

RESEARCH ARTICLE

**A NEW SPECIES OF AQUATIC ORIBATID MITE
“*HYDROZETES CRASSIPES* SP. N.” (FAMILY: HYDROZETIDAE)
FROM SOHAG GOVERNORATE, EGYPT**

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ABSTRACT

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A new species of oribatid mite in the genus *Hydrozetes* (Suborder: Oribatida, Family: Hydrozetidae) is described in the current study for the first time from Egypt. The aquatic oribatid mite, *Hydrozetes crassipes* sp. n., was collected from roots of the aquatic plant, *Eichhornia crassipes*, floating in the River Nile, Sohag Governorate, Egypt. The descriptive characters of the present species are in accordance with those of the family and genus such as: the dorsum of individuals is smooth or finely punctate, never granulated or rugose, the legs are monodactylous, the prodorsum of the body is characterized with transverse and longitudinal ridges, the exobothridial setae are mostly very short; and trichobothria (bothridium and sensillus) is present. *Hydrozetes crassipes* sp. n. differs from the other published species in certain characters such as: the humeral regions are supported by two pairs of sclerotized plates, which are tapering inwardly towards the prodorsal lamellae, seven sclerotized opisthosomal plates, the longitudinal distance between setae of (*l*-) and (*d*-) series is not equal, the presence of five pairs of genital setae (*gl-g5*), and three pairs of genital discs.

INTRODUCTION

Hydrozetids are oribatids that composed of freshwater species^[1]. The genus *Hydrozetes* of oribatid mites lives in aquatic habitats like ponds, lakes, and rivers^[2-6]. The identification and description of *Hydrozetes* species were studied from different regions all over the world: South Africa, *Hydrozetes capensis*^[7]; Europe, *Hydrozetes confervae*, *Hydrozetes lacustris*, *Hydrozetes lemnae*, *Hydrozetes octosetosus*, *Hydrozetes parisiensis*, and *Hydrozetes thienemanni*^[8]; Poland, *Hydrozetes longisetosus*^[9]; Philippines, *Hydrozetes mindanaoensis*^[10], and Ecuador, *Hydrozetes behanpeltierae*^[6]. The adults of published species of genus *Hydrozetes*

differ from each other mainly by the shape of the bothridium and sensillus, the shape and number of notogastral setae, the number of genital setae, the epimeral setal formula, the shape of setae on the legs near the claw, and the number of claws on leg IV^[6,9,10]. The present paper aims to illustrate and describe the morphology of the adult of aquatic oribatid mite, *Hydrozetes crassipes* sp. n. collected from roots of the floating aquatic plant, *Eichhornia crassipes*, in River Nile, Sohag Governorate, Egypt.

MATERIAL AND METHODS

The adult specimens of the present species, *Hydrozetes crassipes* sp. n., were collected from roots of the floating plant, *Eichhornia*

crassipes (water hyacinth). The site of collection located on the western bank of the River Nile (26°21'N and 31°53'E) at Sohag, Egypt. The specimens were mounted in lactic acid and a droplet of Hoyer's medium for illustration, identification, and measurements of the present species. The images were obtained using JEOL 5300 Scanning Electron Microscope (JEOL Ltd., Akishima, Tokyo, Japan).

- Holotype: female (448 µm in length)

- Paratypes: 18 females

Holotype and paratypes of the present species are deposited in the Zoology Department, Faculty of Science, Sohag University.

Drawings were done with the aid of a camera Lucida. The body length was measured in lateral view, from the tip of rostrum to the posterior edge of the notogaster. Notogastral width refers to its maximum width in dorsal aspect. All body measurements were taken by calibrated eye piece and presented in micrometres. Formulas for leg setation are given in parentheses according to the following sequence: trochanter-femur-genu-tibia-tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the following sequence: genu-tibia-tarsus.

The present oribatid mite, *Hydrozetes crassipes* sp. n., was identified according to the keys included in the previously published papers^[5,6,10-13]. General morphological terminology and abbreviations of the oribatid mite setae are developed by Luxton^[13], and those for leg setal nomenclature by Bayartogtokh and Ermilov^[6] and Norton^[14].

RESULTS

Description of the *Hydrozetes crassipes* sp. n.

The body of the present species consists of two regions, prodorsum (*pr*) and notogaster (*no*). The prodorsal region has distinct trichobothria (bothridium and sensillus), two narrow lamellae (*la*), two pairs of prodorsal ridges (*tua*, *tup*), and short smooth setae.

The notogaster (*no*) is oval in shape with lenticulus (*lent*), two pairs of sclerotized plates in the humeral regions, seven sclerotized opisthosomal plates, and thirteen pairs of long and smooth simple setae. The anogenital area has five pairs of genital setae (*g1-g5*), one pair of aggenital setae (*ag*), two pairs of anal setae (*an1*, *an2*), and three pairs of adanal setae (*ad1-ad3*) (Figure 1a,b).

The body is oval in shape, reddish-brown in colour and with medium size (about 448 µm × 272 µm) (Figure 1a). The prodorsum (*pr*) is measured about 120 µm and 152 µm in length and width, respectively. It is triangular in shape with rounded rostrum. The prodorsal region carries two pairs of prodorsal ridges (*tua*, *tup*), two narrow lamellae (*la*), four pairs of simple smooth setae (*ro*, *le*, *in*, *ex*), and one pair of distinct trichobothria (bothridium and sensillus). Transverse (*tua*) and longitudinal (*tup*) prodorsal ridges are well developed and located lateral to lamellae. Rostral setae (*ro*) are smooth, curved outwardly and situated anteriorly on prodorsum. Lamellar setae (*le*) are tiny, smooth and located at apex of lamellae. Interlamellar setae (*in*) are tiny, smooth and located on basal part of lamellae in front of bothridium. Exobothridial setae (*ex*) are fine, smooth and lie posterior to the bothridium. Each bothridium (*bo*) is oval in shape and located near to basal part of lamellae. Each sensillus (*ss*) is smooth with short stalk and clavate head (Figures 1a and 2a,d,f).

Each pedipalp (*p*) consists of five segments (trochanter, femur, genu, tibia, and tarsus) with typical setation 0-2-1-3-9(+ω). Palpal trochanter is trapezoidal in shape with concave anterior margin and without setae, while palpal femur is the longest one and carries two long and smooth setae (*l''*, *v''*). Palpal genu is rectangular in shape and bears one long and smooth seta (*d*). Palpal tibia is slightly square in shape and carries two simple setae [one short (*l''*) and one long (*l'*)] and only one pectinate seta (*d*).

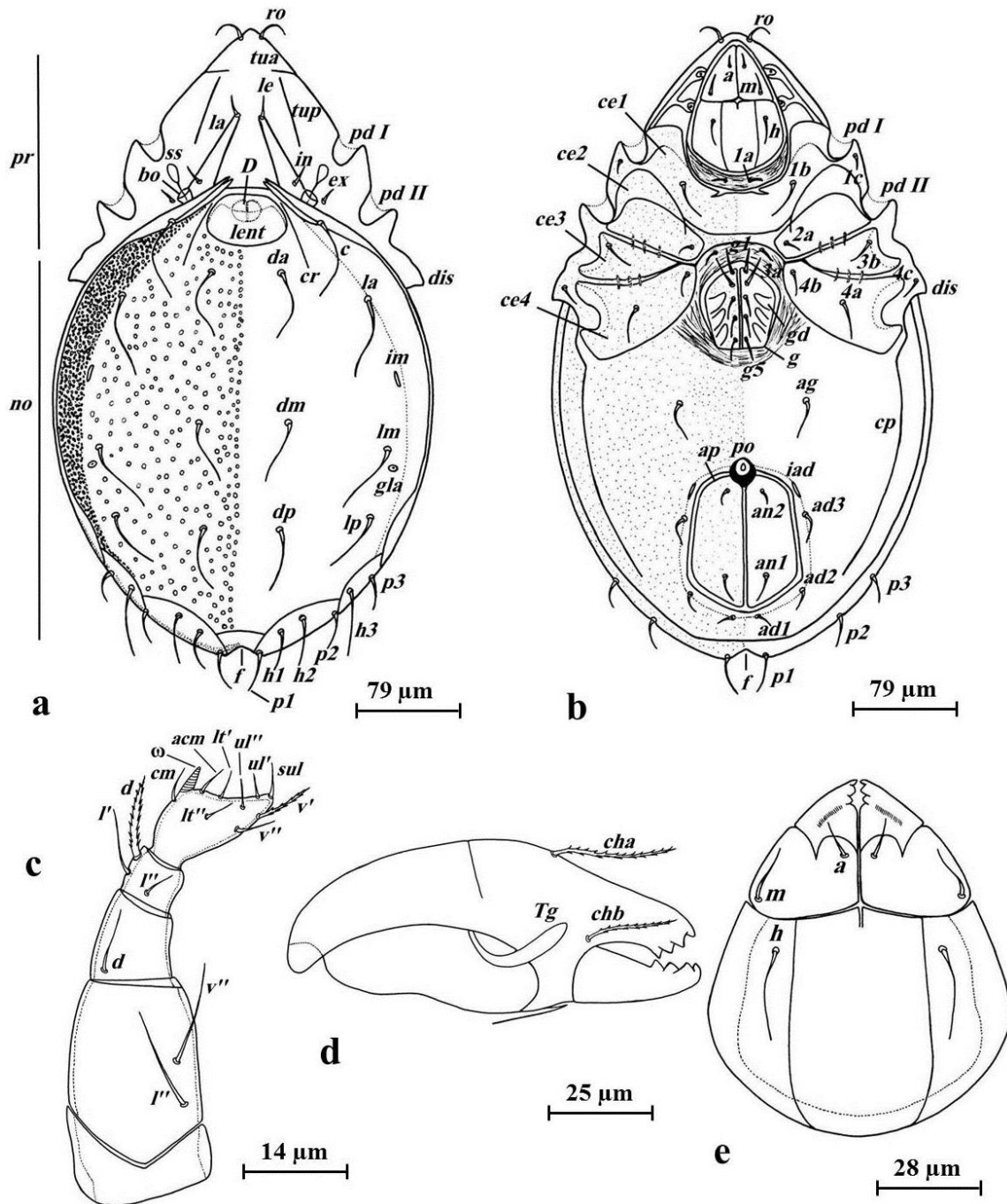


Figure 1: Camera Lucida drawings of the adult female *Hydrozetes crassipes* sp. n. showing: (a) dorsal view, (b) ventral view, (c) pedipalp, (d) chelicera, and (e) subcapitulum. Single prime (') marks setae on the anterior and double prime (") marks setae on the posterior side of a given palp segment.

Palpal tarsus is nearly cone-like in shape and carries nine different sized setae [eight smooth (*cm*, *acm*, *lt'*, *lt''*, *ul'*, *ul''*, *sul*, *v''*) and one pilose (*v'*)] and one solenidion (ω) (Figures 1c, 2h and 3a). Each chelicera (*ch*) is chelate-dentate with a base and two chelate digits (one fixed and the other

movable). Each digit bears four teeth. The base of chelicera is nearly elongated with two distinct barbed setae (*cha*, *chb*). Trägårdh's organ (*Tg*) of each chelicera is elongated and rounded distally (Figures 1d, 2h and 3b).

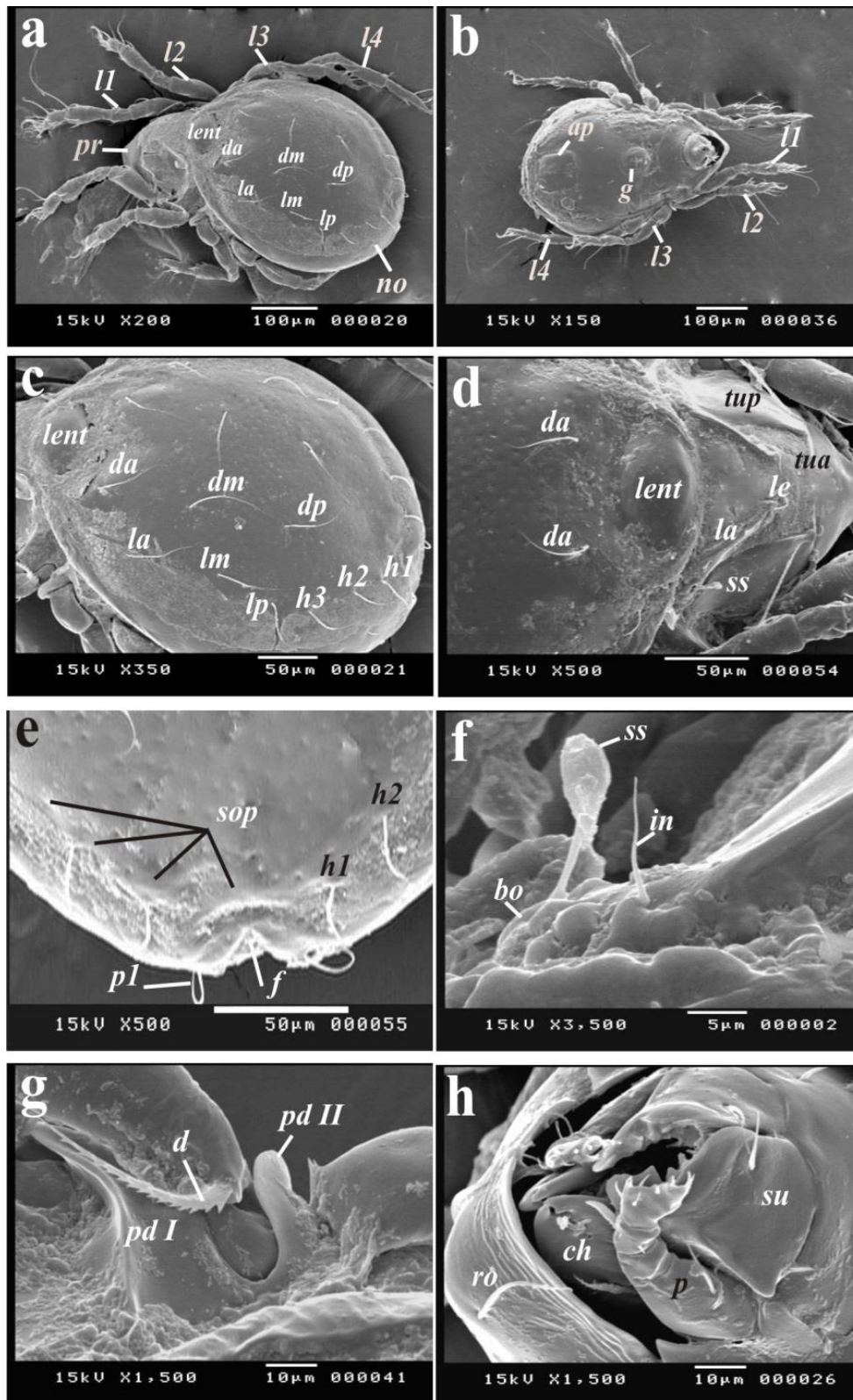


Figure 2: Scanning electron micrographs of adult female *Hydrozetes crassipes* sp. n. showing: (a) dorsal view, (b) ventral view, (c) higher magnification of (a) showing lenticulus and notogastral setae, (d) higher magnification of (a) showing lenticulus and prodorsum, (e) posterior end of notogaster showing longitudinal furrow and sclerotized opisthosomal plates, (f) clavate sensillus and interlamellar seta, (g) pedotecta I and II, and (h) subcapitulum, pedipalp and chelicerae.

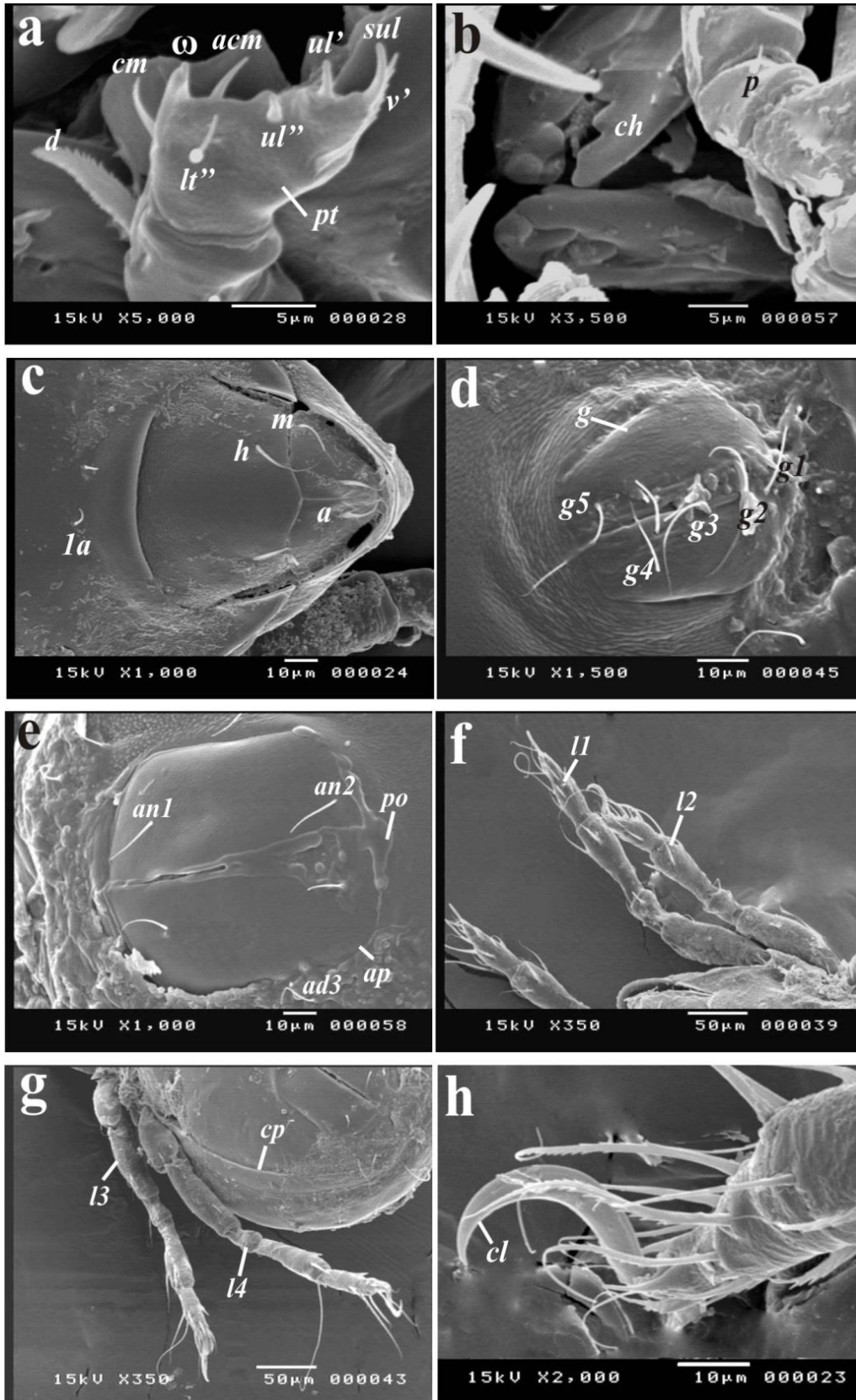


Figure 3: Scanning electron micrographs of adult female *Hydrozetes crassipes* sp. n. showing: (a) higher magnification of (2h) showing palpal tarsus setae and palpal solenidion, (b) chelicerae, (c) subcapitulum and subcapitular setae, (d) genital region, (e) anal region, (f) legs I and II, (g) legs III, IV, and circumpedal carinae, and (h) tarsus of leg II.

The notogaster (*no*) is oval in shape with anterior convex margin and measured about 328 μm in length and 272 μm in width (Figure 1a). The posterior margin of notogaster is characterized by presence of longitudinal furrow (*f*). In the dorsal aspect, the notogaster has lenticulus (*lent*), dorsophragmata (*D*), one pair of cristae (*cr*), two pairs of sclerotized plates in the humeral regions, seven sclerotized opisthosomal plates, thirteen pairs of long and smooth setae, one pair of lyrifissures (*im*), and one pair of opisthonotal gland openings (*gla*). The lenticulus (*lent*) is well visible, clear, nearly rounded and located in the anterior part of the notogaster behind the prodorsum. Dorsophragmata (*D*) are oval in shape and connected medially. Each crista (*cr*) is located lateral to lenticulus in the anterior region of the notogaster. The humeral regions supported by two pairs of sclerotized plates which tapering inwardly towards the prodorsal lamellae. The seven sclerotized opisthosomal plates decreased gradually towards the humeral regions. Three pairs of these plates located in the lateral margins of notogaster, while the remaining one found in the central area of notogaster (Figures 1a and 2a,c,d,e).

The notogastral setae are long, simple, and smooth, including only one pair of setae *c*, three pairs of setae in *l*-series, three pairs of setae in *d*-series, three pairs of setae in *h*-series, and three pairs of setae in *p*-series (Figures 1a). Each seta (*c*) situated lateral to cristae in the humeral regions, while seta (*lm*) located anterior to opisthonotal gland openings (*gla*). The setae in *l*- and *d*-series are arranged in longitudinal rows, while setae in *h*- and *p*-series are positioned on the posterolateral margin of notogaster. Longitudinal distance between setae of *l*- and *d*-series is not equal. These setae are described in details as follows: setae (*lm*) and (*dm*) are closer to setae (*lp*) and (*dp*) than to setae (*la*) and (*da*), respectively. Lyrifissure (*im*) located between setae (*la*) and (*lm*). The opisthonotal gland openings (*gla*) are located lateral to setae (*lm*). The cuticle of the lateral

margins of notogaster is densely microfoveolate, while the central region of notogaster is ornamented with sparse foveolae (Figures 1a and 2a,c,d,e).

The ventral aspect displays subcapitulum, two groups of coxal epimerae, and anogenital area. Subcapitulum is longer than wide, surrounded by striation, and measured about 91 μm in length and 78 μm in width. Subcapitulum carries three pairs of short smooth setae (*h*, *m*, *a*) and two groups of adoral setae, which located in front of setae (*a*) (Figures 1e, 2h, and 3c). The first group of coxal epimerae contains epimerae I and II, while the second one includes III and IV. The epimeral setae are paired in number and setal formula on each side of epimerae from I-IV is 3-1-2-3. All epimeral setae (*1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *4a*, *4b*, *4c*) are smooth and located as follows: setae (*1a*) behind subcapitulum, (*1b*) on coxal epimerae I, (*1c*) on apical part of pedotecta I, (*2a*) on coxal epimerae II, (*3a*) anterolateral of genital region, (*3b*) on coxal epimerae III, (*4a*, *4b*) on coxal epimerae IV, and (*4c*) on pedotecta IV (Figures 1b and 2b). Discidia (*dis*) are triangular in shape and extended externally above the coxae of leg IV. Circumpedal carinae (*cp*) are semi-oval in shape, directed to discidia anteriorly, and interrupted behind the anal aperture (Figures 1b and 3g).

Anogenital area includes anal and genital regions. The genital region includes genital opening, pair of genital plates, and pair of aggenital setae. The genital opening is elongated, slit-like structure, and guarded by one pair of genital plates. The genital plates (*g*) are elongated in shape and surrounded by striation. Each genital plate carries five pairs of simple setae (*g1-g5*) and three genital discs (*gd*). The aggenital setae (*ag*) are simple, smooth and located laterally between anal and genital plates (Figures 1b, 2b, and 3d).

The anal region includes anal opening, pair of anal plates, three pairs of adanal setae, preanal organ, and pair of lyrifissures. The anal opening is long slit-like structure and surrounded by pair of anal plates. The

anal plates (*ap*) are elongated in shape and carry two pairs of simple setae (*an1*, *an2*), which situated in the anterior and posterior parts. The adanal setae (*ad1*, *ad2*, *ad3*) are simple and smooth. Adanal setae (*ad3*) situated laterally, while setae (*ad1*) and (*ad2*) situated posteriorly to anal plates. The preanal organ (*po*) situated in the anterior margin of anal plates. One pair of lyrifissures (*iad*) is located anteriorly of adanal setae (*ad3*) (Figures 1b, 2b, and 3e).

Legs of the *Hydrozetes crassipes* sp. n.

Each leg from (I-IV) has five segments and carries different shapes and sizes of setae (serrated and simple setae). Tarsus of each

leg terminates with one distinct claw (monodactylous) (Figures 2a,b, 3f-h, and 4a-e). Leg II is the shortest and followed by III, I, and IV (Table 1). Formulas of leg setation (famulus included) and solenidia are: leg I (1-5-4-4-17) [1-2-2], leg II (1-5-3-4-15) [1-1-2], leg III (2-4-1-3-13) [1-1-0], leg IV (1-3-2-4-10) [0-1-0].

Measurements of paratype

The measurements (μm) of morphological characters for paratype individuals of the present species *Hydrozetes crassipes* are summarized in Table "1". Formulas of paratype leg setation and solenidia are mentioned in Table "2".

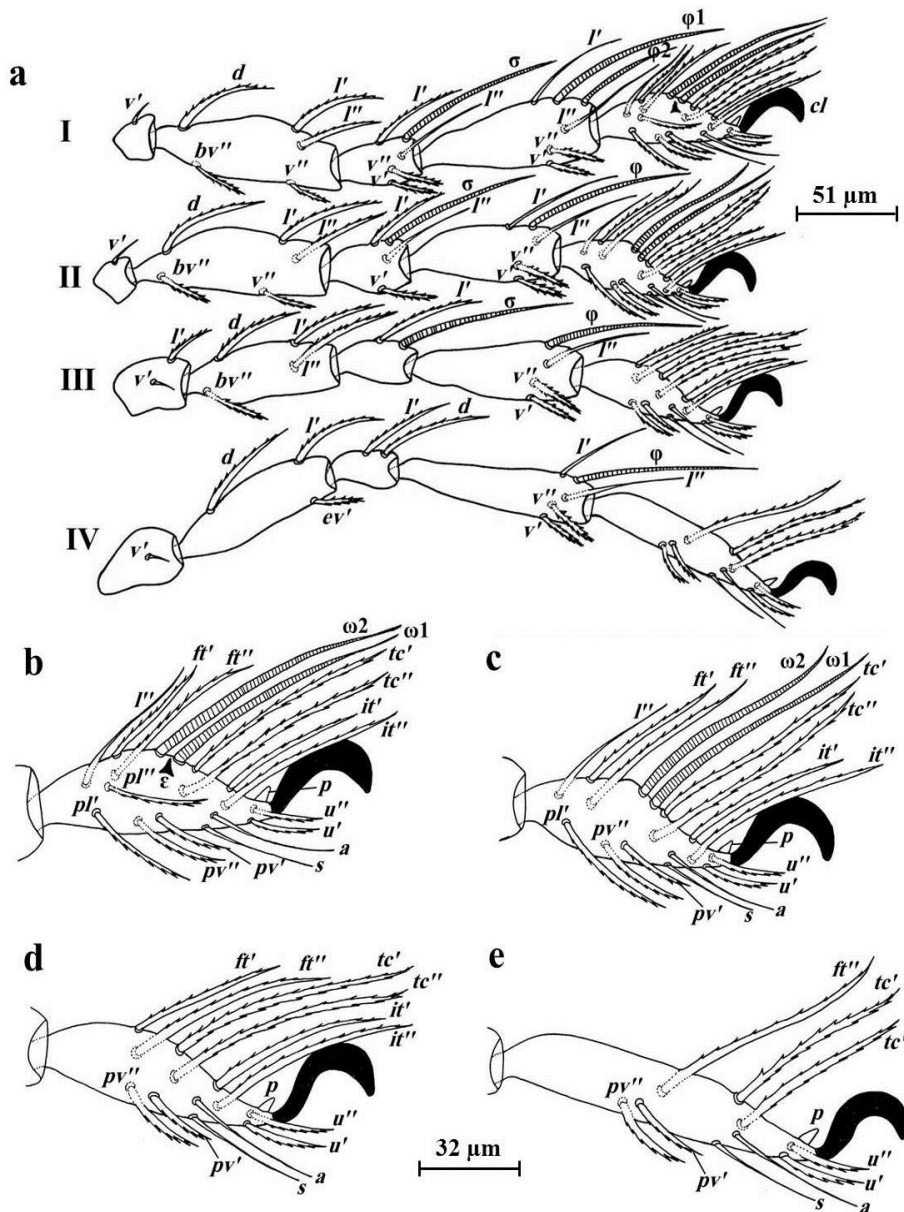


Figure 4. Camera Lucida drawings of the adult female *Hydrozetes crassipes* sp. n. showing: (a) legs (I-IV), (b-e) higher magnification of (a) showing tarsus of legs I, II, III, and IV, respectively. Single prime (') marks setae on anterior and double prime (") marks setae on posterior side of the given leg segment.

Table 1: Paratype measurements (μm) of different morphological characters of adult female *Hydrozetes crassipes* sp. n. (N= 18).

Characters	Microns (μm)	Characters	Microns (μm)	Characters	Microns (μm)
Body length	432-480	Notogaster		Length of genital opening	48-56
Body width	256-320	length	296-336	Length of anal setae	
Prodorsum		width	256-320	seta <i>an1</i>	12-16
length	120-160	Length of notogastral setae		seta <i>an2</i>	9-14
width	144-176	seta <i>c</i>	44-52	seta <i>ad1</i>	10-13
Length of prodorsal setae		seta <i>la</i>	42-52	seta <i>ad2</i>	9-14
seta <i>ro</i>	21-29	seta <i>lm</i>	34-52	seta <i>ad3</i>	9-15
seta <i>le</i>	13-21	seta <i>lp</i>	31-47	Length of anal opening	
seta <i>in</i>	10-16	seta <i>da</i>	39-47	Length of coxal epimeral setae	
seta <i>ex</i>	5-10	seta <i>dm</i>	34-52	seta <i>1a</i>	9-11
<i>ss</i>	21-29	seta <i>dp</i>	34-47	seta <i>1b</i>	16-21
<i>bo</i>	8-13	seta <i>h1</i>	26-31	seta <i>1c</i>	9-11
Length of pedipalp	54-59	seta <i>h2</i>	26-34	seta <i>2a</i>	9-10
Chelicerae		seta <i>h3</i>	31-39	seta <i>3a</i>	9-11
length	92-96	seta <i>p1</i>	26-31	seta <i>3b</i>	15-18
width	37-42	seta <i>p2</i>	23-26	seta <i>4a</i>	18-21
Length of cheliceral setae		seta <i>p3</i>	23-26	seta <i>4b</i>	11-14
seta <i>cha</i>	23-27	Length of genital setae		seta <i>4c</i>	11-14
seta <i>chb</i>	18-21	seta <i>g1</i>	16-20	Length of legs	
Length of subcapitular setae		seta <i>g2</i>	16-20	leg I	288-304
seta <i>h</i>	18-22	seta <i>g3</i>	16-18	leg II	264-288
seta <i>m</i>	14-16	seta <i>g4</i>	16-20	leg III	272-304
seta <i>a</i>	12-14	seta <i>g5</i>	16-19	leg IV	320-352
adoral setae	9-11	seta <i>ag</i>	17-20		

Table 2: Leg setation and solenidia of adult female *Hydrozetes crassipes* sp. n.

Leg	Segments				
	Trochanter	Femur	Genu	Tibia	Tarsus
I	<i>v'</i>	<i>d, (l), bv'', v''</i>	<i>(l), (v), σ</i>	<i>(l), (v), $\phi 1, \phi 2$</i>	<i>(ft), (tc), (it), (u), p, a, s, (pv), (pl), l'', $\epsilon, \omega 1, \omega 2$</i>
II	<i>v'</i>	<i>d, (l), bv'', v''</i>	<i>(l), v', σ</i>	<i>(l), (v), ϕ</i>	<i>(ft), (tc), (it), (u), p, a, s, (pv), pl', l'', $\omega 1, \omega 2$</i>
III	<i>v', l'</i>	<i>d, (l), bv''</i>	<i>l', σ</i>	<i>l'', (v), ϕ</i>	<i>(ft), (tc), (it), (u), p, a, s, (pv)</i>
IV	<i>v'</i>	<i>d, l', ev'</i>	<i>d, l'</i>	<i>(l), (v), ϕ</i>	<i>ft'', (tc), (u), p, a, s, (pv)</i>

Roman letters refer to normal setae, Greek letters refer to solenidia (except ϵ = famulus). Single prime (') marks setae on the anterior and double prime (') marks setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

DISCUSSION

According to the diagnostic characters extracted from the keys of families, genera, and species^[5,6,10-12,15,16], the present species has the characteristic features of family Hydrozetidae, where the dorsum of individuals is smooth or finely punctate, never granulated or rugose. In addition, the genital and anal openings are separated by a distance equal to or greater than the length of genital opening. Moreover, the legs are monodactylous.

The lamellae are present, ridge-like, slightly convergent and without spines in their apex. The prodorsum of the body is characterized with transverse and longitudinal ridges. The exobothridial setae are mostly very short. Trichobothria (bothridium and sensillus) is present. Sensillus is short and clavate. Palps with setation 0-2-1-3-9(+ω). The solenidion of each palp is bacilliform and located close to *acm* seta. The anterolateral margins of notogaster without pteromorphae. The

number of the notogastral setae is ranged from thirteen to seventeen pairs of setae. All coxal areas are well defined by carinae in mature adult. These characters are in accordance with the genus *Hydrozetes*.

The diagnostic characters of the present species

Host: Aquatic plant, *Eichhornia crassipes*
 The site of infection: Roots of floating aquatic plant
 Distribution: River Nile, Sohag Governorate, Egypt

The specific characters of the present species

- 1- Two pairs of sclerotized plates in humeral regions
- 2- Seven sclerotized opisthosomal plates
- 3- Longitudinal distance between setae of (*l*-) and (*d*-) series is not equal
- 4- Five pairs of genital setae (*g1-g5*)
- 5- Three pairs of genital discs

The systematic position of the present species

Phylum:	Arthropoda	von Siebold, 1848
Subphylum:	Chelicerata	Heymons, 1901
Class:	Arachnida	Cuvier, 1812
Subclass:	Acari	Leach, 1817
Superorder:	Acariformes	Zakhvatkin, 1952
Order:	Sarcoptiforms	Reuter, 1909
Suborder:	Oribatida	Van der Hammen, 1968
Superfamily:	Hydrozetoidea	Balogh, 1961
Family:	Hydrozetidae	Grandjean, 1954
Genus:	<i>Hydrozetes</i>	Berlese, 1902
Species:	<i>crassipes</i>	

Etymology: The specific name of the present mite species "*crassipes*" refers to the specific name of the host plant (*Eichhornia crassipes*).

These diagnostic and specific characters of the present species were compared with those of other species of the same genus^[6-10]. It was found that the present species has specific characters that separate it from the other previously published species of genus *Hydrozetes*. Also, the present species

is recorded for the first time in the roots of floating aquatic plant, *Eichhornia crassipes*, which is collected from the Nile River, Sohag, Egypt. So, the present species is considered as new one that should be added to the previously published species.

LIST OF ABBREVIATIONS

<i>1a, 1b, 1c, 2a, 3a, 3b, 4a, 4b, 4c</i>	Epimeral setae	<i>im</i>	Notogastral lyrifissure
<i>ad1-ad3</i>	Adanal setae	<i>in</i>	Interlamellar setae
<i>ag</i>	Aggenital setae	<i>ll-l4</i>	Legs 1-4
<i>an1-an2</i>	Anal setae	<i>la</i>	Lamellae
<i>ap</i>	Anal plate	<i>le</i>	Lamellar setae
<i>bo</i>	Bothridium	<i>lent</i>	Lenticulus
<i>c, la, lm, lp, da, dm, dp, h1, h2, h3, p1, p2, p3</i>	Notogastral setae	<i>no</i>	Notogaster
<i>ce1-ce4</i>	Coxal epimerae I-IV	<i>p</i>	Pedipalp
<i>ch</i>	Chelicera	<i>pd I, pd II</i>	Pedotecta I and II, respectively
<i>cha, chb</i>	Cheliceral setae	<i>po</i>	Preanal organ
<i>cl</i>	Claw	<i>pr</i>	Prodorsum
<i>cp</i>	Circumpedal carinae	<i>pt</i>	Palpal tarsus
<i>cr</i>	Cristae	<i>ro</i>	Rostral setae
<i>D</i>	Dorsophragmata	<i>sop</i>	Sclerotized opisthosomal plates
<i>dis</i>	Discidia	<i>ss</i>	Sensillus
<i>ex</i>	Exobothridial setae	<i>su</i>	Subcapitulum
<i>f</i>	Longitudinal furrow	<i>Tg</i>	Trägårdh's organ
<i>g</i>	Genital plate	<i>tua, tup</i>	Transverse and longitudinal prodorsal ridges
<i>g1-g5</i>	Genital setae	<i>v, ev, bv, l, d, ft, tc, it, p, u, a, s, pv, pl</i>	Leg setae
<i>gd</i>	Genital discs	<i>v, l, d, cm, acm, ul, sul, lt</i>	Palpal setae
<i>gla</i>	Opisthonotal gland opening	ω	Palp and leg solenidion
<i>h, m, a</i>	Subcapitular setae	σ, φ	Leg solenidia
<i>iad</i>	Adanal lyrifissure	ϵ	Leg famulus

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CONFLICT OF INTEREST

The authors declare no potential financial conflict of interest.

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نوع جديد من الحَلْم المائي "*HYDROZETES CRASSIPES* SP. N."
(فصيلة: HYDROZETIDAE) من محافظة سوهاج، مصر

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تضمنت الدراسة الحالية وصف نوع جديد من الحَلْم المائي ينتمي إلى تحت رتبة "Oribatida" و جنس "*Hydrozetes*" لأول مرة من مصر. تم جمع هذا النوع من الحَلْم المائي من جذور نبات ورد النيل المائي "*Eichhornia crassipes*" العائم في نهر النيل. تتوافق الخصائص الوصفية للنوع الحالي مع تلك الخاصة بالفصيلة والجنس مثل: ظهر الأفراد يكون أملساً أو مثقوباً بدقة وليس محبباً، الأرجل أحادية الأصابع، تتميز مقدمة الجسم بحواف عرضية وطولية، وتكون شعيرات "Exobothridial" قصيرة جداً في الغالب، كما يوجد بها تركيب "*Trichobothria (bothridium and sensillus)*". ويختلف هذا النوع من الحَلْم المائي عن الأنواع الأخرى في أن منطقة العضد مدعومة بزوجين من الألواح ذات التغلظ الكيتيني وهي تنحرف إلى الداخل نحو الصفائح الأمامية الظهرية، ويوجد به سبع صفائح في منطقة البطن الخلفية لمؤخرة الجسم مدعومة بتغلظ كيتيني، والمسافة الطولية بين سلسلة الشعيرات (*l-*) و (*d-*) غير متساوية، كما يوجد به خمسة أزواج من الشعيرات التناسلية (*g1-g5*)، بالإضافة إلى ثلاثة أزواج من الأقرص التناسلية.