

Study of Teratocephalidae (Nematoda) from the Ukraine. Description of a population of *Teratocephalus* de Man, 1876 with a compendium on species from the "lirellus-group"

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Summary. A population of *Teratocephalus* cf. *lirellus* Anderson, 1969 from the Ukraine is described on the basis of light and scanning electron microscopy. The specimens examined differ from the original description, and other populations described as *T. lirellus*, mainly by having shorter body length and structure of cuticular blocks. The identity of the population is discussed in relation to current knowledge of the taxonomy and the intraspecific variability of the genus. Some populations of *Teratocephalus* ("lirellus-group") with cuticle annules interrupted by longitudinal incisures forming cuticular blocks are compared.

Key words: morphology, scanning electron microscopy, taxonomy, *Teratocephalus lirellus*.

The genus *Teratocephalus* de Man, 1876 is rather small, comprised of 20 nominal species, (Andrássy, 1984; Swart *et al.*, 1989). Unfortunately, many species descriptions are less complete and it is difficult to make good comparisons between species and populations when several characters are missing. Observations by SEM show that some characters in external morphology (anterior end structure, structure of lateral field and cuticle) can be used in the taxonomy of this group (Boström, 1989; Swart *et al.*, 1989; Karegar *et al.*, 1997). Here we describe a population that is difficult to identify accurately due to absence of clear criteria for separation of species, with little or no information available on external morphology for most *Teratocephalus* species, and little information available on intraspecific variability of external characters (cuticle) in species that have been studied by SEM. The identity of the specimens is discussed in relation to current knowledge of the taxonomy and the intraspecific variability of the genus.

The systematic position of the genus has been

discussed by several authors (see review in Boström, 1989). We follow Karegar *et al.* (1997) in placing the superfamily Teratocephaloidea Andrássy, 1958 (family Teratocephalidae Andrássy, 1958 with the two genera *Teratocephalus* and *Steratocephalus* Andrássy, 1984) within the suborder Cephalobina Andrássy, 1974. The other two genera formerly placed in the Teratocephalidae, viz. *Euteratocephalus* Andrássy, 1958 and *Metateratocephalus* Eroshenko, 1973, are regarded as belonging to the order Chromadorida *sensu* Lorenzen (1981) in the family Metateratocephalidae Eroshenko, 1973.

MATERIALS AND METHODS

Specimens were extracted by a modified Baermann funnel method, relaxed by heat, fixed in cold TAF, and processed to pure glycerine by a slow evaporation method. Because of the small number of specimens available, only a single female was picked for SEM-studies. It was taken from glycerine, washed in distilled water (four

1-hour changes) and refixed in TAF. This specimen was then processed for SEM according to Boström (1989).

DESCRIPTION

Teratocephalus cf. lirellus Anderson, 1969

(Figs. 1 & 2)

Females (n=8): L = 381±23 (344-404) µm; L' = 300±12 (283-312) µm; VBD = 15±1.1 (13-16) µm; neck length = 98±5 (91-105) µm; tail length = 81±13 (60-95) µm; ABD = 8±0.5 (7-9) µm; a = 26±2.6 (22-30); a' = 20±1.9 (18-23); b = 3.9±0.2 (3.5-4.1); b' = 3.1±0.1 (2.9-3.2); c = 4.7±0.6 (4.3-5.8); c' = 10±1.6 (8-12); nerve ring = 62±4.2 (57-75) µm; excretory pore = 68±3.8 (65-75) µm; nerve ring = 63±1.8 (62-67)%; excretory pore = 70±1 (68-72)%; R_{nr} = 29±1 (27-31); R_{ep} = 34±2 (30-36); R_{neck} = 51±3 (46-54); R_{vulva} = 109±7 (101-117); R_{anus} = 164±11 (149-178); V = 54±2.1 (52-58)%; V' = 68±1.1 (68-70)%; vagina = 5.8±0.8 (4.7-7.1) µm; PUS = 9.2±1.7 (7.1-11.4) µm; PUS/VBD = 0.64±0.11 (0.50-0.77); rectum = 12±0.9 (11-13) µm; rectum/ABD = 1.5±0.1 (1.4-1.6); cuticle thickness = 1.9±0.3 (1.4-2.4) µm; annule width = 1.7±0.2 (1.5-2.0) µm; LRW = 9.2±0.9 (7.6-10.2) µm; LRH = 4.8±0.6 (4.0-5.5) µm; buccal cavity length = 8.8±0.8 (7.6-10.0) µm.

Female. Body strongly arcuate ventrad, C-shaped, almost cylindrical from base of stoma to vulva, then narrowing gradually to posterior end. Cuticle coarsely annulated, annules longitudinally striated by deep incisures, starting on third annule and forming 18-20 ridges (excluding lateral field) at midbody. Cuticular blocks rectangular, their length about two times their width. Lateral fields with two less distinct incisures demarcating a single wing. First body annule broad, sloping anteriorly, second annule narrower than the others. Amphid aperture small, an arcuate slit located in the first transverse body stria. Lip region well offset with six high and truncate lips, sloping downward. Each subdorsal and subventral lip with single cephalic seta. Stoma consists of two parts: anterior wide part and a posterior narrow part enveloped by the pharyngeal collar. Digestive system typical of the genus. Pharynx without differentiation between corpus and isthmus. Excretory pore posterior to nerve ring. Deirids and phasmids apparently absent. Female reproductive system monodelphic, prodelphic; ovary compact, on the right side of the body (dextral); postvulval uterine sac shorter than

vulval body diameter. Vulva a transverse slit with slightly protruding lips situated posterior to midbody. Intrauterine eggs: 43-46 x 11-14 µm, each egg 3.3-4.0 times longer than its diameter. Rectum equal to, or slightly longer than, anal body diameter. Anus with raised anterior lip. Tail elongate, posterior part finely annulated, terminus minutely bifurcate.

Male. Not found.

Material examined. The specimens were collected from sandy soil around roots of *Salix* sp. on the left bank of the Dnieper river, Kiev, Ukraine, 7 February 1998; leg. O. Holovachov.

Relationships. The specimens from Ukraine resemble many previously described species and specific populations of species of *Teratocephalus*, but they also differ from these in several respects. The major characters used for differentiating the Ukrainian population from other species and populations in the *Teratocephalus "lirellus-group"* are listed in Table 1.

Remarks. Several characters that are commonly used in the taxonomy of the genus *Teratocephalus* vary within wide limits and character ranges overlap between species, whereas for other characters the intraspecific variability is less well known. Some characters are listed and discussed below:

1. Body length varies within the genus within wide limits from 0.3 to 0.9 mm. Ranges of variability in body length of different species vary within ±0.05-0.1 mm in a single population and intraspecifically within ±0.1-0.15 mm in general. Total body length is useful only for separation of *T. tenuis* Andrassy, 1958 and *T. paratenius* Eroshenko, 1973.

2. Tail length in relation to anal body width is highly variable, and the genus can be divided into three groups on the basis of the c' ratio:

- a) *T. brevicaudatus* Schuurmans Stekhoven, 1951 with c' = 3;
- b) *T. tenuis* and *T. paratenius* with c' = 6-7;
- c) all other species with c' = 8-35.

Especially for the species in the last group, tail length varies within wide limits and is less suitable for taxonomic purposes.

3. Nerve ring position is relatively stable, and only *T. deconincki* Anderson, 1969 differs from all other species by having a more posterior position of the nerve ring (slightly anterior to bulbous vs. level with middle of pharynx).

4. Length of postvulval uterine sac: most species can be placed in the groups:

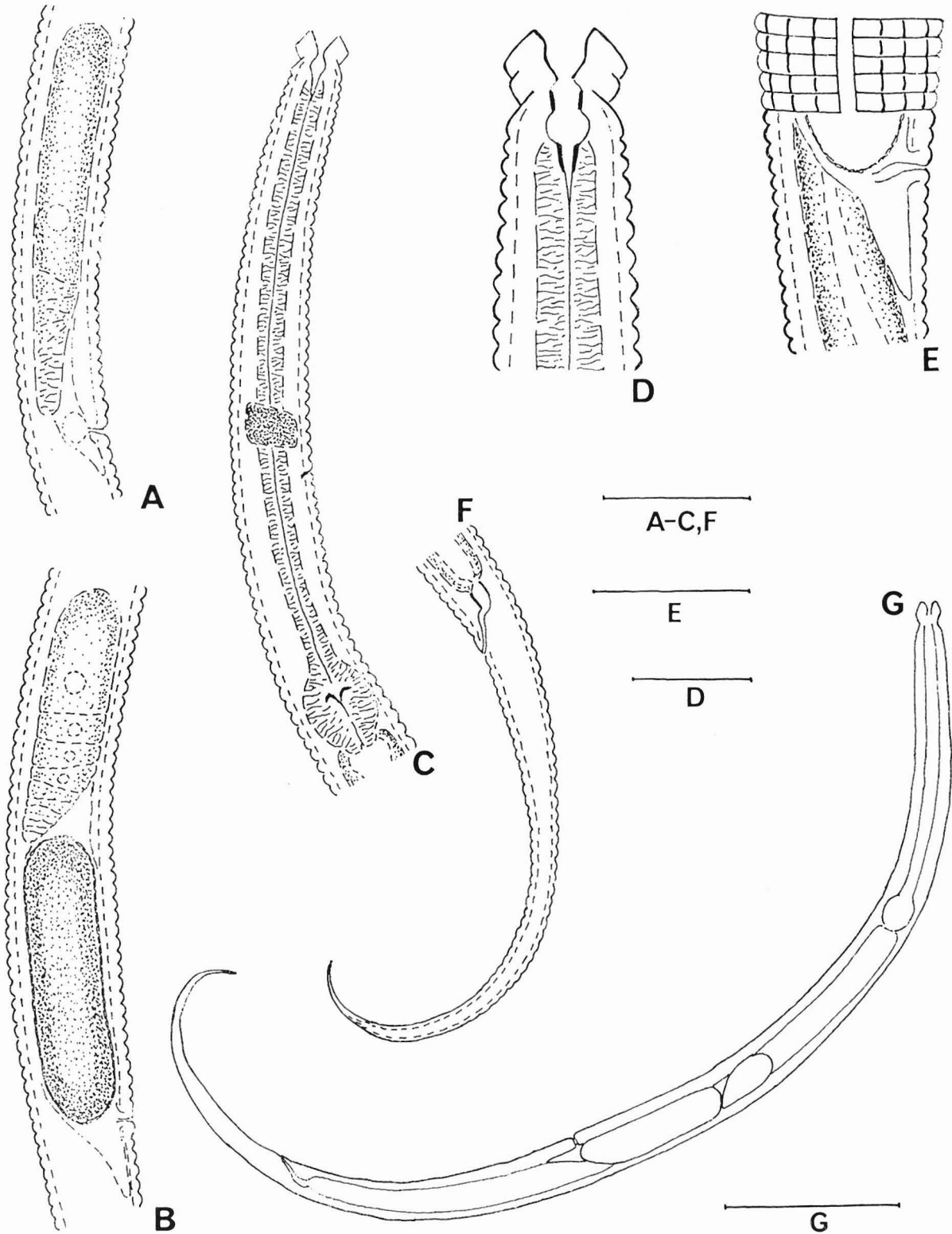


Fig. 1. *Teratocephalus* cf. *lirellus* Anderson, 1969. Female (A-G). A & B: Reproductive system without and with intrauterine egg, respectively; C: Pharyngeal region; D: Head end, median section; E: Vaginal region showing postvulval uterine sac and cuticle structure; F: Tail. G: Entire body. Scale bars: D-E - 10 μ m, A-C, F - 20 μ m, G - 50 μ m.

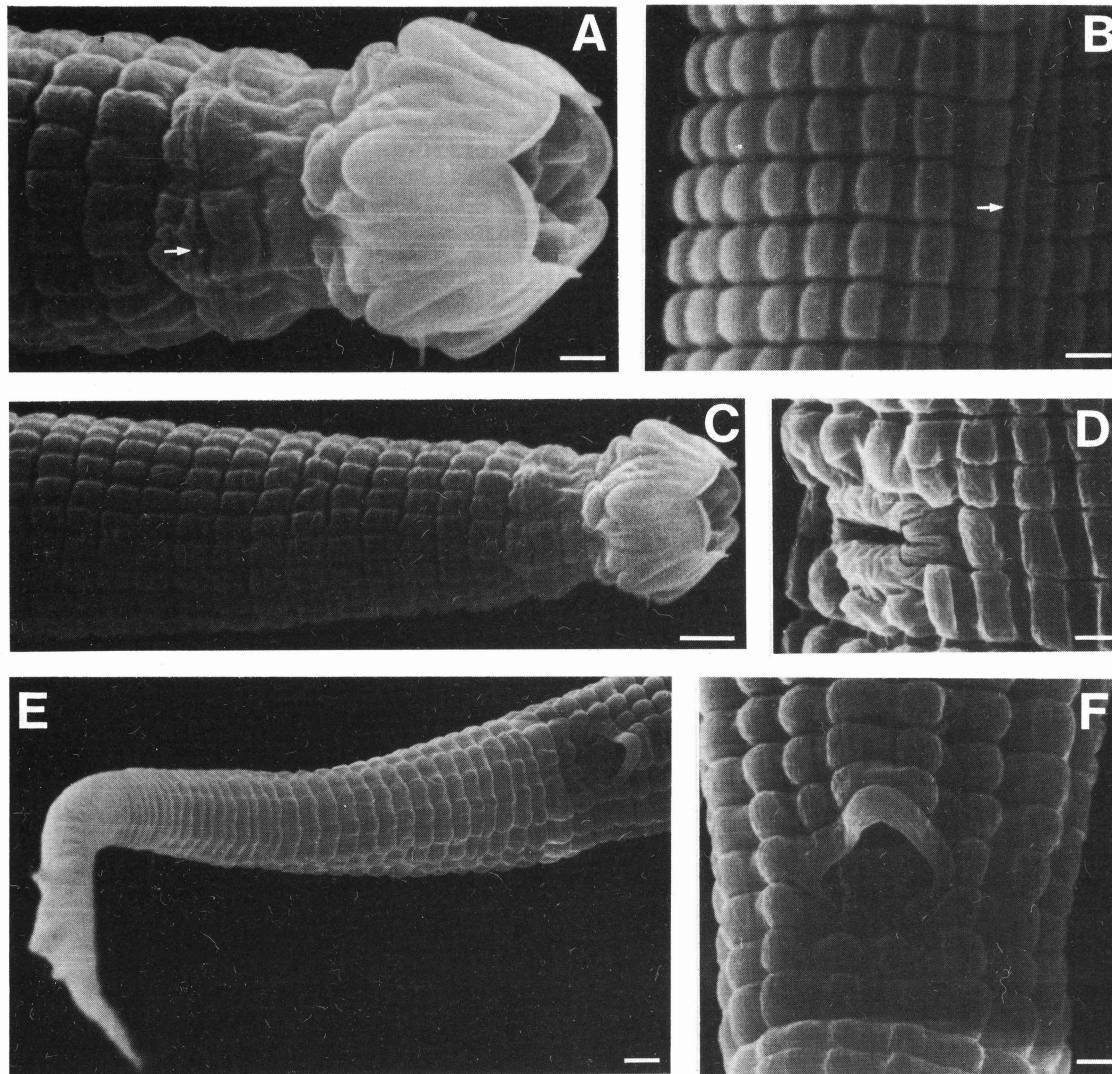


Fig. 2. *Teratocephalus cf. lirellus* Anderson, 1969. SEM micrographs of female (A-F). A: Lip region, lateral view (arrow points at amphid aperture); B: Cuticle and lateral field (arrow) at midbody; C: Anterior region, lateral view; D: Vulva; E: Tail region; F: Anus. Scale bars: A-B, D, F - 1 μ m, C, E - 2 μ m.

- a) PUS < 1 VBD (majority of species);
- b) PUS = 1.5-3 VBD (1.4-2.2 in *T. rugosus* Maslen, 1979, 1.5-2.5 in *T. tilbrookii* Maslen, 1979, and 2.8 in *T. bisexualis* Meyer & Coomans, 1977).

However, in *T. diversiannulatus* PUS length seems to vary from 0.5 to 1.5 VBD, as measured from figures in Swart *et al.* (1989), thus overlapping these two groups.

5. Presence or absence of males and amphimixis or parthenogenesis: males are described for about 50% of the species. They are very rare in some species, whereas in others males are as common as females. This character can be used

only if gravid females are found, and spermatozoa are observed in the female reproductive system.

6. External structure of the cuticle is commonly used in the taxonomy of the genus, but its intraspecific variability is little known. The genus can be divided into two groups of species:

- a) without longitudinal ridges;
- b) with longitudinal ridges between 8 and 24 in numbers.

7. Characters such as the number of annules along the body and from the anterior end to different structures (R_{nr} , R_{ep} , R_{neck} , R_{vulva} , R_{anus}) have been described almost exclusively by Karegar

Table 1. Comparison of some morphometric and morphological characters of females from different species and populations in the *Teratocephalus* "lirellus-group".

Species and references	L	c	c'	PUS (VBD)	Annule width	Longit. striae	Start striae	Cuticle blocks	R _{neck}	Male	Locality	Remarks
<i>Teratocephalus</i> cf. <i>lirellus</i> (current population)	344-404	4.3-5.8	7-12	<1	1.5-2.0	ca.18	3 rd ann.	rectangular, length 2 x w.	46-54	-	Ukraine	
<i>T. lirellus</i> (Anderson, 1969)	396-535	2.6-5.1	?	<1	1.0-1.6	18-24	?	rounded	?	-	Canada	
<i>T. lirellus</i> apud Loof (1971)	370-540	2.3-3.5	19-35	<1	1.3-1.4	?	?	?	?	-	Spitzbergen	
<i>T. lirellus</i> apud Boström (1989)	515-575	4.0-4.2	13-16	<1	1.5-2.0	16-18	3 rd ann.	rounded, angular	60-62	-	Spitzbergen	
<i>T. lirellus</i> apud Swart <i>et al.</i> (1989)	411-420	3.3-4.8	8-17	<1	1.3-1.7	16-18	3 rd ann.	angular, indented	?	+	South Africa	Separate species ¹
<i>T. lirellus</i> apud Karegar <i>et al.</i> (1997)	429-558	3.6-5.7	10-19	<1	1.4-1.9	17	10th ann.	rounded, angular	63-77	-	Iran	
<i>T. lirellus</i> apud Karegar <i>et al.</i> (1997)	457-497	4.1-4.4	12-16	<1	1.4-1.7	17-20	10th ann.	rounded, angular	?	-	Belgium	
<i>T. pseudolirellus</i> (Maslen, 1979)	530-635	3.2-4.0	16-20	<1	1.4-2.2	18-21	?	rounded	?	-	Signy Island	
<i>T. bisexualis</i> (Meyer & Coomans, 1977)	462-473	6.4-7.3	?	2.8	1.6-1.8	16-18	?	angular	?	+	Kenya	
<i>T. rugosus</i> (Maslen, 1979)	555-735	4.0-5.0	11-16	1.4-2.2	1.7-2.0	13-17	?	angular	?	+	Signy Island	
<i>T. dadayi</i> (Andrássy, 1968)	330-340	5.1-5.3	9-10	absent?	1.3	12	?	?	70-72	-	Paraguay	
<i>T. dadayi</i> apud (Hernandez & Jordana, 1988)	545-565	5.2-5.5	8-9	<1	(1.8-2.0)	(12)	?	(angular)	?	+	Spain	(data for males)
<i>T. subvexus</i> (Anderson, 1969)	338-443	4.9-6.2	?	<1	1.0-1.6	12-13	?	angular	?	-	Canada	= <i>T. dadayi</i> ²
<i>T. sigillarius</i> (Eroshenko, 1973)	344-381	5.3-5.9	?	<1	1.0	?	?	rectangular, length ½ x w.	?	-	Russia, Far East	= <i>T. dadayi</i> ²
<i>T. occalatus</i> (Eroshenko, 1973)	360-362	4.1	15-17	<1	1.4	?	?	oval	?	-	Russia, Far East	= <i>T. lirellus</i> ²
<i>T. diversiannulatus</i> (Swart <i>et al.</i> , 1989)	542-598	3.8-5.0	11-16	0.5-1.5	1.4-2.0	12	9th ann.	rounded	?	+	South Africa	

Figures and letters in bold indicate substantive differences from the population described in this paper;

? - data are not available;

¹ Karegar *et al.* (1997); ² Andrásy (1984).

et al. (1997) and were studied in the present specimens, and in specimens of *T. lirellus* described by Boström (1989). Consequently, their variability in most other populations thus remains unknown.

DISCUSSION

The population described above is close to Anderson's (1969) description of *T. lirellus*, but differs from it in some respects (Table 1). It also differs from other populations of *T. lirellus*, described by SEM, in structure of the cuticular blocks.

Different methods for preparation of specimens for SEM can influence the external structures in various ways, see for example Eisenback (1986). This must be considered when allocating a population to a particular species or establishing it as new to science. However, such an effect can be difficult to appreciate as several methods of fixation and preparation are in use and their effects on specimens may not have been determined. Thus, we have considered the few descriptions of species of *Teratocephalus*, including SEM, to accurately determine the external characters without distortions.

SEM data show that some species (populations) differ from each other mainly by structure of cuticular blocks and number of longitudinal ridges. *T. lirellus* *apud* Swart *et al.* (1989) differs from *T. lirellus* *apud* Boström (1989) and Karegar *et al.* (1997) mainly in structure of cuticular blocks. Obviously, the descriptions of *T. lirellus* by Boström (1989) and Karegar *et al.* (1997) show intraspecific variability in one species, whereas *T. lirellus* described by Swart *et al.* (1989) may represent a separate species, as suggested by Karegar *et al.* (1997).

The species described by Eroshenko (1973) are difficult to compare with other species because of the short and incomplete descriptions and schematic drawings. Only *T. paratenuis* and *T. stratumus* Eroshenko, 1973 have subsequently been recorded since descriptions (Zell, 1986; Háněl, 1997). The remainder of Eroshenko's species are probably valid, but need to be further studied and redescribed on the basis of type or new material.

Although there are combinations of characters that separate our population from the described species of *Teratocephalus*, we have refrained from describing it as a new species. The principal reason for this is pragmatic as at it seems unwarranted to introduce another species until more data become available on characters that currently appear to have wide ranges of intraspecific variability.

Accumulation of new data on morphology (LM and SEM) will enable the taxonomy of the genus to be revised and will provide information about the usefulness of different characters in the systematics of this group. Probably, some widely distributed species such as *T. lirellus* can be divided into a few closely related species that form collectively species group.

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Boström S., Holovachov O., Susulovsky A. Изучение Teratocephalidae (Nematoda) Украины. Описание популяции *Teratocephalus* de Man, 1876 и анализ видов группы “*lirellus*”.

Резюме. На основании данных полученных с помощью световой и сканирующей электронной микроскопии описана украинская популяция *Teratocephalus* cf. *lirellus* Anderson, 1969. Изученные особи отличаются от оригинального описания вида и других популяций описанных как *T. lirellus*, в основном более коротким телом и строением кутикулярных блоков. Видовая принадлежность украинской популяции тератоцефалосов обсуждается в свете современных представлений о таксономии и межвидовых различиях в этом роде. Проведено сравнение нескольких популяций видов *Teratocephalus* из группы “*lirellus*”, у которых кутикула разделена продольными инцизурами на кутикулярные блоки.
