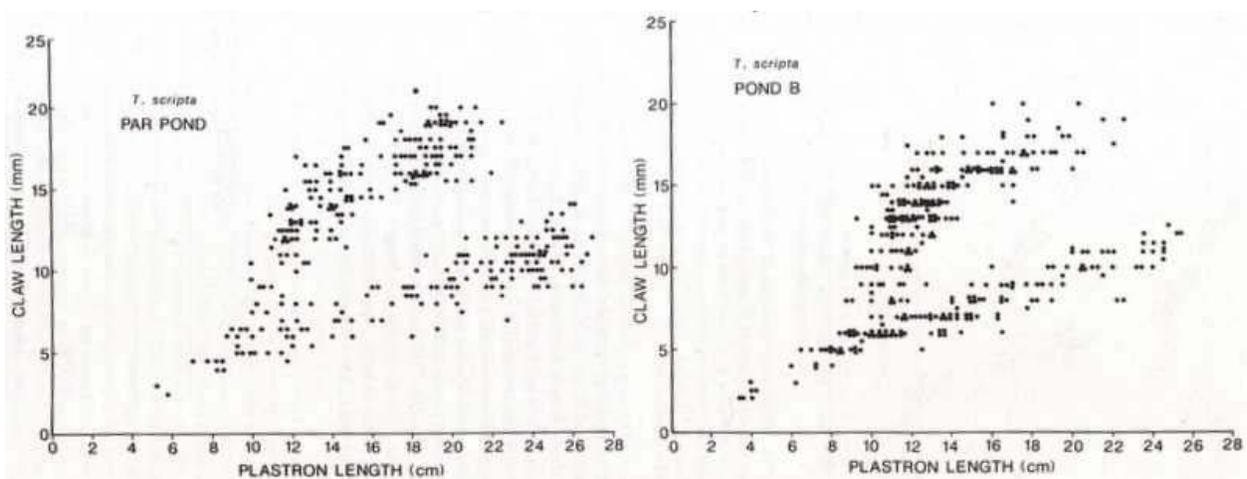


FIGURE 9.2. Relationship between body size (plastron length) and claw length to determine size at maturity in male *T. scripta* from four SRP populations. Incipient maturity is expressed by claw elongation in males that are 9 to 11 cm in plastron length, at which point they begin to diverge from females.

Relationship between body size and claw length to determine size at maturation (Gibbons).

Oviposition of the first clutch will occur when the shells of the eggs are fully formed and the environment is suitable. After the first clutch is laid, a female may oviposit multiple additional clutches distributed between separate nesting sites. A clutch consists of anywhere from 2 – 25 eggs and females may lay as many as five clutches per year. Females may be particular about their nests. Nesting sites are generally in full sunlight for some portion of the day in order to gain sufficient warmth and UV rays from the sun. The female will choose a location with little vegetation that is easy to dig into, as she will dig out a nest using her hind limbs. Clutch size is positively correlated with body size of the individual. Other variants influence the size of the clutch such as season, age, and habitat qualities, however body size has a greater effect on number of eggs in a clutch.

Sixty to ninety days after the clutch is laid, hatchlings emerge from the eggs using an ‘egg

tooth’ which they subsequently lose and do not regain. Red-eared slider hatchlings are approximately 25mm in length; they emerge ready for the elements. Hatchlings have a green carapace that gradually grows darker with age. The sex of the red-eared slider hatchlings is determined by the ambient temperature;  $>29^{\circ}\text{C}$  females,  $<29^{\circ}\text{C}$  males. Once emerged, the hatchlings are on their own as far as parental care goes and begin foraging almost immediately. Hatchlings will grow at a linear rate until they reach the full size of 250-300mm in females, and 200-250mm in males.

In the winter months, red-eared sliders go through a hibernation-like state called brumation. This is an adaptation of many ectothermic reptiles so as to maintain viable body temperatures when the ambient temperature drops below a certain point. Red-eared sliders attempt to keep a body temperature of  $28^{\circ}\text{C}$ , spending hours a day basking in full sunlight in order to maintain this optimal temperature. When the temperature of the water drops below  $10\text{-}15^{\circ}\text{C}$  the turtles enter brumation in order to thermoregulate. During this period of brumation, the turtles sustain a drop in metabolism and become incredibly lethargic. Most red-eared sliders will brumate under water, surviving only on oxygen absorbed through their skin. Otherwise, sliders will brumate in burrows, logs, or stumps. When the temperature begins to increase the sliders will re-animate and come out, basking on logs and feeding after an extended period without food.

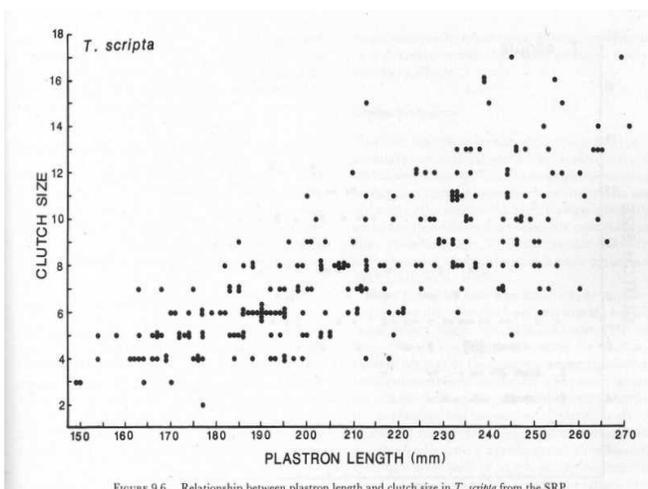


FIGURE 9.6. Relationship between plastron length and clutch size in *T. scripta* from the SRP.

Relationship between plastron length and clutch size (Gibbons).

Red-eared sliders are opportunistic omnivores, one of the characteristics that make them good invaders. They consume a diet of mixed greens such as dandelions (*Taraxacum officinale*) as well as aquatic vegetation including water hyacinth (*Eichhornia crassipes*), duckweed (*Lemna minor*), and anacharis (*Elodea canadensis*). Protein-based foods in their diets include earthworms (*Lumbricus terrestris*), ghost shrimp (*Palaemonetes kadakensis*), frogs, crayfish, small fish, tadpoles, and arthropods. Young red-eared sliders are generally more carnivorous than adults, but become more omnivores with age. This shift in diet is most likely due to the slight change in habitat as the turtles grow larger and occupy greater depths of the pond. Plant vegetation is more common at depth than are animal prey. Sliders are opportunistic, aggressive feeders, with a preference for moving prey. Their diet shifts seasonally from plant vegetation and a variety animal prey in the summer to a vegetation dominant diet in the winter months. This is attributable to the availability of prey during these seasons.

Slider turtles forage during the day, using both keen eyesight and olfactory sense to detect prey in the water. They typically forage in shallower waters with increased sunlight allowing for better visibility. They can detect odors in the water, however this sense does not play as large a role as visual perception does in their foraging. Red-eared sliders may forage for the majority of

their waking hours, swimming slowly in the pond shallows. Hatchlings will commence foraging immediately upon emerging from the egg. Temperature dictates feeding regimes in these turtles; basking for extended periods after foraging in order to activate their metabolism.

The main predator of the red-eared slider is the human. Because sliders are highest in abundance in urban parks, ponds, and wetlands, they often interact in negative ways with humans; crushed by cars, collected by kids, hooked by fishermen, etc. Other predators include raccoons, otters, fish (pike and bass), frogs, snakes, skunks, birds (herons, crows), as well as ants and maggots that invade the eggs. Hatchlings are at most danger to predators due to their small size and tendency to forage in shallow waters. Due to their susceptibility to predation, young turtles exhibit a particular tactic to prevent consumption; when swallowed by fish they hold their breath and chew on the stomach lining until regurgitated. This depicts this the aggressive nature of the red-eared slider, even as a prey item.

Disease, infection, and parasitism are common in red-eared sliders as in many turtle species. Because their primary defense is their shell, most of their energy is expended on the construction and maintenance of a durable carapace. However, this results in little energy allocation towards other defensive tactics such as an immune system. As a consequence, these turtles have weak immune systems that are highly susceptible to attack from viral and

bacterial infections. Common illnesses include gram-negative bacterial infections of the mouth or the carapace. These infections are contagious to other turtles. Pneumonia and respiratory infections are other common illnesses due to poor thermoregulation. Reptiles are known carriers of *Salmonella* bacteria, although it does not always infect them. Red-eared sliders can pass *Salmonella* to other turtles as well as humans.

### Current geographic distribution

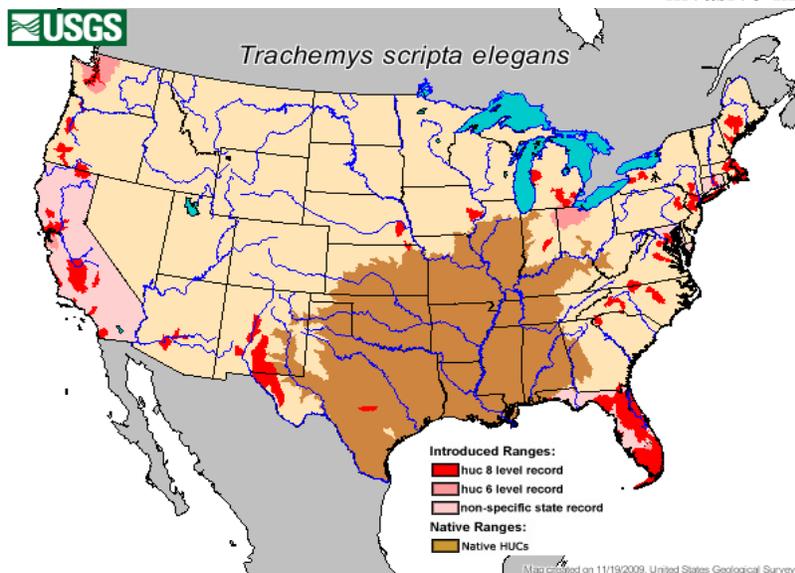
The red-eared slider's native range is in the Mississippi Valley, distributed from Illinois down through the Gulf of Mexico. However, its current range within the United States extends past its native range to the east and west coasts, as well as Hawaii and Puerto Rico. North,

south, and inland of the east coast the red-eared slider is documented to have been introduced and established with thriving populations in many states. More northern states such as Maine and Wisconsin with harsh winters report possible sightings but doubt survival through the colder months. It is reported to be well established in the southwest, and clearly invasive on the west coast. Washington, Oregon, and California have established and invasive populations of the sliders and reports suggest probable underestimation of the full distribution of the species in these states.

The slider has been introduced into Southeast Asia and is clearly invasive in this region, specifically Taiwan, Japan, South Korea, Singapore, and Thailand. Additionally it has been introduced into Europe; France, Germany, Italy, and the United Kingdom and is considered invasive in many of these locations. Red-eared

sliders have also been introduced to the Caribbean, Guam, Trinidad, Israel, Australia, New Zealand, and South Africa. Complete and current distributions of this turtle may be greatly underestimated.

Due to the vector by which the red-eared slider is introduced, it occurs in many developed countries, specifically in urban settings. In Washington state sliders have been sighted most frequently in Washington in King,



Current U.S. distribution, not including Alaska, Hawaii, Puerto Rico (3).

Pierce, and Thurston counties, including the Puget Sound area. In Oregon, slider occurrences are in Multnomah, Klamath, Jackson, Douglas, and Lane counties.

### **History of Invasiveness**

As early as 1900 the red-eared slider was captured in the wild and sold at flea markets and dime stores in the United States. It was a popular turtle because of its small size and low price; being sold while no bigger than a silver dollar in size. By 1950 the slider turtles were being farmed in order to increase exporting abilities as their popularity as pets grew. It is reported that millions of red-eared slider turtles were exported within the United States and overseas to be sold as pets. Due to lack of knowledge and septic conditions on farms, the turtles were often sold bearing *Salmonella* and *Arizona* bacteria. Farming conditions involved feeding of slaughterhouse offal to the ranched turtles. Turtles being sold were typically no larger than hatchlings and were often sold as pets to young children. Due to a turtle-transmitted *Salmonella* outbreak in nearly 300,000 young children, the sale of turtles less than 100mm (4 inches) in length was banned in 1975 by the U.S. Food and Drug Administration. Turtles less than 100mm were considered to be of a size that could easily fit into a child's mouth. Red-eared sliders continue to be the most popular aquatic turtle for home aquarists. The release of the second volume of Teenage

Mutant Ninja Turtles comic books boosted sales of the red-eared sliders in Great Britain. The comics revealed that the TMNT characters were in fact red-eared slider turtles.

The turtles are sold as pets and released by owners when they tire of them or they become too large to be taken care of. Additionally, the turtles are released as part of a Buddhist mercy ceremony in many Asian countries. In some places they are sold specifically for this purpose.

### **Invasion Process**

#### *Introduction*

Red-eared slider turtles are entrained and transported outside their native range through the aquatic pet trade and through prayer and ritualistic release. They are the most popular aquatic turtle species for home aquarists and have subsequently been transported globally. They are farmed in their native range and subsequently shipped within the United States as well as overseas to Europe and Asia. Red-eared sliders are one of several species commonly released during prayer and ritualistic release. This primarily occurs in Asia and is well documented in Taiwan where sliders can be purchased specifically for this ceremony.

The turtles are released into the wild when the owner tires of the pet, it grows too large, lives longer than expected, or becomes sick. It is a general consensus that releasing the turtle to a nearby pond is more humane than euthanizing it. Red-eared sliders have a relatively long life span

compared to the typical dog or cat. Owners often are not prepared to take care of a pet for several decades and tire of it or can no longer take care of it. Sliders are sold as young turtles only 4" in length and continue to grow after purchase to a full size of 10-12". Owners may not expect this increase in size and are not prepared to take of such a large turtle. Occasionally, due to poor caretaking, the turtle may become sick, commonly with respiratory disease or parasites. Illness can be remedied, however many owners do not wish to pay for medication for pet they purchased for less than ten dollars. Thus, turtles are released bearing illnesses. In general, the turtles are released to nearby ponds and lakes, infiltrating urban ecosystems. In Taiwan and other primarily Asian locations, red-eared sliders are released in prayer ceremonies. It is a belief among Buddhist that one can accrue merits from the gods by freeing animals from captivity. By this mechanism, red-eared sliders are released into remote locations far from urban centers.

Red-eared sliders are farmed and transported locally, nationally, and internationally by plane, truck, etc. They can be purchased online and shipped directly to the owner or purchased in pet stores. Their mode of transport to the release location is via the owner; most likely in car or on bus to the nearest pond, lake, or wetland.

### *Establishment*

Several factors contribute to the establishment of this invasive species. These

include propagule pressure, ecological attributes of the red-eared slider, and the characteristics of the environment in which they are released.

Red-eared sliders are released into the environment at extremely low propagule size, typically one turtle at a time. Propagule number is higher, with a constant influx of newly arriving turtles to the ecosystem. Due to their popularity in pet stores for decades, they have been released continuously over the years. Continued release of the turtles to urban ponds allows for an increase in genetic diversity of establishing populations. By adding genetic variation, the turtles diversify the phenotype which can increase their resistance to environmental change as well as minimize Allee effects. Because they are popular pets worldwide, they are released into the wild with great spatial distribution. This increases their likelihood of establishment, in that at least one location will provide suitable conditions. Quality of the released propagule also plays a role. Because the individuals being released and establishing populations come from home aquariums, they are most likely in good condition. Unless the individual is being released because it sick, the turtle is most likely to be larger in size and well taken care of. This increases the probability of establishment because the individuals themselves are in good condition.

Ecological attributes of the red-eared slider turtle may predispose it to successful establishment. Red-eared sliders have a

relatively expansive native range; from Illinois to the Gulf of Mexico. This gives the slider an advantage when transported outside of this range because it is distributed across a variable landscape. A wide distribution in its native range also conditions the red-eared sliders to have a high environmental tolerance. The temperature difference from Illinois to Texas is large, and the turtles can survive throughout. Brumation allows red-eared sliders to endure harsh temperatures that it may encounter outside of their native range. As long as the point of release provides summer temperatures sufficient to fully develop the eggs, the red-eared slider can establish.

The genetic variability of the founding populations is important for the establishment of an invasive species. Due to the mechanism of release of red-eared sliders as well as the dispersal of clutches laid by the females, genetic variability can be kept high. Female red-eared sliders lay their clutches in various nesting sites throughout the summer, spreading their eggs over the landscape. Though this is not over a large area, it means the hatchlings emerge in relatively different locations. Additionally, the reproductive cycle of the red-eared sliders is timely; hatchlings emerge approximately two months after oviposition fully developed and begin foraging. The longer lifespan of the red-eared slider aids in the establishment of the species because they reproduce consistently every year.

The ability for the red-eared slider to consume a

broad, omnivorous diet allows it to fit in to a multitude of ecosystems. This is one of the key characteristics of a good invader because they are not limited by the resources at the point of release. Though they are not typically associated as being a fast-moving species, the red-eared slider is surprisingly quick. Their most common mode of dispersal is simply walking. Although this does not necessarily enable them to move between ponds, they do have the ability to do so, being amphibious organisms. The most important quality of this invader relative to establishment is its association with human activity. Red-eared sliders would not be so widely dispersed throughout the world and establishing in so many ecosystems without the aid of human activity. Not only do they provide the vector by which the turtles are introduced, they provide a constant influx of individuals to the system, they care-for and farm the turtles, and they disperse the sliders over long-distant ranges.

Successful establishment of an invader depends on the environment in which the organism is introduced. Red-eared sliders can be observed taking advantage of the vacant niches in the majority of their introductions and subsequent establishment. The turtles are frequently released into urban wetlands and ponds. These ecosystems have generally undergone disturbance by humans by means of urbanization. In several cases, the native turtle population has been decimated by the increase in habitat disturbance. With red-eared sliders

consistently released in these systems, they successfully establish in urban ecosystems. Because the native turtles are not able to survive due the human disturbance, a niche in the ecosystem is opened. Red-eared sliders move right in and take advantage of the unused resources and basking sites.

### *Spread*

Once self-sustaining populations are established, the red-eared slider can spread beyond its new range. This does not readily occur by natural methods of dispersal attributed to the turtle. Walking across long ranges is not a common occurrence of red-eared sliders. However, if they are established in a location with surrounding bodies of water; multiple ponds or lakes, a wide-spread wetland, then they can move across the landscape. Because the turtles are more vulnerable on dry land, they prefer not to be out of water for extended periods of time. Thus, this leading-edge expansion process can occur but is not the most frequent mode of dispersal for the red-eared slider.

More frequently, the turtle is dispersed via humans across large distances. Red-eared sliders would not have made it across both Pacific and Atlantic oceans to invade Europe and Asia without the hand of humans. Due to their popularity in the United States as aquatic pets, they were subsequently transported globally and re-released by their owners. This is an example of extreme long distance, or jump

dispersal. Humans have made it possible for the red-eared sliders spread to become a global issue. Additionally, red-eared sliders are farmed, or cultivated and shipped within the U.S. and overseas. In the past, farming was done under unsanitary conditions and the turtles were not healthy individuals. However, due to changes in farming practice, the turtles are healthy and vigorous individuals. Because we take care to farm the animals, we are introducing and spreading viable red-eared sliders to the ecosystem.

### *Impact*

There is little known about the full impact of red-eared sliders on the ecosystems they invade. Part of this has to do with the turtles being released into urbanized areas as opposed to areas of higher ecological value. Additionally, they have been introduced in the ecosystem going on decades and it is difficult to gain an idea of the baseline ecosystem prior to the invasion. There are several indicators that this species inflicts both ecological and subsequently economical impacts on the local invasion sites.

Ecologically, the red-eared slider impacts the system on a multilevel scale. Genetically, there are documented cases of the red-eared slider hybridizing and intergrading with native turtle species. Interbreeding between red-eared sliders and yellow-bellied sliders (*T. s. scripta*) has been documented, as well as hybridizing with the big-bend slider (*T. gaigeae*). Hybridization

and introgression results in genetic swamping by the red-eared slider gene pool and compromises the genetic integrity of the native species.

On the individual level, the red-eared slider negatively affects the native turtle species by out competing it for food resources. This effectively lowers the body size of the native turtles, decreasing their fitness, and increasing mortality rates. Due to the aggressive behavior exhibited by red-eared sliders, they also out compete natives for basking sites; a crucial element in the daily routine of these ectothermic reptiles. Reduced availability of basking sites for native turtles due to the presence of red-eared sliders may affect their growth rates and mortality rates. Population-wise, red-eared sliders are known vectors of diseases and parasites. Due to the previously unsanitary farming conditions by which millions of exported red-eared sliders are reared, they bring infection and illness to the ecosystem they invade. Improper care by the home aquarist can result in disease and infection of their pet red-eared slider. Upon introduction to the ecosystem, these turtles can infect the natives. The native turtle population has no inherent defenses to the diseases brought by the red-eared sliders. This reduces the abundance of the native species, subsequently allowing more room for the red-eared slider to move in.

Community and ecosystem level impacts are not yet documented. Implications of impact by the red-eared slider on these levels is high but not well known at this point in time. Critical levels of native turtle populations due to red-eared

sliders could change the composition of the native community in adverse ways. Ecosystem-level impacts are doubtful but possible in the long run, considering the extent of this invader thus far.

The red-eared slider's economic impact is apparent in the methods of management and control employed due to its invasion. Methods of removing the red-eared sliders require time, effort, and funding. Red-eared slider shipping and trading is a multi-million dollar market, the ban of importation of the turtle to many countries has negative economic impacts on turtle farms. Many states, including Oregon and Washington, have management regimes in place to control red-eared slider invasion. Additionally, recovery plans are being implemented for resurrection of native turtle populations adversely affected by the red-eared slider. These managerial strategies require funds that could be going elsewhere if not for the extensive impacts of the red-eared slider.

Impacts both ecologically and economically by the red-eared slider are negative. However, a social study done in Paris asked locals their feelings on the red-eared sliders that invaded the urban ponds. Many citizens who went on walks and hikes in and around the city enjoyed seeing the turtles, especially in an urban setting. The red-eared sliders represented an element of nature which is not common in cities and large towns. It is suggested that a positive attitude towards these turtles in urban settings could attract people back to nature. However, anyone

who knew the impact of these turtles would not be so positively influenced by seeing it at a local pond.

Here in the Pacific northwest, red-eared sliders out compete the two native species of turtles. Western Pond turtles (*Actinemys marmorata*) and the Western Painted turtle (*Chrysemys picta*) are distributed throughout Oregon, Washington, and California. Introduction and establishment of the red-eared slider turtle has resulted in a decrease in abundance of these two natives. Red-eared sliders compete these turtles for basking sites and food resources. They often bring disease which can result in localized decimation of native turtle populations. Biologists are concerned about the viability of Western Pond turtle and Western Painted turtle populations if red-eared sliders continue to prevail. Oregon has enacted strict laws pertaining to the possession, release, purchasing, or selling of red-eared sliders. Washington attempted to outlaw red-eared sliders but was inhibited by lobbyists.

### **Management strategies and Control methods**

Management and control of such a heavily invasive species is difficult and costly. Many places where the red-eared slider has impacted the local ecosystem, strict penalties have been put in place to regulate the animal. In 1997 the European Union put a ban on the importation of red-eared sliders under the Protection of Species of Wild Flora and Fauna

by Regulating Trade. In addition to the ban, education programs are being implemented, but at low levels and not necessarily specific to the red-eared slider turtle. In Australia, the red-eared slider is classified as at Class 1 pest and banned from importation. There are serious penalties for ownership, sale, or release including \$100,000 in fines and a 5 year jail sentence. The Department of Natural Resources, Mines & Water has nearly eradicated the species in Australia, with only one known population in the wild. Australian officials increased public awareness of the invasiveness of the pest, putting up identification fliers, and used sniffer dogs as a successful method for eradication.

In the United States, the FDA put a ban on the sale of red-eared sliders under 4" in carapace length. However this was due to turtle-contracted Salmonella and not for the inhibition of the species. Florida and Oregon are the only two states that have outlawed red-eared sliders; making it illegal to possess, release, sell, or buy the turtles. In Oregon red-eared sliders are classified as an invasive nonnative species with no place in the northwest ecosystem. There are several management plans to resurrect the native Pond turtle populations that have been decimated by the introduction of the red-eared slider. These recovery plans involve captive breeding and headstart programs in hopes of increasing the abundance of these turtles.

Control against red-eared sliders involves catching the turtles and either euthanizing them

or sterilizing them and returning them to the environment. Catching is possible using floating basking traps or baited traps. Such traps are in place in several states in order to control for the species. Biologists who know the species well may observe nesting females and confiscate the eggs. Although public opinion and animal laws are in opposition, some resort to catching turtles on a hook and line or shooting them while basking. These are not preferred methods for urban settings.

Education programs are in effect in an attempt to educate the general public about the invasiveness of the species. Many purchase the animal from a pet shop without knowing its history as an invasive species and the potential impact it has on the ecosystem. Additionally, it's sale is only outlawed in two of fifty states in the U.S. even though it is reported as introduced, established, and possible invasive in many more. Consistent regulation of the animal across states would improve control and management efforts. Some wonder if control and management is worthwhile considering its current invasive distribution and projected modeled distributions accounting for global warming.

### Literature Cited

- Boersma, P. D., Reichard, S. H., Van Buren, A. N. (2006) Invasive Species in the Pacific Northwest. University of Washington Press, 166 pp.
- Bury, R. Bruce. (2008) Do Urban Areas Favor Introduced Turtles in Western North America? *Urban Herpetology*, 343-345 pp.
- CADI, A., & JOLY, P. (2003). Competition for basking places between the endangered European pond turtle (*Emys orbicularis galloitalica*) and the introduced red-eared slider (*Trachemys scripta elegans*). *Canadian Journal of Zoology*. 81, 1392-1398.
- CADI, A., & JOLY, P. (2004). Impact of the introduction of the red-eared slider (*Trachemys scripta elegans*) on survival rates of the European pond turtle (*Emys orbicularis*). *Biodiversity and Conservation*. 13, 2511-2518.
- Chen, Tien-His (2006) Distribution and status of the introduced red-eared slider (*Trachemys scripta elegans*) in Taiwan. *Assessment and Control of Biological Invasion Risks*. 187-195.
- Ferri, Vincenzo and Soccini, Christiana. (2008) Management of Abandoned North American Pond Turtles (*Trachemys scripta*) in Italy. *Urban Herpetology*, 529-533pp.
- Gibbons, J. Whitfield (1990) Life History and Ecology of the Slider Turtle. Smithsonian Institution Press.
- OUTERBRIDGE, M. E. (2008). Ecological Notes on Feral Populations of *Trachemys scripta elegans* in Bermuda. *Chelonian Conservation and Biology*. 7, 265-269.

Ruiz, Gregory M., Carlton, James T.. (2003) Invasive species: vectors and management strategies. Island Press.

Teillac-Deschamps, Pauline; Delmas, Viginie; Lorrilliere, Romain; Servais, Veronique; Cadi, Antoine; Prevot-Julliard, Anne-Caroline. (2008) Red-Eared Slider Turtles (*Trachemys scripta elegans*) Introduced to French Urban Wetlands: an Integrated Research and Conservation Program. *Urban Herpetology*, 535-537 pp.

Williams, Ted. (1999) The Terrible Turtle Trade. *Audubon* 44, 101, 2

"Project offers endangered turtles a head start to recovery." *Fish & Wildlife Science*. July 2002. WDFW, Web. 6 Dec 2009. <[http://wdfw.wa.gov/science/articles/po nd\\_turtle/index.html](http://wdfw.wa.gov/science/articles/po nd_turtle/index.html)>.

"*Trachemys scripta elegans* (reptile)." *Global Invasive Species Database*. 13 May 2007. IUCN/SSC Invasive Species Specialist Group (ISSG), Web. 6 Dec 2009. <<http://www.issg.org/database/species/ecology.asp?si=71&fr=1&sts=sss<=EN>>

<http://www.turtlefarms.com/>.

(2) *The Turtle Source*. Web. 6 Dec 2009. [http://www.theturtlesource.com/turtle\\_inventory.asp?cat=333&id=100200300](http://www.theturtlesource.com/turtle_inventory.asp?cat=333&id=100200300).

(3) "USGS Interactive Map." *NAS*. Web. 6 Dec 2009. <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=1261>.

*ODFW-Oregon Conservation Strategy*. Web. 6 Dec 2009. <<http://www.dfw.state.or.us/conservationstrategy/turtles.asp>>.

## Other sources

### Figures and Photos

(1) "Red-Eared Slider (*trachemys scripta elegans*)." *Concordia Turtle Farm, LLC*. Web. 6 Dec 2009.