Prevalence of *Placobdella costata* (Fr. Müller, 1846) (*Hirudinida: Glossiphoniidae*) on the European pond turtle (*Emys orbicularis*) in northeast Algeria

Samira Fediras¹, Rachid Rouag²*, Nadia Ziane¹, Anthony Olivier¹, Arnaud Béchet³ and Slim Benyacoub¹

Abstract. In Algeria, Emydidae is represented by only one species, the European pond turtle *Emys orbicularis* (Linnaeus, 1758). A population was studied in the spring of 2013 in the El Kala National Parc. The objective of this study was to identify and quantify the number of leech species. *Placobdella costata* (Fr. Müller, 1846) (*Hirudinida: Glossiphoniidae*) proved to be the only leech species of that was parasite of this *Emys orbicularis* population. Its prevalence was 50.9%, which was very low at the juvenile stage (14.2%). The intensity (average number of leeches per turtle) was 0.51 ± 1.20 for this population, but it was lower at the juvenile stage (0.14 ± 0.37). No relationship exists between the parasitic load and the morphological parameters. However, posterior part (hind limbs) had the highest parasite load (57.14%).

Keywords: *Emys orbicularis*, Glossiphoniidae, *Placobdella costata*, prevalence, parasite, Algeria

Introduction

The European pond turtle (*Emys orbicularis*) occurs over an extensive distribution range. It's found from Portugal to Aral Sea (Kazakhstan), from northern Germany and Moscow province (Russia) to southern Italy, Sicily and northern Africa and south-eastwards from Turkey to the eastern Caucasus Republics and the southern shore of the Caspian Sea (Fritz, 1998; Fritz, 2003). The European pond turtle is considered to be endangered in many parts of its range (Fritz and Andreas, 2000). Intensification of agriculture and water management, as well as the loss of suitable habitat are the major threats facing this species. However, the species is protected in many European countries (e.g., Schneeweiss, 1998; Zuffi and Ballasina, 1998; Mitrus, 2005). Despite its wide distribution, little is known about the potential role of leeches as vectors of parasites that could affect *E. orbicularis*, yet, parasites can significantly alter host population demography (Iglesias et al., 2015; Meyer et al., 2015), and are critical to study in evolutionary and ecological contexts (Tyre et al., 2003). In this paper, we identify and analyze the prevalence of the leeches in an Algerian population of *Emys orbicularis*, which constitutes the first study on this subject for Algeria.

Materials and Methods

Our study was conducted from March to August 2013 on a 5 ha area situated in northern part of the Lake Tonga, which is situated in the northeastern of Algeria between 36°43’N and 36°57’N and between 07°43’E and 08°37’E. The climate there is Mediterranean, with most of the annual rainfall (630 mm) falling during the winter months. The lake is about 2700 ha in area, and as a shallow water body with rich vegetation, it represents one of the most important freshwater wetlands in northeastern Algeria (De Belair, 1990). Vegetation beds composed of emergent and floating-leaved plants are very extensive. The emergent vegetation of Lake Tonga is dominated by the common reed (*Phragmites australis* Cav.) and the lesser reed mace (*Typha angustifolia* L.). The submerged and surface-floating vegetation of this lake is dominated by the white water-lily (*Nymphaea alba* L.) and pondweeds (*Potamogeton lucens* L.) (Bakaria et al., 2009).
During the study, 53 European pond turtles caught by hand were marked by notching, the marginal scutes (Cagle 1939; Servan et al. 1986). Individual variables were measured on every specimen caught such as, weight, size and age. Age determination of each captured tortoise was done by growth annuli counts on the shell, one growth annulus being added each year (Castanet and Cheylan, 1979; Castanet, 1988; Germano and Bury, 1998). Carapace length was measured using a digital calliper (precision ±0.1 mm) with the same measurement criteria as Stubbs and Swingland (1984). The weight of the turtles was measured using a digital balance (precision ±1 g). Sex was determined by secondary sexual characteristics (e.g., plastral concavity, tail length) (Servan, 1988). Turtles less than 12 cm long were considered too small for sexing and were classified as juveniles.

Leeches were collected manually and placed in individual vials (labelled by turtle code) in 70% EtOH until further examination was possible. All turtles were released immediately at the point of capture. Leeches differed in age and ranged in size from about two mm for the young to two centimeters for adults. The studied turtles consisted of 25 females, 21 males and 7 juveniles. Of the 53 turtles examined, 27 (50.9%) were infested by leeches: 42.8% of the males, 68% of the females, and 14.2% juveniles were parasitized (Table 1).

![Figure 1. A- dorsal view of P. costata, B- ventral view of P. costata (Photos by Fediras S.).](image)

**Table 1. Prevalence and intensity of infestation.**

<table>
<thead>
<tr>
<th>Turtle data</th>
<th>Leech Prevalence</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Σ</td>
</tr>
<tr>
<td>Males (n=21)</td>
<td>42.8</td>
<td>9</td>
</tr>
<tr>
<td>Females (n=25)</td>
<td>68.0</td>
<td>17</td>
</tr>
<tr>
<td>Juveniles (n=7)</td>
<td>14.2</td>
<td>1</td>
</tr>
<tr>
<td>Total (n=53)</td>
<td>50.9</td>
<td>27</td>
</tr>
</tbody>
</table>

The mean intensity is of 0.51 ± 1.20 leeches/turtle (range 0–7 leeches). It was higher in females than in males with respective values of 0.68 ± 1.27 and 0.42 ± 0.99, and very low among juveniles with a value of 0.14 ± 0.37. Males and females did not differ significantly in parasite load with (t-value = -0.7; p-value = 0.491; df = 37 at t-test), and there was no difference between adults and juveniles (t-value = 1.79; p-value = 0.083; df = 32).
Data show that the hind limbs are the most common attachment site with a prevalence of 57.14% (8/14). The head and forelimbs with 7.14% (1/14) have the lowest infection. We observed 28.57% (4/14) of the leeches were both on the plastron and on the carapace (Fig. 2).

The plastron and the hind limbs of the turtles had the highest parasite load with 0.85 ± 1.92 leeches for the plastron, 0.57 ± 0.51 for the hind limbs. The forelimbs and the head were loaded with 0.07 ± 0.26 leeches. No parasites were found on the tail (Table 2). The turtle with the most parasites was a female with 7 leeches. The posterior part of the turtle (hind limbs) seems to be the most vulnerable area and the head and fore limbs were the least infested parts.

We observed an 8 year old male (129 mm carapace length) with a leech attached on a marginal scale (14 young leeches were on its underside); when it was removed, there was a pit in the carapace. It is clear from these observations that *P. costata* can penetrate the bony tissues of turtle shells with its proboscis to obtain blood, as described for *P. ornata* by Siddall and Gaffney (2004). No relation was found between the biometric parameters and the parasite load (Table 3).

**Discussion**

*Placobdella costata* (Fr. Müller, 1846) has proven to be the only leech species which parasitizes our population of *Emys orbicularis*. This species is known for its haematophagous ectoparasitic feeding on freshwater turtles, in Europe mainly on *Emys orbicularis* (Nesemann and Neubert, 1999; Vamberger and Trontelj 2007), but it has also been reported on *Mauremys leprosa* (Romero et al., 2014) and *M. caspica* (Yadollahvand and Kami, 2014). It is suspected to be a vector of haemogregarine blood parasites in turtles (McAuliffe, 1977; Siddall and Desser, 2001). Danilewsky (1885) and Reichenow (1910) described Haemogregarina species of turtles, and *Haemogregarina stepanowi* as the parasite of the European pond turtle (*Emys orbicularis*), whose sexual development occurs in the leech hosts. Meanwhile, the final part of the life cycle comprising the formation of gamonts occurs in the erythrocytes of the turtle, allowing for relatively easy detection (Siddall and Desser, 1990). In Algeria, *Haemogregarina stepanowi* was detected in a wild population of *Mauremys leprosa* that are always present with *E. orbicularis* in our study area (Dvořáková et al., 2013). It has also been reported in Iranian populations of *M. caspica* and *E. orbicularis* (Yadollahvand and Kami, 2014). Thus, it is probable that this parasite is also present in Algerian *E. orbicularis*, and further studies may confirm this hypothesis.

The intensity of the infestation by the leech may be related to its preference for attaching to turtles of a greater length and body weight (McCoy et al., 2007; Siddall and Gaffney, 2004). The head and forelimbs of the turtles had the highest parasite load with 0.85 ± 1.92 leeches for the plastron, 0.57 ± 0.51 for the hind limbs. The forelimbs and the head were loaded with 0.07 ± 0.26 leeches. No parasites were found on the tail (Table 2). The turtle with the most parasites was a female with 7 leeches. The posterior part of the turtle (hind limbs) seems to be the most vulnerable area and the head and fore limbs were the least infested parts.

**Table 2. Prevalence on attachment sites on turtles.**

<table>
<thead>
<tr>
<th>Attachment sites</th>
<th>Turtle (N=14)</th>
<th>leeches</th>
<th>Σ Mean ± SD (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hind limbs</td>
<td>8</td>
<td>8</td>
<td>0.57 ± 0.51 (0–1)</td>
</tr>
<tr>
<td>Tail</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Head</td>
<td>1</td>
<td>1</td>
<td>0.07 ± 0.26 (0–1)</td>
</tr>
<tr>
<td>Forelimbs</td>
<td>1</td>
<td>1</td>
<td>0.07 ± 0.26 (0–1)</td>
</tr>
<tr>
<td>Carapace</td>
<td>4</td>
<td>5</td>
<td>0.35 ± 0.63 (0–2)</td>
</tr>
<tr>
<td>Plastron</td>
<td>4</td>
<td>12</td>
<td>0.85 ± 1.92 (0–7)</td>
</tr>
</tbody>
</table>

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**Table 3. Relation between parasite load and biometric parameters (Number of turtles=53).**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Carapace length (mm)</th>
<th>Plastron length (mm)</th>
<th>Body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of leeches</td>
<td>r = -0.293 (p= 0.175)</td>
<td>r = -0.008 (p= 0.972)</td>
<td>r = 0.047 (p= 0.830)</td>
</tr>
</tbody>
</table>
While most leeches were observed on female *E. orbicularis* in our study, the prevalence of *P. costata* did not differ significantly according to sex, length, weight or ages. With 27 leeches found on 53 turtles, the prevalence of the parasite (50.9%) in our study area is high in comparison with other populations. In Southern Spain, only one leech was found attached to a turtle (*Mauremys leprosa*) out of almost 100 captured turtles (Romero et al., 2014). McCoy et al. (2007) reported higher prevalence in bottom-dwelling species. In North-western Spain turtles usually carry heavier loads during summer, when the water level drops (Ayres, pers. comm).

Our analysis of the attachment sites of *P. costata* on the turtles revealed that there are preferences for some places. The posterior part, namely the hind limbs, is the most highly affected zone (57.14%), while the anterior part (head and forelimbs) had a 14.28% of parasite load. Our results were similar to those found in other studies on leeches attachment sites on turtles in North America (Koffler et al., 1978; Dodd, 1988; McCoy et al., 2007) where the most preferred site of attachment was the posterior region. Many leeches were found attached to the plastron where they could also find protection from the environment and especially from desiccation when the turtle leaves the water (Vogt, 1979). In Spain, in two populations, all leeches were found attached to the plastron, on the junctions or over broken scutes, and never on the soft parts of the body of the animal (Ayres and Alvarez, 2008).

Leeches generally prefer to attach to softer skin areas; however, the specific attachment sites observed in our study, suggest that there is also a preference for the sulci between the scales overlying the bones. This is not surprising since another species of leeches (*Placobdella ornata*) is able to feed on the bony tissues of turtles (Siddall and Gaffney, 2004). Another study on the prevalence of *Placobdella costata* in *Mauremys leprosa* would be very interesting to verify the parasitic relationship between this leech and the turtles living in our study region.

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