An Annotated Bibliography of the Order Temnocephalida (Plathelminthes, Rhabdocoela, “Turbellaria”) from Japan, Taiwan, China and Korea, with Other Far Eastern Records of Temnocephalids

By

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Introduction

Two well known groups of symbiotic worms are found either in the branchial chambers, or on the surface of freshwater shrimps and crayfishes: one is in the Phylum Plathelminthes Schneider, 1873 (or Platyhelminthes Claus, 1887) (see Ehlers & Soppot-Ehlers, 1995), Subphylum Rhabdocoela von Graff, 1904, Class “Turbellaria,” Order Temnocephalida Bresslau & Reisinger, 1933, and the other one is in the Phylum Annelida, Subphylum Clitellata, Order Branchiobdellidae Holt, 1965.

Gelder (1999) pointed out that the Branchiobdellida, commonly known as crayfish worm, has an endemic distribution only across the northern continents (i.e., North America including Mexico, Europe and the Far East) while the Temnocephalida is restricted to mainly the southern continents (i.e., Australia, New Zealand, New Guinea, Indonesia, South and Central America, Madagascar; except South Africa where alien species were recently introduced) (cf. Williams, 1981; for old records, see von Ihering, 1891; Baer, 1931).

This web article is affectionately dedicated to the late Dr. Robert E. Ogren, Professor Emeritus, Wilkes University. He was 83 years old, born February 9, 1922 in Jamestown, N.Y., and passed away on July 13, 2005 while vacationing in New York State, U.S.A.

Dr. Ogren was recognized as an eminent specialist on land planarians. He was the leader of the annual joint publications entitled “Indices for Land Planarians of the World” (Kawakatsu et al., 1987 to 2005; it is continued to the present) for 18 years. We will long remember the scientific life and work of Dr. Robert E. Ogren.
A critical comparison of the speciation and geographical distribution of the Branchiobdellida and Temnocephalida is urgently needed. For details of the world-wide distribution of the Branchiobdellida and Temnocephalida, see Gelder, 1999 (op. cit., p. 23, fig. 1) and Ohtaka (2004, p.3, fig. 3, modified from the former) (see also Banarescu, 1990).

A review of the taxonomy together with phylogenetic analyses of branchiobdellidans in the Far East is currently one of the main projects of Gelder-&-Ohtaka team. However, the present level of taxonomic information on the Temnocephalida in Japan, Taiwan and China is insufficient to understand the taxon’s relationship. During the past 85 years or so, we can find only a few English papers on the taxonomy of this group in the region (Lee, 1936, Honjō, 1937; Oki, Tamura, Takai & Kawakatsu, 1993; Matjašič, 1990). Very recently, we had a record of temnocephalid occurring in Korea.

The present bibliographic study of the Far Eastern Temnocephalida was mainly constructed by Kawakatsu in conjunction with the other authors. This is the first step of an ongoing, cooperative taxonomic review and study of the temnocephalids in Japan and neighbouring countries. More than 50 articles included in this annotation were written only in Japanese. The photographs and figures taken from some of the listed papers are reproduced in this web article.

It must be emphasized that the list of species shown in the present web article is the result of the bibliographic study. The author’s aim is for this publication serve the starting point for the future taxonomic study of the Temnocephalida in the Far East. Our recent accumulation of preserved temnocephalid specimens from the various areas of Japan will be sent to and be studied by Ponce de León and Volonterio at the Invertebrate Zoology Laboratory, Faculty of Sciences, Iguá, Montevideo, Uruguay, in near future.

This web article contains: I. Annotated bibliography; II. The previous records of Temnocephalida species from Japan, Taiwan, Southern China and South Korea (with 2 appendices); and III. References for Temnocephalida and Branchiobdellida taxonomy and taxa.

I. Annotated Bibliography

Abbreviations for figure citation: DB, dorsal view of the body; VB, ventral view of the body.

1) An Annotated Bibliography of Japanese Temnocephalida


The three family classification of the Temnocephalida was employed: Temnocephalidae, Actinodactyliidae and Scutariellidae (n. fam.). Cardincola indica (n. g. et n. sp.) was described. This SE Asiatic species is now classified as Scutariella indica (Annandale,
1912). Although this species is not distributed in Japan, the name of "C. indica" is erroneously mentioned in many taxonomic articles listed in this section.


In the paragraph ‘Temnocephaloidea’ (on p. 131), Dr. Annandale wrote: “The existence of a primitive member of this group in Lake Biwa is interesting. It belongs to the genus Caridinicola, and occurs in abundance in the gill-chamber of prawns of the genera Caridina and Parata. Caridina appears to be a connecting link between the Temnocephaloidea and the true Trematodes. If it is really distinct from the imperfectly known European Scutariella of Mrazek, it has been found hitherto only in India, China and Japan, always associated with prawns of the family Atydae.”


The order ‘Temnocephalidea’ was separated into 2 new suborders: Scutariellida and Temnocephala. “Caridinicola indica” from Japan (=Scutariella japonica) is mentioned according to articles by Honjô (1937) and Kobayashi (1935).


A complete and useful article on the Classe Temnocéphales published in the 1960’s. “Scutariella indica” (=S. japonica) from Japan is mentioned. A schematic figure of “S. indica” by Honjô (1937) is cited (on p. 221, fig. 118). For this figure, see Kawakatsu, Murayama, Nishino & Ohtaka (1999, pp. 88-89: III. A Correction of Honjô’s (1939) Anatomical Figure of Scutariella japonica (Matjašič, 1990) (Temnocephalida, fig. 7; see also fig. 8).


This is the most important and comprehensive review of the ectosymbiotic worms on freshwater crustaceans of the world. In the section of ‘Zoogeography of temnocephalidans’ (on pp. 23-25), the appropriate and useful comments were given for various taxa and local fauna of this animal group in the world by means of the extensive literature investigations. The section ‘Zoogeography of branchiobdellidans’ is given on pages 22-23.

The world-wide distributions of branchiobdellidian annelids and temnocephalidan platyhelminthes (p. 23, fig. 1) are extremely useful for the taxonomic and phylogenetic consideration of these animal groups. See Ohtaka (2004, fig. 3 on p. 3).

‘Scutariella japonicus’ (Matjašić, 1990) is mentioned on page 641. The specific name “japonicus” is a lapsus calami; ‘japonica’ is correct.


The samples used were collected from Lake Biwa-ko and the host had been identified by the original author as “*Xiphocaridina compressa*” (=*Paratya compressa compressa* (De Haan, 1844)). For his plate figure of “*Cardinicola indica*” (=*Scutallia japonica*), see Kawakatsu, Murayama, Nishino & Ohtaka (1999).


Japanese records of “*Cardinicola indica*” (=*Scutallia japonica*) were cited from the previous papers: Annandale (1912), Kemp (1917), Kobayashi (1935), Negishi (1935), Umemoto (1936), and Yanada (1955).

Dr. Kamita found “*Cardinicola indica*” (=*Scutallia japonica*) from the bottles of his preserved freshwater shrimp collection. Their localities are labeled as from Miyagi, Fukushima and Yamaguchi Prefectures, Honshū.


“*Cardinicola indica* Annandale” was shown on fig. 594 (p. 669). This species should be *Scutallia japonica* (Matjašić, 1990). For attached schematic figure of the worm, see Kawakatsu (1999: 88, fig. 7).


This species is *Scutariella japonica* (Matjašić, 1990).


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Part II of this publication is as follows. Revision of Tricladid described and illustrated in Encyclopedia of the Fauna of Japan (pp. 35-40 + a folder). (In English and Japanese.) Temnocephalida — "Caridincola" is found in 'New Illustrated Encyclopedia of the Fauna of Japan,' Part I. P. 40, table 1. Cf. Katō (1965).


"Temnocephala indica (Annandale, 1912)" (=Scutariella japonica) from Japan is mentioned.


Temnocephalida is found in the table (pp. 34-35).

A short note on the temnocephalid species recorded in Japan is given: *Scutariella indica* (Annandale, 1912) (=*Scutariella japonica*) from Honshū; *Temnocephala* spp. from Tanegashima Island and Iriomote-jima Island.


In the Order Temnocephalida, 2 families, a subfamily and 3 species recorded from Japan were listed. Their new Japanese names were also given except for *Scutariella japonica*. New Romanized Japanese names were shown in brackets as follows: Scutariellidae [Yadori-futatsuno-mushi Ka]; Scutariellinae [Yadori-futatsuno-mushi Aka]; *Scutariella japonica* (Matjašič, 1990) (Ebi-yadori-tsunomushi); Temnocephalidae [Yadori-itsutsuno-mushi Ka]; “*Temnocephala semperi* Weber, 1889” [Kani-yadori-tsunomushi]; “*Temnocephala minor* Haswell, 1887” [Australia-zarigani-yadori-tsunomushi]. For English explanation of Japanese names, see Grygier (1993). For the correct scientific names of *T. semperi* and *T. minor*, see the Section II of the present publication.


Part II of this publication is as follows: The scientific name of the Japanese temnocephalid species was erroneously known as “*Caridinicola indica* Annandale, 1912” (pp. 72-74 + pl. I). The correct scientific name of the Japanese temnocephalid species is as the following:

*Scutariella japonica* (Matjašič, 1990).

*nec Scutariella indica* (Annandale, 1912) (olim *Cardinicola indica*); *nec Paracardinicola indicus* (Plate, 1914) (olim *Cardinicola indica* in Plate, 1914).

Synonymy

*Caridinicola sinica* Matjašič, 1990. Loc.: Gūangxī (=Kuanghsi, Kwangtī), Autonomous Region, China (ca. 300km NW of Hong Kong). Host: *Caridina* sp.

Reproduction of reduced page copies (pp. 70-73) of Matjašič’s (1990) Monograph of the Scutariellidae was added as Plate I (p. 74).

Kawakatsu, M., Murayama, H., Nishino, M. & Ohtaka, A., 1999. Miscellaneous records of Turbellarians mainly from Kawakatsu’s Collection. I: A freshwater planarian from the cave “Ngalau Surat” in Sumatra, Indonesia; II: Freshwater planarians from caves and epigean waters in China; III: A correction of Honjō’s (1937) anatomical figure of *Scutariella japonica* (Matjašič, 1990) (Temnocephalida); IV: Two neohabdocoelid

The late Dr. I. Honjô wrote to Kawakatsu (dated Sept. 2, 1966, in litt.) that “...According to Dr. Katô (1943), my plate figure of “Cartidincola indica” may contain some errors. Those were corrected in Dr. Katô’s figure published in 1943 (p. 669, fig. 594).”

Section III (pp. 88-89) of a paper by Kawakatsu, Murayam, Nishino & Ohtaka (1999) contains two reproduced schematic figures showing the anatomical structure of Scutariella japonica (fig. 7 left and right on p. 88). Ovary and terminal organ in Honjô’s figure are corrected in Katô’s figure.

A photograph of a live specimen of Scutariella japonica is also shown (p. 89, fig. 8) (host: Paratyia compressa improvisa; loc. Chiba Pref., Kantô Region, Honshû).


The related publication on temnocephalids is listed. Reproduction of the schematic figure of “Scutariella indica,” (= S. japonica) (after Honjô, 1937) is shown (on p. 99, pl. II, fig. P). New abbreviations were employed (see p. 97).


The related publication on temnocephalids is listed. “Scutariella indica (Annandale, 1912)” is listed in ‘A List of Turbellarian Species Recorded from Lake Biwa-ko’ (compiled by Kawakatsu & Nishino) (on p. 97).


A brief explanation of the Temnocephalida was given on page 55. Two (or 3?) Japanese species were also mentioned. “Scutariella indica” (= S. japonica) from Honshû and Temnocephala sp. (spp.?) from Tanegashima Island and Iriomote-jima Island, the Southwest Islands of Japan. See Suzuki, Ninagawa & Kawakatsu (1983).

Taxonomic status of "Scutariella indica" (Annandale, 1912) and Paracaridinicola indicus (Plate, 1914) were clarified bibliographically. Later, it became clear that two species are erroneously included under the name of "S. indica": Scutariella indica (Annandale, 1912) and Scutariella japonica (Matjašić, 1990). Cf. Kawakatsu (1998: 72-74, pl. 1); Kawakatsu, Murayama, Nishino & Ohtaka (1999: 88-99, figs. 7 and 8).


Photograph of an Australian crayfish, Cherax tenuimanus (Smith, 1912), photomicrographs of "Temnocephala minor Haswell, 1887" (on the first cover page), chromosomes (fig. 2 left on p. 3) and idiogram (fig. 3 top on p. 3) are shown. Cf. Oki, Tamura, Takai & Kawakatsu (1995).


Three temnocephalid species recorded from Japan are tentatively listed with their localities, hosts and geographical distribution. They are: Scutariella japonica (Matjašić, 1990); "Temnocephala minor Haswell, 1887"; and "Temnocephala semperi Weber, 1889." T. minor is a symbiont of a crayfish introduced from Western Australia. The taxonomy of T. semperi found in Japan is not yet determined.


A short description of Temnocephaloidea is given with a brief figure of "Caridinicola indica" (p. 163, fig. 246).


Kemp (1917), who examined samples of Paratya compressa (De Iaan, 1844) collected by the late Dr. Annandale in Japan and Korea, wrote as follows (on p. 299):

"Dr. Annandale noted that the species was abundant among weeds or dense vegetation at Komatsu and in pools and back-water round Lake Biwa; in the lake itself it was much scarcer." .... "The Temnocephaloid worm Caridinicola was present in the gill-chamber of a large proportion of the individuals examined at Komatsu".

Although Kemp (loc. cit.) did not use the name of "Caridinicola indica" for Japanese species, Kawamura (1918) concluded the Lake Biwa worm as "Caridinicola indica" (i.e., Scutariella japonica). See Kawamura (1918); Kawakatsu, Nunomura & Suzuki (1989); Kawakatsu (1998b); Kawakatsu, Murayama, Nishino & Ohtaka (1999).

In the section of Cardina denticulata (de Haan) (= Neocaridina denticulata), Kemp (1918: 289) wrote as follows:

"The parasitic Temnocephalid, Caridinicola, was very abundant on the Chinese specimens." .... "The Japanese specimens were obtained at Hikone on the eastern shores of Lake Biwa and in ditches at the edge of the Seta River at its exit from the lake." .......

In the section of Paratya compressa (de Haan) (= P. c. compressa), Kemp (loc. cit.: 293) also wrote as follows: ... "The Temnocephaloid worm Caridinicola was present in the gill chambers of a large proportion of the individuals examined at Komatsu."


A brief description of "Caridinicola indica" (= Scutariella japonica) collected from a common shrimp ("Xiphocaridina compressa"; = Paratya compressa (De Haan, 1844)) from Lake Biwa-ko was given with figures (DB, general structure, egg, juvenile). The living worm is less than 8 mm long. From April to October, a high parasitic rate of "C. indica" was observed (nearly 100%). Five to 6 (or more) parasitic worms were found from a single host shrimp.


General explanation of this animal group in the world was given. Taxonomic system is mainly based upon Annandale (1912 and others). "Caridinicola indica" (= Scutariella japonica) from Lake Biwa-ko is mentioned.


A monograph of the family Scutariellidae. "Caridinicola japonica" (n. sp.), a Japanese species erroneously known as C. indica, was described as a new species. A schematic figure of "C. indica" (= Scutariella japonica) by Honjô (1937) is cited (on p. 71, fig. 30). See also pp. 42-43 (host), 46, fig. 16 (distribution map, with Insert Missing Legends). The Japanese species should be classified as Scutariella japonica (Matišič, 1990).

Another new species, "Caridinicola sinica" (n. sp.) was also described from the Lijian River in the northern part of Autonomous Province Guanxi (= Guângxi, Kuanghsi,
Kwangsi) Zhuang, SW of China (pp. 71-73, fig. 31A-C; see also pp. 42-43, 46, fig. 16, 100, with Insert Missing Legends). This Chinese species is now considered a junior synonym of Scutariella japonica. Cf. Kawakatsu, 1998 (pp. 72-74, pl. 1).


Occurrence of “Caridincola indica” (= Scutariella japonica) from the vicinity of Hirosaki, Aomori Prefecture, Honshû, was reported. Two simple sketch figures of “C. indica” from Lake Biwa-ko (figs. 1 and 2, Negishi’s original sketches drawn in 1926) were given.


In the [Species of Shiga in Need of Protection], Paratya compressa compressa (a shrimp and the host of Scutariella japonica) is listed as a rank of ‘Rare Species’ (Near Threatened =NT); S. japonica is listed as a rank of ‘Caution’ (Data Deficient =DD).


Occurrence of “temnocephalid turbellarians” from the Japanese freshwater atyid shrimp, Neocaridina denticulata denticulata (De Haan, 1849), is mentioned from rivers in Hyôgo Prefecture, Kinki Region, Honshû, Central Japan. Imported Chinese freshwater shrimps are also mentioned.


For the International Conference articles, see Niwa & Ohtaka, 2004. Three species of temnocephalans from Japan are briefly mentioned based upon the present web article: Scutariella japonica (Matjiašič, 1990), Temnoswellia sp. (?T. sempedr (Weber, 1889)) and Temnoswellia minor (Haswell, 1888). Imported Chinese freshwater shrimps and their ectosymbionts are also mentioned.


A relationship between crayfish worms and temnocephalids is discussed from an
ecological viewpoint.


Occurrence of “Temnocephala” (sic) sp. from the Henoki River, Okinawa Island (Mar. 29, 1935) was mentioned on p. 5; host: a freshwater crab.

Additionally, Dr. Okada mentioned that he once observed the same “Temnocephala sp.” (host: a freshwater crab) at Sōzan (=Yang-Ming Shan) in the suburbs of Taipei, Taiwan.


“Temnocephala minor Haswell, 1887,” an ectocommensal on an Australian crayfish, was found from culture ponds of Cherax tenuimanus (Smith, 1912) in Kagoshima Pref. in Kyūshū, Southern Japan. T. minor had chromosome number of 2x=18, with a karyotype of 2sm + 2m + 2m + 2sm +2m +2m + 2m + 2m + 2m. Photomicrographs of a preserved specimen and chromosomes, a sketch figure of penis stylet and an idiogram are shown in figs. 1 (A-C) and 2 (on p. 74).


The species is Scutariella japonica (Matjašič, 1990). Taxonomic status of Temnocephalida is noted.


Temnocephalida (Temnocephalidae and Scutariellidae) is listed in the “Platyhelminthes Turbellaria.”


A detailed taxonomic history of “Scutariella indica (Annandale, 1912) Baer, 1953” (Rhadocoela: Temnocephalida, Scutariellida) was reviewed. The previous occurrence records of Temnocephalidae species in Japan were also mentioned after Katō (1943), Suzuki, Ninagawa & Kawakatsu (1983) and Oki, Tamura, Takai & Kawakatsu (1995).

Additionally, Kawakatsu’s (1998) taxonomic correction of Scutariella japonica (Matjašič, 1990) is not mentioned in this publication. Later, Dr. Shimazu prepared a private ‘Additional Note’ on this matter (a slip of paper which will be put between the leaves of his reprint; not a publication).


This is an English version of Shimazu (1999) published in “[The Study of Parasitology in Japan]”. In Class Turbellaria, Order Rhadocoela: Suborder Temnocephalida (pp. 63-64), the contents of his previous Japanese article (op. cit.) is revised with new distribution data of Temnocephalida in Japan.

Family Scutariellidae: Scutariella japonica (Matjašič, 1990). Previous distribution records and two new records in Toyama and Hiroshima Prefectures, Honshū, are given.

Family Temnocephalidae: Temnocephala spp. Previous distribution records are given, together with a new record of T. semperi Weber, 1889 (?) from Tokushima Prefecture, Shikoku.

Additionally, the data of publication of the ‘Progress of Medical Parasitology in Japan, Vol. 7’ is only shown as 2003. Thus, the last day of the year (December 31, 2003) is specified as the official publication date of the book. Cf. ICZN, 4th ed., 1999, Art. 21.3.2.


A preliminary report on “Temnocephala sp.” from Iriomote-jima Island, the Southwest Islands of Japan, was given (an abstract of a lecture; not an official publication). Host: Geothelphusa miyazakii (Miyake et Chu, 1965).

Previous records of this animal group in Japan were briefly reviewed.

“Scutariella indica” (= Scutariella japonica) and 2 undescribed temnocephalid species were recorded from Japan.


2. “Temnocephala” sp. of Iriomote-jima Island. Tentative description on p. 489. Photographs on p. 488 (fig. 2 1-4): 1, host crab with several specimens of “Temnocephala sp.”; 2, enlarged living specimen (DB, ca. 8mm in length); 3, photomicrograph of penis stylet; 4, egg capsules attached to limbs of the host. Original photographs by Dr. H. Suzuki. Host: Geothelphusa miyazakii Miyake et Chiu, 1965. Loc.: Iriomote-jima Island, Southwest Islands of Japan; collected by Mr. H. Chokki on May 1974.

3. “Temnocephala” sp. of Tanegashima Island. Tentative description on p. 489. Photographs on p. 489 (figs. 3 and 4 1-5): 3, Eriocheir japonicus De Haan, 1835 (host); 1 and 2, preserved specimens (DB, VB); 3, whole mount; 4, anterior portion of the body with 2 eyes; 5, penis stylet. Original photographs by Kawakatsu. Host: See above. Loc. Anjō, Nishi-no-Omote City (Kawasaki River), Tanegashima Island, Southwest Islands of Japan; collected by Mr. M. Ninagawa on October 28, 1980.

“Temnocephala” spp.” cited above are very similar to “Temnocephala sempei” Weber, 1889.” Kawakatsu’s sample of “Temnocephala sp.” of Tanegashima Island (KSL No. 1648) was sent to Dr. H. Suzuki in 1983. The returned slide (whole mount) from Dr. Suzuki was sent to Dr. Ponce de Leon and Mrs. Volonterio for identification (Oct., 2006).


In a culture pond of an introduced Australian crayfish, Cherax tenmanus (Smith, 1912), in southern Kyūshū (Ibusuki, in Kagoshima Pref.), many specimens of a freshwater planarian, “Dugesia tigrina” (= Girardia tigrina (Girard, 1850)), were found. Specimens of “Temnocephala minor” (?) were also found from the branchial chamber of the crayfish. Photographs of the host and living specimens of T. minor (and “D. tigrina”) are shown in Tamura, Oki, Kawakatsu, Ninagawa, Matsusato & Suzuki (1985: 133-135, fig. 1A-C).


http://limus.umesci.maine.edu/biology/turb/temn.txt
The latest Database of the Order Temnocephalida. The known suborders, families, subfamilies, genera, and subgenera were given. The Japanese species is listed as *Caridinicola japonica* Matjašić, 1990; the Chinese species, *Caridinicola sinica* Matjašić, 1990. For the correction of their generic name and the taxonomic rearrangement, see Kawakatsu (1998).


*General explanation of Temnocephalida was given. “Caridinicola indica” (=Scutariella japonica) was mentioned.*


*Four families and 7 genera of the Temnocephalida are listed without species names.*


See Uchida, T., 1972.

Umemoto, H., 1936. [*Caridinicola indica* was found in the Tsuruoka district in Yamagata Prefecture, Honshū]. Botany & Zoology (Shokubutsu to Dōbutsu), Tōkyō, 4: 949-951. (In Japanese.)

*Occurrence of “Caridinicola indica” (=Scutariella japonica) from the vicinity of Tsuruoka, Yamagata Prefecture, Tōhoku Region, Honshū, was reported with 2 sketch figures of the animal.*


Morphology and histology of “Temnocephala indica” (=Scutariella japonica) from Okazaki, Aichi Prefecture, Honshū, were given with a photograph of the preserved specimen (fig. 1), diagrammatic representation of the body and 12 sketch figures of cross sections of the body (pl. 49, fig. and figs I-XII). Host: *Paratyia compressa improvisa* Kemp, 1917. Cf. Yanada (1955).

This mimeographic print is not an official publication in strict meaning. It is of a bad quality (many characters in the text are hard to read). An English abstract of this print prepared by Kawakatsu is given below.

Abstract. Fifty specimens of a freshwater shrimp, *Paratyx compressa improvisa* Kemp, 1917, were collected monthly from a small pond fed by a narrow brook at Muba-chô, Okazaki City, Aichi Prefecture (Aug. 1953 – Aug. 1954). The breeding season of the host shrimp is from April to August (water temp., 19-25°C). In winter, young shrimps are common in this habitat.

The endoparasitic rate of "*Caridinicola indica*" varies from 70% to 100% according to each month (samples collected, 52 to 1617 specimens). The high endoparasitic rate (90-100%) was observed from April to October; the low rate (60-70%), from December to January (Table 1).

Relations between the size of the host shrimps and the number of endoparasites were also observed. The average body length of the host shrimps varies from 13.5mm (September) to 28.6mm (February). The maximum number of "*C. indica*" specimens collected from 50 shrimps was 604 in September; the minimum number, 101 in May (Table 2). Cf. Yanase (1954).

Yanada, T., 1956. Seasonal variation of the parasitic rate of *Caridinicola indica* in *Partia [sic] compressa*. Collect. & Breed (Saishu to Si’iku), Tôkyô, 18 (4): 109-111. (In Japanese.)

The contents of this article is exactly similar to Yanada (1955). See the foregoing commentary.

2) An Annotated Bibliography of Taiwan Temnocephalida


The English abstract of the lecture by Lo & Wu is as follows:

Abstract. "Flatworms with 5 tentacles were seen living on the surface of the crab *Geol[h]elphusa miyazakii* collected from the northern end of Taiwan during the course of a study on paragonimiasis. The same worms were also found on the same crab in a small water hole in Keelung Park and they were identified to be *Temnocephala semperi* Weber, 1890. Specimens from the first site were white to slightly pinkish in color but those from Keelung were orange-colored, probably due to the difference in geology. Another temnocephalid identified as *Caridinicola indica* Annandale, 1912 with 2 tentacles was found living in the branchial cavities of atyid shrimps *Neocaridina denticulata sinensis* which were collected from 2 localities in northern Taiwan. Both species, commensals of crustaceans, are found in several countries in Asia. To our knowledge this is the first record of them from Taiwan."
The justification of the species identification of Taiwan sampled by Lo & Wu (1991) will be discussed in another paper.


Occurrence of “Themocephala” (sic) sp. from Okinawa Island (the Henoki River: Mar. 29, 1935) was mentioned on p. 5; host: a freshwater crab. He also mentioned that he once observed the same “Themocephala sp.” (host: a freshwater crab) at Sōzan (=Yan-Ming Shan) in the suburbs of Taipei, Taiwan. None of morphological characters of his samples published.

3) An Annotated Bibliography of Chinese Temnocephalida


“Temnocephala semperi” was reported from the Narmada (=Narbada) River, that running through the west-central area of India and discharges into the Gulf of Cambay. On the distribution map on p. 423, T. semperi was indicated to occur in Yunnan, Southern China.


Previous occurrence records of “Temnocephala semperi Weber, 1890” were reviewed based upon the publications by Gravely (1913), Kemp (1917), Lee (1936), Chauhan & Ramakrishna (1953), Kawakatsu, Nunomura & Suzuki (1989), Kawakatsu (1998b), Kawakatsu, Murayama, Nishino & Ohtaka (1999), and others.


For Temnocephala semperi Weber, 1889, Gravely (1913: 229) wrote as follows:

“Specimens in the Indian Museum Collec[t]ion of P. manii from Tavoy, and of P. andersonianum from Yunnan and from the Sheete (Kakhyen) and Manipur Hills, bear eggs closely resembling those evidently belonging to this species on crabs from the Abor county and Dawna Hills.”

The reidentification of the Yunnan “Temnocephala” species based upon the sexual specimens is needed. Additionally, the generic name of the host river crab, Potamon Ortmann, 1896, is a synonym of the genus Geothelphusa Stimpson, 1858.

In the section of *Caridina denticulata* (de Haan) (=*Neocaridina denticulata*), Kemp (1918: 289) wrote as follows:

"The parasitic Temnocephalid, *Caridinicola*, was very abundant on the Chinese specimens." ..."The Chinese specimens were found in creeks and irrigation channels at the edge of the Tai Hu Lake in Kiangsu province." (p. 289.) See Kemp (1918) in ‘Japanese Temnocephalida.’

Lake Tāi Hu (=Tài Hú) in Kiangsu (=Jiāngsū, Chianghsi, Kiangsi) Province is located approximately 1150 km NE of Hong Kong (see Fig. 10).


Chinese introduction and description are given on pp. 131-132. Occurrence of *“Temnocephala semperi”* Weber, 1890 from Fùzhōu (=Foochow, Fuchou), Fújian (=Fukien, Fuchien) Province in SE China was reported; host: a freshwater crab, *Potamon* sp. The author gave a detailed description of this Chinese samples with morphological and anatomical figures (pl. X, figs 1-6). See Section 2) of the present publication.

A justification of the species identification of Chinese samples by Lee (1936) will be discussed in another paper.


A new description of *Caridinicola sinica* sp. nov. was given on pp. 71-72 (fig. 31 A-C; see also pp. 43, 46, fig. 16, 100, with insert Missing Legends). The locality of this new species is the Lijiang River in the northern part of Autonomous Province Guanxi (=Guāngxì, Kuanghsi, Kwangsi) Zhung, SW of China. His diagnosis of *C. sinica* is as follows:

"Diagnosis: The tentacles are not very long. The germarium lies more to the right than in the other species. The vitelline glands consist of six separate follicles on each side."

See also the following Slovenian description (on page 100):

*Caridinicola sinica* sp. nova.

Podajam samo provizorični opis vrste rodu *Caridinicola*, ki sem jo našel na Kitajskem. Telo je podobno kot pri prejšnjih vrstah. Tentakli niso prveč dolgi in so prav tako dvodelni. Bazalni del je selo širok in ima zgoraj močan nabor, na katerem skoraj ravnem delu stoji prcem ožja kupulasta terminalna dela, ki sta polovico krajaša od bazalnih delov. Dolžina farinksa je skoro enaka dolžini črevesa, ki je vrečasta. Germarij leži bolj desno
kot pri ostalih vrstah. Vitelariji so sestavljeni iz šestih ločenih foliklov na vsak stran. Pri ostalih vrstah so bolj strnjeni.

Lokaliteta: reka Lijiang na severu pokrajine Kwangsi.

Kawakatsu (1998b: 72-74, pl. I) considered Caridincola sinica is a synonym of Scutariella japonica (Matjašič, 1990).


Imported Chinese freshwater shrimps (Neocaridina denticulata group) and their ectosymbionts (branchiobdellidians and temnocephalidians) are mentioned. See Section II, 3) China, e).

II. The Previous Records of Temnocephalid Species from Japan, Taiwan, China, and South Korea

1) Japan

a) Scutariella japonica (Matjašič, 1990) of Honshū (Fig. 9, localities 1-11)

Japanese name: Ebi-yadori-uzumushi


Living specimens are 0.7 – 2.8 mm in length, with a lanceolate form that having a pair of conspicuous, horn-shaped antennae at the anterior end of the body (Fig. 1). The animal has an obreiniform sucker at the postero-ventral position, with 2 eyes at the slightly anterior level of the pharyngeal base. A translucent body sometimes shows yellowish or brownish coloration according to the contents of the intestine (Nishino, 2000).

A detailed anatomical figure of Scutariella japonica was at first published by Honjō (1937, pl. XXIII, under the name of Caridincola indica collected from Paratya compressa compressa of Lake Biwa-ko). Later, Katô (1943: 669, fig. 594) published a slightly corrected Honjō’s (loc. cit.) figure. Reproductions of those 2 figures are shown in Figs. 2 and 3 in the present web article (see also Kawakatsu, Murayam, Nishino & Ohtaka, 1999: 88, fig. 7).

Yanada (1954) published schematic sketches of Scutariella japonica (under the name of Caridincola indica) based upon his histological section of the animal (loc. Okazaki City, Aichi Pref., Honshū). His sketches consist of a single anatomical figure (dorsal view of the body) and 12 figures of the transverse sections at 12 levels of the body. Four of them reproduced from Yanada’s (loc. cit.) figures are shown in Fig. 4 in the present publication.

Shimazu (1999) gave a review of previous distribution records of this species under the name of “*Scutariella indica*.” In his latest English publication (Shimazu, 2003), he gave nearly the same review of *Scutariella japonica* (Matjašič, 1990), together with the following new occurrence records based upon his own observation.

1) The Shiō-kawa River (near Takaoka City), Toyama Prefecture, Chūbu Region, Honshū (host: *Paratya compressa improvisa*).
2) The Seno River (near Hiroshima City), Hiroshima Prefecture, Chūgoku Region, Honshū (host: *Neocaridina denticulata*).

In Lake Biwa-ko (Shiga Pref.), the host shrimp of *Scutariella japonica* (*Paratya compressa compressa*) is now considered as a ‘Rare Species’ (NT). *S. japonica* is not recorded after the 1940’s (cf. Nishino, 2000).

b) **Scutariella japonica** (Matjašič, 1990) of Kyūshū (Fig. 9, localities 13-15)

Recently, those animals seem to be *Scutariella japonica* were collected from 3 localities in northern Kyūshū (Urabe’s unpublished data). One population is the Kurokawa River, Nakama City, at the northeastern part of Fukuoka Prefecture (host: *Neocaridina denticulata* (De Haan, 1849)).

The second population is the Futatsu-gawa River, Mitsuhashi-machi, Yamato-gun, at the southwestern part of Fukuoka Prefecture (hosts: *Neocaridina denticulata* and *Macrobranchium nipponense* (De Haan, 1849)). Additionally, *M. nipponense* is the first record of the host for *S. japonica* in Japan (a symptomatic symbiosis?).

The third population is the main stream of the Chikugo-gawa River, Hita City, Ōita Prefecture (host: *Neocaridina denticulata*).

c) **Scutariella sp. of Okinawa Island** (Fig. 9, locality 19)

Recently, Ohtaka collected many specimens of some atyid shrimps (may include *Caridina* and *Paratya*) from forest streams in the northern area of Okinawa Island, the Southwest Islands of Japan (June, 2004). Several specimens of *Scutariella* sp. were found from the formalin preserved atyid hosts. The samples are now kept in Ohtaka’s laboratory of Hirosaki University.

This is the first occurrence record of *Scutariella* species in Okinawa Island. Externally, animals are very similar to *S. japonica* from Honshū.

d) **Temnocephala s.l. sp. of Iriomote-jima Island** (Fig. 9, locality 21)
This undescribed *Temnocephala* s.l. sp. was collected in Irionote-jima Island, the Ryūkyū Islands in the Southwest Islands of Japan (March, 1974) by Mr. H. Chokki. Host (freshwater crabs): *Geothelphusa minei* Shy & Ng, 1998, or *Geothelphusa marginata fulva* Naruse, Shokita & Shy, 2005, and *Eriocheir japonicus* De Haan, 1835. The samples from this collection studied preliminarily by Dr. H. Suzuki (cf. Suzuki, 1977; Suzuki, Ninagawa & Kawakatsu, 1983). His whole mount specimen is registered: Kawakatsu’s Specimen Lot No. 2370. This slide was sent to Dr. Ponce de Leon and Mrs. Volenterio for identification (Oct. 2006).

Large, living specimens attain 8 mm long, with an elongated ovoid form; with 5 long and slender tentacles at the anterior end of the body (Fig. 5-1 and 5-2). The animal has a shallow, discoid sucker at the postero-ventral position; with 2 close eyes at the posterior of the base of tentacles. The body is translucent (or whitish); the pharynx and intestine can be seen through the integument. Two pairs of rounded testes present; tubular penis slightly curved in the chitinous sheath and the distal portion with many spinules (Fig. 5-3). Elipsoidal cocoons are brown in coloration without a stalk (600 µ in long axis; Fig. 5-4).


e) *Temnocephala* s.l. sp. of Tane-ga-shima Island (Fig. 9, locality 18)

This undescribed *Temnocephala* s.l. sp. was collected by the late Mr. M. Ninagawa from the Kawakaki River, Anjō, in Nishino’omote City, Kagoshima Prefecture (i.e., Tane-ga-shima Island, the Satsunan Islands in the Southwest Islands of Japan (November, 1980). Host (freshwater crab): *Eriocheir japonicus* De Haan, 1835. According to the collector’s information for Kawakatsu (in litt.), 2 to 5 temnocephalid symbionts were found from a single host crab.

Kawakatsu received a single preserved specimen of *Temnocephala* s.l. sp. for preliminary examination. The animal was fixed with Nozawa’s fluid (95% ethanol 45cc + 3% formalin 10cc + acetic acid glacial 2 cc) and then kept in 70% ethanol (Kawakatsu’s Specimen Lot No. 1648).

The sample examined was strongly contracted. The body was an obovate with 5 contracted tentacles at the anterior end. Two closed eyes and a discoid ventro-posterior sucker were conspicuous (Figs. 6-1 and 6-2). In the whole-mounted sample of the same specimen (Fig. 6-3), photomicrographs of an anterior portion of the body (Fig. 6-4) and a moderately curved penis (Fig. 6-5) are shown.

The whole mount (KSL No. 1648, 1 slide) sent to Dr. Suzuki for his comparative observation is at Kawakatsu’s hand (it was sent to Dr. Ponce de Leon and Mrs. Volenterio).

f) *Temnocephala* s.l. sp. of Okinawa Island (Fig. 9, locality 19)
Okada (1938: 5) mentioned the occurrence of “Temnocephala sp.” from the Henoki River, Kunigami-son, Kunigami-gun, Okinawa Prefecture (i.e., the northern part of Okinawa Island, the Ryūkyū Islands in the Southwest Islands of Japan). Host: a freshwater crab. Any of taxonomic data of this Temnocephala s.l. sp. was not given.

**g) Temnocephala s.l. sp. of Ishigaki-jima Island** (Fig. 9, locality 20)

Recently, several unidentified *Temnocephala* s.l. sp. were collected from the Nagura River, Ishigaki-jima Island, the Ryūkyū Islands in the Southwest Islands of Japan (September 16, 2004) by Fujita. Host (freshwater crab): *Geothelphusa minei* Shy & Ng, 1998. The samples are now kept in Fujita’s Collection.

**h) Temnocephala s.l. sp. of Kagoshima** (Fig. 9, locality 17)

Mr. N. Kobayashi of the Freshwater Biological Research Company (Kasen-Seibutsu Kenkyūsho, Saitama Pref.) and Nishino found a number of *Temnocephala* s.l. sp. from the Anraku-gawa River, Shibushi-chō, So’o-gun, Kagoshima Prefecture, Kyūshū (February and March, 2004). Host (freshwater crab): *Eriocheir japonicus* De Haan, 1835. The Anraku-gawa River discharges into the Shibushi Bay (the eastward of the Ōsumi Peninsula; ca. 55 km SE of Kagoshima City).

Kawakatsu received photographs of living specimens of *Temnocephala* s.l. sp. from the Anraku-gawa population (both dorsal and ventral views of the body and cocoons). The animal has 5 blunt tentacles, 2 closed eyes and a discoid ventro-posterior sucker. Externally, the animal of the Anraku-gawa population is exactly similar to that of the Kawasumi population in Tane-ga-shima Island. Kawakatsu also examined several preserved specimens received from Ohtaka: *Kawakatsu’s Specimen Lot No. 2371.*

**i) Temnosewellia semperi (Weber, 1889)? of Shikoku** (Fig. 9, locality 12)

Shimazu (2003: 64) reported the occurrence of a temnocephalid species from the Kaifu River, Tokushima Prefecture, Shikoku (host: *Eriocheira japonicus*). He wrote: “L. Cannon (personal communication) has identified this temnocephalid as *Temnocephala semperi.*”

**j) Temnosewellia minor (Haswell, 1887) of Ibusuki** (Fig. 9, locality 16)

Japanese name: Australia-zarigani-yadori-tsunozumushi

Introduced Host: In June of 1984, about 29 specimens of a freshwater crayfish *Cerax tenuimanus* (Smith, 1912) (called marron, or yabbies, in Australia) were introduced from Western Australia into the Ibusuki Branch of the Kagoshim Prefectural Fisheries Experimental Station (Japanese name: Kagoshim-ken Naisuinen Shikenjō, Ibusuki Bunshitsu), Ibusuki City, Kyūshū, Japan. It is located near the top of the Satsuma Peninsula.

Occurrence of *Temnosewellia minor* and the samples examined: *Temnosewellia minor* was first observed in the beginning of April, 1985. Another introduced trilobate species, *Girardia trigrina* (Girard, 1850) was also found in culture ponds for yabbies fed by underground waters
(over 15°C in mid-winter). After the disinfection of culture ponds and yabbies by a 30 ppm formalin solution, the T. minor and G. tigrina populations decreased sharply (cf. Tamura, Oki, Kawakatsu, Ninagawa, Matsusato & Suzuki, 1985; Kawakatsu, Oki, Tamura, Takai, Timoshkin, Porfirjeva, 1993; Oki, Tamura, Takai & Kawakatsu, 1995).

The five groups of samples of Temnosewella minor were obtained from two sources for Kawakatsu’s preliminary study. Kawakatsu’s Specimen Lot Numbers (KSL Nos.1781-1785) were given for each group.

KSL No. 1781. Many preserved specimens fixed with 3% formalin solution (June 4, 1985). Received from Dr. Noel Morrissy of the West Australian Marine Research Laboratory, Perth, Western Australia.

KSL Nos. 1782-1785. Samples collected by the late Mr. M. Ninagawa at the Ibusuki Branch of the KPFES (May 7, 1985). They were fixed with 4 different fixatives by Kawakatsu: Carnoy’s fluid (KSL No. 1782); 70% ethanol (KSL No. 1783); Bouin’s fluid (KSL No. 1784); Nozawa’s fluid (KSL No. 1785).

Whole mounted specimens, preserved samples and films are now keeping in Kawakatsu’s Collection (safe keeping in his home at present).


Morphology: Living specimens of Temnosewella minor attain 5 to 7 mm long in an elongated state (Fig. 7-1). The animal has a narrow lanceolate form; with 5 slender and moderately long tentacles at the anterior end of the body (Fig. 7-1 and 7-2). A shallow, discoid sucker is present at the postero-ventral position; with 2 close eyes at the slightly anterior level of the pharynx (Fig. 7-2). The body is nearly translucent; with meshy patterns on the dorsal surface (Fig. 7-2). Two testes are found on either side of the intestine. The tubular penis slightly curved and its distal portion is having awn-like spines of a barrel shape (Fig. 7-3). (Cf. Kawakatsu, Oki, Tamura, Takia, Timoshkin & Porfirjeva, 1993: cover page; Oki, Tamura, Takai & Kawakatsu, 1995: 74, Figs1A and B.)

Karyology: Chromosomal numbers are 2x = 18, with a karyotype of 2sm + 2m + 2m + 2sm + 2m + 2m + 2m + 2m + 2m + 2m (Figs 7-4 and 7-5). (Cf. Kawakatsu, Oki, Tamura, Takia, Timoshkin & Porfirjeva, 1993; Oki, Tamura, Takai & Kawakatsu, 1995.)

2) Taiwan

a) Scutariella japonica (Matjašič, 1990) of Northern Taiwan (Figs 9 and 10, Locality 22)
The first occurrence of this *Scutariella* species in Taiwas reported from 2 localities in Northern Taiwan by Lo & Wu (1991) under the name of “*Caridinicola indica* Annandale, 1912.” Host (a freshwater shrimp): *Neocaridina denticulata sinensis*.

Morphological data were not given in their English abstract (see the ‘Section I-2’ in the present publication).

b) *Temnosewellia semperi* (Weber, 1889) of Keelung, Taiwan (Figs 9 and 10, locality 22)

The first occurrence record of this temnocephalid species in the Keelung Park and its vicinity of the Northern Taiwan was reported by Lo & Wu (1991). Host (a freshwater crab): *Geothelphusa miyazakii* (Miyake & Chiu, 1965).

Morphological data were not given in their English abstract (see the ‘Section I-2’ in the present publication).

c) *Temnocephala* s.l. sp. of Sôzan, Taiwan (Figs 9 and 10, locality 22)

Okada (1938: 5) noted the occurrence record of “*Temnocephala* sp.” at Sôzan (= Yan-Ming Shan) in the suburbs of Taipei, Taiwan. Host: a freshwater crab.

Any of taxonomic data of this *Temnocephala* s.l. sp. was not given.

3) China

a) *Scutariella japonica* (Matjašič, 1990) of Guangksi, China (Fig. 10, locality 24)

Matjašič (1990: 71-73, fig. 31 A-C) described *Caridinicola sinica* sp. nov. from the Lijiang River, Autonomous Province Guanxi (=Guāngxi, Kuanghsi, Kwangsi) Zhung, SW of China. Host: *Caridina* sp.

Kawakatsu (1998b) treated ‘*Caridinicola sinica*’ as a synonym of *Scutariella japonica* (Matjašič, 1990) because the diagnosis given by Matjašič (loc. cit.) is insufficient for the separation of a new Chinese species from *S. japonica*. For details, see the ‘Section I-1.’

The name of the Lijiang River, Kuanghsi Province in SW China, has a question. Judging from the distribution map in Matjašič (1990: 46, fig. 16) paper, the location of the type locality of his ‘*C. sinica*’ is the Guilijiang River (=Kuichiang River), a tributary of the Xijiang River (=Hsichiang River) in Guangxi (=Kuanghsi) Province. It is located approximately 400 km NW of Hong Kong (Fig. 10).

b) *Scutariella japonica* (Matjašič, 1990)? of Lake Tài Hú, China (Fig. 10, locality 26)

Kemp’s (1918) record of *Caridinicola* from Lake Tài Hú is also shown on Fig. 10. The Lake is located approximately 1150 km NE of Hong Kong.
c) *Temnosewllia semperi* (Weber, 1889) of Fúzhōu, China (Fig. 10, locality 23)

Lee (1936) gave details of general morphology and anatomy on Chinese *Temnocephala* species from Fúzhōu (= Foochow, Fuchou) population, identified as "*Temnocephala semperi* Weber, 1890." Figures (op. cit., pl. X, figs. 1-6) on the general morphology and genital anatomy are now provided in the present web article (see Fig. 8, 1-6). Host (freshwater crab): *Potamon* sp.

According to Lee (1936: 127-129, 132), 40 preserved specimens with 80% ethanol have attain 2.8-3 mm long (without tentacles) and 2.5-2.9 mm wide; with 5 tentacles (0.5-1 mm long) anteriorly and a ventral sucker, situated near the end of the body; with 2 close eyes on the anterodorsal side. There are 2 pairs of testes. The proximal portion of penis is smooth; its distal portion, the glans, is armed with many spinules. A single ovary and many yolk glands are present (see Fig. 8, 1-6).

For the final identification of the Chinese *Temnocephala* s.l. species, a further comparative taxonomic study based upon samples from several localities in the Southeast Asia (Japan, Taiwan, China, Korea, The Philippines, Indonesia, India, etc.) is urgently needed.

d) *Temnosewllia semperi* (Weber, 1889)? of Yunnan, China (Fig. 10, locality 25)

The Yunnan record of *Temnosewllia semperi* is only based upon the cocoons attached to the preserved samples of the host river crab "*Potamon andersonianum*" (the Indian Museum Collection). See Gravely (1913); Chauhan & Ramakrishna (1953) and its Note in the present web article.

e) *Scutariella japonica* (Matjašič, 1990)? From Northeastern China (Fig. 9, locality 27)

Niwa & Ohtaka (2004) mentioned *Scutariella* sp. obtained from live specimens of Northeastern Chinese freshwater shrimps introduced into Japan.

According to Niwa & Nishino (2004, 2005, etc.), a large amount of live freshwater shrimps have been imported into Japan from Korea (1973-1980s) and Central and Northeastern China (1990- ) for live baits of recreational fishings. In recent years, an imported amount of Chinese shrimps may attain 20 tons per year (via the Kansai International Airport and the Fukuoka International Airport). Their main habitats are the vicinities of Shenyang (=Shényáng; Shényang) in Liáoning (=Liaoning) Province and Changchún (=Ch’angch’ün, Changchun) in Jilin (=Chílin, Kirin) Province.

The following data were obtained by Niwa-and-Ohtaka’s examination (unpublished data).

1. October 24, 2003: 365 specimens of *Scutariella* sp. were obtained from 629 specimens of the host examined.
2. April 12, 2004: 6 specimens of *Scutariella* sp. were obtained from 10 specimens of the host examined.