

## Checklist and Distribution of Marine and freshwater leeches (Annelida, Clitellata, Hirudinea) in Tunisia with identification key

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Received 20 November 2014 | Accepted 25 December 2014 | Published online 8 January 2015.

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### Abstract

In this study 13 leech species from Tunisia are listed. They belong to 2 orders, 2 suborders, 4 families and 11 genera. The paper includes also data about hosts and habitats, distribution in the world and in Tunisia. Faunistic informations on leeches were found in literature and in the results of recent surveys conducted by the authors in the North East and the South of the country. The objectives of this study were to summarize historical and recent taxonomic data, and to propose an identification key for species signalized. This checklist is to be completed, taking into account the hydrobiological network of the country especially the North West region, which may reveal more species in the future.

**Key words:** Hirudinea, Checklist, leeches, geographic distribution, Tunisia, identification key.

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### Introduction

Available information on the distribution, taxonomy, and ecology of Tunisian leeches has been scattered throughout various historical (Blanchard 1891, 1908, Megnin 1891, Seurat 1922) as well as recent papers (Ben Ahmed *et al.* 2008a, 2008b, 2008c, Ben Ahmed & Tekaya 2009, Ben Ahmed *et al.*, 2013, Neseemann & Neubert 1994). None of these papers have focused on the country's fauna as a whole. Furthermore, until 2006, only 5 leech species have been reported for Tunisia. Also, the taxonomy of Mediterranean marine leeches is poorly known, and information on Tunisian fauna is limited to a single species recently recorded by Ben Ahmed *et al.* (submitted paper). The principal limitation on availability of material is because marine leeches are difficult to obtain with standard sampling equipment.

This paper lists 12 freshwater and one marine leech species and the list is expected to get much longer in the future.

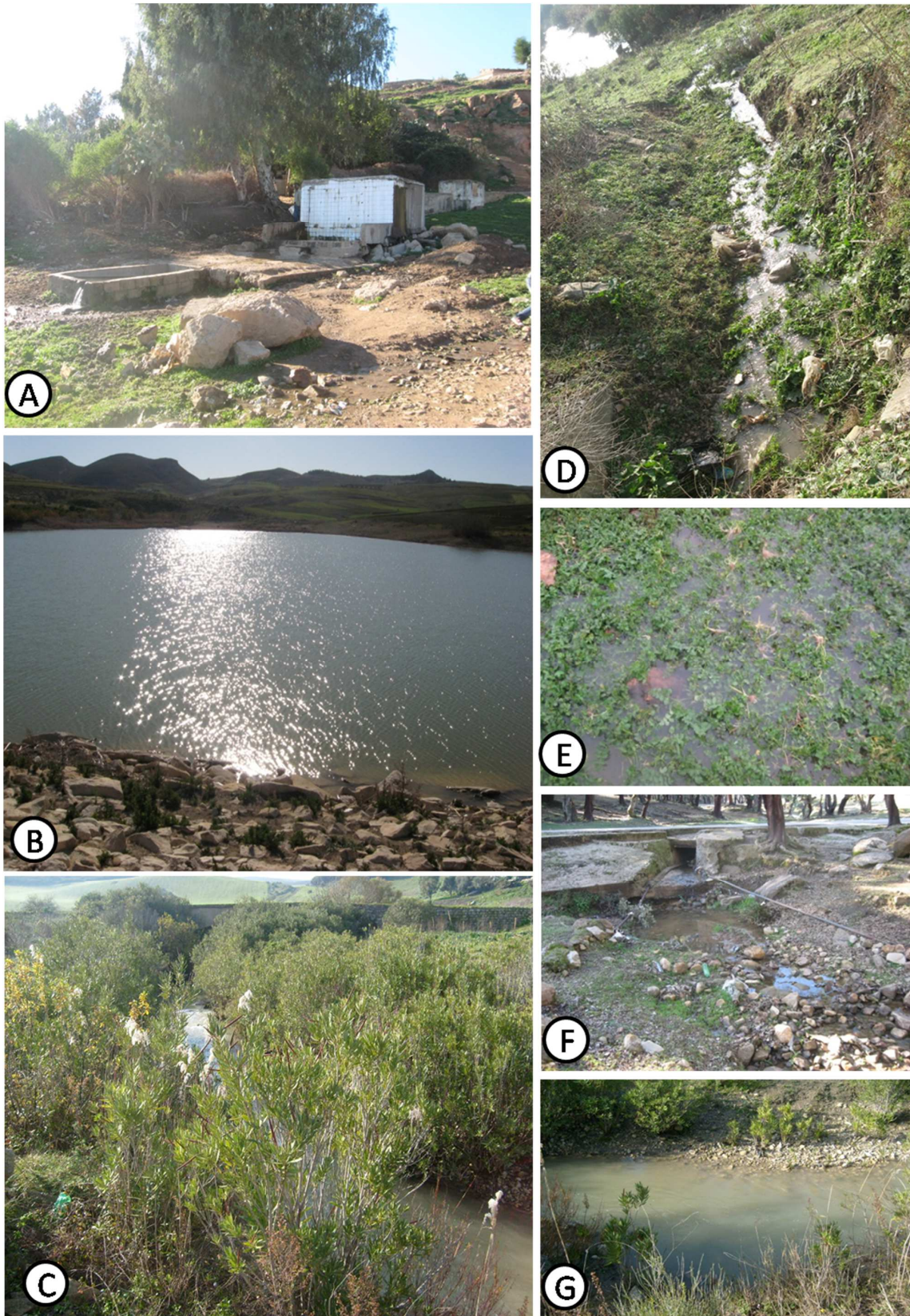
### Material and Methods

The information and data summarised herein have been obtained from previously published papers and from extensive material collected by the authors during the period 2006-2012. Freshwater leeches were collected from rivers, drainage basin, springs and streams (Fig.1). Leeches were found attached to the underside of a variety of objects, such as rocks and submerged vegetation. The material examined was deposited in the first author's collection at the Faculty of Science of Tunis. A Tunisian marine leech, attached to the fish *Symphodus tinca* (Linnaeus, 1758), was collected from the lagoon of Bizerte.

In the laboratory, the living leeches were first photographed using a Nikon Coolpix digital camera, then a preliminary identification was made based on external features as that several specimens could be identified using

CHECKLIST OF LEECHES OF TUNISIA

external morphology only. Other leeches requiring the internal structure study, were narcotised, dissected, preserved in 70% ethanol and then identified using an Olympus SZ-ST stereomicroscope.



**Figure 1.** Some sites of leech collection in Tunisia. **A:** Ain Sidi Saleh (Bizerte governorate); **B:** Elkhalsa drainage basin (El Kef governorate); **C:** Stream Oued el Melih Ouechtéta (Beja governorate); **E:** Ain Ennfeja (Bizerte governorate); **D:** Ain Rouissat, (Kairouan governorate); **F:** Ain Soltane, (Jendouba governorate) **G:** National Parc ElFaija, Oued Chobit Elmée (Jendouba governorate).



**Systematic account**

In total, 13 species of Hirudinea representing four families (Table I) are now known to occur in Tunisia based upon records in the literature and/or specimens collected during our seven-year study (2006-2012). Detailed accounts on these leeches are presented below.

**Table I:** List of leech species of Tunisia.

Order	Sub-order	Family	Sub-family	Genus	Species
Rhynchobdellida Blanchard, 1894		GLOSSIPHONIIDAE Vaillant, 1890	Haementeriinae Autrum, 1936	<i>Alboglossiphonia</i> Vaillant, 1890	<i>Alboglossiphonia hyalina</i> (O.F. Müller, 1774)
				<i>Helobdella</i> Linnaeus, 1758	<i>Helobdella stagnalis</i> (Linnaeus, 1758)
				<i>Batracobdella</i> Viguiet, 1879	<i>Batracobdella algira</i> (Moquin-Tandon, 1846)
			Theromyzinae Sawyer, 1986	<i>Theromyzon</i> Philippi, 1867	<i>Theromyzon tessulatum</i> (O.F. Müller, 1774)
		Glossiphoniinae Sawyer, 1986	<i>Placobdella</i> (Blanchard, 1893)	<i>Placobdella costata</i> (F. Müller, 1846)	
PISCICOLIDAE Johnston, 1865	Piscicolinae Caballero, 1956	<i>Trachellobdella</i> Diesing, 1850	<i>Trachellobdella lubrica</i> (Grube 1840)		
Arhynchobdellida Blanchard, 1894	HIRUDINIFORMES Caballero, 1952	HIRUDINIDAE Withman, 1886		<i>Hirudo</i> Linné, 1758	<i>Hirudo troctina</i> Johnson, 1816
				<i>Limnatis</i> Moquin-Tandon, 1826	<i>Limnatis nilotica</i> (Savigny, 1822)
	ERPOBDELLIFORMES Sawyer, 1986	ERPOBDELLIDAE Blanchard, 1894	Erpobdellinae Blanchard, 1894	<i>Erpobdella</i> Blainville, 1818	<i>Erpobdella testacea</i> (Savigny, 1822)
				<i>Dina</i> Blanchard, 1892	<i>Dina punctata punctata</i> Johansson, 1927
			Trochetinae Perrier, 1897		<i>Dina punctata maroccana</i> Nesemann et Neubert, 1994
				<i>Trocheta</i> Dutrochet, 1817	<i>Trocheta africana</i> Nesemann et Neubert, 1994
					<i>Trocheta tunisiana</i> Ben Ahmed et al., 2013

**Order Rhynchobdellida Blanchard, 1894**

**Family Glossiphoniidae Vaillant, 1890**

**Genus *Alboglossiphonia* Lukin, 1976**

***Alboglossiphonia hyalina* (O. F. Müller, 1774)**  
(Fig. 2B)

**Diagnosis:** The body is flattened and uniform yellowish coloured. The rounded head has three pairs of eyes. The dorsal surface is more or less rough by small regularly arranged papillae. The genital pores are joined and open in a common pore. Ectoparasite of freshwater Gastropods, sometimes penetrating into the mantle cavity.

**Habitat:** Found under stones, it seems to prefer stagnant to slow flowing water bodies often of artificial origin such as drainage basin. The presence of aquatic molluscs appears to be important.

**Distribution:**

*A. hyalina* was described from Denmark under the name *Hirudo heteroclita* var. *hyalina*. It has further been reported from Poland as *Glossiphonia heteroclita* var. *hyalina* (Pawlowski, 1936). A common species, occurring in central- and western-Europe (Soós 1969, Nesemann & Neubert 1999). Recently, Jueg *et al.* (2013) collected it in Central Asia (Kyrgyzstan).

In Tunisia (Fig. 5B), this species was reported for the first time by Ben Ahmed *et al.* (2008a) in Lebna drainage basin (36.44326 N, 10. 55 255 E). In the present study, we add its presence in Port Prince drainage basin (36.51162 N, 10. 39404 E). It seems that this species has a limited distribution and up till now only known from two localities in Nabeul governorate in the North East of the country.



**Figure 2.** **A** Dorsal face of *Batracobdella algira*: Scale bar = 1.3cm ; *in set* : disposition of eyes in *B. algira* : Scale bar = 0.26 cm ; **B** Dorsal face of *Alboglossiphonia hyalina*: Scale bar = 1.3cm ; *in set* : disposition of eyes in *A. hyalina* : Scale bar = 0.6cm ; **C** Dorsal face of *Helobdella stagnalis*: Scale bar = 1cm ; *in set* : disposition of eyes in *H. stagnalis* : Scale bar = 0.3cm ; **D** Dorsal face of *Placobdella costata*: Scale bar = 1.8cm ; *in set* : disposition of eyes in *P. costata* : Scale bar = 0.6cm ; **E** Dorsal face of *Theromyzon tessulatum*: Scale bar = 1,9cm ; *in set* : disposition of eyes in *T. tessulatum* : Scale bar = 0.8cm .

**Genus *Batracobdella* Viguier, 1879*****Batracobdella algira* (Moquin-Tandon, 1846)**

(Fig. 2A)

**Diagnosis:** The body is dorsoventrally flattened. The dorsal surface is covered by papillae with three distinct longitudinal rows of larger papillae. The body colour is brown. The head bears two separate eyes. The caudal sucker is large. The genital pores are separated by two annuli and seven pairs of crop caeca are present.

**Habitat:** Eurytopic species, found in many freshwater environments (drainage basins, oueds, springs, marshes...). An ectoparasitic association with the toad *Amietophrynus mauritanicus* (Schlegel, 1841) was noted by Ben Ahmed *et al.* (2014).

**Distribution:**

This species was described from Algeria. Viguier (1879) attributed this leech to the genus *Batracobdella*. Seurat (1922) recorded it under the name *Helobdella algira* from Algeria and Tunisia but without citing localities. It has been collected from the skin of several Amphibian Anura species (*Discoglossus pictus*, *Pelopphyllax ridibundus*) and Urodeles (*Hydromantes genei*). Soós (1969) reported the following distribution: North Africa, Portugal, Spain, Balearic Islands, Corsica and the Crimean Peninsula. Minelli (1979) mentioned the same distribution, but added its presence in Sardinia. Nesemann & Neubert (1999) mentioned that this rare species is only known from North West Africa and from the western Mediterranean. They also noted that there are records from Morocco, Algeria, Portugal, Spain and Corsica. *B. algira* is widespread on the Iberian Peninsula, but not common.

In Tunisia (Fig. 5E), *B. algira* was recorded by Blanchard (1908) under the name *Helobdella algira* in Jendouba governorate in the valley of El Lebga (Aïn Drahem). Ben Ahmed *et al.* (2008a) reported it from North East Tunisia in Nabeul governorate (Lebna drainage basin) and Ben Ahmed *et al.* (2008b) from Beja governorate (Aïn El Goussa, 36.44N, 9.11E). In the present study we add several new records for the country: Nabeul governorate: Port Prince drainage basin, 36.51162 N, 10.39404 E; drainage basin Tebouda El Haouria, 37.3.0 N, 11.0.36E; Marsh sidi Ameur in El Haouria, 37.3.0 N, 11.0.33 E; Bizerte governorate: Ichkeul, 37.11255N, 09.34953E; Beja governorate: Aïn Zaga (Nefza), 36.58965N, 09.569329E; Siliana governorate: Aïn Tejra (Baten ezreyeb) 36.26N, 09.43E; El kef governorate: Marsh Elkhalsa (Sers), 35.95437N, 09.17461E; Kairouan governorate: El khadhra drainage basin, 36.1668N, 10.06214E; and Aïn Rouissat, 35.47229 N, 09.51176 E; Jendouba governorate: Marsh, 36.57N, 08.54E); for the first time in the south of the country: Tozeur governorate: Chbika (37.1912N, 7.55588E) and Tamaghza (34.2248N, 7.570E).

**Genus *Helobdella* Blanchard, 1896*****Helobdella stagnalis* (Linnaeus, 1758)**

(Fig. 2C)

**Diagnosis:** The body is flattened and lanceolate. The general colouration is gray. The head bears one pair of eyes. A brown plaque (scute) is present on the dorsal side in the neck region. The gonopores are separated by a single annulus.

**Habitat:** The species was collected under stones, especially in stagnant and slowly running waters. Associated fauna: chironomids and *Gammarus*.

**Distribution:** *Helobdella stagnalis* is a cosmopolitan species. It is common in Europe and fairly frequent in Asia and in North and South America. It is poorly represented in India and in Africa. It was reported from Morocco (Moore 1939) and recently from Egypt by Gouda & El-Shiemy (2004). Additional records from South Africa have been reported by Oosthuizen & Siddall (2003).

In Tunisia (Fig. 5A), this species was collected under emergent stones by Ben Ahmed *et al.* (submitted paper) from: El Kef governorate: Elkhalsa drainage basin, Sers (35.95437N, 09.17461E), Siliana

governorate: Essoudiya Spring (36.95995N, 09.531145E) and Bizerte governorate: Oued Joumine, Mateur-Séjnen (37.00351N, 09.37315E).

**Genus *Placobdella* (Blanchard, 1893)**

***Placobdella costata* (F. Müller, 1846)**

(Fig. 2D)

**Diagnosis:** *P. costata* is a flattened species. The colour of living specimens is green to brown. Seven longitudinal rows of numerous papillae are present on the dorsal face. The mouth pore is situated on the anterior rim of the cranial sucker. The latter bears two unseparated eyes. The crop has seven pairs of crop caeca and the genital pores are separated by two annuli.

**Habitat:** Found in small groups under rocks and under various objects such as plastic bottles. It colonizes several habitats (drainage basins, oueds and springs ...). An ectoparasitic association with the turtle *Emys orbicularis* was noted (Ben Ahmed & Tekaya 2009).

**Distribution:** *P. costata* was described from the Crimean Peninsula, under the name *Clepsine costata*. Rousseau (1912) recorded it from Southern Europe (France, Italy and Crimean Peninsula). Soós (1969) recorded that this species is widely distributed in Europe (except North and Northwest Europe) and North Africa. Minelli (1979) found it in Italy (Rome, Sassari and Padova). In the Middle East, this species has been recorded from Lake Hula in Israel (Bromley 1989). Neesemann & Neubert (1999) have characterized *P. costata* as a Mediterranean species extending eastwards to the Ukraine, south-eastwards to Greece, Turkey and the Levant, and to the southern Arabian Peninsula. In West and Central Europe, this species was recorded from southern England, the Netherlands, Poland and Germany (Neesemann & Neubert 1999). Recently, Sağlam (2001) collected *P. costata* in discharge channels at Elazığ in Turkey, which correspond to the first record for the country. More recently, Vamberger & Trontelj (2007) recorded it for the first time in Slovenia.

In Tunisia (Fig. 5C), this species was collected by Henri Gadeau de Kerville in Jendouba governorate: the valleys of el Omor (Tabarka) and El Lebga (Aïn Drahim), being identified by Blanchard (1908) as *Placobdella catenigera*. Ben Ahmed *et al.* (2008a) have recorded it in Nabeul governorate (Lebna drainage basin). In this paper, we add its presence in a new locality of this later governorate: Port Prince drainage basin (36.51162 N, 10.39404E); in a marsh in Jendouba governorate (36.30N, 8.47E) and in a source in El Kef governorate (36.1056N, 8.4253E).

**Genus *Theromyzon* Philippi, 1867**

***Theromyzon tessulatum* (O.F. Müller, 1774)**

(Fig. 2E)

**Diagnosis:** The body is dorsoventrally flattened and nearly translucent. The colour of living specimens is green to grey. The dorsal body surface shows four rows of longitudinal papillae. The head bears four pairs of eyes and the genital pores are separated by four annuli. The species is known as bloodsucker of birds.

**Habitat:** Found under stones, it seems to prefer stagnant or slow flowing water bodies most often of artificial origin such as drainage basins. The presence of aquatic birds appears to be important.

**Distribution:** This species was described as *Hirudo tessulata* from Lake Frederiksdahl, Denmark. Soós (1969) and Minelli (1979) reported it from the Palaearctic region and South America. In the Middle East, *T. tessulatum* was reported in Palestine and Lebanon by Blanchard (1893) and Moore (1944). Bromley (1994), in his investigation in the Middle East, did not find this leech and suggested that it may have disappeared in this region. Recently, Jueg (2008a) has collected it in Central Asia (Kyrgyzstan) and Spain. The species was already reported by Johansson (1927) in Spain.

In Tunisia (Fig. 5D), this species was recorded in the North East of the country in the governorate of Nabeul in two stations: Lebna drainage basin (36.44326N, 010.5525,5E) by Ben Ahmed *et al.* (2008a) and in Port Prince drainage basin (36.51162N, 10.39404E) (this study).

**Family Piscicolidae Johnston, 1865**

**Subfamily Piscicolinae Caballero, 1956**

**Genus *Trachellobdella* Diesing, 1850**

***Trachellobdella lubrica* (Grube 1840)**

(Fig. 3B)

**Diagnosis:** The maximum length is 3 cm. The body has obvious paired pulsatile vesicles. The colour of living specimens is yellow-orange. The oral sucker has one pair of eyes. The posterior sucker is very small and is without ocelli. The male and female gonopores are separated by one annulus. This parasitic species was found in the gill cavity of teleosts.

**Habitat:** This leech lives exclusively in the gill chambers of a variety of teleost fish in warm temperate and tropical seas worldwide. The mature leeches leave the fish to lay eggs, after which they die (Sawyer 1986; Williams *et al.* 1994).

**Distribution:** *Trachellobdella lubrica* has been reported on marine fishes from the Mediterranean, west coast of Africa, Caribbean, Gulf of Mexico, South Carolina and near the Hawaiian Islands (Sawyer 1986).

In Tunisia (Fig. 5F), the species was collected from the fish *Symphodus tinca* (Linnaeus 1758) in the lagoon of Bizerte.

**Order Arhynchobdellida Blanchard, 1894**

**Suborder Hirudiniformes**

**Family Hirudinidae (Whitman, 1886)**

**Genus *Hirudo* Linné, 1758**

***Hirudo troctina* Johnson, 1816**

(Fig. 3A,C)

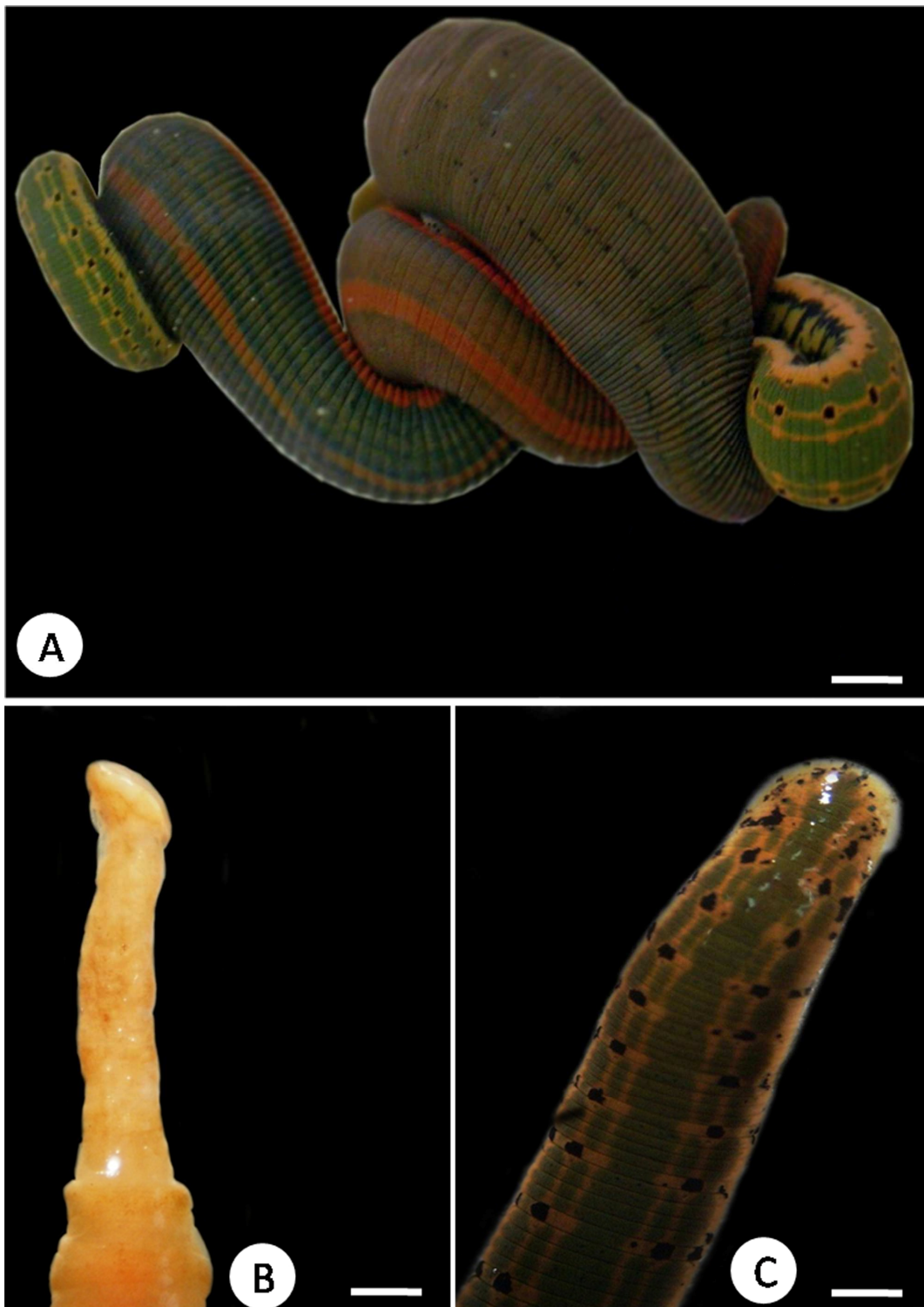
**Diagnosis:** The colour of living animals is grass green. The dorsal surface shows six longitudinal bands of orange and black spots. The venter is greenish to yellow with large black spots. Laterally, there are two marginal longitudinal zigzag lines. This species has three muscular jaws. The anterior sucker has a parabolic arc of 10 eyespots and the genital gonopores are separated by five annuli.

**Habitat:** Found under stones and other submerged objects. It seems to prefer drainage basins and marshes. It was not found in springs.

**Distribution:** Seurat (1922) recorded it from Algeria (in Mitidja) and reported its presence in Spain, Portugal and Italy (Sardinia).

In Tunisia (Fig. 5G), Blanchard (1908) recorded this species in two localities in the North West of the country Tabarka and Ain Drahim (Jendouba governorate). Hetchel & Sawyer (2002) recorded it in North Africa (Algeria, Morocco and Tunisia). Ben Ahmed *et al.* (2008a) collected this species from a new locality in Tunisia in Nabeul governorate: Lebna drainage basin. In the present study, we add new records in this

later governorate: Ain Oued Edheb (El Haouria); drainage basin Tebouda (37.30N, 11.036E) and Marsh sidi Ameer (37.3.0N, 11.0.33E) and we report its presence for the first time in Jendouba governorate (Marsh in Fernena) and in the south of the country: governorate of Tozeur (Chbika, 37.1912 N, 7.55588 E); Tamaghza (34.2248N, 7.570E).



**Figure 3.** A Dorsal face of *Limnatis nilotica* and *Hirudo troctina*: Scale bar = 0.7cm; B Morphology of *Trachellobdella lubrica*: Scale bar = 0.5cm; C Details of dorsal face of *Hirudo troctina* Scale bar = 10mm.

Genus *Limnatis* Moquin-Tandon, 1826



***Limnatis nilotica* (Savigny, 1822)**

(Fig. 3A)

**Diagnosis:** The dorsal side shows two different color patterns: the typical pattern is green to brown with four interrupted black lines, while some specimens have an additional median orange band. Marginally, there are two orange stripes. The ventral side of the body is dark brown. The anterior sucker has five pairs of parabolic eyes, the posterior sucker is very large and the genital pores are separated by five annuli

**Habitat:** Eurytopic species, common in the springs, oueds and drainage basins.

**Distribution:** *L. nilotica* (Syn. *Bdella nilotica* Savigny, 1822) was the first species discovered by Savigny, who accompanied Napoleon's expedition to Egypt. This species was attributed by Moquin-Tandon (1846) to the genus *Limnatis* because the name *Bdella* was preoccupied by a genus of Arachnida. Blanchard (1908) and Seurat (1922) mentioned the following distribution for *L. nilotica*: Egypt, Turkestan, Middle East, southern Italy (Sicily) and Spain (Balearic and Canary islands). Nesemann & Neubert (1999) mentioned it as a circum-Mediterranean species, occurring in the Ukraine and the Crimean Peninsula, in the Middle East, the Arabian Peninsula and eastern Africa.

In Tunisia (Fig. 5H), Megnin (1891) collected this species from the oral cavity of horses brought by the French military from Bizerte (Tunisia). Autrum (1936) recorded *L. nilotica* from North Africa (Morocco, Algeria and Tunisia). Ben Ahmed *et al.* (2008a) reported it from the governorate of Bizerte (Aïn Sejnen), governorate Ariana (Aïn djbel Ammar, 36.544070N, 10.015739E), governorate Ben Arous (Valley bir el bey and Marsh Borj el cedria, 36.423148N, 10.255222E), governorate Béja (Aïn testour, 36.322726N, 09.27004 E), Governorate Zaghuan (Aïn gbar elsbia, 36.23768N, 10.75410E), governorate Siliana (Aïn bit hsouna, 36.72021 N, 09.213744 E; Aïn waheb, 36.72095N, 09.213434E), Governorate Nabeul (Lebna drainage basin, 36.44326N, 10.55255E); governorate Gabès (Bouhedma Parc, N34.185722/E09.245520).

In the present paper we add its presence in the following localities: governorate Nabeul: drainage basin Tebouda (El Haouria), 37.3.0N, 11.0.36E; Marsh sidi Ameur in El Haouria, 37.3.0N, 11.0.33E; Oued Elabid (village), 36.51804N, 10.44711E; governorate of Jendouba: Aïn Delya (14 km before Feïja), 36.4809 N, 08.32511E; governorate Zaghuan: Aïn Sidi Bougabrine, 36.37593N, 10.10507E; governorate Gabes: Oasis Kettana, 33.493357N, 10.001757E; Oasis Chninni, 33.515028N, 10.4600E; governorate Bizerte: Aïn Sidi Saleh, 37.12302N, 10.04002E; governorate of Béja: Aïn 2 to 3 km before Sidi Salem dam, 36.352699N, 09.241621E; governorate of Kairouan: Aïn Chrichira; governorate of Tozeur: Chbika, 37.1912N, 7.55588 E); Tamaghza, 34.2248N, 7.570 E; governorate of Gafsa: Oued el-Akarit, 34.25N, 8.47E.

**Suborder Erpobdelliformes Sawyer, 1986****Family Erpobdellidae Blanchard, 1894****Genus *Erpobdella* De Blainville, 1818*****Erpobdella testacea* (Savigny, 1820)**

(Fig. 4A)

**Diagnosis:** The dorsal surface of the living specimens is reddish brown in colour with minuscule darker specks. The ventral surface is brighter than the dorsal. The mid-body segment consists of five equally long annuli. The head has four pairs of eyes. Gonopores are separated by 4 annuli.

**Habitat:** The occurrence of *E. testacea* in Tunisia is restricted to lowland stagnant waters (50–65 m asl.).

**Distribution:** *E. testacea* is a Palaearctic species. In the Mediterranean region it is present in northern Italy and Greece (Nesemann, 1997) and northern Tunisia (Ben Ahmed *et al.* 2008a). It was recorded from Croatia, Montenegro, Bosnia and Herzegovina (Sket 1968).



**Figure 4** **A** Dorsal face of *Erpobdella testacea*: Scale bar = 1cm; **B** Dorsal face of *Dina punctata maroccana*: Scale bar = 0.9cm. **C** Dorsal face of *Trocheta africana*: Scale bar = 1.3cm; **D** Dorsal face of *Dina punctata punctata*: Scale bar = 1cm. **E** Dorsal face of *Trocheta tunisiana*: Scale bar = 1.2cm.

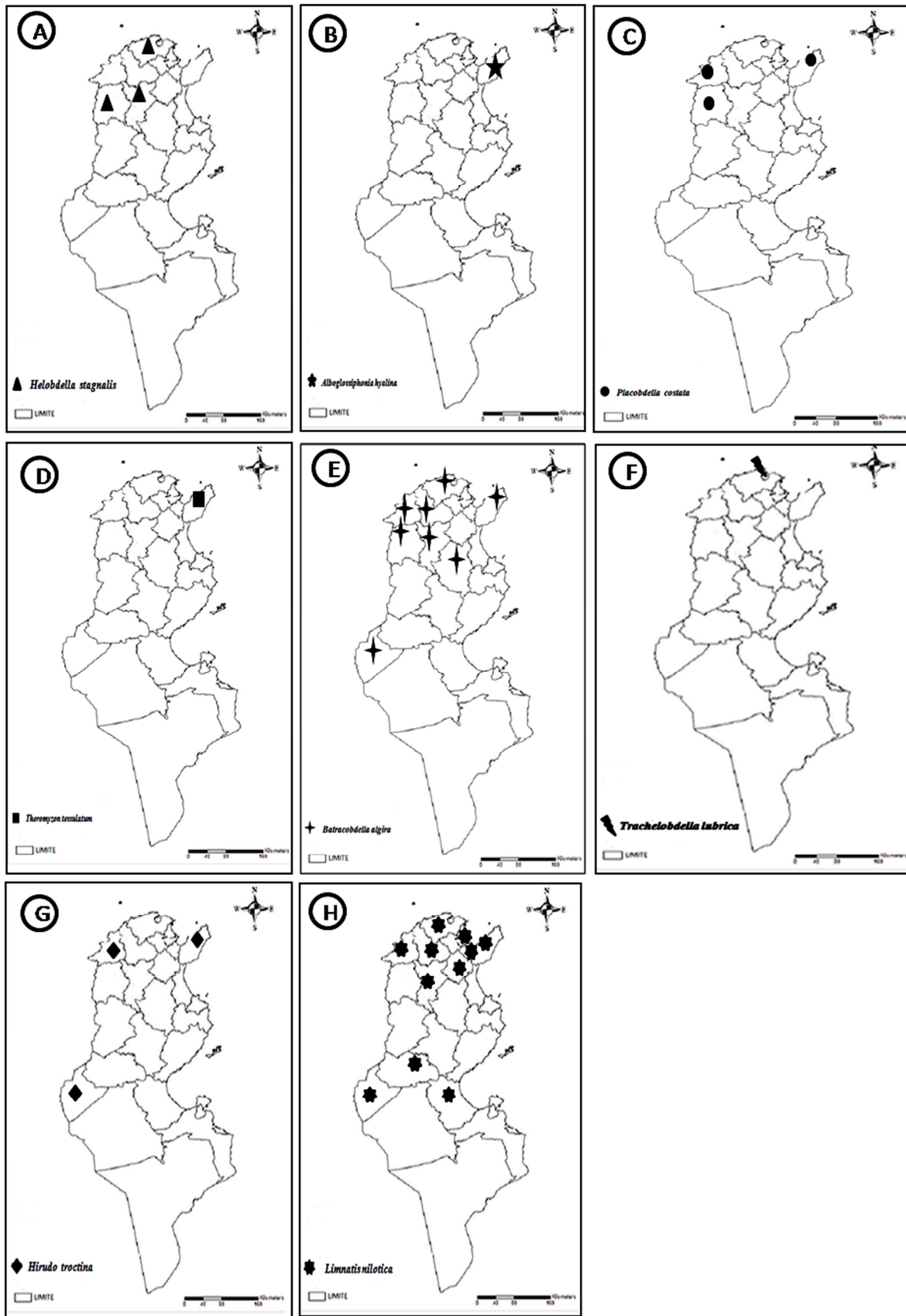
In Tunisia (Fig. 6E), to date this species had been recorded from three reservoirs and from a small Marsh in the North of the country. Ben Ahmed *et al.* (2013) added new records for the country: governorate of Bizerte: Marsh in Sejnen, Bizerte, 37.03N, 09.13 E; El-khirba drainage basin, 37.16354N, 10.09552E; governorate of Nabeul: Port Prince drainage basin, Cap Bon, Korbus, 36.51162N, 10.39404E; Lebna drainage basin, 36.44326N, 10.55255E; governorate of Tozeur: Chbika, 34.19.1.2N, 7.55.58.8 E; Tamaghza, 34.22.48N, 7.57.0E; governorate of Gafsa: Oued el-Akarit, 34.25N, 8.47E.

### Genus *Dina* Blanchard, 1892

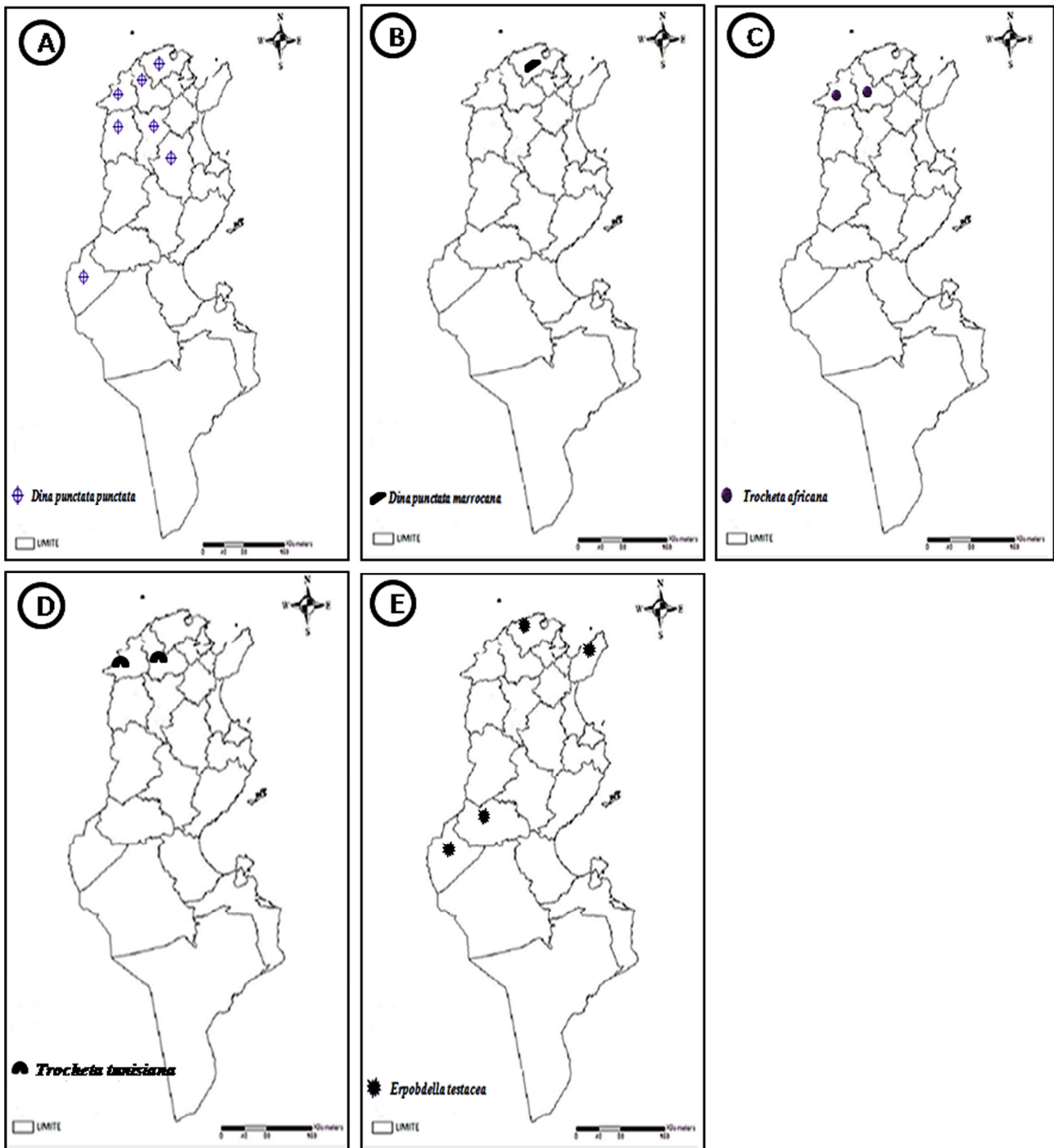
#### *Dina punctata punctata* Johansson, 1927

(Fig. 4D)

**Diagnosis:** The colour of living specimens varies from reddish brown to greenish. The dorsum has a rough surface due to the presence of numerous small papillae and has yellow spots arranged transversally on annulus a2. The somites are divided into four short and one long annuli. The head has four pairs of eyes arranged semi-circular along the anterior edge of the head. The gonopores are separated by 1.5 to 2 annuli.



**Figure 5.** The distribution of selected leech species (families Glossiphoniidae, Piscicolidae and Hirudinidae) in Tunisia based upon literature and specimens collected during this study. The symbol indicates the governorate in which the species is found, and not the exact location.



**Figure 6.** The distribution of selected leech species (Family Erpobdellidae) in Tunisia based upon literature and specimens collected during this study. The symbol indicates the governorate in which the species is found, and not the exact location.

**Habitat:** It was found in small ditches and in temporary streams.

**Distribution:** *Dina lineata* was described from Spain and two varieties *notata* and *punctata* was distinguished. Therefore it is believed that the geographical distribution of *D. punctata* requires confirmation. Prior to Johansson (1927) the variety *punctata* was not known and most recent authors did not discriminate both varieties. Also, the taxonomy of the genus *Dina* in the western Mediterranean requires



revision. Indeed, Minelli (1979) reported that *D. lineata* recorded from Italy is probably *D. punctata*. Also Jueg (2008), during his investigations in the Iberian Peninsula, found that *D. punctata* was very common in this area and *D. lineata* is totally absent. The latter suggested that *D. lineata* reported for the Iberian Peninsula by García-Más & Jiménez (1984) and García-Más *et al.* (1998) is *Dina punctata*. Recently, Nesemann & Neubert (1994) described a new subspecies from Morocco (*D. punctata maroccana*) and they suggest that some of the specimens described as *Dina lineata* by Moore (1939) from Morocco can be considered to be conspecific to their new subspecies. We think that in the eastern Mediterranean, *D. punctata maroccana* may be confused with *D. punctata*. Until further evidence, the taxonomic status of *Dina lineata* and the geographic distribution of *Dina punctata* remain uncertain.

In Tunisia (Fig. 6A), it was found in almost all governorates (Ben Ahmed *et al.* 2013): governorate of Béja: Aïn Oued Ennhas Tébourouk, 36.27.26N, 9.14.54E; Aïn Amdoun, 36.462169N, 09.5682E; Aïn Touta, Fjeyich, 28 km after Tebourba, 36.88403N, 09.53513E; governorate of Jendouba: Aïn Zoulèl Bellarjia (N36.56531/ E08.78953); Aïn Serkha, Fernana, 36.62593N, 08.71408E; governorate of Bizerte Aïn Sidi Saleh, 37.12302N, 10.04002 E; Aïn Oued Saaden, 37.16745N, 10.10974E; El Kef governorate: Aïn Bidha (borj elifa-Sers, 17 km before Sers, 36.17575N, 08.87473E; Aïn Oued Errmal (Tejerouine 9km before el Kef, 36.11539N, 08.63863E; Aïn Sidi Rhouma, village Sidi Omar Route borj elifa-Sérs; governorate of Siliana: Aïn Essaniya kissra-Elgariya, 35.46146N, 09.26450E; Aïn Soltane kissra-village, 35.48424N, 09.21588E; Aïn Zakkar, 36.01298N, 09.32182E; Governorate of Kairouan: Aïn Tffila route oueslatia 44 km before kairouan, 35.51215N, 09.43385E); and by the present paper we add its presence for the first time in the south of the country: Tozeur Governorate: Chbika, 37.1912N, 7.55588E; Tamaghza, 34.2248N, 7.570E.

#### ***Dina punctata maroccana* Nesemann & Neubert, 1994**

(Fig. 4B)

**Diagnosis:** The colour of living specimens varies from greenish brown to blackish. The dorsum is covered with prominent yellow spots and by small papillae and, thus, appears rough. Each somite is divided into five annuli; the first four are short and the fifth is long. The body is dorso-ventrally flattened. The eyes are arranged in four pairs, as in the nominate subspecies. The gonopores are separated by two annuli.

**Habitat:** This leech was found in a stream. It is semi-aquatic, with behaviour similar to that of *D. punctata punctata*. The associated fauna includes planarians (*Dugesia sicula* (Lepori, 1948)), gastropods and isopods.

**Distribution:** *Dina punctata maroccana* was previously known only from Morocco (Nesemann & Neubert, 1994).

In Tunisia (Fig. 6B), it has recently been reported by Ben Ahmed *et al.* (2013) from one station: Aïn Ennfeja (24 km before Séjnene) in Bizerte governorate (37.02291N, 09.26219E).

#### **Genus *Trocheta* Dutrochet, 1817**

##### ***Trocheta africana* Nesemann and Neubert, 1994**

(Fig. 4C)

**Diagnosis:** The colour of living specimens is black. Four dark narrow longitudinal stripes are visible in the smooth dorsal surface. The area between the inner paramedian stripes is less pigmented than the rest. Lateral keels are present. The ventral surface is pale grey. Annulation: somites with eight annuli, the first two of which are short, followed by three longer ones and another three short annuli. Head is with four pairs of eyes. The gonopores are separated by two annuli.

**Habitat:** This species prefers stagnant water or slow running rivers or brooks. It occurs mainly in the higher regions of northern Tunisia (805–868 m asl.). The specimens were found attached to the underside of rocks and stones and underneath the dead leaves of *Quercus suber*.

**Distribution:** It has been discovered in Tunisia (in a stream near Hammam Bourguiba, a mountain stream between Thibar and Tébourouk and in a mountain stream near Ded Melah, Béja governorate) and from one locality in Algeria published as *Dina lineata* by Johansson (1914). In the present study we add its presence in 3 other stations in governorate of Jendouba: Parc ElFaija, Oued Chobit Elmée, 36.30173N, 08.19080E; Oued Elfaija, Jendouba, 36.48634N, 08.30773 E; Ain Soltane, Jendouba, 36.31266N, 08.20157E.

***Trocheta tunisiana* Ben Ahmed et al. 2013**

(Fig. 4E)

**Diagnosis:** The colour of living specimens is light brown. Dorsally, there are four longitudinal stripes. The ventral surface is always somewhat lighter than the dorsum. The head has four pairs of eyes. In the post-clitellar region, lateral keels are present. Annulation is typical for *Trocheta* species. The complete somite is divided into eight annuli, the first two of which are short, followed by three longer ones and another three short annuli. The gonopores are separated by two annuli.

**Habitat:** *Trocheta tunisiana* has been collected in smaller brooks and springs occurring in the mid and higher elevations (usually over 350 m asl.). It is distributed in the northwest of Tunisia.

**Distribution:** This species is so far known only from Tunisia: the type locality is spring Zaga in Béja governorate (36.58965N, 9.5693E), moreover it was recorded from Spring Oued El Madin (36.90107N, 9.16501E); stream Oued el Melih Ouechtéta (36.97467N, 09.01214E) from the same governorate and in spring Ain Sobh (36.57173N, 08.54565E) and spring Touiyatia, Ain Draham (36.74456N, 08.58686E) of Jendouba Governorate.

**Discussion and Concluding remarks**

The check-list of leeches (Hirudinida) of Tunisia discussed in this paper includes thirteen species, reflecting historical and recent records published in the literature and specimens from collections by the authors during this seven-year study (2006 through 2012). The following seven of them were collected by the present authors: *Alboglossiphonia hyalina*, *Helobdella stagnalis*, *Theromyzon tessulatum*, *Erpobdella testacea*, *Dina punctata punctata*, *Dina punctata maroccanna* and *Trocheta tunisiana*. The others (*Batracobdella algira*, *Placobdella costata*, *Hirudo troctina*, *Limnatis nilotica* and *Trocheta africana*) had been recorded before from Tunisia. Further surveys extended to new governorates are recommended since we believe that many more new species await discovery. For example *Glossiphonia complanata* (Linnaeus, 1768), cited for the Maghreb by Mann (1978) without indication of locality is a potential species. The 13 species recorded in the present study show Holarctic, Palaearctic and also endemic Maghrebian distribution. *Dina punctata*, which is considered to be the most common species in Tunisia, is completely absent in the eastern Mediterranean (Ben Ahmed and Tekaya 2009) and thus it shows a western Mediterranean or Alboran distribution. Similarly, *Batracobdella algira* and *Limnatis nilotica* are common in Tunisia occurring in a wide range of water bodies, such as drainage basin, springs and marshes. On the other hand, the actual distribution of these two species shows that they are present mostly in the circum-Mediterranean regions. The genus *Hirudo* Linnaeus, 1758 is composed of five species: the European medicinal leech (m.l.) *H. medicinalis*, the Mediterranean m.l. *H. verbana*, the Caucasian m.l. *H. orientalis*, the African m.l. *H. troctina*, and the East Asian m.l. *H. nipponia*. *Hirudo troctina* is also a common species in Tunisia and it is considered as an interesting biogeographic case worth mentioning. In fact, it is the sole species of the genus in Africa and thus it represents an endemic Maghrebian distribution. Also *Trocheta africana* is the only species of the genus in Africa and seems to be restricted to the western part of Tunisia. This species shows a Tuniso-algerian distribution as it was recorded to date only in these two countries. Perhaps this is also true for *Trocheta tunisiana*. *T. tessulatum* is very rare and only known from two drainage basins in the eastern part of Tunisia. This species has a Holarctic distribution. Its introduction via birds from Europe to North Africa is quite possible. *Alboglossiphonia hyalina* and *Erpobdella testacea* have a wide distribution in Europe and might represent an example of Palaearctic distribution. Both species, as well as the cosmopolitan *Helobdella stagnalis*, are rare in Tunisia and only known from a few localities.

## A key for identification of Tunisian leeches species

We propose the following key for identification of Tunisian Leeches.

- |    |                                                                                                                                                                                                                     |                                                                                 |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 1  | Slender and elongated leeches with a distinct anterior sucker-like disc .....                                                                                                                                       |                                                                                 |
|    | ..... (Piscicolidae) only 1 marine species known for Tunisia: <i>Trachellobdella lubrica</i> )                                                                                                                      |                                                                                 |
| -  | Less slender without anterior sucker-like disc .....                                                                                                                                                                | 2                                                                               |
| 2  | Two eyes.....                                                                                                                                                                                                       | 3                                                                               |
| -  | Six or more eyes .....                                                                                                                                                                                              | 5                                                                               |
| 3  | A dorsal scute present, no dorsal papillae.....                                                                                                                                                                     | <i>Helobdella stagnalis</i>                                                     |
| -  | No dorsal scute. Dorsal papillae present.....                                                                                                                                                                       | 4                                                                               |
| 4  | Seven longitudinal rows of dorsal papillae.....                                                                                                                                                                     | <i>Placobdella costata</i>                                                      |
| -  | Three pairs of longitudinal rows of dorsal papillae, no median row .....                                                                                                                                            | <i>Batracobdella algira</i>                                                     |
| 5  | Eight eyes arranged in 2 rows parallel with the mid dorsal line. Thick green gelatinous species when alive .....                                                                                                    | <i>Theromyzon tessulatum</i>                                                    |
| -  | Six eyes, the most anterior closer together than both other pairs. White and flattened species with numerous papillae.....                                                                                          | <i>Alboglossiphonia hyalina</i>                                                 |
| 6  | Five pairs of eyes arranged in a crescent. Jaws present. Large and dark species, rounded in cross-section. Body often with longitudinal lines.....                                                                  | Hirudinidae -7                                                                  |
| -  | Four pairs of eyes arranged in two distinct groups. Jaws absent. Medium- sized species, often with lateral keels in posterior part. Colour ranging from brown to black, sometime with lack longitudinal lines ..... | Erpobdellidae -8                                                                |
| 7  | Marginally, there are two orange stripes .....                                                                                                                                                                      | <i>Limnatis nilotica</i>                                                        |
| -  | Marginally, there are two longitudinal zigzag lines.....                                                                                                                                                            | <i>Hirudo troctina</i>                                                          |
| 8  | Annuli homonomously .....                                                                                                                                                                                           | <i>Erpobdella</i> (in Tunisia only 1 species known <i>Erpobdella testacea</i> ) |
| -  | Annuli heteronomously .....                                                                                                                                                                                         | Trochetinae 9                                                                   |
| 9  | Annulus b6 homonomously subdivided .....                                                                                                                                                                            | <i>Dina</i> -10                                                                 |
| -  | Annuli b6 heteronomously subdivided.....                                                                                                                                                                            | <i>Trocheta</i> -11                                                             |
| 10 | Ground colour is brown to green .....                                                                                                                                                                               | <i>Dina punctata punctata</i>                                                   |
| -  | Ground colour of the body light brown .....                                                                                                                                                                         | <i>Dina punctata maroccana</i>                                                  |
| 11 | Ground colour of the body black .....                                                                                                                                                                               | <i>Trocheta africana</i>                                                        |
| -  | Ground colour of the body light brown .....                                                                                                                                                                         | <i>Trocheta tunisiana</i>                                                       |

## Acknowledgements

The authors extend their thanks to the “Unité de Recherche Biologie de la Reproduction et du Développement” and the DGRSRT Tunisia for financial support and we like to thank the two reviewers for their helpful comments.

## References

- Autrum, H. (1936) Systematik der Hirudineen. *In*: Bronns Klassen und Ordnungen des Tierreichs, IV, 3 (4), Teil I (1), Akademische Verlagsgesellschaft, Leipzig, 3-96 pp.
- Ben Ahmed, R., Harrath, AH., & Tekaya, S. (2008a) Freshwater Leeches from Tunisia. *Lauterbornia*, 65, 131–148.
- Ben Ahmed, R., Harrath, AH., & Tekaya, S. (2008b) Ecological and biological features of four Tunisian freshwater leeches: *Batracobdella algira*, *Alboglossiphonia hyalina*, *Theromyzon tessulatum*, and *Erpobdella testacea*. *Lauterbornia*, 65, 177–192.

- Ben Ahmed, R., Tekaya, S., & Harrath, A.H. (2008c) Etude préliminaire des Hirudinées en Tunisie: Description et systématique (Clitellata, Hirudinia). *Bulletin de la société zoologique de France*, 133 (1-3), 81–91.
- Ben Ahmed, R., & Tekaya, S. (2009) Etat des connaissances sur la Biogéographie des Hirudinées du pourtour de la Méditerranée. *Bulletin de la société zoologique de France*, 134 (1-2), 99–124.
- Ben Ahmed, R., Bielecki, A., Cichocka, MJ., Tekaya, S., Gorzel, M. & Harrath, AH. (2013) Erpobdellid leeches (Annelida: Clitellata: Hirudinida) from Tunisia: New records with the description of a new *Trocheta* species. *Zootaxa*, 3681 (4), 440–454.
- Ben Ahmed, R., Ben Rached, B. & Tekaya, S. (2014) Observations on leech parasitism and predation for Tunisian Amphibians. *Lauterbornia*, 77, 1–7.
- Blanchard, R. (1891) Courtes notices sur les Hirudinées. I. sur la sangsue du cheval du Nord de l’Afrique. *Bulletin de la société zoologique de France*, 16, 218–221.
- Blanchard, R. (1908) Hirudinées. In: Baillière, J.B. & fils, (Eds.), Voyage Zoologique en Khroumirie (Tunisie). H. Gadeau de Kerville, Paris, pp.307–310.
- Blanchard, R. (1893) Viaggio del Dr. E. Festa in Palestina nel Libano e regioni vicine. III. Hirudinées. *Bollettino dei Musei di Zoologia e Anatomia Comparata della R. Università di Torino*, 8, 1–2.
- Bromley, HJ. (1989) A preliminary outline of the freshwater Hirudinea of Israël. *Israel Journal of zoology*, 3, 107.
- Bromley, HJ. (1994) The freshwater Leeches (Annelida, Hirudinea) of Israël and adjacent areas. *Israel Journal of zoology*, 40, 1–24.
- García Más, I., & Jiménez, JM. (1984) Introducción al estudio de las comunidades macrobentónicas de los rios asturianos : Hirudineos. *Limnetica*, 1, 179–186.
- García Más, I., López, FM., Mora, AMP., & Ortega, GT. (1998) Hirudineos (Annelioda, Hirudinea) de las aguas continentales de la Comunidad Valenciana (España). *Boletín de la Real Sociedad Española de Historia Natural Madrid*, 94 (1-2), 149–161.
- Gouda, AH., & El-Shiemy, NA. (2004) Detailed description of the freshwater leech *Helobdella stagnalis* (Linnaeus, 1758) (Hirudinea: Glossiphoniidae) from Assiut, Egypt. *Journal of Aquatic Biology & Fish*, 8 (4), 145–162.
- Hetchel, FOP., & Sawyer, RT. (2002) Toward a taxonomic revision of the medicinal leech *Hirudo medicinalis* Linnaeus, 1758 (Hirudinea: Hirudinidae): re-description of *Hirudo troctina* Johnson, 1816 from North Africa. *Journal of Natural History*, 36, 1269–1289.
- Johnson, JR. (1816) *A treatise on the medical leach including its medical and natural history*. Longman, Hurst, Rees, Orne & Brown, London, 147 pp.
- Johansson, L. (1914) Hirudineen. Ergebniss von Franz wernes zoologischer Forschungsreise nach Algerien, *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien*, 73, 1–16.
- Johansson, L. (1927) Hirudineen aus dem nördlichen und östlichen Spanien. Gesammelt von Dr. F. Haas in den Jahren 1914-1919, Abh. Senckenb. Naturforsch. Ges, 39, 217–231.
- Jueg, U. (2008) Beitrag zur Egelfauna (Hirudinea) der Iberischen Halbinsel. *Lauterbornia*, 65, 83–104, Dinkelscherben
- Jueg, U., Grosser, C., & Pešić, V. (2013) Bemerkungen zur Egelfauna (Hirudinea) von Kirgistan. *Lauterbornia*, 76, 103–109.
- Mann, KH. (1978) Hirudinea. In: Limnofauna Europea, Illies, J. (Eds.), Gustav Fischer Verlag, Stuttgart, 148–150.
- Megnin, P. (1891) Sangsues d’Algérie et de Tunisie ayant séjourné plus d’un mois dans la bouche de boeufs et de chevaux. *Bulletin de la société zoologique de France*, 16, 222–227.
- Moore, JP. (1939) Leeches (Hirudinea) from the Atlas Mountains of Morocco. *Annals and Magazine of Natural History*, 3, 80–87.
- Moore, JP. (1944) The Leeches (Hirudinea) of Lake Huleh. Palestine, *Annals and Magazine of Natural History*, 6, 182–190.
- Moquin-Tandon, A. (1846) *Monographie de la famille des Hirudinées*. Paris, 448 pp.
- Minelli, A. 1979. Hirudinea. *Fauna d’Italia*. Calderini Bologna, 152pp.
- Nesemann, H., & Neubert, E. (1994) New data to the leeches of the subfamily Trochetinae (Hirudinea, Erpobdellidae). *Miscellanea Zoologica Hungarica*, 9, 19–28.



- Nesemann, H., & Neubert, E. (1999) Annelida, Clitellata: Branchiobdellida, Acanthobdellea, Hirudinea. 94 Abb. In: Schwoerbel, J. & Zwick, P. (Eds.), Süßwasserfauna von Mitteleuropa. Begründet von A. Brauer 6/2, (Spektrum) Heidelberg, 178 pp.
- Nesemann, H. (1997) Egel und Kriebsegele (Clitellata: Hirudinea, Branchiobdellida) Österreichs. Gedruckt mit Unterstützung des Bundesministeriums für Umwelt, Jugend und Familie, Wien, 107 pp.
- Oosthuizen, JH., & Siddall, ME. (2003) The freshwater leeches (Hirudinea) of southern Africa with a key to all species. Volume 5 In: Guide to Freshwater Invertebrates in Southern Africa. South African Water Research Commission.
- Pawlowski, LK. (1936) Pijawki (Hirudinea). *Fauna Stodkowodna*. Warszawa, Polski, 26, 176 pp.
- Rousseau, E. (1912) Les Hirudinées d'eau douce d'Europe. *Anales Bioogia Lacustre*, 5, 259–295.
- Sağlam, N. 2001 First record of the leech *Placobdella costata* (Hirudinoidea: Glossiphoniidae) in Turkey. *Zoology in the Middle East*, 23, 113–118.
- Sawyer, RT. (1986) *Leech biology and behaviour*. Oxford, Clarendon Press, 1065 pp.
- Seurat, L. (1922) Faune des Eaux continentales de la Berbérie. Travaux du Laboratoire de Zoologie Appliquée, Faculté des Sciences, Université d'Alger, 1-66.
- Sket, B. (1968) Zur Kenntnis der Egel-Fauna (Hirudinea) Jugoslawiens. *Academia Scientiarum et Artium Slovenica CL. IV Pars Historiconaturalis*, Diss, 9 (4), 127–178.
- Soós, A. (1969) Identification key to the leech (Hirudinoidea) genera of the world with a catalogue of the species. VI. Family: Glossiphoniidae. *Acta Zoologica Academiae Scientiarum Hungaricae*, 15, 397–455.
- Vamberger, M. & Trontelj, P. (2007) *Placobdella costata* (Fr. Müller, 1846) (Hirudinea: Glossiphoniidae), a leech species new for Slovenia. *Natura Sloveniae Ljubljana*, 9, 35-40.
- Viguiet, C. (1879) Anatomie comparée des Hirudinées (organisation de la *Batrachobdella* (*B. Latasti*)). *Comptes Rendus de l'Academie des Sciences, Paris*, 89, 110–112.
- Williams, E.H., Bunkley-Williams, L. & Bureson, E.M. (1994) Some new record of marine and freshwater leeches from Caribbean, southeastern U.S.A., Eastern Pacific, and Okinawan animals. *Journal of the Helminthological Society of Washington*, 61, 133–138.