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# Taxonomical Studies of the Japanese Naididae (Annelida, Oligochaeta) 1. Four Unrecorded Species in Small Genera

By

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(With 2 Text-figures)

The family Naididae is one of the most important groups of aquatic oligochaetes mainly found as true benthos and epiphytic forms in freshwater, brackish and marine coastal environments. Although twenty seven naidid oligochaetes have so far been recorded from Japan (Stephenson, 1917; Kawamura, 1918; Yoshizawa, 1928; Kondo, 1936; Yamaguchi, 1938a, 1938b, 1953, 1954, 1973; Sato and Kobayashi, 1961; Ohtaka, 1983), these species represent only a part of the Japanese fauna, found in restricted habitat and localities. Further, the reported species include several dubious ones which need accurate taxonomic studies. In the course of my recent study on the Japanese aquatic oligochaetes, I have gotten a good series of Naididae from various parts of Japan, and these species are treated in this and coming papers in which I intend to describe and revise species occurring in Japan. As the first issue, four species, each belonging to different small genus, are dealt with in the present paper. All the four genera have so far not reported from Japan.

*Material and methods:* Collection of specimens was made by myself with the aid of sieves. Observation was generally made on fresh specimens and on total and sectioned preparations. For total observation, materials were mounted with water and synthetic resin, Bioleit®, Ohken Ltd., Tokyo, or for observation of setae, with Amman's lactophenol (Brinkhurst, 1971). Sectioned specimens were cut in 6-10  $\mu$ m thick and stained with Delafield's haematoxylin and eosin. Although the structure of genital organs is important for the classification of oligochaetes in general, they are relatively simple in structure in Naididae and are of little use for the classification of species. Further, reproductive organs in Naididae rarely appear due to their prosperous asexual reproduction. On the

other hand, the form and distribution of setae are especially useful as taxonomic characters in Naididae because of their high diversity probably reflecting adaptation to various aquatic environments. In the present study, the setal characters were minutely analysed and the following items were examined: 1) the distribution of each sort of setae in each segment; 2) the number of setae per setal bundle; 3) the total length and 4) thickness of each sort of setae; 5) length and 6) thickness of distal teeth; 7) position of nodulus; 8) ornamental characters such as serration, and so on. Setal parts measured were followed Sperber (1948). The present paper includes no new species and only synonymic list and diagnosis are given in the text, with reference to some noticeable points found in the Japanese forms as remarks.

*Abbreviations:* The following abbreviations are used in text and figures: l = body length, w = body width, s = number of segments of single zooid, n = number of segments of first zooid in chain, Roman numeral = segmental number.

*Specaria josinae* (Vejdovsky, 1883)

(Fig. 1A-C)

*Nais josinae* Vejdovsky, 1883. Sitz. ber. Böhm. Ges. Naturw. Prag. 1883: 218.

*Nais josinae* Vejdovsky. Vejdovsky, 1884, p. 29, pl. 2, figs. 25-28, pl. 3, figs. 1-4. Piguët, 1906, p. 229.

*Specaria josinae* (Vejdovsky). Sperber, 1948, p. 95, figs. 9, 26d, pl. 4, pl. 5, fig. 1: 1950, p. 58, fig. 7. Brinkhurst, 1964, p. 205, fig. 2B; 1971, p. 25, fig. 5a. Brinkhurst and Jamieson, 1971, p. 324, fig. 7.3 H-J. Hiltunen and Klemm, 1980, p. 21, fig. 29. Brinkhurst and Kathman, 1983, p. 2310.

*Materials examined:* Uryu-numa moor, Hokkaido (43°42' N, 141°37' E; 850 m altitude of Mt. Shokanbetsu), 4 Aug., 14 Oct. 1983, six sexually immature individuals.

*Diagnosis:* In living, l = 4.0-6.1 mm (single), up to 13.0 mm (chain), w = 0.25-0.36 mm, s = 20-30. Body stout, pinkish in color, naked without pigment. No eyes. Dorsal setal bundle beginning in VI consisting of 3-5 smooth hairs and 3-6 weakly curved bifid needles (Fig. 1A) with nodulus at 1/3 from distal end or more distally, and both upper and lower teeth of equal length, short; the upper one thinner (Fig. 1B). Ventral setae 6-10 per bundle, of a sort of bifurcated crotchets (Fig. 1C) with nodulus distally and the upper tooth a little longer and as thick as the lower one. Coelomocytes scattered. Nephridia from VIII. Stomachal dilatation gradual. No swimming.

*Measurements:* Measurements of setae (N = 3): hairs 216-272  $\mu$ m long, 1.5-2.0  $\mu$ m thick in maximum; needles 90-104  $\mu$ m long, 2.7-3.4  $\mu$ m thick, both upper and lower teeth 2.2-2.5  $\mu$ m long; ventral setae 98-110  $\mu$ m long, 3.1-3.3  $\mu$ m thick, the upper tooth 4.6-5.1  $\mu$ m long and the lower one 3.5-4.1  $\mu$ m long.

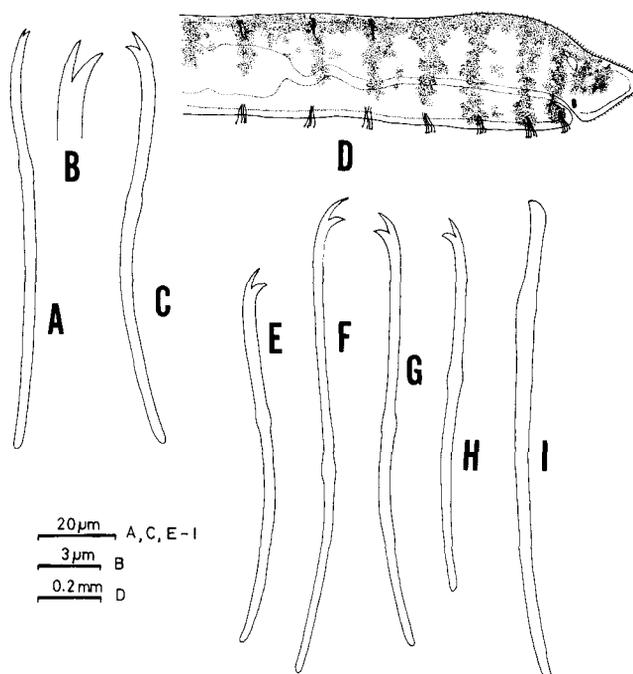


Fig. 1. *Specaria josinae* and *Uncinais uncinata*. A-C, *Specaria josinae*: A, dorsal seta in VII; B, same, distal end; C, ventral seta in IX. D-I, *Uncinais uncinata*: D, outline and pigmentation of the anterior part of body; E, dorsal seta in VI; F, ventral seta in II; G, same in IV; H, same in XII; I, penial seta.

*Remarks*: Dorsal needles have almost the same length and thickness as ventral crotchets. Each type of setae is fairly constant in size in all segments. Piguët (1906) gave setal measurements for specimens from Talent (Switzerland) as follows: hairs 154-171  $\mu\text{m}$  long, needles 77-82  $\mu\text{m}$  long and ventral setae 75-86  $\mu\text{m}$  long; while Sperber (1948) gave for Swedish specimens as: hairs 135-180  $\mu\text{m}$  long, needles 72-85  $\mu\text{m}$  long and ventral setae 69-88  $\mu\text{m}$  long. These values are somewhat shorter than my measurements for Japanese specimens especially in hair setae. Specimens were collected together with another naidid *Vejdovskyella comata* among benthic algae and roots of aquatic plants at some pools in the locality cited above. This species is Holarctic.

*Uncinais uncinata* (Ørsted, 1842)

(Fig. 1D-I)

*Nais uncinata* Ørsted, 1842. Naturhist. Tidsskr. Kjøbenhavn, 4: 136.

*Paranaïs uncinata* (Ørsted). Michaelsen, 1900, p. 19. Piguët, 1906, p. 194, pl. 9, figs. 1-7;

1909, p. 173, pl. 3, fig. 1.

*Uncinaiis uncinata* (Ørsted). Sperber, 1948, p. 98, fig. 26G, pl. 5, figs. 2-4; 1950, p. 58, fig. 8.  
Cain, 1959, p. 193, fig. 1. Brinkhurst, 1964, p. 205, fig. 2C; 1971, p. 18, fig. 2f.  
Brinkhurst and Jamieson, 1971, p. 325, fig. 7.4 A.

*Materials examined*: Sapporo, Hokkaido (42°53'N, 141°15'E; lake Mamisunuma at 1016 m altitude of Mt. Soranumadake), 8 Aug. 1982, 2 July 1983, 15 individuals containing six sexually mature ones.

*Diagnosis*:  $l = 5.5-11.3$  mm,  $w = 0.32-0.45$  mm (living, single zooid),  $s = 25-40$ . Body pinkish in color, stout, tapering backwards. First several segments with reddish brown pigments. Prostomium short, conical, pointed in fixed state. Dorsal setal bundle beginning in VI (rarely V) consisting of 2-6 bifurcated crotchets (Fig. 1E) with distal nodulus and with the upper tooth longer and thinner than the lower. Ventral setae 3-7 per bundle, similar in shape to dorsal ones with distal tooth longer and slightly thinner than the lower; those in II (Fig. 1F) longest; those in III-V (Fig. 1G) longer than the following ones (Fig. 1H). Nodulus of ventral setae gradually shifted from proximal to distal in II-V. Clitellum in V-VIII. Spermatheca and atrium small. Spermathecal ampulla ovoid and spermathecal duct long, well defined. Atrium roundish and ejaculatory duct well defined. 2-3 simple hooked penial setae (Fig. 1-I) in VI. Coelomocytes scattered. Nephridia from VII. Stomachal dilatation sudden in VIII. Swims with spiral movement.

*Measurements*: Eyes rectangular in shape, measured  $35 \mu\text{m}$  by  $10 \mu\text{m}$ , situated close to mouth longitudinally. Sensory hairs long, up to  $12 \mu\text{m}$  dense anteriorly. Setal measurements ( $N = 4$ ): dorsal setae  $70-92 \mu\text{m}$  long,  $2.7-3.3 \mu\text{m}$  thick, the upper tooth  $4.5-5.3 \mu\text{m}$  long and the lower one  $3.4-4.1 \mu\text{m}$  long; ventral setae in II  $116-126 \mu\text{m}$  long,  $2.9-3.1 \mu\text{m}$  thick, the upper tooth  $6.2-6.5 \mu\text{m}$  long and the lower one  $4.0-4.2 \mu\text{m}$  long; those in III-V  $96-110 \mu\text{m}$  long,  $3.0-3.3 \mu\text{m}$  thick, the upper tooth  $6.1-6.5 \mu\text{m}$  long and the lower one  $3.8-4.2 \mu\text{m}$  long; those in the following segments  $80-96 \mu\text{m}$  long,  $2.9-3.3 \mu\text{m}$  thick, the upper tooth  $4.9-5.7 \mu\text{m}$  long and the lower one  $3.5-4.1 \mu\text{m}$  long; penial setae  $110-120 \mu\text{m}$  long,  $3.5-4.5 \mu\text{m}$  thick. Sexual organs in mature specimens collected in August 1983: clitellum  $26-34 \mu\text{m}$  thick; spermathecal ampulla  $55 \mu\text{m}$  in maximum diameter with the wall  $5-9 \mu\text{m}$  thick; spermathecal duct  $50-55 \mu\text{m}$  long, opening just behind septum 4/5; atrium  $40 \mu\text{m}$  in diameter with the wall  $6-8 \mu\text{m}$  thick; peritoneal covering of the atrium  $0.7-1.5 \mu\text{m}$  thick; ejaculatory duct  $20 \mu\text{m}$  long, opening at the middle of VI.

*Remarks*: According to Cain (1959), this species from England have up to seven bands of brown pigments on the dorsal surface of the first few segments. On the other hand, the present specimens have up to ten bands, which are arranged around the middle part of respective segments (Fig. 1D) and are large in

anterior three segments, extending to ventral setal bundle; they gradually become smaller and inconspicuous posteriorly. Dorsal setal bundle usually begin in VI, but in one specimen, it begins in V. In this individual, dorsal setae in V are identical with those behind VI in number, length and shape. Such unusual condition has not been reported in the present species, but reported in a congener, *Uncinatis minor*, by Sokolskaya in 1962 (Brinkhurst and Jamieson, 1971). Each value of my setal measurements is not different from that of European and North American forms (Piguet, 1906; Sperber, 1948; Brinkhurst, 1964). This species is Holarctic.

*Vejdovskyaella comata* (Vejdovsky, 1883)

(Fig. 2A-G)

*Bohemilla comata* Vejdovsky, 1883. Sitz. ber. Böhm. Ges. Naturw. Prag. 1883: 218.

*Bohemilla comata* Vejdovsky. Vejdovsky, 1884, p. 28, pl. 2, figs. 1-7. Michaelsen, 1900, p. 30.

*Vejdovskyaella comata* (Vejdovsky). Sperber, 1948, p. 137, figs. 15C-F, 26C; 1950, p. 65, fig. 17C-F, pl. 2, fig. 3. Brinkhurst, 1964, p. 210, fig. 3D; 1971, p. 23, fig. 4e. Brinkhurst and Jamieson, 1971, p. 347, fig. 7.10A-E (in part). Hiltunen and Klemm, 1980, p. 25. Brinkhurst and Kathman, 1983, p. 2309, fig. 2.

*Materials examined*: Wakkasakanai, Hokkaido (45°05'N, 141°39'E; small pond), 29 Oct. 1984, thirty individuals; Uryu-numa moor, Hokkaido (43°42'N, 141°37'E; 850 m altitude of Mt. Shokanbetsu), 4 Aug., 18 Oct. 1983, 17 June 1984, ten individuals; all sexually immature.

*Diagnosis*: In living,  $l=2.3-3.6$  mm (single), up to 5.1 mm (chain),  $w=0.10-0.25$  mm,  $s=19-34$ ,  $n=18-22$ . Body surface with adhering foreign matters. Prostomium blunt. Eyes present, comma-shaped. Dorsal setal bundle beginning in VI consisting of 3-6 stout, serrated hairs (Fig. 2B, C) and 3-8 simple pointed needles (Fig. 2D) without nodulus, both tapering proximally. Ventral setae less curved, all bifurcated crotchets with proximal nodulus, and the upper tooth a little longer and thinner than the lower one; those in II (Fig. 2E) 2-3 per bundle, longest; those in IV (Fig. 2F) 1-2 per bundle, smaller than the rest; those in V wholly absent; those in from VI on (Fig. 2G) 2-4 per bundle, slightly thicker than those in the forward segments. Stomachal dilatation in VIII. Nephridia from VIII. No swimming.

*Measurements*: Setal measurements (two specimens from Uryu-muma moor): hairs 200-416  $\mu\text{m}$  long, 3.3-4.9  $\mu\text{m}$  thick in maximum; needles 76-100  $\mu\text{m}$  long, 2.3-3.3  $\mu\text{m}$  thick in maximum; ventral setae in II 98-104  $\mu\text{m}$  long, 2.3-2.6  $\mu\text{m}$  thick, the upper tooth 5.5-5.6  $\mu\text{m}$  long and the lower one 4.8-5.0  $\mu\text{m}$  long; those in III 86-90  $\mu\text{m}$  long, 2.3-2.6  $\mu\text{m}$  thick, the upper tooth 5.1-5.4  $\mu\text{m}$  long and the lower one 4.8-5.0  $\mu\text{m}$  long; those in IV 76-80  $\mu\text{m}$  long, 1.9-2.1  $\mu\text{m}$  thick, the

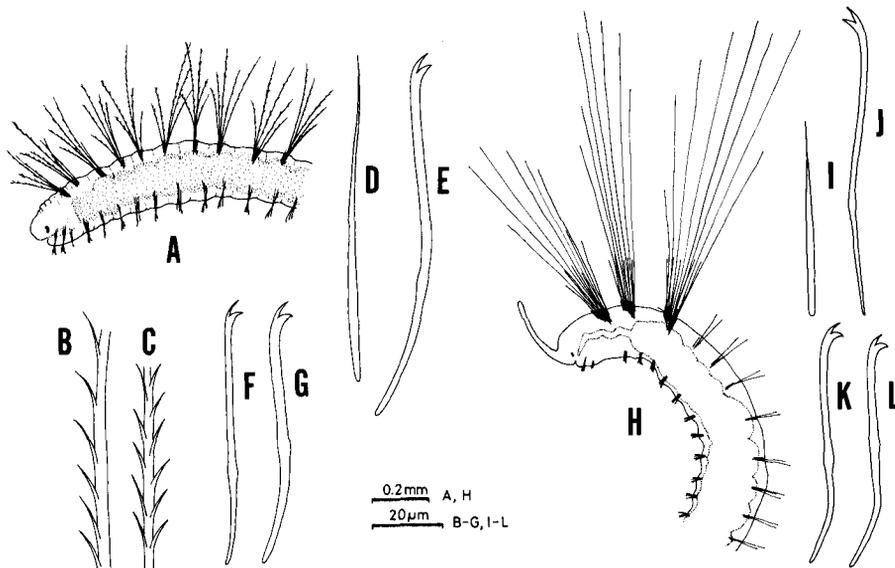


Fig. 2. *Vejdovskyella comata* and *Ripistes parasita*. A-G, *Vejdovskyella comata*: A, anterior parts of body; B, hair seta in lateral view; C, same in front view; D, needle seta in VI; E, ventral seta in II; F, same in IV; G, same in VI. H-L, *Ripistes parasita*: H, anterior part of body; I, needle seta in XII; J, ventral seta in II; K, same in III; L, same in VI.

upper tooth 4.6–4.9  $\mu\text{m}$  long and the lower one 4.0–4.3  $\mu\text{m}$  long; those in the following segments 68–82  $\mu\text{m}$  long, 2.9–3.3  $\mu\text{m}$  thick, the upper tooth 5.3–6.4  $\mu\text{m}$  long and the lower one 5.3–5.7  $\mu\text{m}$  long. Serrations of hairs 8–18  $\mu\text{m}$  long, 8–25  $\mu\text{m}$  of intervals, becoming wider distally.

*Remarks:* Serrations of hairs are restricted on the convex side, absent on proximal part. Arrangement of serrations is not so regular, usually in two rows alternately, but it was often disordered. These serrations are weakly recurved (Fig. 2B, C), but they are often curled back as figured by Brinkhurst and Kathman (1983, Fig. 2, left figure) when observed by SEM after drying. All the specimens examined lacked ventral setae in V and giant ventral setae in any segment. I have never observed hair setae with cleft tip which Hiltunen (Brinkhurst, 1978) and Brinkhurst and Kathman (1983) described. The present species has been known from Europe and North America.

***Ripistes parasita*** (Schmidt, 1847)

(Fig. 2H-L)

- Stylaria parasita* Schmidt, 1847. Froriep's Notizen der Heilkunde. Weimar (3) 3: 320.  
*Ripistes parasita* (Schmidt). Michaelsen, 1900, p. 31. Sperber, 1948, p. 143, fig. 15H-K, 16, 26A, pl. 9, figs. 4-7; 1950, p. 68, fig. 17H-K, pl. 2, fig. 4. Brinkhurst, 1971, p. 23, fig. 4g. Brinkhurst and Jamieson, 1971, p. 351, fig. 7.10L-N. Hiltunen and Klemm, 1980, p. 19.  
*Ripistes rubra* Lastockin. Yamaguchi, 1940, p. 384, figs. 3-4.

*Materials examined*: Pon-numa, Hokkaido (45°10'N, 142°17'E), 28 Oct. 1984, one individual; Wakkasakanai, Hokkaido (45°05'N, 141°39'E; small pond), 29 Oct. 1984, two individuals; Sapporo, Hokkaido (42°59'N, 141°23'E; Nishioka reservoir), 26 July 1980, 6 Aug. 1983, five individuals; Lake Konuma, Oshima district, Hokkaido (41°58'N, 140°40'E), 25 Aug. 1983, eight individuals; Nagaoka, Niigata prefecture (37°26'N, 138°53'E), 4 Nov. 1980, two individuals; Lake Ono, Gunma prefecture (36°33'N, 139°11'E; Mt. Akagi), 11 Nov. 1980, one individual; all sexually immature.

*Diagnosis*: In living, l = 2.3-4.0 mm (single), up to 5.7 mm (chain), w = 0.13-0.30 mm, s = 18-28, n = 19-21. Eyes present. Body surface of I-VIII yellowish brown pigmented. Prostomium forming a proboscis. Dorsal setal bundle beginning in VI consisting of smooth hairs and simple pointed needles without nodulus. In VI-VIII those composed of 3-16 giant hairs, 2-5 short hairs and 7-15 needles; in the following segments, 2-3 normal hairs and 1-3 needles (Fig. 2I). Ventral setae all bifurcated crotchets, absent in IV and V; those in II (Fig. 2J) 3-5 per bundle, longest, thinner than the rest with proximal nodulus and the upper tooth longer, as thick as the lower; those in III (Fig. 2K) 3-5 per bundle, a little longer than those in the following segments with proximal nodulus and both teeth almost same in length but the upper one thinner; those in from VI on (Fig. 2L) 2-6 per bundle with median to distal nodulus and the upper tooth as long as or slightly shorter and much thinner than the lower. Ventral setae in from III on with a proximal bent at the middle between nodulus and proximal end. Stomachal dilatation sudden in VII. Dorsal vessel situated mid dorsally. Swims vigorously with sagittal movement.

*Measurements*: Proboscis 140-280  $\mu\text{m}$  long, nearly as long as width of middle segments. Setal measurements (eight specimens collected from Sapporo, L. Konuma, Nagaoka and L. Ono combined): giant hairs in VI-VIII 760-1360  $\mu\text{m}$  long, 2.3-2.9  $\mu\text{m}$  thick in maximum; short hairs in the same segments 200-536  $\mu\text{m}$  long, 2.5-2.9  $\mu\text{m}$  thick in maximum; normal hairs in from IX on 110-140  $\mu\text{m}$  long, 2.5-2.7  $\mu\text{m}$  thick in maximum; needles in VI-VIII 56-102  $\mu\text{m}$  long, 0.9-1.3  $\mu\text{m}$  thick; same in the following segments 36-60  $\mu\text{m}$  long, 1.6-1.9  $\mu\text{m}$  thick;

ventral setae in II 82-98  $\mu\text{m}$  long, 1.6-2.5  $\mu\text{m}$  thick, the upper tooth 4.9-5.7  $\mu\text{m}$  long and the lower one 3.7-4.1  $\mu\text{m}$  long; those in III 70-84  $\mu\text{m}$  long, 2.0-2.5  $\mu\text{m}$  thick, the upper tooth 4.5-4.9  $\mu\text{m}$  long and the lower one 4.1-4.9  $\mu\text{m}$  long; those in from VI on 60-76  $\mu\text{m}$  long, 2.3-2.6  $\mu\text{m}$  thick, the upper tooth 3.4-4.5  $\mu\text{m}$  long and the lower one 3.4-4.9  $\mu\text{m}$  long.

*Remarks:* Yamaguchi (1940) reported *Ripistes rubra* from north eastern China. However, his *R. rubra* seems to be a junior synonym of *R. parasita* as already pointed out by Sperber (1948). In Yamaguchi's description, hairs in VI-VIII are 11-15 per bundle, up to 1,200  $\mu\text{m}$  long; needles of the same segments are 8-16 per bundle; in the following segments, giant hairs are 1-2 per bundle, 140  $\mu\text{m}$  long and needles are 1-2 per bundle; ventral setae in II are 100  $\mu\text{m}$  long and those in from VI on are 80  $\mu\text{m}$  long. These values are consistent with the measurements of the present materials. Further, other characters of Yamaguchi's *R. rubra* such as body length and distal shape of ventral setae are also identical with the present species. A considerable variation is found in length of giant hairs in VI-VIII even among a single setal bundle. This is caused by the tendency that hairs in both sides of a setal bundle are shorter than those in middle part (Fig. 2H) as Yamaguchi (1940) noted. The present species seems to be Palaearctic, so far known from Europe and Asia.

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#### References

- Brinkhurst, R.O. 1964. Studies on North American aquatic Oligochaeta I: Naididae and Opisthocyttidae. Proc. Acad. Nat. Sci. Philadelphia **116**: 195-230.
- 1971. A guide for the identification of British aquatic Oligochaeta. Sci. Publ. Freshwater Biol. Assoc. **22**: 1-55.
- 1978. Freshwater Oligochaeta in Canada. Can. J. Zool. **56**: 2166-2175.
- and B.G.M. Jamieson 1971. Aquatic Oligochaeta of the World. Oliver & Boyd, Edinburgh. 860 pp.
- and R.D. Kathman 1983. A contribution to the taxonomy of the Naididae (Oligochaeta) of North America. Can. J. Zool. **61**: 2307-2312.
- Cain, A.J. 1959. Oligochaeta new to Britain. Ann. Mag. nat. Hist. Ser. 13, **2**: 193-198.
- Hiltunen, J.K. and D.J. Klemm 1980. A guide to the Naididae (Annelida: Clitella: Oligochaeta) of North America. United States Environmental Protection Agency Research Reports, Environmental Monitoring Series 600/4-80-031. 48 pp.
- Kawamura, T. 1918. The Freshwater Biology of Japan. Vol. 1. Shôkabo, Tokyo. 362 pp. (in Japanese)

- Kondo, M. 1936. A list of naidiform Oligochaeta from the waterworks plant of the City of Osaka. *Annot. Zool. Japon.* **15**: 382-393.
- Michaelsen, W. 1900. Oligochaeta. *Das Tierreich*, 10. Berlin. 575 pp.
- Ohtaka, A. 1983. Four naidiform oligochaetes from Lake Otawa-ike, Sado Island. *Bull. Niigata Pref. Biol. Soc. Education* **18**: 57-62. (in Japanese)
- Piguet, E. 1906. Observations sur les Naïdées et revision systématique de quelques espèces de cette famille. *Revue suisse Zool.* **14**: 185-315.
- 1909. Nouvelles observations sur les Naïdées. *Ibid.* **17**: 171-217.
- Sato, R. and N. Kobayashi 1961. On Naididae from southern Hokkaido. *Seibutsu-kyozai no Kaitaku* **1**: 39-44. (in Japanese)
- Sperber, C. 1948. A taxonomical study of the Naididae. *Zool. Bidr. Uppsala* **28**: 1-296.
- 1950. A guide for the determination of European Naididae. *Ibid.* **29**: 45-78.
- Stephenson, J. 1917. Zoological results of a tour in the Far East. Aquatic Oligochaeta from Japan and China. *Mem. Asiat. Soc. Beng.* **6**: 85-99.
- Vejdovsky, F. 1884. System und Morphologie der Oligochaeten. Prag. 166 pp.
- Yamaguchi, H. 1938a. On aquatic Oligochaeta in Japan. II. *Shokubutsu oyobi Dôbutsu* **6**: 1056-1061. (in Japanese)
- 1938b. Studies on the aquatic Oligochaeta of Japan. V. The description of a new variety of *Branchiodrilus hortensis* (Stephenson). *Annot. Zool. Japon.* **17**: 530-535.
- 1940. Oligochaeta of Manchoukuo. In: Report of the Limnobiological Survey of Kwantung and Manchoukuo. pp. 382-394. Kwantung Government. (in Japanese).
- 1953. Studies on the aquatic Oligochaeta of Japan. VI. A systematic report, with some remarks on the classification and phylogeny of the Oligochaeta. *Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool.* **11**: 277-342.
- 1954. A catalogue of the aquatic Oligochaeta in Japan. *Jour. Hokkaido Gakugei Univ. (Sec. B)* **5**(1): 93-120. (in Japanese)
- 1973. Oligochaeta. In: *Freshwater Biology of Japan* (M. Uéno ed.), Hokuryukan, Tokyo. pp. 346-355. (in Japanese)
- Yoshizawa, H. 1928. On the aquatic Oligochaeta, *Stylaria lacustris* L. *Sci. Rep. Tôhoku Imp. Univ.* **4 Ser. 3**: 587-613.
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