

# Two new species and three known species of free-living marine nematodes of the genus *Enoplus* Dujardin, 1845 (Nematoda: Enoplidae) from the North Pacific

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**Summary.** Illustrated descriptions are given for five species of the genus *Enoplus* from Pacific coastal waters. *E. paralittoralis* and a new species, *Enoplus kurilensis* sp. n. were collected from the area of the Kurile Island; *E. velatus* and a new species *E. paralpha* sp. n., were collected from the area of the San Juan Islands, and *E. michaelseni* from the Sea of Japan.

**Key words:** *Enoplus kurilensis* sp. n., *E. paralpha* sp. n., *E. velatus*, *E. paralittoralis*, *E. michaelseni*, marine nematodes, North Pacific, taxonomy.

The genus *Enoplus* Dujardin, 1845 is one of the largest groups of the family Enoplidae, and is represented by 33 valid species (Platt & Warwick, 1983). This genus of free-living marine species is widespread with some of its representatives having a cosmopolitan distribution.

The nematofauna of the North Pacific ocean has been little studied. Five species of *Enoplus* nematodes are reported here from Western part of North Pacific, including two new species which are described and illustrated. Additional information is provided for the three known species: *E. paralittoralis* Wieser, 1953, *E. velatus* Wieser, 1953, *E. michaelseni* (Linstow, 1896). Photographs of diagnostic features of the different species are included.

## MATERIAL AND METHODS

Specimens of *Enoplus kurilensis* sp. n. and *E. paralittoralis* from the Kraternaya Bight (Yankicha Island, Kurile Islands) were collected whilst SCUBA diving, from the sublittoral bottom (muddy sediment, 5-11 m depth) and between the holdfasts of *Fucus* algae. *E. michaelseni* specimens collected from the Peter the Great Bay (Sea of Japan) were obtained from between the byssal threads of the bivalve *Crenomytilus grayanus* at the Vostok Marine Biological Station of the Institute of Marine Biology (Vladivostok). *E. paralpha* sp. n. and *E. velatus* from the San Juan Island were collected from silty sand and algae

in the intertidal zone of the Argyle Lagoon (San Juan Archipelago, Washington, North-West Pacific) in the vicinity of the Friday Harbor Laboratories of Washington State University, USA.

All samples were fixed in 4% formalin in sea water. Specimens were extracted by decantation using a sieve with 68 µm mesh size. Nematodes were processed by slow evaporation to pure glycerin and mounted on glass slides. Whole-mount specimens were studied and photographed using a Polyvar Reichert light microscope.

## DESCRIPTIONS

### *Enoplus kurilensis* sp. n. (Figs. 1A-D & 4A, B)

**Holotype male:** L = 4920 µm; body diameter at: level of cephalic setae = 25 µm; cephalic capsule = 55 µm; esophagus end = 138 µm; cloacal = 113 µm; maximum = 168 µm; spicules = 145 µm; gubernaculum = 25 µm; a = 29.2, b = 6.2, c = 16.9.

**Paratype female (n=1):** L = 6360 µm; body diameter at: cephalic setae = 65 µm, cephalic capsule = 70 µm, esophagus end = 225 µm, anus = 160 µm, maximum = 366 µm; t = 300; a = 17.3, b = 8.1, c = 21.2, V = 56%.

**Males.** Body slightly tapered anteriorly and shar-

ply to the posterior end. Cuticle marked with small punctations. Lips small, with six inner papillae. One crown of ten (6+4) cephalic setae, 15  $\mu\text{m}$  long. Cephalic capsule well developed. Three solid mandibles, bilobed anteriorly, without onchia, 15  $\mu\text{m}$  long. Amphid very small, with opening slightly anterior to the posterior edge of the cephalic capsule. Ocellar pigments approximately 50  $\mu\text{m}$  behind anterior end. Eleven longitudinal rows of somatic setae 20–25  $\mu\text{m}$  in the cervical region. Oesophagus cylindrical 110  $\mu\text{m}$  long. Cardia well developed. Two testes; gonads opposed, outstretched. Spicules stout, curved, without semicircular plates, but with a single distal wart; capitulum 45  $\mu\text{m}$  long. Gubernaculum small, median part (25–20  $\mu\text{m}$ ) long, provided with rounded lateral pieces. Tail conical-cylindrical, elongated with scattered somatic setae. One pre-cloacal supplement, 85  $\mu\text{m}$  long, 175  $\mu\text{m}$  anterior to cloacal opening; slightly trumpet-shaped and distally with small teeth. Spinnerette from 3 incaudal glandular cells.

**Female.** Similar to male in general habitus, but body longer. Cephalic setae 18  $\mu\text{m}$ . Mandibles 24  $\mu\text{m}$  long, cephalic capsule 27  $\mu\text{m}$  long. Reproductive system amphidelphic. Ovaries reflexed; vulva 3060  $\mu\text{m}$  from anterior end; the tail posterior third cylindrical. Spinneret present.

**Type material.** Holotype male (MN-2015) and one paratype female (MN-1029) deposited with nematode collection of the Zoological Department of the Far East State University, Vladivostok, Russia.

**Type locality.** Pacific Ocean, Kurile Islands, Yankicha Island, Kraternaya Bight, 5 m depth, muddy sediment collected 25 August 1986.

**Diagnosis.** *Enoplus kurilensis* sp. n. is characterized by slightly trumpet-shaped precloacal supplement, by lacking a pair of post-cloacal papillae, spicules with a single distal wart, row from 12–14 of the preanal setae.

**Relationship.** The new species is similar to *E. alpha* Inglis, 1971 in habitus and shape of gubernaculum in male, but differs by having a longer body ( $L = 4920 \mu\text{m}$  vs 2390–3190  $\mu\text{m}$  in male), having a slightly trumpet-shaped cloacal supplement (vs tubular in *E. alpha*), by the larger number of preanal setae (12–14 vs 5 in *E. alpha*), by lacking a pair of post-cloacal papillae, present in *E. alpha*. It differs from *E. meridionalis* Steiner, 1921 in that the spicules do not terminate posteriorly as hooks, and by lacking a pair of post-cloacal papillae; from *E. benhami* Ditlevsen, 1930 it differs by lacking a pair of post-cloacal papillae and the smaller spicules.

## *Enoplus paralpha* sp. n. (Figs. 2G-I, 4E & 5A)

**Holotype male:**  $L = 5187 \mu\text{m}$ ; body diameter at: level of cephalic setae = 60  $\mu\text{m}$ ; cephalic capsule = 70  $\mu\text{m}$ ; esophagus end = 160  $\mu\text{m}$ ; cloacal = 125  $\mu\text{m}$ ; maximum = 190  $\mu\text{m}$ ; spicules = 213  $\mu\text{m}$ ; gubernaculum = 55  $\mu\text{m}$  long, 33  $\mu\text{m}$  wide. The distance from anterior end to: nerve ring = 311  $\mu\text{m}$ , rennetae = 333  $\mu\text{m}$ , end of esophagus = 843  $\mu\text{m}$ ;  $a = 27.3$ ,  $b = 11.6$ ,  $c = 20.1$ .

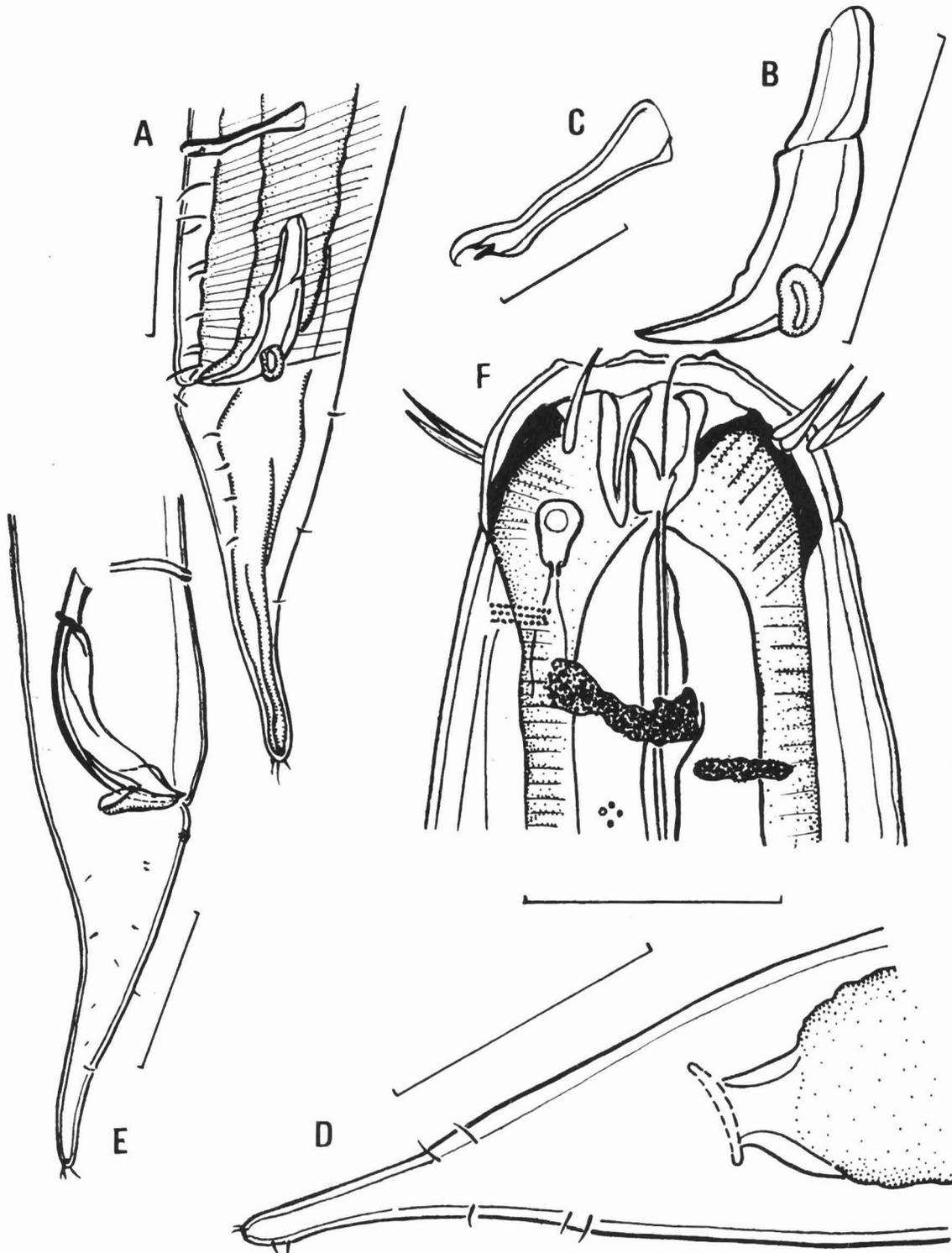
**Paratype male (n=1):**  $L = 4570 \mu\text{m}$ ; body diameter at: level of cephalic setae = 53  $\mu\text{m}$ ; cephalic capsule = 60  $\mu\text{m}$ ; esophagus end = 150  $\mu\text{m}$ ; cloacal = 118  $\mu\text{m}$ ; maximum = 188  $\mu\text{m}$ ; spicules = 203  $\mu\text{m}$ ; gubernaculum = 55  $\mu\text{m}$  long, 33  $\mu\text{m}$  wide;  $a = 24.3$ ,  $b = 10.2$ ,  $c = 19.2$ .

**Males.** Cuticle marked with small circular punctations. Six labial papillae. Cephalic setae arranged as a circle of 6+4, 20  $\mu\text{m}$  and 15  $\mu\text{m}$  long respectively. The head with typical cephalic capsule. Mandibles 25x10  $\mu\text{m}$ . Amphids very small 3x5  $\mu\text{m}$ , at the anterior side of the mandible base. Excretory pore of renette opening posterior nerve ring. Masses of pigment present on the lateral sides of the esophagus at about 63  $\mu\text{m}$  from the anterior end. Short setae along body, especially in the anterior and caudal regions of males. Spicules smooth, stout, equally arcuate with large proximal part (20x5  $\mu\text{m}$ ). Gubernaculum small, with rounded lateral and triangular pieces. Precloacal supplement tube-shaped, 45–50  $\mu\text{m}$  long, about 175–183  $\mu\text{m}$  from cloaca. Row of 10–12 setae between precloacal supplement and cloaca. Two large papillae, 8  $\mu\text{m}$  long, are situated on the oval base of the posterior lip of the cloacal opening, another papillae at 152–165  $\mu\text{m}$ . Tail 238–258  $\mu\text{m}$  (2.0–2.1 anal diameters) long.

**Type material.** Holotype male (MN-4000) and one paratype male (MN-4000/1) deposited with nematode collection of the Zoological Department of the Far East State University, Vladivostok, Russia.

**Locality.** Intertidal zone of the Argyle Lagoon, San Juan Island, Washington, USA, silty sand, collected 25 August 1994.

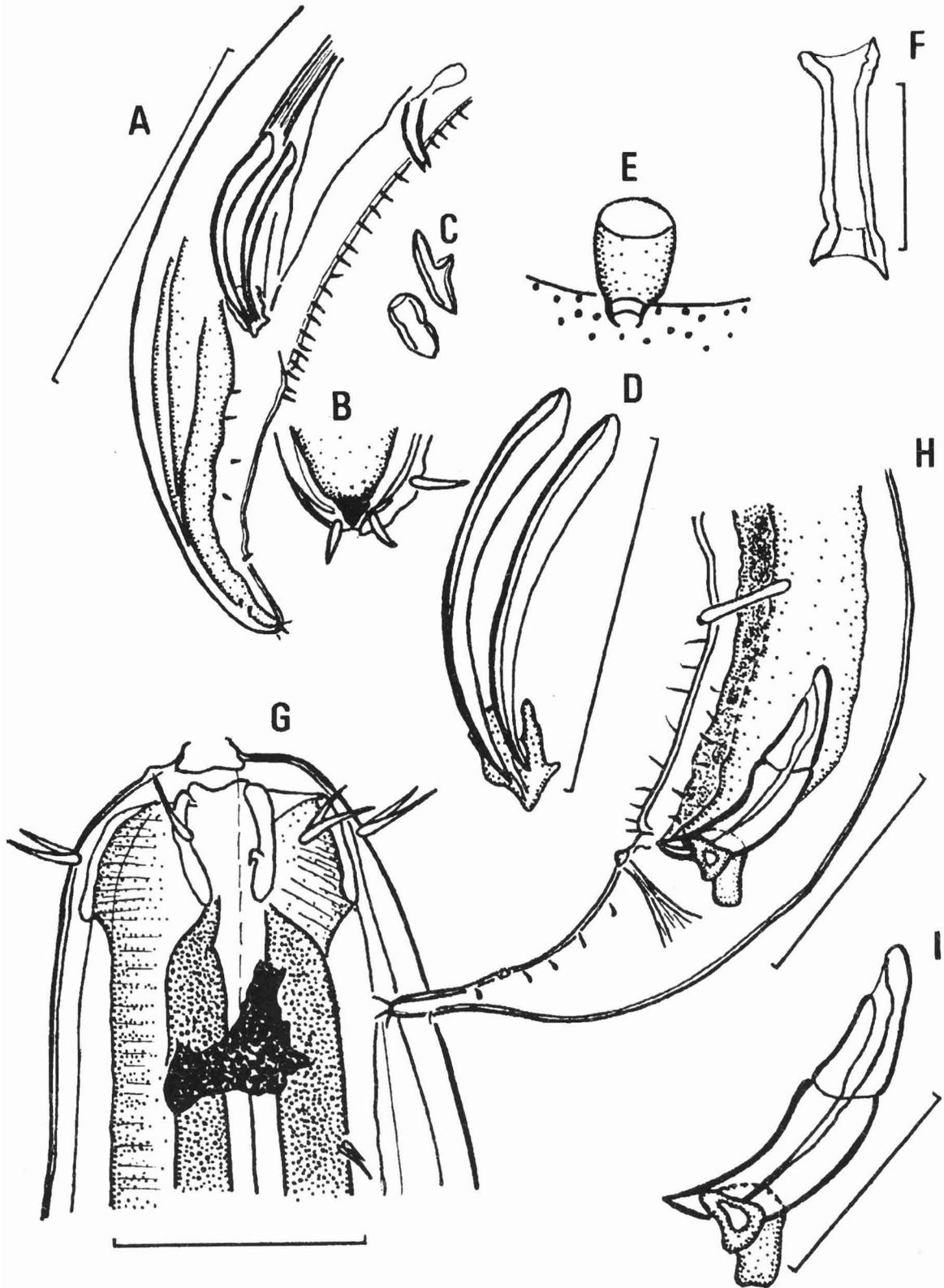
**Diagnosis.** *Enoplus paralpha* sp. n. is characterized by the shape of copulatory apparatus (spicules 203–213  $\mu\text{m}$ , smooth, stout, equal arcuate with large proximal part, gubernaculum with rounded lateral and triangle pieces), by small, simple, tubular supplement and a row of 10–12 setae between the precloacal supplement and the cloaca.



**Fig. 1.** *Enoplus kurilensis* sp. n. Holotype male. (A-C). A: Posterior body; B: Spicules and gubernaculum; C: Precloacal supplement. Paratype female. D: Posterior body. *Enoplus velatus* Wieser, 1959 (E-F). E: Posterior body. F: Cephalic end. Scale bars: A, B, E = 100  $\mu$ m; C, F = 50  $\mu$ m; D = 200  $\mu$ m.

**Relationship.** *Enoplus paralpha* sp. n. most closely resembles *E. alpha* Inglis 1971, but have a longer body (L = 4570-5187  $\mu$ m vs 2390-3190  $\mu$ m), shorter

tail (c = 19.2-20.1 vs 12.0-15.7), longer cephalic setae (20 and 15  $\mu$ m vs 14 and 10  $\mu$ m) and longer mandibules (25  $\mu$ m vs 16-17  $\mu$ m). They also differ



**Fig. 2.** *Enoplus paralittoralis* Wieser, 1953 (A-F). A: Male posterior body; B: Spinneret; C: Dorsal and lateral pieces of gubernaculum; D: Spicules; E: Amphid and edge of cephalic capsule; F: Precloacal supplement. *Enoplus paralpha* sp. n. Male (G-I). G: Cephalic end; H: Posterior body; I: Spicules and gubernaculum. Scale bars: A, H = 200  $\mu$ m; D, I = 100  $\mu$ m; F = 25  $\mu$ m; G = 50  $\mu$ m.

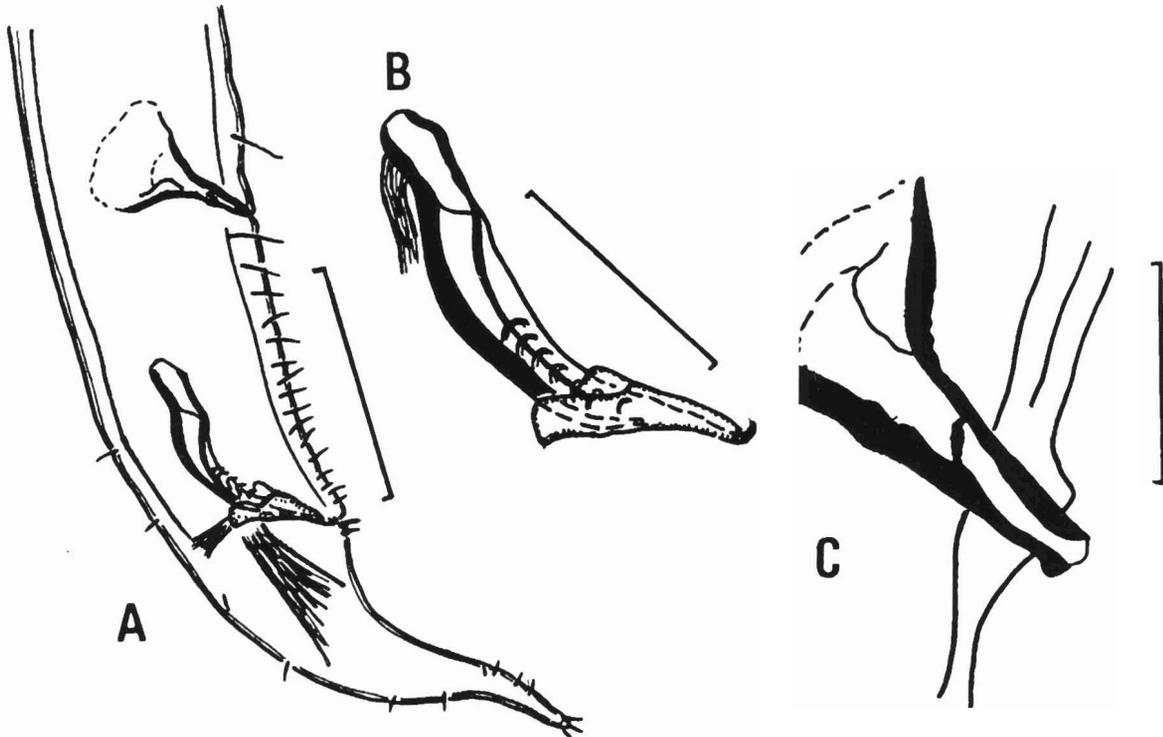


Fig. 3. *Enoplus michaelsoni* (Linstow, 1896) de Man, 1904. A: Male posterior body; B: Spicules and gubernaculum; C: Precloacal supplement. Scale bars: A = 200  $\mu\text{m}$ ; B = 100  $\mu\text{m}$ ; C = 50  $\mu\text{m}$ .

by having spicules which are twice as long (203–213  $\mu\text{m}$  vs 109–149  $\mu\text{m}$ ) and of different shape of those in *E. alpha*, by having long a precloacal supplement (50  $\mu\text{m}$  vs 29  $\mu\text{m}$ ); and having 10–12 precloacal setae vs 5 precloacal setae.

### *Enoplus velatus* Wieser, 1959 (Figs. 1E, F & 4C)

The only previous record of *E. velatus* is that of the species. The specimens reported here largely correspond with the type material, but their morphometric data provide additional information on the intraspecific range of diagnostic features.

**Males** (n=3): L = 4469–4703  $\mu\text{m}$ ; body diameter at: cephalic setae = 46–53  $\mu\text{m}$ , cephalic capsule = 45–54  $\mu\text{m}$ , at the end of esophagus = 110–115  $\mu\text{m}$ , cloacal = 78–83  $\mu\text{m}$ , maximum = 152–160  $\mu\text{m}$ , spicules = 160–180  $\mu\text{m}$ ; t = 190–200  $\mu\text{m}$ ; a = 28.8–30.2, b = 5.4–5.6, c = 20.0–23.5.

**Males.** The distance from anterior end to: pore of renette 280  $\mu\text{m}$ , nerve ring 343  $\mu\text{m}$ . Cuticle marked with small round punctations. Six small lips, provided with papillae. Ten cephalic setae, 20  $\mu\text{m}$  long. Cephalic capsule well developed and typical. Mandibles 21  $\mu\text{m}$  long and 7  $\mu\text{m}$  wide. Amphids very small 10x8  $\mu\text{m}$  situated, just at the base of the mandibles,

at a distance of 20–22  $\mu\text{m}$  from the anterior end. Ocellar pigments situated at 57–63  $\mu\text{m}$  from the anterior end, folled by four short setae. Spicules smooth, with velum. Gubernaculum with short caudodorsal apophysis. The precloacal supplement tubular, 70  $\mu\text{m}$  long, about 125–140  $\mu\text{m}$  from cloaca.

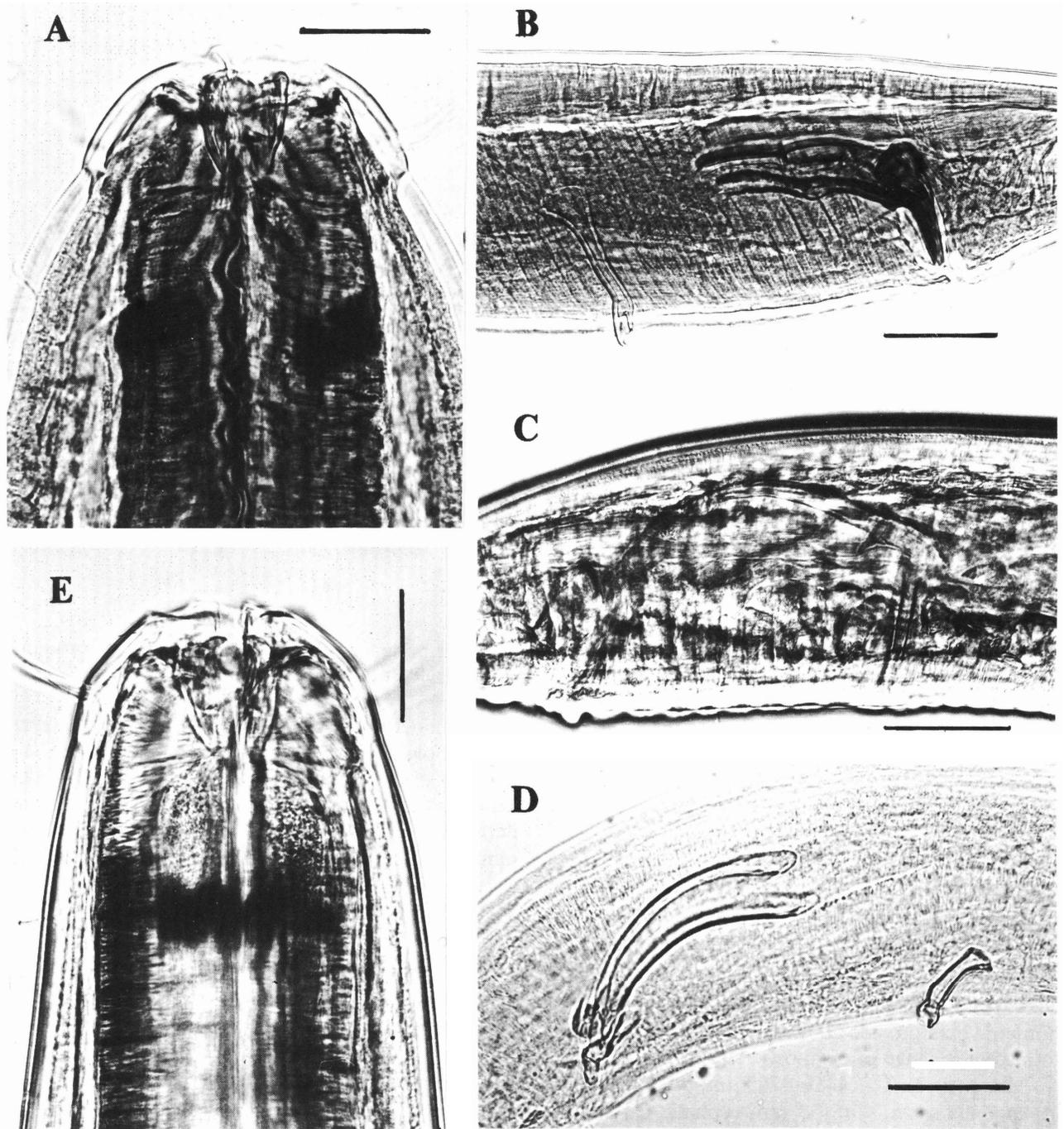
**Locality.** Intertidal zone of the Argyle Lagoon, San Juan Island, Washington, USA, silty sand, collected 25 August 1994.

**Distribution.** Bay of Puget Sound (Wieser, 1959), Argyle Lagoon, San Juan Islands.

### *Enoplus paralittoralis* Wieser, 1953 (Figs. 2A–F & 4D)

**Males** (n=2): L = 4626–4959  $\mu\text{m}$ . Body diameter at: cephalic setae = 41–43  $\mu\text{m}$ , cephalic capsule = 48  $\mu\text{m}$ , at the end of esophagus = 110–115  $\mu\text{m}$ , cloacal 93–100  $\mu\text{m}$ , maximum = 118–145  $\mu\text{m}$ , spicules = 93–100  $\mu\text{m}$ ; t = 138–145  $\mu\text{m}$ ; a = 28.8–30.2, b = 5.4–5.6, c = 20.0–23.5.

**Males.** Cuticle smooth. Six labial papillae; on crown of 10 cephalic setae: six longer setae 15–16  $\mu\text{m}$ , four shorter, 12  $\mu\text{m}$ . Mandibles 16  $\mu\text{m}$  long. The distance from anterior end to small amphid 15  $\mu\text{m}$ .



**Fig. 4.** Light field microphotographs. A-B: *Enoplus kurilensis* sp. n., female cephalic end (A) and male posterior (B); C: *Enoplus velatus* Wieser, 1959, male posterior; D: *Enoplus paralittoralis* Wieser, 1953, male posterior; E: *Enoplus paralpha* sp. n., male cephalic end. Scale bars: A, E = 30  $\mu$ m; B-D = 50  $\mu$ m.

Faint pigmented areas present in the cervical region. Spicules smooth, slightly bent, 93-100  $\mu$ m long (1 anal dia.). Gubernaculum a complex structure, enveloping the distal third of spicules. The precloacal supplement tubular, bent, 35-38  $\mu$ m long, 130-150

$\mu$ m anterior of cloaca. A row of 18, long setae extending from cloacal opening anteriorly to beyond the precloacal supplement. Tail conical, with short and scattered setae on posterior half.

**Locality.** Pacific Ocean, Kurile Islands, Yankicha

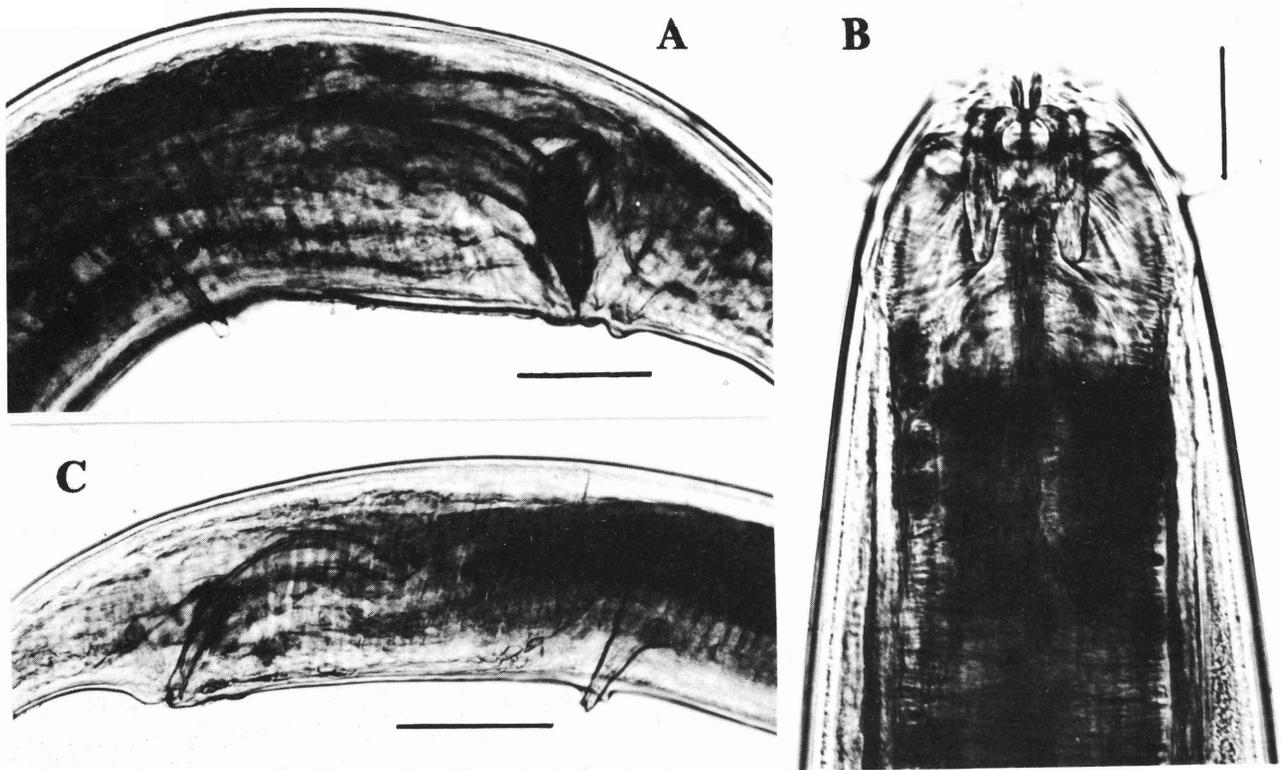


Fig. 5. Light field microphotographs. A: *Enoplus paralpha* sp. n., male posterior; B-C: *Enoplus michaelsoni* (Linstow, 1896) de Man, 1904, male cephalic end (B) and male posterior (C). Scale bars: A, C = 100  $\mu$ m; B = 25  $\mu$ m.

Island, Kraternaya Bight, 1 m depth, sand with gravel, of holdfasts of *Fucus* sp., algae, 25 August 1986.

**Remarks.** The Kuril specimens largely agree with those of the original description (Wieser, 1953), but most closely resemble the Puget Sound specimens described by Wieser (1959) by having shorter setae and shorter tails than the type specimens. However, the Kuril specimens differ from both former descriptions by the shorter spicules (93–100  $\mu$ m vs 143  $\mu$ m); 120  $\mu$ m (Puget Sound) and thinner body [(a = 42–46 vs 28 (types); 37 (Puget Sound)].

**Distribution.** Chile (Wieser, 1953), Kerguelen Islands, Heard Island, Macquarie Islands (Mawson, 1958), Bay of Puget Sound (Wieser, 1959), Isles of Scilly, the Exe estuary (Platt, Warwick, 1983), Kurile Islands.

***Enoplus michaelsoni* (Linstow, 1896) De Man, 1904**  
(Figs. 3A-C & 5B, C)

**Males** (n= 6): L = 5437–5644  $\mu$ m. Body diameter at: cephalic setae = 54–65  $\mu$ m, cephalic capsule = 72–75  $\mu$ m, cloaca = 120–123  $\mu$ m, at the end of esophagus = 148–155  $\mu$ m, maximum = 180–195  $\mu$ m; a = 28.9–30.2, b = 5.5–6.0, c = 22.9–24.7.

**Males.** Six longer cephalic setae 27–30  $\mu$ m, four others only 18–27  $\mu$ m. Mandibles 32–33x14–15  $\mu$ m. Amphids 9  $\mu$ m long, opening 3  $\mu$ m anterior to the posterior edge of the cephalic capsule. Masses of ocellar pigments present 75  $\mu$ m from anterior end. Spicules provided with 6–8 semi-circular plates, 220–247  $\mu$ m long. Gubernaculum with lateral piece with two processes, 83–85  $\mu$ m long. Precloacal supplement trumpet-shaped, 73–75  $\mu$ m, situated 280–288  $\mu$ m anterior of cloaca. A row of 16–18 long bristles (12–38  $\mu$ m) extending from the cloaca to the anterior precloacal supplement. Two pairs of stout setae on the posterior lip of the cloacal opening. Tail long, 220–243  $\mu$ m (1.2–1.9 anal diameters).

**Locality.** Druses of the bivalve *Crenomytilus grayanus*, Vostok Bay, Sea of Japan, collected 16 September 1995.

**Remarks.** Our specimens agree with several published descriptions (Wieser, 1953, Inglis, 1964, Yoshimura, 1980) but have longer spicules: 220–247  $\mu$ m vs 144  $\mu$ m (Inglis, 1964), 182  $\mu$ m (Wieser, 1953), and 172–190  $\mu$ m (Yoshimura, 1980).

**Distribution.** Fuegian Archipelago (Linstow, 1896; de Man, 1904); Falkland Islands (Baylis,

1916); Chile (Wieser, 1953); Mediterranean (Wieser, 1956); Kerguelen Islands, Macquarie Islands (Mawson, 1958); Argentina (Allgen, 1959); South Africa (Inglis, 1964); Tanabe Bay (Yoshimura, 1980).

## DISCUSSION

The geographic distribution of marine nematodes of the genus *Enoplus* in the Pacific Ocean is poorly studied. Species of this genus were not previously collected in regions such as the Kurile Islands and the Sea of Japan (*E. kurilensis* sp. n., *E. paralittoralis* and *E. michaelseni*).

*Enoplus paralittoralis*, collected from the Kurile Islands, is a widely distributed species and has been recorded from the Pacific, Atlantic and Indian Oceans (Wieser, 1959; Platt & Warwick, 1983). Our specimens from the eastern North Pacific region extend the area of distribution of this nematode.

Another species, *E. michaelseni*, has also been recorded from many regions of the Pacific, Indian and Atlantic Oceans (de Man, 1904; Baylis, 1916; Wieser, 1953, 1959; Mawson, 1958). *E. paralittoralis* and *E. michaelseni* appear to be cosmopolitan species (Gerlach & Riemann, 1974).

*Enoplus anisospiculus* Nelson, Hopper & Webster, 1972 was described from specimens collected from the greater Vancouver area of British Columbia (Canada), *E. paralpha* sp. n. and *E. velatus* collected from the San Juan Islands, are the most northern species of the genus recorded from the Pacific region. *E. velatus* was first described from the Bay of Puget Sound, which is an adjacent, but more southern region of the western North Pacific (Wieser, 1959).

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Фадеева Н.П., Юшин В.В. Два новых и три известных вида свободноживущих морских нематод рода *Enoplus* Dujardin, 1845 (Nematoda: Enoplidae) из Северной части Тихого океана.

**Резюме.** Даются иллюстрированные описания для пяти видов нематод из рода *Enoplus* Dujardin, 1845, собранных в прибрежных водах Тихого океана. Новый вид *Enoplus kurilensis* sp. n., а также известный вид *E. paralittoralis* были собраны у Курильских островов, остальные виды (*E. paralpha* sp. n. и *E. velatus*) были собраны у побережья островов Сан-Хуан и в Японском море (*E. michaelseni*).

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