

MICONCHUS PROKINI SP. NOV. (NEMATODA: MONONCHIDA) FROM LAKE EL'GYGYTGYN, CHUKOTKA, RUSSIA

Vladimir G. Gagarin^{id}, Vladimir A. Gusakov*^{id}

Papanin Institute for Biology of Inland Waters RAS, Russia

*e-mail: gusakov@ibiw.ru

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A new nematode species in the order Mononchida, *Miconchus prokini* sp. nov., found in Lake El'gygytgyn (Chukotka, Russia) is described and illustrated. The new species is the largest member of the genus known to date. It is morphologically close to *Miconchus rex* in the big body size, vulva position in females, the number of preloocal supplements in males and in the relative length of the pharynx in both sexes, but it has a longer body ($L = 7.7\text{--}13.1$ mm in *M. prokini* vs. $L = 6.5\text{--}7.0$ mm in *M. rex*) and spicules ($225\text{--}252$ μm in *M. prokini* vs. 180 μm in *M. rex*), and a shorter tail ($c = 9.3\text{--}15.2$ in *M. prokini* vs. $c = 5.3\text{--}7.1$ in *M. rex*).

Key words: Anatonchidae, crater lake, Far East of Russia, free-living nematodes, State Nature Sanctuary

Introduction

Nematodes are one of the most diverse and numerous metazoan organisms on our planet, including the Arctic and Subarctic latitudes. More than 70 papers are known containing data on the fauna and distribution of nematodes in these regions, where 391 species, belonging to 140 genera, 54 families, and ten orders of the phylum Nematoda, are reported (Holovachov, 2014). This list includes 27 representatives of the order Mononchida. In freshwaters of the Arctic and Subarctic regions of Russia, about 180 valid species, from 28 families and nine orders of nematodes, have been found to date (Gagarin, 2001; Holovachov, 2014). The order Mononchida is represented by 18 species from eight genera: six *Mononchus* (*M. angarensis* Gagarin, 1984; *M. aquaticus* Coetzee, 1968; *M. macropapillatus* (Mulvey, 1967); *M. niddensis* Skwarra, 1921; *M. tajmiris* Gagarin, 1991; *M. truncatus* (Bastian, 1865)), four *Prionchulus* (*P. longus* (Thorne, 1929); *P. major* Gagarin, 2001; *P. muscorum* (Dujardin, 1845); *P. sedatus* Gagarin, 2000), three *Mylonchulus* (*M. brachyuris* (Bütschli, 1873); *M. gigas* Gagarin, 1993; *M. incurvus* (Cobb, 1917)), as well as *Clarkus papillatus* (Bastian, 1865), *Coomansus zschokkei* (Menzel, 1913), *Miconchus exilis* (Cobb, 1917), *Paramonchus absconditus* (Tsalolikhin, 1974), and *Prionchuloides micoletzkyi* (Meyl, 1954) (Gagarin, 2001; Holovachov, 2014). Recently, during the study of the bottom fauna of the unique deep-water crater Lake El'gygytgyn, two more mononchids, new for the territory of Russia,

were discovered, including *Mononchus superbus* Mulvey, 1978, previously known only from water bodies of northwestern Canada (Mulvey, 1978; Holovachov, 2014), and an undescribed, new member of the genus *Miconchus*. The aim of the present paper is to provide a description of this new species.

Material and Methods

Lake El'gygytgyn is located in the Chukotka Region (north of the Far East of Russia) at 67.491111° N and 172.091667° E. Both the water area of the lake and the territory surrounding it have the status of State Nature Sanctuary of Regional Importance (IAS, 2022). The lake depression has a meteorite origin. Its age is estimated at about 3.5–3.6 million years. The water body is situated at an altitude of 492 m a.s.l. Its catchment area, diameter and water area are about 183 km², 12 km and 110 km², respectively; the volume is 14.1 km³; the maximum depth reaches 175 m. For most of the year, usually from late September to early July, the lake El'gygytgyn is covered with ice. Sometimes the ice does not have time to melt completely in the short summer period. The maximum summer temperature of the surface layer of water in the lake El'gygytgyn commonly does not exceed 2–3°C; at high depths, throughout the year the temperature is about 3°C. The water in the lake El'gygytgyn is slightly mineralised, well saturated with oxygen, the transparency is more than 15 m. According to the concentration of nutrients, primary productivity and composition of plankton, the lake is currently

assessed as ultraoligotrophic. The thickness of bottom sediments in the deep-water part of the lake exceeds 200 m. At depths of up to 10–20 m, they are mainly represented by gravel and pebbles with an admixture of sand, deeper the surface of the bottom is covered by light-yellow, greenish and brown silts. Due to the ancient origin, isolated location, climatic features of the region and the peculiarities of the morphometry of the lake itself, a unique ecosystem was formed here, inhabited by cold-loving representatives of flora and fauna, including endemic ones. Because of the remote, inaccessible location, some communities of aquatic organisms inhabiting the lake El'gygytgyn, in particular benthic, are still poorly studied (Belyi & Chereshev, 1993; Cremer & Wagner, 2003; Nolan & Brigham-Grette, 2007; Database, 2022).

Samples, in which the described nematode species was detected were collected in early August 2020 at depths of 5 m, 13 m, 30 m, 50 m, 75 m, 100 m, 120 m, and 150 m. At shallow-water stations (5 m and 13 m), periphyton was taken by scraping off stones elevated from the bottom, and at deeper stations, benthos was collected with a DAK-250 bottom grab. All collected material was filtered through a sieve with a mesh size of $200 \times 200 \mu\text{m}$ and preserved in 96% alcohol. The nematodes found in the samples were mounted in glycerol on slides. Their examination, measurement and photography were conducted using a Nikon Eclipse 80i light microscope equipped with Nomarski DIC accessories, a Nikon DS-Fi1 digital camera and a PC with NIS-Elements D 3.2 software for imaging and analysis of mounts.

Results

Order Mononchida Jairajpuri, 1969

Family Anatonchidae Jairajpuri, 1969

Genus *Miconchus* Andrassy, 1958

Type species. *Miconchus digiturus* (Cobb, 1893) Andrassy, 1958.

Diagnosis. It is made according to Andrassy (2009) and Zullini & Peneva (2006) and with some modifications based on the characteristics of the new species described in the present paper. The body length varies from 1 mm to 13 mm. The buccal cavity is roomy, armed with three teeth (one dorsal and two subventral, pointed forwards), equal in shape and location, lying at the base or in posterior haft of the stoma. There are no other denticles or ridges. The female genital apparatus is predominantly didelphic, amphi-

delphic, rarely prodelphic or pseudoprodelphic; $V = 50\text{--}80\%$. Males are relatively common. Spicules are arcuate, with lateral pieces. The number of supplements varies between 9 and 24. In both sexes, the tail is similar, mostly conoid, occasionally filiform, 2 to 25 anal body widths long. Caudal glands and spinneret are present or reduced.

Description of the new species

Miconchus prokini Gagarin & Gusakov sp. nov.

Type material. Holotype female, two paratype males, and five paratype females are deposited in the museum collection of the Centre for Parasitology of the A.N. Severtsov Institute of Ecology and Evolution of the RAS (Moscow, Russia): inventory slide number – 102/74. Three paratype males and three females are deposited in the nematode collection of the Papanin Institute for Biology of Inland Waters RAS (Borok, Yaroslavl Region, Russia): inventory slide number – El.1.

Type locality and habitats. Russia, Chukotka Autonomous Okrug, Lake El'gygytgyn. Samples were collected on 07.08.2020 (leg. G.N. Markevich). Individuals of the new species were found at all investigated depths, from 5 m to 150 m.

Etymology. The species is named in honour of our colleague, Alexander A. Prokin (Papanin Institute for Biology of Inland Waters RAS), who provided nematodes from the material collected in the lake.

Description of females. Body is long and thin (Table, Fig. 1, Fig. 2). Cuticle is smooth, 10–13 μm thick at mid-body. Lips are amalgamated. Labial region is not offset from the adjacent body. Labial papillae are conical, protruding. Cheilostoma is spacious. Pharyngostoma (buccal cavity) is barrel-shaped, with concave base. Its length is 1.6–1.8 times more than its width. Its walls are strongly cuticularised. One dorsal tooth and two subventral teeth are located in the posterior portion of the pharyngostoma, at a distance 120–147 μm (77–80% of the buccal cavity total length) from the anterior edge of pharyngostoma. Pharynx is cylindroid, strongly muscular. Cardia is muscular, projecting into the lumen of intestine. Tubercles are present. Amphidial fovea is stirrup-shaped and located at the level of the anterior portion of the pharyngostoma, at a distance 48–55 μm from the anterior edge of the body. A renette cell and its excretory pore are not observed.

Table. Morphometrics of females and males of *Miconchus prokini* sp. nov.

Characters	Holotype female	Paratypes			
		Males (n = 5)		Females (n = 8)	
		range	mean	range	mean
<i>L</i> , μm	8071	8110–13 147	10 194	7652–12 242	9526
<i>a</i>	35	24–41	33	27–37	31
<i>b</i>	4.6	4.4–5.4	4.7	4.5–5.2	4.9
<i>c</i>	13.1	9.6–14.7	11.6	9.3–15.2	12.2
<i>c'</i>	4.9	4.3–9.3	6.1	4.2–8.6	5.6
<i>V</i> , %	54.3	–	–	53.8–59.9	57.0
labial region diameter, μm	103	94–158	122	92–157	119
mid-body diameter, μm	229	215–413	315	274–394	313
anal or cloacal body diameter, μm	125	129–174	150	125–176	145
stoma length, μm	175	180–239	215	174–247	205
buccal cavity length, μm	145	148–198	179	144–201	169
buccal cavity width, μm	87	84–134	112	91–137	107
length of the stoma divided by labial region diameter	1.7	1.3–1.7	1.5	1.6–1.9	1.7
pharynx length, μm	1759	1826–2450	2148	1639–2360	1942
distance from the pharynx base to the cloaca, μm	–	5682–9387	7127	–	–
distance from the pharynx base to the vulva, μm	2627	–	–	2820–4938	3498
distance from the vulva to anus, μm	3067	–	–	2555–3803	3262
length of anterior genital branch (<i>G</i> ₁), μm	1384	–	–	1211–1432	1320
length of posterior genital branch (<i>G</i> ₂), μm	1681	–	–	1523–1741	1632
spicule length along the arc, μm	–	225–252	242	–	–
gubernaculum length, μm	–	64–75	71	–	–
length of lateral guiding pieces, μm	–	76–89	81	–	–
number of supplements	–	17–22	19	–	–
length of supplement row, μm	–	407–732	566	–	–
tail length, μm	618	602–1310	919	547–1210	824

Note: *L* – body length; *a* – ratio of body length to body width in its middle part; *b* – ratio of body length to pharynx length; *c* – ratio of body length to tail length; *c'* – ratio of tail length to body width at the anus or cloacal region; *V* – ratio of the distance from the anterior end of the body to the vulva to the total body length.

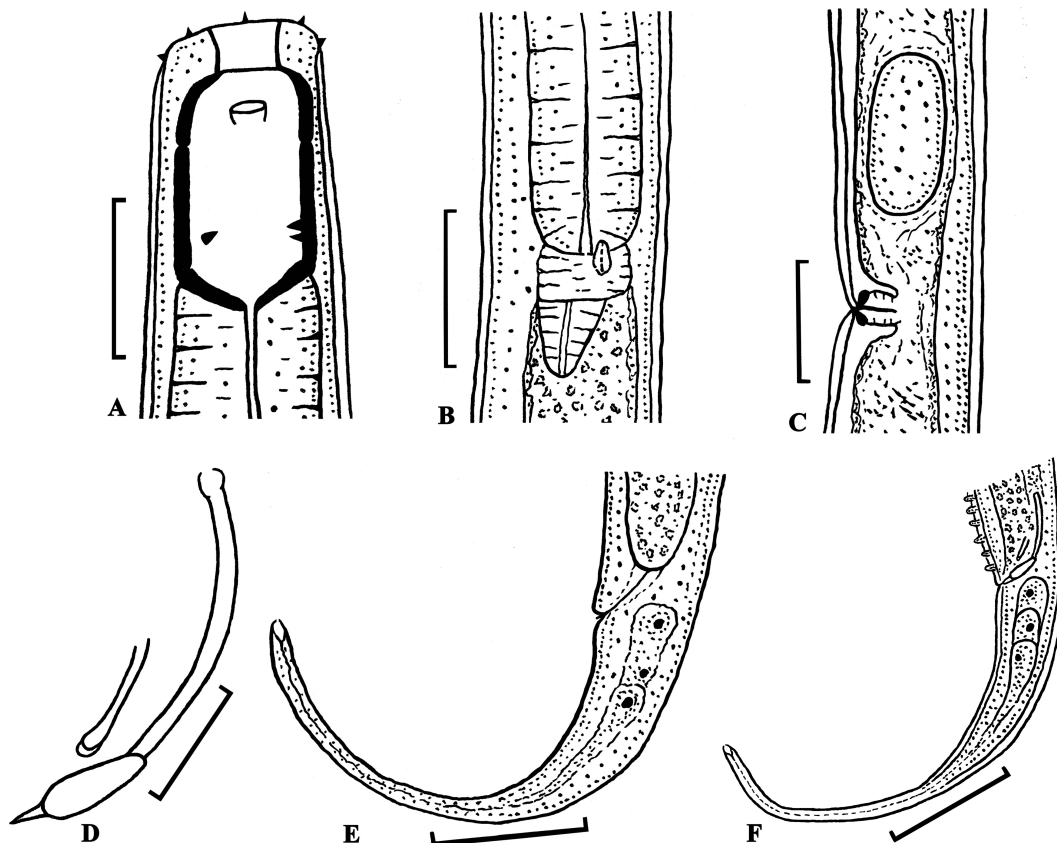


Fig. 1. Holotype female and paratype male of *Miconchus prokini* sp. nov. Designations: A: female head region; B: cardia region; C: vulva region; D: spicular apparatus; E: female tail; F: posterior body end of male. Scale bars: C, F – 300 μm; E – 250 μm; B – 200 μm; A – 100 μm; D – 80 μm.

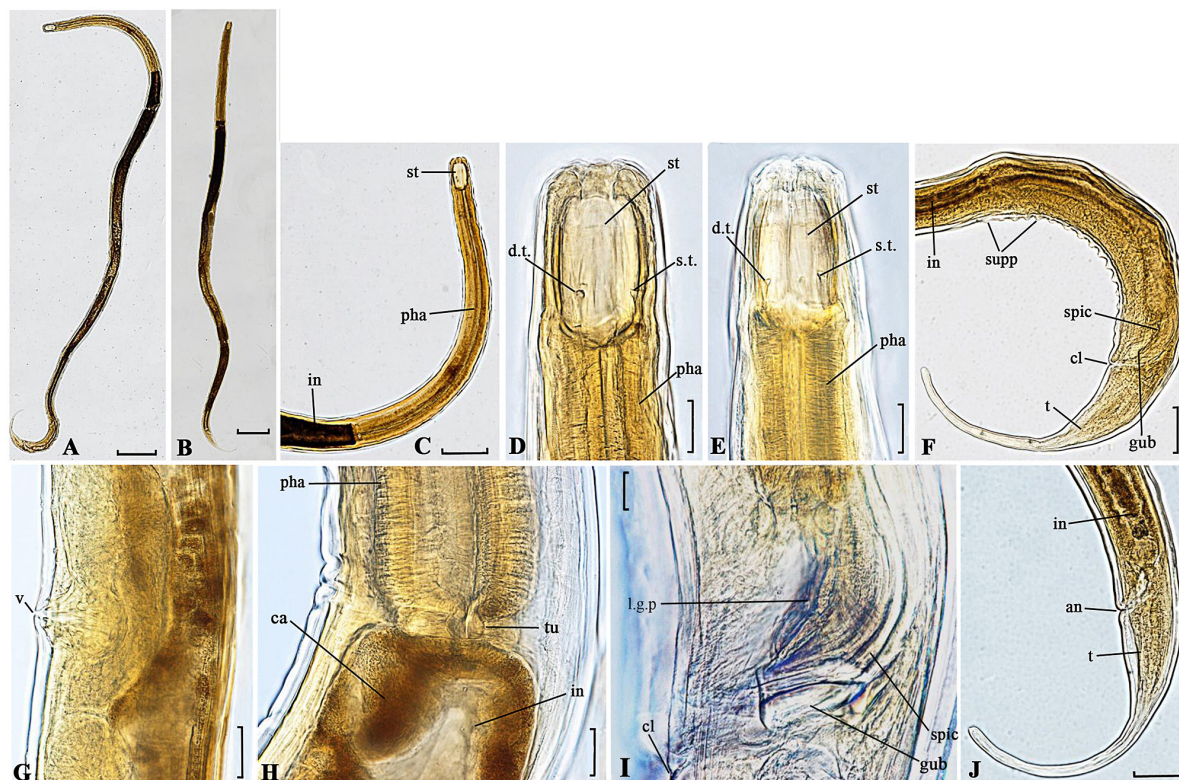


Fig. 2. Holotype female and paratype male of *Miconchus prokini* sp. nov. Designations: A: male, entire body; B: female, entire body; C: male, anterior body end; D: male head; E: female head; F: male, posterior body end; G: female, vulva region; H: male, cardia region; I: male, cloaca region; J: female, posterior body end. Scale bars: A, B – 500 μm ; C – 250 μm ; F, J – 100 μm ; D, E, G, H – 50 μm ; I – 20 μm . Abbreviations: an – anus; ca – cardia; cl – cloaca; d.t. – dorsal tooth; in – intestine; pha – pharynx; gub – gubernaculum; s.t. – subventral tooth; l.g.p – lateral guiding pieces; spic – spicule; st – stoma; supp – supplements; t – tail; tu – tubercles; v – vulva.

Reproductive system is didelphic, amphidelphic. Ovaries are relatively short, not reaching the oviduct-uterus junction. Anterior ovary is on right, and posterior ovary is on left side of intestine. Length of anterior genital branch (G_1) is 1211–1432 μm . Length of posterior genital branch (G_2) is 1523–1741 μm . Terminal zone of oogonia is arranged in one or two rows; growth zone with a single row of gradually enlarging oocytes. Oviduct is very short. Uterus-oviduct junction looks like strong contraction. Uterus is spacious, with thick walls, straight, filled with small rounded spermatozoa and containing one to two eggs measuring 203–339 \times 124–216 μm . Vagina occupies 35–40% of the corresponding body width. *Pars proximalis vaginae* is long, with almost parallel walls, 135–150 μm long. *Pars refringers vaginae* is with two triangular, very weakly refractive sclerotisations. *Pars proximalis vaginae* and *pars refringers vaginae* are surrounded by strong cuticular muscles. *Pars distalis vaginae* is 6–8 μm long. Vulva is a transverse slit, situated slightly posterior to mid-body. Vulval lips are not protruding outside the body contour. Tail is long, consisting of anterior conical portion and posterior thin, whip-like portion. Length of the posterior por-

tion reaches 65–72% of the total tail length. Caudal glands are in tandem, spinneret terminal.

Description of males. It is similar to females in the general characteristics, structure of cuticle, stoma, and anterior part of the body.

Testes are two; one is anteriorly outstretched, the other is reflexed. Spicules are paired, ventrally arcuate, with a small rounded head, its distal end conspicuously notched. Gubernaculum is 64–75 μm long. Lateral guiding pieces are straight with bifid end. Preloacal supplements are 17–22, in the form of large papillae, lying close to each other. Tail is long, consisting of anterior conical portion and posterior thin, whip-like portion. Length of posterior portion reaches 57–65% of total tail length. Caudal glands are in tandem. Spinneret is in the shape of a pore, terminal.

Diagnosis. Body is large and slender ($L = 7652\text{--}13\,147\ \mu\text{m}$, $a = 24\text{--}41$). Lips are amalgamated, labial region not offset from the adjacent body. Labial papillae are conical, protruding. Pharyngostoma (buccal cavity) is barrel-shaped, 144–201 μm long. Its length is 1.6–1.8 times more than its width. Dorsal tooth and two subventral teeth are located in the posterior por-

tion of buccal cavity, at level of 77–80% from its anterior edge. Cardia is muscular, projecting into the lumen of intestine. Tubercles is present. Tail is long, consisting of anterior conical portion and posterior thin, whip-like portion. Length of posterior portion reaches 57–65% of total tail length in females and 55–72% in males. Caudal glands and spinneret are present. Spinneret is terminal.

Females are dideiphic, amphidelphic. G_1 is 1211–1432 μm long, G_2 is 1523–1741 μm long. Vulva is slightly post equatorial ($V = 54\text{--}60\%$). Vagina is strait, with two drop-shaped refractive vaginal pieces. Uterus is spacious, filled with small rounded spermatozoa and containing one or two eggs, measuring 203–339 \times 124–216 μm .

Spicules in males are comparatively thin, arcuate, with a small rounded head, 225–252 μm long. Gubernaculums are 64–75 μm long. Lateral guiding pieces are present. Precloacal supplements are 17–22, in the shape of large papillae.

Differential diagnosis. Currently, according to various sources, the genus *Miconchus* includes 40–44 valid species, mostly soil inhabitants (Andrássy, 2009; Ahmad & Jairajpuri, 2010; Siddiqi, 2015; Rodríguez Molina, 2020). To date, only six species have been recorded in water bodies, exclusively in fresh water: 1) *M. aquaticus* Khan, Ahmad & Jairajpuri, 1978; 2) *M. crenicaudatus* Gagarin, 1984; 3) *M. rex* (Cobb, 1904) Andrásy, 1958 (syn.: *Mononchus rex* Cobb, 1904; *Iotonchus rex* (Cobb, 1904) Cobb, 1917); 4) *Miconchus schneideri* (Meyl, 1955) Andrásy, 1958 (syn.: *Iotonchus schneideri* Meyl, 1955); 5) *Miconchus studeri* (Steiner, 1914)

Andrássy, 1958 (syn.: *Mononchus studeri* Steiner, 1914; *Iotonchus studeri* (Steiner, 1914) Cobb, 1916); 6) *Miconchus trionchus* (Thorne, 1924) Siddiqi, Handoo & Chitwood 2015 (syn.: *Mononchus trionchus* Thorne, 1924; *Comiconchus trionchus* (Thorne, 1924) Jairajpuri & Khan, 1982) (Cobb, 1904, 1916, 1917; Steiner, 1914; Thorne, 1924; Meyl, 1955; Andrásy, 1958; Khan et al., 1978; Jairajpuri & Khan, 1982; Gagarin, 1984; Zullini & Peneva, 2006; Siddiqi et al., 2015). *Miconchus prokini* sp. nov. is the largest species of the genus (Mulvey, 1962; Andrásy, 2009; Ahmad & Jairajpuri, 2010; Siddiqi, 2015; Rodríguez Molina, 2020). It is morphologically similar to the known from New Zealand lakes congener *M. rex* in the big body size, vulva position in females, the number of precloacal supplements in males and in the relative length of the pharynx in both sexes; but it differs in an even longer body ($L = 7.7\text{--}13.1$ mm in *M. prokini* vs. $L = 6.5\text{--}7.0$ mm in *M. rex*), comparatively shorter tail ($c = 9.3\text{--}15.2$ in *M. prokini* vs. $c = 5.3\text{--}7.1$ in *M. rex*) and longer spicules (225–252 μm long in *M. prokini* vs. 180 μm long in *M. rex*) (Cobb, 1904).

Below, we provide a dichotomous key of the representatives of the genus *Miconchus* occurring in water bodies. The key also includes generalised main morphological characteristics and data on distribution of the species from the original descriptions (Cobb, 1904; Steiner, 1914; Thorne, 1924; Meyl, 1955; Khan et al., 1978; Gagarin, 1984) and additional sources (Mulvey, 1962; Popovici, 1990; Zullini & Peneva, 2006; Andrásy, 2009; Ahmad & Jairajpuri, 2010; Siddiqi et al., 2015; Rodríguez Molina, 2020).

Key to the aquatic species of the genus *Miconchus*

1. Large species, body length is about 4.8 mm or more 2
 - Small species, body length is about 4.0 mm or less 4
2. Body length is about 4.8 mm, $V = 68\%$; males are unknown (♀ : $L = 4.83$ mm, $a = 59$, $b = 4.6$, $c = 8.9$, $c' = 8.0$, $V = 68\%$; distribution: Brazil, Tanzania, Zaire) *M. schneideri*
 - Body length is over 6.0 mm, $V \leq 60\%$; males are present 3
3. Body length is 6.5 mm to 7.0 mm; female tail is as long as 13 anal body diameters; spicules are 180 μm long (♀ : $L = 6.5\text{--}7.0$ mm, $a = 46$, $b = 5$, $c = 5.3$, $c' = 13$, $V = 58\%$; ♂ : $L = 6.5\text{--}7.0$ mm, $a = 44$, $b = 5$, $c = 7.1$, c' – not given, supplements 17; distribution: New Zealand) *M. rex*
 - Body length is about 8–13 mm, female tail is 4 to 9 anal body diameters; spicules are 225–252 μm long (♀ : $L = 7.7\text{--}12.2$ mm, $a = 27\text{--}37$, $b = 4.5\text{--}5.2$, $c = 9.3\text{--}15.2$, $c' = 4.2\text{--}8.6$, $V = 54\text{--}60\%$; ♂ : $L = 8.1\text{--}13.1$ mm, $a = 24\text{--}41$, $b = 4.3\text{--}5.4$, $c = 9.6\text{--}14.7$, $c' = 4.3\text{--}9.3$, supplements 17–22; distribution: Russia) *M. prokini* sp. nov.
4. Caudal glands and spinneret are absent; tail tip is sharply pointed with clear dorsal notch (♀ : $L = 2.7\text{--}2.9$ mm, $a = 23$, $b = 3.6\text{--}4.2$, $c = 17\text{--}22$, $c' = 2.2\text{--}2.5$, $V = 70\text{--}72\%$; ♂ : $L = 2.8\text{--}3.2$ mm, $a = 23\text{--}26$, $b = 4.0\text{--}4.5$, $c = 23\text{--}30$, $c' = 1.6$, supplements 21–23; distribution: Russia) *M. crenicaudatus*
 - Caudal glands and spinneret are present; tail is rounded at tip 5
5. Females are with 3–7 prevulval and 0–7 postvulval papillae (the latter may be weak or absent at all); spicules are 62–70 μm long (♀ : $L = 1.9\text{--}2.8$ mm, $a = 24\text{--}37$, $b = 3.7\text{--}4.6$, $c = 15\text{--}21$, $c' = 2.4\text{--}3.0$, $V = 66\text{--}73\%$; ♂ : $L = 1.4\text{--}2.5$ mm, $a = 26\text{--}40$, $b = 3.9\text{--}4.6$, $c = 17\text{--}20$, $c' = 2.2\text{--}2.5$, supplements 17–21; distribution: Romania, India) *M. aquaticus*

- Pre- and/or postvulval papillae in females are absent; spicules are over 78 μm long 6
6. Buccal cavity is 38–48 \times 23–28 μm ; teeth are basal in position with apex at 20–25% from cavity base; spicules are 78–100 μm long (♀ : $L = 1.4\text{--}2.2$ mm, $a = 24\text{--}38$, $b = 3.6\text{--}4.6$, $c = 12\text{--}20$, $c' = 2.0\text{--}4.0$, $V = 60\text{--}70\%$; ♂ : $L = 1.4\text{--}2.1$ mm, $a = 25\text{--}33$, $b = 3.7\text{--}4.4$, $c = 14\text{--}21$, $c' = 2.2\text{--}2.7$, supplements 11–20; distribution: Albania, Austria, Bulgaria, France, Germany, Hungary, Italy, Netherlands, Poland, Romania, Slovakia, Spain, Switzerland, United Kingdom, Iran, Mauritius, USA, El Salvador) ***M. studeri***
- Buccal cavity is 58–70 \times 30–40 μm ; teeth are middle in position with apex at 45–50% from cavity base; spicules are 106 μm long (♀ : $L = 2.6\text{--}4.1$ mm, $a = 31\text{--}42$, $b = 3.9\text{--}5.1$, $c = 15\text{--}25$, $c' = 3.5\text{--}4.6$, $V = 60\text{--}65\%$; ♂ : $L = 2.4$ mm, $a = 30$, $b = 3.9$, $c = 26$, $c' = 3.5$, supplements 24; distribution: Canada, USA, Russia, Ukraine) ***M. trionchus***

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MICONCHUS PROKINI SP. NOV. (NEMATODA: MONONCHIDA) ИЗ ОЗЕРА ЭЛЬГЫГЫТГЫН, ЧУКОТКА, РОССИЯ

В. Г. Гагарин , В. А. Гусаков* 

Институт биологии внутренних вод имени И.Д. Папанина РАН, Россия

**e-mail: gusakov@ibiw.ru*

Приведено иллюстрированное описание нового вида нематод из отряда Mononchida – *Miconchus prokini* sp. nov., обнаруженного в озере Эльгыгытгын (Чукотка, Россия). Новый вид – самый крупный из известных на настоящий момент представителей рода. По величине тела, положению вульвы у самок, числу преклоакальных суппLEMENTОВ у самцов и относительной длине пищевода у обоих полов *M. prokini* sp. nov. наиболее близок к *M. rex*, но отличается от последнего более длинным телом ($L = 8.1–13.1$ мм у *M. prokini* против $L = 6.5–7.0$ мм у *M. rex*), относительно более коротким хвостом ($c = 9.3–15.2$ у *M. prokini* против $c = 5.3–7.1$ у *M. rex*) и более длинными спикулами (225–252 мкм у *M. prokini* против 180 мкм у *M. rex*).

Ключевые слова: Anatonchidae, государственный природный заказник, Дальний Восток России, кратерное озеро, свободноживущие нематоды