

Dimensions, mass and volume of the liver of turtles (*Trachemys scripta elegans* WIED, 1839)

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Abstract

Turtles are the oldest representatives of the class Reptilia, as they appeared on earth about 340 million years ago. Currently, there is little more than 200 species, varying greatly between sizes and natural environment. The *Trachemys scripta elegans*, belonging to the suborder Cryptodira and family Emydidae, comes from the Mississippi Valley in the United States of America. This study aimed to determine the size, mass and volume of the liver of Turtle *T. scripta elegans* (WIED, 1839) correlating the hepatic data with body biometrics and gender. The liver is across the middle third of the coelomic cavity, with two lobes, right and left, taking the carapace and the dorsal vertebrae, and the plastron, ventral. Furthermore, we observed that the organ has reddish-brown color, but in the case of males, were slightly pale, yellowish-brown all over its surface. The gallbladder was present on the rear-end face of the organ. In females, most of the variables (mass, volume and dimensions) established correlations, demonstrating the interdependence of physical biometric parameters and liver of the turtle *Trachemys scripta elegans*. However, in males, few variables were correlated, i.e. the parameters are developed independently. It follows therefore that only in female *Trachemys scripta elegans*, the values of hepatic biometry are proportional to the values somatometric, i.e. the larger the animal, the bigger the liver.

Keywords: biometry, liver, turtles.

1 Introduction

The tortoises are the oldest representatives of the class Reptilia, as they appeared on earth about 340 million years ago. Currently, there is little more than 200 species, varying greatly between sizes and natural environment. Some features are common to several species, such as: rapid growth in early life, becoming slower over the years, short limbs, corneous skin consists of scales that provide greater resistance to moisture loss and make up the shell and plastron, and are variegated animals.

The *Trachemys scripta elegans*, belonging to the suborder Cryptodira and family Emydidae, comes from the Mississippi Valley in the United States of America. Its skin is greenish, ranging from the yellow-green and dark green stripes when young, losing its tone, becoming olive-green when adult. It features a red-orange band in the caudal to the eye, which extends to the neck. Males can measure 13 to 29 cm, being smaller than females, with oval, flattened dorsal carapace, yellowish plastron with dark spots, and longer fingernails. Females have front claws and shorter tail. When young they are carnivorous, feeding mainly on minnows, tadpoles and snails, as adults, incorporate vegetables to their diet, becoming omnivorous. They live in aquatic environment, but they need land to nest or hibernate. They survive

on average 30 years in captivity but in the wild, no one knows for sure because they do not have a balanced diet, being more vulnerable to predators, among other factors. (ERNST, BARBOUR, 1989 apud VIEIRA, COSTA, 2006; MALVASIO, 1996).

The liver of the turtle *T. scripta elegans*, the most voluminous organ of the body (HILDEBRAND, 1995), is found in the coelomic cavity and is lined by coelomic epithelium, remaining connected to the organ by the ventral mesentery (omentum minor) and in the tail (lower surface) for ligament sickle cell (ROMER and PARSON, 1985). It consists of two lobes, right and left sides bordering the shell and has a depression printed by the heart (HYMAN, 1942). The liver is brownish and has sintopicity with the heart (craniomedial) (GRASSÉ, 1970), with the lungs (cranial), the gizzard and intestine (caudal) and in some cases, the ovaries with (dorsocaudal) (ASHLEY, 1969). Its functions are many and diverse (DYCE, SACK and WENSING, 2004), for example, serving to store and convert protein to carbohydrates and fats, and waste release and remove toxic.

The knowledge about the anatomy of turtles is still immature, especially in regard to somatometric and internal organs biometrics. Therefore, this study aimed to determine

the dimensions, mass and volume of the liver of Turtle *T. scripta elegans* (WIED, 1839) and correlate liver data with body biometrics and gender.

2 Materials and methods

Thirty-eight specimens of the Turtle (*Trachemys scripta elegans*) were studied, 26 females and 12 males from Sensory Psychophysiology Laboratory, Department of Experimental Psychology Institute of Psychology, University of São Paulo (IP-USP), where body size was measured with a millimetric caliper approach (Vonder®) or millimeter tape measure, considering only the largest distance between points, to determine the height, length and width. We obtained the volume and body mass through the Scherle's Method (1970), where the specimens were immersed in water containing graduated becker on digital analytical scale (Bioprecisa®), observing the displacement of liquid caused by the animal body volume and analyzing directly the scale display. Subsequently, turtles was submitted to the orthothanasia process and, after freezing, sent to the Laboratory of Anatomy of Domestic Animals and Wild, Federal University of Vale do São Francisco, in Petrolina city, Pernambuco State (Latitude: 09° 23' 55"/Longitude: 40° 30' 03"/Altitude:376 m).

After somatometric, the plastron was retorted with the help of chisel and hammer (Figures 1 and 2). With a scalpel and surgical scissors, the thoraco-abdominal muscles were stripped out, promoting, then the incision on the coelomic serous, allowing access to the liver to extract it from the cavity and provide biometric data using the millimetric approximation caliper (Vonder®) (Figure 3). The dimensions of the body (height, length width) were measured taking into account the greater distances from it. Subsequently, for determination of liver mass and volume, the gallbladder was emptied and proceeded to the method Scherle (1970), as previously mentioned.

Regarding the nomenclature used, we decided to adopt the *Nomina Avium*, because there is no specific nomenclature for turtles, since, on the evolutionary scale, reptiles resemble more to birds than to mammals.

After dissection and determination of dimensions, mass and volume of animals, data were tabulated and analyzed using the SAS software and the R software, using the Pearson Correlation Test and the "Student t" Test, respectively.

3 Results and discussion

During the preparation procedure of the pieces, it was noted that the liver showed up across the middle third of the coelomic cavity, with two lobes, right and left, taking the carapace and the dorsal vertebrae, and the plastron, ventral, confirming the findings of Messer (1947), Pisano and Barbieri (1967), Ashley (1969), Getty (1986) and Hyman (1942) (Figure 4). Furthermore, we observed that the organ has reddish-brown color, but in the case of males, were slightly pale, yellowish-brown all over its surface. The gallbladder present on the rear-end face of the organ.

Cranially, the organ established a close relation with the pericardium and lungs and, caudally, it was syntopic the gizzard, the descending duodenum, the jejunum and transverse colon, and still, the peripheral portion of the left



Figure 1. Using a chisel to open the bridge – Petrolina-PE, 2010.



Figure 2. Plastron Bounce – Petrolina-PE, 2010.

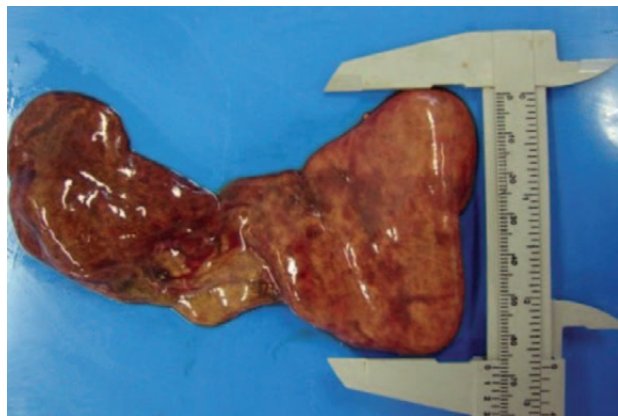


Figure 3. Measurement of *Trachemys scripta elegans* turtle liver, using the milimetral approach caliper – Petrolina-PE, 2010.



Figure 4. Positioning the liver of turtles *Trachemys scripta elegans* in the coelomic cavity – Petrolina-PE, 2010.

lobe had an affinity for the spleen, corroborating with Grassé (1970, 1986).

In a study conducted by Ashley (1969) and Luz and Stringhini (2002), it was found that the liver is the heaviest gland of the body, accounting for 2.90% of body weight, a fact corroborated with the findings in this study where the liver corresponded to 3.24% of body weight of the turtle that is not statistically significant. Table 1 describes the mean values and standard deviations of size, weight and volume of the liver of turtles.

Table 1. Means and standard deviations of size, weight and volume of the liver of turtle *Trachemys scripta elegans* – Petrolina, 2010.

Parameters	Liver	
	Females	Males
Height (cm)	3,9 ± 2,4	3,1 ± 1,8
Length (cm)	2,9 ± 1,2	3,0 ± 1,3
Width (cm)	13,2 ± 3,6	11,6 ± 3,0
Mass (g)	40,4 ± 23,4	28,2 ± 17,4
Volume (cc)	41,8 ± 26,0	27,9 ± 16,8

Legend: cm: centimeter/ g: grams/ cc: cubic centimeters.

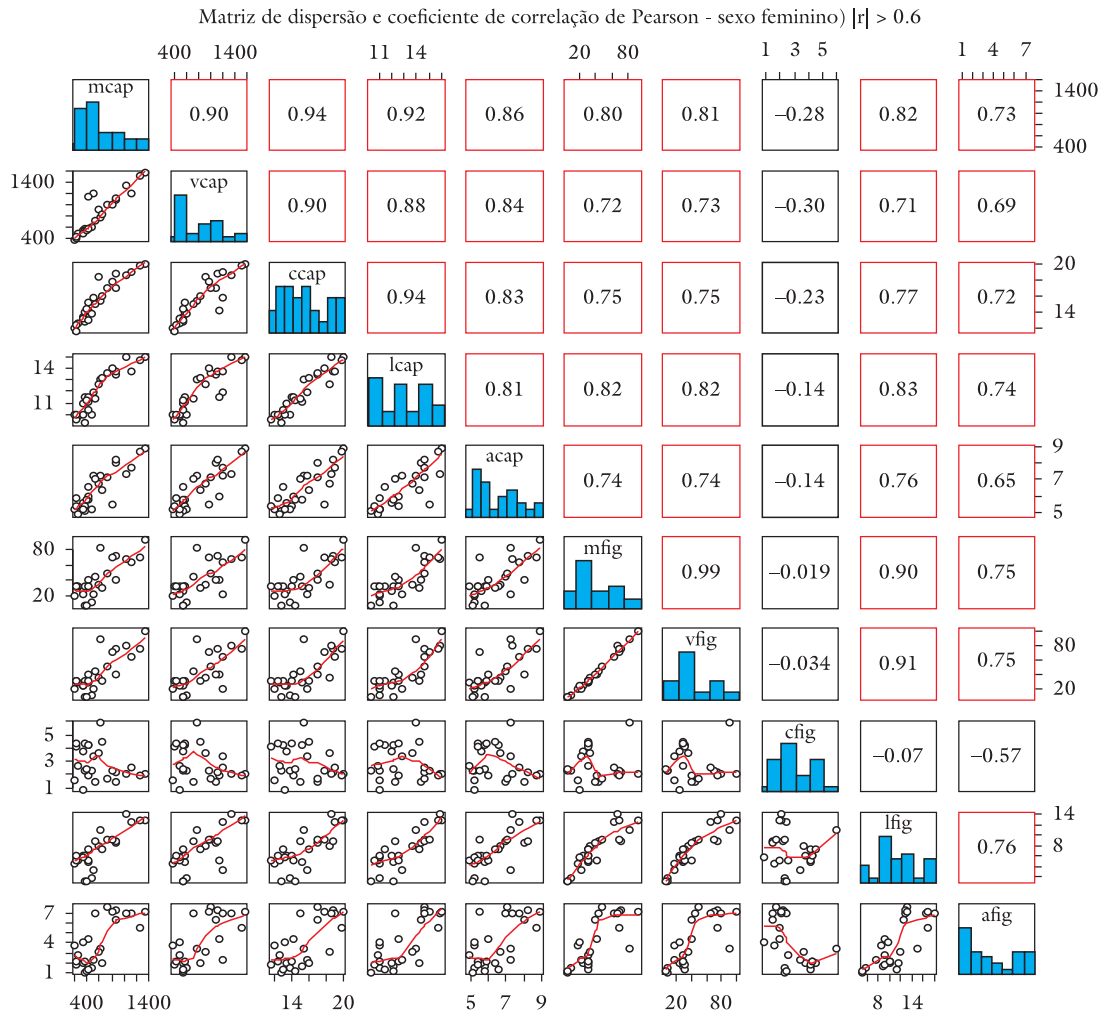


Figure 5. Matrix of scatter and Pearson correlation coefficient, to compare liver and body physical parameters of female turtles *Trachemys scripta elegans* ($|r| > 0.6$) – Petrolina, 2010.

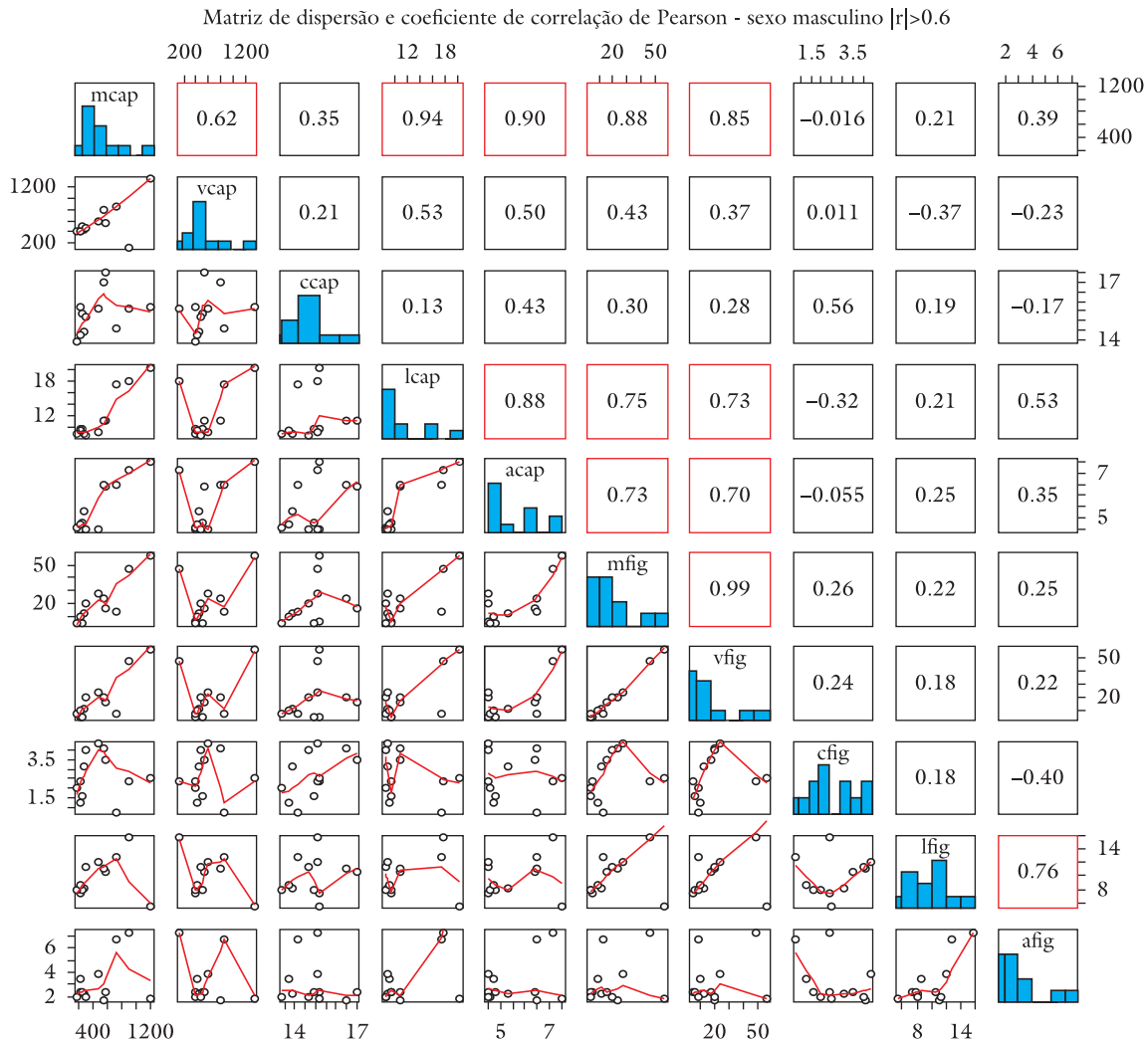


Figure 6. Matrix of scatter and Pearson correlation coefficient to compare liver and body parameters of male turtles *Trachemys scripta elegans* ($|r| > 0.6$) – Petrolina, 2010.

After statistical analysis, data were analyzed; the correlations can be noted (Figures 5 and 6). In proposing a comparative study between the genders, the treatments proposed that all the statistical variables of the carapace of the females were larger than in males, except the width. The same was observed in the liver, noting that the proportions of the body were higher in females than in males, except for its length, which was lower. Both findings confirm the presence of sexual dimorphism with respect to the bodily dimensions, where females are larger than males.

With respect to the carapace biometrics, it was observed that in females, all variables were highly correlated and, in males, only mass and carapace length are not related.

Comparing the somatometric and liver parameters of females, we observed no correlation between the carapace and liver, and other related variables. Unlike the males, where only the masses of the liver and shell correlated. Thus, the results contradict a study by Hyman (1942), which states that the liver borders laterally on the carapace.

Analyzing the liver biometrics it was found that for females Turtle *T. scripta elegans*, the length of liver shows

no correlation with any other variables of liver, having mass, volume, height and width positive correlations between them. And males showed a positive correlation between liver mass and volume, width and height. For all other male liver parameters there was no correlation.

4 Conclusion

Due to the limited literature on the topic proposed, the results could be elaborated upon, but with slim discussions.

The present work was possible to determine the size, mass and volume of the liver of turtles, correlating them with biometric body. In females, most of the variables (mass, volume and dimensions) established correlations, demonstrating the interdependence of physical biometric and liver parameters of the turtle *Trachemys scripta elegans*. However, in males, few variables were correlated, i.e. the parameters are developed independently.

It follows therefore that only in female *Trachemys scripta elegans*, the values of hepatic biometry are proportional to the somatometric values, i.e. the larger the animal, the bigger its liver.

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