

Geomonhystera breviseta sp. n., *G. mexicana* sp. n. and observations on *G. australis* (Cobb, 1893) Andrassy, 1981 (Nematoda : Monhysteridae)

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Summary - *Geomonhystera breviseta* sp. n. from Korea is characterized by short outer labial and cephalic sensilla directed almost perpendicular to the body, relatively long vulva-anus distance, plump spinneret and subterminal setae. *G. mexicana* sp. n. collected in Mexican mountains is the shortest species, has long vulva-anus distance, thin and long sensilla directed anteriorly, pouch like spermatheca filled with sperm and relatively slim spinneret. *G. australis* (Cobb, 1893) Andrassy, 1981 is redescribed from Poland. It is characterized by short body setae, vulva-anus distance not very long, amphids rather close to anterior body end, rectum relatively short. The usefulness of some characters for species differentiation is discussed. The actual measurements are more variable than some of the ratios used. The various body parts show highly significant correlations indicating the studied species preserve proportions of various body parts during growth after last moult. The most useful features for species characterization are enumerated.

Résumé - *Geomonhystera breviseta* sp. n., *G. mexicana* sp. n. et observations sur *G. australis* (Cobb, 1893) Andrassy, 1981 (Nematoda : Monhysteridae) - *Geomonhystera breviseta* sp. n., provenant de Corée, est caractérisé par des sensilles labiales externes et des sensilles céphaliques courtes et dirigées presque perpendiculairement au corps, une distance vulve-anus relativement longue, un « spinneret » trapu et des soies subterminales. *G. mexicana* sp. n., provenant de régions montagneuses du Mexique, l'espèce la plus courte du genre, est caractérisé par des sensilles fines et longues dirigées vers l'avant, une distance vulve-anus longue, une spermatheque en forme de poche remplie de spermatozoïdes et un « spinneret » relativement fin. *G. australis* (Cobb, 1893) Andrassy, 1981 est redécrit sur du matériel provenant de Pologne; il est caractérisé par les soies du corps courtes, une distance vulve-anus moyenne, des amphides proches de l'extrémité antérieure et un rectum relativement court. L'utilité de certains caractères pour la différenciation spécifique est discutée. Les mesures brutes sont plus variables que les rapports utilisés. Les différentes parties du corps montrent des corrélations hautement significatives ce qui indique que, chez les espèces étudiées, les proportions entre les différentes parties sont maintenues pendant la croissance, après la dernière mue. Les critères les plus utiles pour la caractérisation des espèces sont énumérées.

Key-words : *Geomonhystera*, nematodes.

Little work has been recently published on taxonomy of inland *Geomonhystera* Andrassy, 1981 species and this paper presents descriptions of two new species and re-description of a known species for comparison with the new ones.

The specimens of new species were killed by pouring hot 2% formaldehyde over specimens collected in a small drop of water, while those of *G. australis* were relaxed by gentle heating. All nematodes were processed to glycerine using methanol-glycerine procedure based on Seinhorst method. The measurements were taken with the micrometer ocular at the magnification of 1000× and are expressed in micrometers.

Geomonhystera breviseta sp. n.

(Fig. 1)

MEASUREMENTS

Females : see Table 1.

DESCRIPTION

Female : Body of relaxed specimens usually arcuate ventrad, sometimes almost straight. Cuticle not striated, subcuticle finely striated. Thickness of cuticle slightly less than 1 μm. Body setae scattered along body, not numerous. The most anterior seta always posterior to amphid. Lips amalgamated, 3-5 μm high. Lip papillae high. Head width at cephalic sensilla base 12-20 μm depending on body size of specimen. Outer labial sensilla usually 5-8 μm, in one female 4 μm and in another one 9 μm seen. Each sensillum composed of two segments. Length of sensilla usually within 30-45% of head diameter at sensilla base, except for three females with 25% and one with 50%. Cephalic sensilla 3-5 μm. All anterior sensilla mostly directed aside and very slightly anteriorly. Amphids rounded or almost rounded, seldom both amphids at the same level. *Porus centralis* at the center of fovea. The anterior margin of amphids 1.0-1.5 of head width from anterior end, except for one female

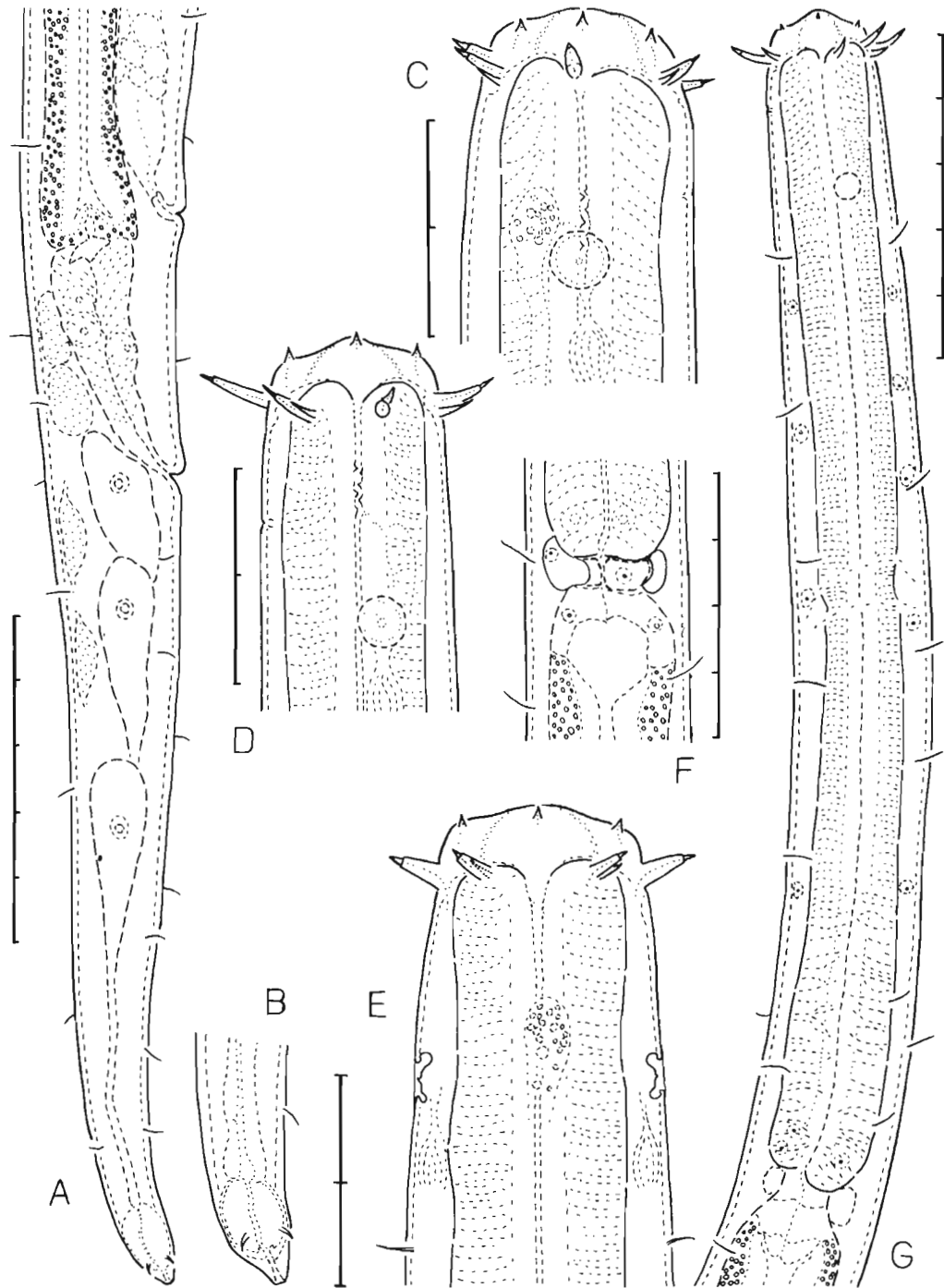


Fig. 1. *Geomonhystera breviseta* sp. n. A : Posterior part of female; B : Tail end; C, D : Head (lateral view); E : Head (dorsal view); F : Junction of pharynx and intestine; G : Pharyngeal region (Smallest unit on scale bars = 10 μ m.)

Table 1. Measurements of *Geomonhystera breviseta* sp. n. (females; all measurements in μm).

	Holotype	Paratypes (n = 24)			
		Mean	SD	Range	CV
Body length	965	881	100.8	680-1028	11.44
Head width	18	18.6	3.2	11-22	17.10
Pharynx length	201	185	20.3	139-208	10.97
Vulva-anus distance	40	37	3.8	29-43	10.31
Tail length	132	117	12.1	97-144	10.35
Longer cephalic sensilla	6	6	1.2	4-9	20.55
Shorter cephalic sensilla	4	4	0.9	3-5	20.58
Anterior end to amphid	28 and 30	23	3.8	15-28	17.03
Amphid diameter	4.5	4.3	0.3	4.5	7.95
Rectum length	39	34	4.3	27-42	12.45
a	36	33	2.3	29-37	6.85
b	4.8	4.8	0.2	4.2-5.1	4.33
c	7.3	7.5	0.4	6.8-8.2	4.80
c'	5.8	5.7	0.5	4.8-6.4	8.49
V	82	82	0.9	81-84	1.06
Vulva-anus : anal diameter	1.8	1.8	0.2	1.5-2.2	9.80
Tail : vulva-anus	3.3	3.2	0.2	2.8-3.8	6.67
Anterior end-amphid : head width	1.2 and 1.4	1.2	0.2	0.6-1.8	14.98
Longer cephalic sensillae % head width	35	34	6.7	25-45	19.58

with more posterior position of amphids where 1.7 and 1.8 of head width was measured. Excretory pore always between base of anterior sensilla and amphids. Excretory glandular cell could not be detected. Stoma with large hexaradiate vestibulum surrounded by six amalgamated lips, then becomes triradiate and more or less funnel shaped, surrounded by muscular pharynx. Posterior stoma end not demarcated from pharyngeal lumen. No distinct buccal ring observed. Each pharyngeal sector armed with three denticles arranged in row along pharyngeal lumen. The middle denticle appears slightly larger than the anterior and the posterior ones. No distinct stomatal chamber observed. Dorsal pharyngeal gland outlet opens into pharyngeal lumen between middle and posterior denticles. Pharynx a muscular tube slightly expanded near posterior end and surrounded by nerve ring just anterior to the middle of pharynx length. Pharyngeal glands nuclei near the posterior end of pharynx. Pharyngo-intestinal valvae composed of three small cells with large nuclei, and these are surrounded by two lateral coelomocytes. Most anterior intestine cells hyaline, intestine walls composed of outer zone with many small granular inclusions and the inner hyaline zone that probably represents microvilli. No cell membranes of intestinal cells could be detected. Rectum thick, anteriorly almost reaches to vulva. Length of rectum 1.4-1.9 of anal body width, except for two females where 2.0 and 2.3 were observed. Anterior anal lip bulging, anal opening a large slit. Ovary on right body side,

with cells in a single row in younger specimens and partly arranged in two rows in older ones. Vagina short, anteriorly bent. No post vulval uterine sac. Vulval lips bulging, vulva a large slit. Tail straight, with few setae and large internal chamber just in front of spinneret. Three large caudal glands appear alike, each gland with a canal apparently joining together in a chamber (this feature could not be established with certainty). Spinneret plump, 2-3 μm long. Short subterminal setae located subdorsally and subventrally on both body sides.

Male : not found.

TYPE LOCALITY AND HABITAT

Kaesong, Korea, collected in a moss in deciduous forest in July 1990 by Prof. Regina Pisarska.

TYPE SPECIMENS

Holotype female, nineteen paratype females and thirteen juveniles deposited at the nematode collection of the Instytut Zoologii PAN, Warszawa, Poland. Four paratype females and five juveniles temporarily kept with the author.

DIAGNOSIS AND RELATIONSHIPS

G. breviseta sp. n. is a relatively large species with short anterior sensilla directed aside. Cuticle unstriated, body setae not numerous. Amphids rounded, 0.6-1.8 (mostly 1.0-1.5) of head width from anterior body end. Vulva-anus distance 1.5-2.2 of anal body width long. Rectum

Table 2. Measurements of *Geomonhystera mexicana* sp. n. (females; all measurements in μm).

	Holotype	Paratypes (n = 24)			
		Mean	SD	Range	CV
Body length	546	551	26.7	499-604	4.85
Head width	11	11	0.4	10-11.5	3.33
Pharynx length	117	118	3.6	110-123	3.09
Vulva-anus	22	26	3.0	20-31	11.30
Tail length	78	79	4.3	71-87	5.45
Longer cephalic sensillae	5.5	5.6	0.4	5-6	7.66
Shorter cephalic sensillae	4	4.1	0.4	3.5-5	9.16
Anterior end to amphid	14 and 15	15	1.0	13-16	6.73
Amphid diameter	3.5	3.2	0.3	3-4	10.29
Rectum	20	21	1.1	19-23	5.42
a	28	29	1.4	26-31	4.76
b	4.6	4.7	0.2	4.4-5.1	3.71
c	7.0	7.0	0.2	6.6-7.7	3.51
c'	5.8	6.0	0.4	5.6-6.5	5.44
V	82	81	0.7	80-82	0.93
Vulva-anus : anal diameter	1.6	2.0	0.2	1.5-2.4	11.26
Tail : vulva-anus	3.6	3.1	0.3	2.5-3.9	11.30
Rectum : anal diameter	1.5	1.5	0.1	1.2-1.8	9.48
Anterior end-amphid : head width	1.3 and 1.4	1.4	0.1	1.2-1.8	9.48
Longer cephalic sensillae % head width	50	51	3.4	25-45	6.53

almost reaches vulva. Tail with few setae, spinneret plump, short subterminal setae located subdorsally and subventrally on both body sides.

G. breviseta sp. n. should be compared with other inland species characterized by relatively long vulva-anus distance. The new species differs from *G. villosa* (Bütschli, 1873) having fewer body setae, rounded amphids, shorter cephalic sensillae, smaller c' coefficient and apparently lack of post vulval uterine sac (according to Andrassy, 1984). *G. villosa* has numerous body setae, oval amphids, outer labial sensilla 2/3 to 3/4 of head width long, $c' = 6-9$, small post vulval uterine sac present). *G. pervaga* (Argo & Heyns, 1973) is characterized by striated cuticle and longer anterior sensilla, which sufficiently differentiate the two species. *G. australis* (Cobb, 1893), as redescribed in this paper, has much shorter body setae, longer anterior sensilla, smaller and more posterior amphid, shorter rectum, lack of subterminal setae on tail. *G. breviseta* sp. n. differs from *G. mexicana* being longer, having shorter anterior sensilla, larger amphid diameter and lack of subterminal setae. *G. chitwoodi* (Steiner, 1958) and *G. uniformis* (Cobb, 1914) are marine species that also have relatively long vulva-anus distance. However, the former (Chitwood, 1951) have inner labial and cephalic sensilla in two separated whorls, more anterior and smaller amphids and more anterior vulva (in *G. chitwoodi* amphids are 11 μm

from head end and 3 μm in diameter, $V = 76$). *G. uniformis* description is very short and lacks some important diagnostic details (Cobb, 1914), although female length (0.44 mm) appears to be beyond limit of *G. breviseta* sp. n., amphids are drawn about 3 head widths from anterior end, anterior setae are drawn very short.

Geomonhystera mexicana sp. n.

(Fig. 2 A-F)

MEASUREMENTS

Female : see Table 2.

DESCRIPTION

Female : Body of relaxed specimens straight or very slightly arcuate ventrad. Cuticle less than 1 μm thick, unstriated. Body setae few, thin, never anterior to amphid. Lips amalgamated, 2-3 μm high with coniform papillae. Anterior sensilla thin, directed anteriorly. Outer labial sensilla appears articulate, the terminal segment very short and poorly visible. Length of outer labial sensilla 50-55 % of head width at sensilla base (except for 4 out of 21 females where it is 45-48 %). Amphids rounded or almost rounded, seldom both amphids at the same level. *Porus centralis* at the center of fovea. A short canal leads from fovea to ciliary pouch. The distance from head end to anterior margin of amphids usually 1.3-1.4 of head width. Hexaradiate vestibulum leads to

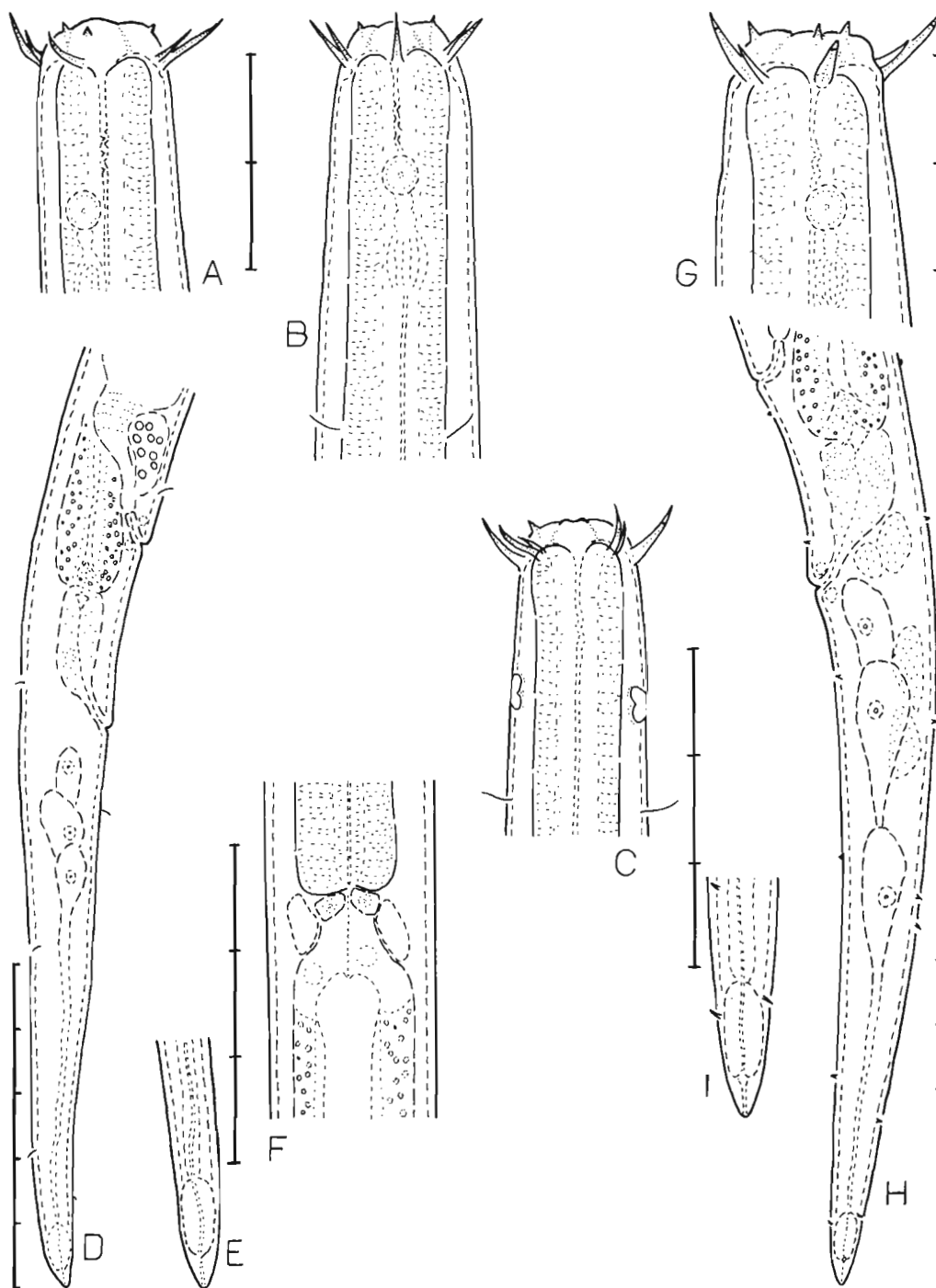


Fig. 2. *Geomonhystera mexicana* sp. n. A, B : Head (lateral view); C : Head (ventral view); D : Posterior part of female; E : Tail end; F : Junction of pharynx and intestine – *Geomonhystera australis*. G : Head (lateral view); H : Posterior end of female; I : Tail end. (Smallest unit on scale bars = 10 μ .)

triradiate stoma, which is armed with three very small teeth in each of the sectors. No buccal ring observed. Outlet of dorsal pharyngeal gland opens into pharyngeal lumen between teeth. Pharynx a muscular tube that may be slightly expanded anteriorly and/or posteriorly. Pharyngo-intestinal valvae composed of three small cells immediately posterior to pharynx. Laterally from the valvae are two ceolomocytes. Most anterior cells of intestine hyaline. Outer zone of intestinal walls with many granular refractive inclusions, inner zone hyaline. Rectum mostly 1.5-1.6 of anal body width long, does not reach to vulva level. Anus as large perpendicular slit. The distance between vulva and anus mostly 1.8-2.2 of anal body width long. Female reproductive system on right body side. Vulva indistinct in lateral view, ventrally a large transverse slit. Vulval lips not much protruding. Vagina with thick walls, bent anteriorly, no post vulval uterine sac seen. A small pouch-like sac anterior to vagina in most females filled with refractive globules of about 1 μm in diameter. This sac is either ventrad or dorsad to the reproductive tract. It is interpreted as a spermatheca filled with sperm. Two intra uterine eggs observed measured 57×20 and $59 \times 17 \mu\text{m}$, that is 2.5 and 2.6 of maximum body width in length. Three caudal glands arranged in line, the most anterior always begins posterior to anus. Tail tapers evenly, ends with slim spinneret. No terminal or subterminal setae observed. Male not found.

TYPE LOCALITY AND HABITAT

Tlaminas, near Texcoco, Mexico St., Mexico. Collected under moss grown on rock near little stream in a valley above Tlaminas at the elevation of about 2400 m above sea level. Collected on January 15, 1984, by Prof. L. S. Jankiewicz.

TYPE SPECIMENS

Holotype female and 24 paratype females and one juvenile deposited in nematode collection of the Instytut Zoologii PAN, Warszawa, Poland. Five paratype females and single juvenile temporarily kept in author collection.

DIAGNOSIS AND RELATIONSHIPS

G. mexicana sp. n. is one of the smallest species of the genus. Cuticle unstriated, body setae few and thin. Anterior sensilla rather long and thin, directed anteriorly. Amphids rounded, 1.2-1.5 of head width from anterior end. Offset, pouch-like spermatheca often filled with sperm. Distance from vulva to anus 1.5-2.4 (mostly 1.8-2.2) of anal body width long. Spinneret slim, no subterminal or terminal setae.

G. mexicana sp. n. should be compared with species characterized by vulva-anus distance about twice of anal diameter: *G. uniformis*, *G. pervaga*, *G. villosa*, *G. australis*, *G. breviseta* and *G. chitwoodi*. It differs from the former, a marine species, by position of amphids which are

about 3 head widths from anterior end and by very short anterior setae. *G. mexicana* differs from *G. pervaga* having unstriated cuticle, diameter and position of amphids and probably also presence of spermatheca (in *G. pervaga* cuticle is striated, amphids 3.6-4.6 μm in diameter located less than a body width at outer labial sensilla base from anterior end, spermatheca is not mentioned in description). *G. villosa* has more posterior amphids, more numerous body setae and longer rectum (in *G. villosa* amphids are 1.5-2 of head width from anterior end and rectum is 2.5-2.8 of anal diameter long). *G. australis*, as diagnosed by Andrassy (1984) and redescribed in this paper, has very short body setae, body narrows markedly posterior to vulva. For comparison with *G. breviseta* sp. n. see under that species. The differences between *G. mexicana* sp. n. and *G. chitwoodi* are in head sensillae, body length and probably also vulva position (in *G. chitwoodi* outer labial and cephalic sensillae are well separated forming two whorls, $L = 1.9\text{-}2.2 \text{ mm}$, $V = 76$).

Geomonhystera australis (Cobb, 1893) Andrassy, 1981 (Fig. 2 G-I)

MEASUREMENTS

Female: see Table 3.

DESCRIPTION

Female: Younger relaxed specimens arcuate ventrad, older more curved up to closed C shape. Cuticle thin, unstriated. Body setae short. Outer labial sensilla articulate, directed anteriorly. Amphids rounded, usually 0.9-1.2 of head width at sensilla base from anterior body end, except for one female where 1.4 was measured. Lips amalgamated, each with coniform papilla. Stoma with three teeth on each pharyngeal sector. Dorsal pharyngeal gland opens into stoma at the teeth level. Pharyngo-intestinal valvae composed of three cells. Most anterior intestinal cells hyaline, walls with distinct hyaline inner part. Rectum usually 1.0-1.3 of anal diameter long, except for two females where 1.6 was measured. Anteriorly rectum never reaches vulva. Vulva-anus distance usually 1.6-2.0 of anal body width, except for one female where 1.4 was observed. Body tapers considerably immediately posterior to vulva. Vagina anteriorly bent, no post vulval uterine sac nor spermatheca seen. Tail tapers evenly, ends with rather elongated spinneret. No terminal or subterminal setae observed.

The above description is based on specimens collected in Poland, Skierniewice, in loamy sand soil of arable field.

G. australis is distinctive because of very short body setae, relatively long vulva anus distance, anterior position of amphids and lack of terminal setae.

Table 3. Measurements of *Geomonhystera australis* (Cobb, 1893) Andriássy, 1981 (12 females; all measurements in μm).

	Mean	SD	Range	CV
Body length	867	84.9	759-1036	9.80
Head width	15	1.9	13-20	12.54
Pharynx length	157	10.7	132-178	6.82
Vulva-anus	34	4.2	28-40	12.21
Tail length	115	14.3	100-138	12.39
Longer cephalic sensillae	8.2	0.8	7-9	9.17
Shorter cephalic sensillae	5.0	0.9	4-7	7.4
Fore end to amphid	17	2.7	14-23	15.53
Anterior end to amphid	3.4	0.4	3-4	0.50
Rectum	24	3.2	19-29	13.57
a	35	3.3	30-39	9.47
b	5.5	0.4	4.9-6.2	6.99
c	7.5	0.5	6.6-8.5	6.53
c'	5.9	0.5	5.2-6.8	7.81
V	83	1.3	80-85	1.56
Vulva-anus : anal diameter	1.7	0.2	1.4-2.0	9.29
Tail : vulva-anus	3.4	0.3	2.9-4.1	9.21
Rectum : anal diameter	1.2	0.2	1.0-1.6	16.75
Anterior end-amphid : head width	1.1	0.1	0.9-1.4	11.87
Longer cephalic sensillae in % of head width	55	3.8	47-60	7.05

Table 4. Significance of correlation coefficients calculated for measurements of *Geomonhystera breviseta* (upper row of astericks). *G. mexicana* (middle row) and *G. australis* (lower row) - *** : correlation significant at 0.001 level, ** : correlation significant at 0.01 level, * : correlation significant at 0.05 level.

	Head width	Pharynx	Vulva-anus	Tail	a	b	c	c'	v	VA : ABD ⁽¹⁾	Tail : ABD
Body length	*** ** ***	*** *** *	*** **	*** *** ***		*		***			
Head width		*** *** *	*** *	*** **			**	* -*	***	**	
Pharynx	*** *** *		*** ** *	*** *			**	*	***	-**	
Vulva-anus	*** *	*** ** *		*** *			*			***	-***
Tail	*** **	*** *	*** *			***	-*				

⁽¹⁾ VA : vulva-anus; ABD : anal body diameter.

Specific characters useful for diagnoses of *Geomonhystera* species

The specific diagnosis contains quantitative and qualitative characters. As no modern studies of the genus has been published, it may be worthwhile to consider the usefulness of various features for *Geomonhystera* characterization.

The calculated coefficients of variability show the extent of variability of the examined populations being different. *G. breviseta* sp. n. is the most variable, *G. mexicana* sp. n. the least, and *G. australis* occupies intermediate position. Generally the actual length or width of body or body parts are more variable than the ratios used. Longer specimens usually have longer and better developed reproductive system, and this suggests the longer specimens are the older. That would indicate the growth of *Geomonhystera* species after last moult. Most of the body parts are highly significantly correlated indicating the growth of various body parts is more or less parallel. It is also evidenced by little correlation between ratios and length of body parts that are constituents of these ratios (Table 4). All these considerations indicate the ratios should be used beside actual measurements in the descriptions of the species of *Geomonhystera*.

However, most stable ratios (a, b, c, c', V) are similar in various species and their usefulness for diagnostic work is limited. Some other ratios, as vulva-anus : anal diameter, anterior end-amphid : head width, and anterior sensilla length expressed in percentage of head width should receive proper attention. On the other hand higher coefficients of variability of these characters call for larger differences when used for species differentiation.

The limited usefulness of numerical characters call for use of qualitative features to the greater extent than it is found in many previous descriptions. The shape of

body setae may differentiate some species (e.g. *G. australis*). These setae may be more numerous in some species (e.g. *G. villosa*) than in other, but it is difficult to express this precisely while counting is not practical. Subterminal tail setae (e.g. *G. breviseta* sp. n.) may also be useful. The shape and direction of outer labial and cephalic sensilla may differentiate some species. The spermatheca, as observed in *G. mexicana* sp. n., has never been mentioned in previous descriptions, although males are occasionally reported. However, a spermatheca is easily visible when filled with refractive sperm but is obscured by granular intestinal inclusions, when empty. The spinneret may be more elongated or more plump, but is difficult to describe and should be drawn accurately. Some other features may well differentiate species as cuticular annulation of *G. pervaga*.

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