

Imminent competition between *Trachemys scripta* and *Emys orbicularis* in France

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Abstract

Recent massive importation of slider turtles (*Trachemys scripta*) into France as a pet induces significant release in nature of turtles kept in captivity by private owners. Our study indicates that *T. scripta* is now widely distributed in France and reproduction has been recorded in some places in the south of the country where *Emys orbicularis* occurs. Published data of the two species are compared, as sexual maturity, reproduction, diet and population structure. It appears there is a wide overlap of their ecological niches.

Key words: Testudines: Emydidae: *Emys orbicularis*, *Trachemys scripta*; France, introduction, distribution, population, diet, reproduction, competition.

Zusammenfassung

In jüngerer Zeit wurden sehr große Mengen von Schmuckschildkröten (*Trachemys scripta*) als Heimtiere nach Frankreich importiert. Viele Exemplare werden von ihren Besitzern später freigelassen. Wie unsere Untersuchung zeigt, ist *Trachemys scripta* in Frankreich inzwischen weit verbreitet, und an einigen Stellen im Süden des Landes, wo auch *Emys orbicularis* vorkommt, wurden Reproduktionen verzeichnet. Veröffentlichte Daten beider Arten werden verglichen, wie sexuelle Reife, Fortpflanzung, Ernährung und Populationsstruktur. Ihre ökologischen Nischen scheinen sich in weiten Bereichen zu überlappen.

Schlagwörter: Testudines: Emydidae: *Emys orbicularis*, *Trachemys scripta*; Frankreich, Einführung, Verbreitung, Population, Ernährung, Fortpflanzung, Wettbewerb.

Introduction

Some American turtle farms export cooter and slider turtles (*Pseudemys*, *Trachemys*) overseas following the ban in the USA in 1975, mainly to Europe and Asia, where the pet market in baby turtles has grown in the past 10 years. The most commonly exported species is *Trachemys scripta* (usually the red-eared slider, *T. s. elegans*), with about 26,000,000 specimens between 1989 and 1994 (SALZBERG pers. comm.). France is no exception to this general trend, with an average importation of 200,000 individuals and a maximum of more than 600,000 in 1991. Today a lot of observations are done in the field, closely associated with releasing the animals by the owners after some years of keeping, due to the loss of interest for the animal or by the rapid growth of the turtle, requiring a too costly aquarium. This phenomenon also occurs in Europe in Great Britain, Germany and the Netherlands (WARWICK 1991), in South Africa (NEWBERRY 1984), and in Asia: South Korea, Taiwan, Malaysia, Hongkong, and Japan (WARWICK 1991, MOLL 1995, SALZBERG pers. comm.).

Two indigenous species of freshwater turtles are present in France: *Emys orbicularis* which is widely distributed in the South in 41 departments. Its northern limit of distribution is represented by a line crossing Rochefort, the regions of Brenne, Allier and Lyon (SERVAN 1990). Large utilization of pesticides and

transformation of marshes for agriculture have led to its disappearance in a number of regions (SERVAN 1986). Catching has been responsible for the diminution of populations in France and Italy (FRISENDA & BALLASINA 1990). The other species is the rare *Mauremys leprosa*, known from only four localities in South France.

The introduction of new species is always a risk for the fauna and the flora of ecosystems, for example, the competition resulting between species of similar ecological niches. Such a competition is conceivable between *T. scripta* and *E. orbicularis*.

Among the numerous subspecies of *T. scripta* (ERNST 1990), *T. s. elegans* is the most commonly imported. Three subspecies of *E. orbicularis* occur in France (FRITZ 1992, 1995). Published data are rather rare for this species, the main study area in France is the Brenne region in the central part of the country.

In France we conducted a survey in 1995 on the distribution (localization, number and size of turtles) of abandoned *T. s. elegans* in the field. Another study in 1994 was managed by the French Ministry of Environment.

This paper presents results of the two surveys and a comparison of some aspects of the biology of *E. orbicularis* and *T. scripta* to evaluate the potential competition between both species.

Results

Distribution of *Trachemys scripta elegans* in France

The red-eared slider, *T. s. elegans*, is present in almost all parts of the country (fig. 1), including Corsica. There were no observations in only three of 96 departments of France. *T. s. elegans* is present in lakes, ponds and rivers of all main hydrographic basins. Observations of one animal are 42%, 2 to 10 animals are 44% and more than 10 animals are 14% (n=722). Animals with a carapace length more than 10 cm comprise 71.7% of observations. Only three observations of reproduction (mating, nesting and hatching) have been made: in the southwest part of France (Haute-Garonne: Toulouse), in the middle of the country (Indre-et-Loire: Tours) and in the South (Gard: Alés). Releasing occurs generally 1 to 8 years after



Fig. 1. Distribution of the different species of turtles in France by department presence of *Trachemys scripta* and *Emys orbicularis* (●), presence of *Trachemys scripta* only (■), presence of *Mauremys leprosa* (○); no data available (?).

Verbreitung der verschiedenen Schildkrötenarten in den Départements von Frankreich. Vorkommen von *Trachemys scripta* und *Emys orbicularis* (●), Vorkommen nur von *Trachemys scripta* (■), Vorkommen von *Mauremys leprosa* (○); keine Daten verfügbar (?).

purchase of the pet, when the aquarium becomes too confining or when children have other interests than a small chelonian pet (SOPTOM unpubl. data).

Comparative Ecology of *Emys orbicularis* and *Trachemys scripta elegans*

E. orbicularis usually is present in rivers, large ponds, marshes, swamps, brooks, ditches and canals (ROLLINAT 1934, SERVAN 1988). When in Central France the water depth is below 15-20 cm, turtles swim away to another pond or bury themselves in the mud (SERVAN 1987). In this area females after nesting sometimes go to another pond (SERVAN 1988). Hibernation occurs in mud or in a hole in the embankment (SERVAN 1988, NAULLEAU 1991).

In the USA, *T. s. elegans* inhabits ditches, ponds, slow-running rivers, bayous and swamplands (CAGLE 1946, MINYARD 1947, WARWICK 1985). In Illinois turtles are active most of the year except during winter. Slider turtles can live in water where the temperature is between 1°C and 40°C. They hibernate in the mud when the temperature is below 10°C. During winter days turtles may bask (CAGLE 1946, SCHUBAUER & PARMENTER 1981). In France, a swimming *T. s. elegans* was observed under the ice in winter (NAULLEAU pers. comm.).

Several observations show that *T. s. elegans* seems to be more aggressive than *E. orbicularis*.

Carapace Length

Males and females of *T. s. elegans* have respectively greater carapace lengths than *E. orbicularis* (tab. 1). However, the minimum carapace length is less for mature male *T. s. elegans* (90 mm). This can be explained by the fact that they reach sexual maturity between 2 and 5 years whereas males of *E. orbicularis* in Brenne become mature only between 6 and 16 years of age (CAGLE 1950, SERVAN 1988). The minimum carapace lengths for mature female *T. s. elegans* noted by CAGLE (1950) and GIBBONS (1990) varied greatly: 153 and 107 mm respectively, whereas the minimum carapace length for mature *E. orbicularis* is 125 mm in most populations studied in France.

	Sex	Carapace length [mm]			Author
		Mean	Minimum	Maximum	
<i>E. orbicularis</i>	Male	136	111	168	present study
	Female	147	125	182	present study
<i>T. s. elegans</i>	Male	156	90	214	GIBBONS 1990
		—	90	196	CAGLE 1946, 1950
	Female	204	107	257	GIBBONS 1990
		—	153	220	CAGLE 1946, 1950

Tab. 1. Carapace length at sexual maturity of *Emys orbicularis* and *Trachemys scripta elegans*.

Carapaxlängen bei Geschlechtsreife von *Emys orbicularis* und *Trachemys scripta elegans*.

Density

Densities are variable for both species (tab. 2); in general they range from one to twenty turtles/hectare. In Brenne, the density of *E. orbicularis* is higher in small ponds than in big ones (SERVAN 1988). Exceptional densities occur only in very small areas due to low water level during summer or winter: a density greater than 3,000 adult *T. s. elegans* per hectare is noted by CAGLE (1950) and for western France a density greater than 1,000 *E. orbicularis* individuals per hectare in two pools is noted by NAULLEAU (1991).

			Author
Density (animals/ha)	<i>E. orbicularis</i>	2.9 to 15	SERVAN 1988
	<i>T. s. elegans</i>	1.2 to 2.5	CAGLE 1950
Sex ratio	<i>E. orbicularis</i>	0.47	SERVAN et al. 1989
	<i>T. s. elegans</i>	0.69	CAGLE 1942
		0.95	CAGLE 1950
Adults [%]	<i>E. orbicularis</i>	69	SERVAN 1988
	<i>T. s. elegans</i>	81	CAGLE 1942
		69	CAGLE 1950

Tab. 2. Some characteristics of populations of *Emys orbicularis* and *Trachemys scripta elegans*.

Einige Populationscharakteristika von *Emys orbicularis* und *Trachemys scripta elegans*.

Proportion of Juveniles and Adults

A high proportion of adults is noted for both species in natural populations (tab. 2). This is the general case for freshwater turtles: juveniles appear to comprise a low percentage of most populations, whereas there is a high proportion of long-lived mature individuals (BURY 1979).

Sex Ratio

Sex ratio values for *T. s. elegans* vary from 0.69 to 0.95 (tab. 2). Data for *E. orbicularis* show that sex ratio (males/females) is deviated in favour of adult females in Brenne (SERVAN et al. 1989). Sex of *E. orbicularis* seems to be determined by environmental parameters; the hypothesis of a genetic component is proposed by GIRONDOT et al. (1994). Moreover GIRONDOT & PIEAU (1993) pointed out that a slight difference in survival between males and females could be responsible for adult sex ratio difference in a population of long-lived species like *E. orbicularis*.

Diet

Both species are mainly predatory (tab. 3), but *T. s. elegans* show a dietary shift towards vegetation as they increase in size (HART 1983), and even can survive on

a diet composed only of algae (MINYARD 1947). *E. orbicularis* eats mainly in twilight, whereas *T. s. elegans* usually eats in early morning and late afternoon (CAGLE 1950). Both species hunt in shallow water: 40 to 80 cm for *T. s. elegans* (HART 1983) and 20 to 80 cm for *E. orbicularis* (SERVAN 1986), mainly in places where aquatic vegetation is abundant.

	<i>E. orbicularis</i> ROLLINAT 1934	<i>T. s. elegans</i> HART 1979	<i>T. s. elegans</i> MINYARD 1947
Algae	+	+	+
Vascular plants		+	+
Crustaceans	+	+	+
Insects	+	+	+
Molluscs	+	+	+
Amphibians	+	+	
Fishes	+	+	+
Snakes			+

Tab. 3. Diet spectrum of *Emys orbicularis* and *Trachemys scripta elegans*.
Nahrungsspektrum von *Emys orbicularis* und *Trachemys scripta elegans*.

Reproduction

Both species have a principal courtship period in April and May (ROLLINAT 1934, CAGLE 1950). In Brenne, *E. orbicularis* begins to mate in deep water, then females go to places of 20 cm water depth or less (SERVAN 1988). Egg-laying for *E. orbicularis* occurs from the end of May to the beginning of July (ROLLINAT 1934). Females can move as far as 500 m from ponds to find a suitable place beyond flooding and well exposed to sun (ROLLINAT 1934, SERVAN 1988). Egg-laying of *T. s. elegans* occurs earlier, from April to June, and females can move 1.6 km in Louisiana to find a place (CAGLE 1950). The average number of eggs per clutch is about 4 to 16 for *E. orbicularis*. As shown in table 4, eggs usually are 30 to 39 mm long and 19 to 21 mm wide and have a weight of about 7 to 8.4 g (ROLLINAT 1934, SERVAN & PIEAU 1984). For *T. s. elegans* the average number of eggs per clutch is 7 in Louisiana, 9.3 in Illinois and 10.5 in Tennessee. According to CAGLE (1944, 1950) they are usually 36.2 to 37.7 mm long and 21.6 to 22.6 mm wide, with a weight of 9.71 to 11.1 g. The incubation period for *E. orbicularis* is about 55 to 60 days at 28°C (SERAMOUR & SERAMOUR 1979) but usually takes 2 to 4 months in the field (ROLLINAT 1934). The incubation period for *T. s. elegans* ranges from 57 to 65 days at 29 to 30°C in the northern USA (CAGLE 1950). Hatching in *E. orbicularis* occurs from August to September (ROLLINAT 1934) or during the next spring (SERVAN 1983), whereas hatching in *T. s. elegans* occurs at the end of August or the beginning of September in Illinois (CAGLE 1946). Overwintering is also noted in Illinois by CAGLE (1950). In France hatchlings of *E. orbicularis* (tab. 4) have 26.2 to 27 mm carapace length and about 24 mm plastron length, with a weight of 3 to 6 g (ROLLINAT 1934), whereas *T. s. elegans* hatchlings are usually 20% larger and 40% heavier.

Eggs					
	Length [mm]	Width [mm]	Weight [g]	n	Author
<i>E. orbicularis</i>	35.9	19.9	8.4	367	SERVAN & PIEAU 1984
	26.5 to 45.3	18.1 to 21.7			
	31 to 39	20 to 22	6 to 8		
<i>T. s. elegans</i>	36.2	21.6	9.71	221	CAGLE 1944
	30.9 to 43.0	19.4 to 24.8	6 to 15.4		
	37.7	22.6	11.1	406	CAGLE 1950
	23.5 to 44.2	18.4 to 24.6	9 to 14		
Hatchlings					
	Carapace length [mm]	Plastron length [mm]	Weight [g]	n	Author
<i>E. orbicularis</i>	26.2	24	4.94	80	SERVAN & PIEAU 1984
	23.2 to 29.6	20.7 to 28.2			
<i>T. s. elegans</i>	32.5	30.9	8.07	86	CAGLE 1950
	28.0 to 35.8	27.1 to 33.8	5.4 to 10		

Tab. 4. Sizes of eggs and hatchlings of *Emys orbicularis* and *Trachemys scripta elegans*, n = number of observations.

Größe der Eier und Schlüpflinge von *Emys orbicularis* und *Trachemys scripta elegans*, n = Zahl der Beobachtungen.

Discussion

T. s. elegans is now a widely distributed species in France, even if observations of more than 10 animals at the same place are rather rare. Both *T. s. elegans* and *E. orbicularis* have been found in 39 departments, and in 4 departments in the southern part of France both European freshwater turtles (*E. orbicularis*, *Mauremys leprosa*) and *T. s. elegans* are present.

Some observations have pointed out breeding success, and multiple observations over many years in the field show that the acclimatization of *T. scripta* is beginning. This is not surprising, as French climates are not very different from American ones and there is no particular predator or competitor of *T. s. elegans* in Europe.

The wide distribution of *T. s. elegans* in France is also not surprising considering the great number of animals imported each year. Estimates around the world indicate that about 90% of animals will be dead within their first twelve months as a household pet (WARWICK 1985). Theoretically in France this means annually more than 10,000 survivors since 1985. We have no data about the portion which is released in the field; the hundreds of observations related in our study are certainly an underestimate of its true abundance. In the southern part of France, where populations of *E. orbicularis* are present and where *T. s. elegans* can reproduce, we are facing a potential competition between both species. *T. s. elegans* is bigger, sexual maturity occurs earlier, densities are higher in very small areas, the diet is more varied and overlaps the *E. orbicularis* diet spectrum. Hence, one can hypothesize that *T. s. elegans* is able to colonize areas where *E. orbicularis* cannot live. Both species overwinter in the mud, thus the European climate is not

a detriment to colonization. Reproductive potential is not very different. All these points seem to favour *T. s. elegans*. Other unknown environmental factors in Europe could influence or promote *T. s. elegans* acclimatization. Protecting areas from slider turtle immigrations is quite impossible in regard to the colonizing character of the species. Unfortunately, other species of turtles like *Chelydra serpentina* have also probably been introduced in French ecosystems, as a consequence of the importation by profit-seeking merchants and an ignorant public when the importation of *T. s. elegans* was temporarily prohibited by the French Ministry of Agriculture in 1992.

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