Helminths of Tago's Brown Frog, *Rana tagoi tagoi* (Ranidae), from Japan

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Abstract. -Of 32 *Rana tagoi tagoi*, 22 (69% prevalence) harbored helminths. One cestode *Cylindrotaenia japonica* (prevalence 25%, mean intensity 3.4), three nematodes *Cosmocerca japonica* (prevalence 53%, mean intensity 3.1), *Oswaldocruzia socialis* (prevalence 3%, mean intensity 1.0), *Rhabdias nipponica* (prevalence 22%, mean intensity 2.9) and an acanthocephalan, *Acanthocephalus lucidus* (prevalence 22%, mean intensity 4.7) were found. *Rana tagoi tagoi* represents a new host record for *Cylindrotaenia japonica, Cosmocerca japonica, Oswaldocruzia socialis* and *Rhabdias nipponica.*

Key words: Rana tagoi tagoi, Ranidae, *Cylindrotaenia japonica, Cosmocerca japonica, Oswaldocruzia socialis, Rhabdias nipponica, Acanthocephalus lucidis*, Japan

Introduction

Tago's brown frog, *Rana tagoi tagoi* Okada, 1928 is known from Honshu, Shikoku, Kyushu Islands, Japan where it lives in montane regions (Maeda and Matsui, 1990). To date the only helminth known from *R. t. tagoi* is the acanthocephalan, *Acanthocephalus lucidus* Van Cleave, 1925 reported by Uchida (1975). With world-wide concern over declining amphibian populations (Heyer et al., 1994), possible negative effects of parasites on frogs has become a topic of interest; however, the helminth fauna are incompletely known or has yet to be studied in many species of amphibians. The purpose of this note is to report the results of a helminth survey of *R. t. tagoi.*

Materials and Methods

Thirty two (25 males, 7 females) *Rana tagoi tagoi* (mean snout-vent length 40.9 ± 6.2 SD, range 26-54) were examined. Specimens were collected on Honshu Island during the period June 1988-May 1995 between elevations of 160-800 m. Twenty-nine were from Kanagawa Prefecture; seventeen from Tanzawa (35°28'N, 139°10'E), eight from Hakone (35°12'N, 139°02'E), two from Hadano (35°22'N, 139°14'E) and two from Kiyokawa (36°12'N, 138°30'E). Two were from Shizuoka Prefecture; Gotemba (35°18'N, 138°56'E) and one was from Fukushima Prefecture, Hinoemata (37°02'N, 139°24'E).

The body cavity was opened ventrally and the esophagus, stomach, small intestine, large intestine, lungs and urinary bladder were slit longitudinally and examined under a dissecting microscope. The liver and body cavity were also examined for helminths. All helminths were identified utilizing a glycerol wet mount. Selected cestodes were stained with hematoxylin and mounted whole in Canada Balsam. Frogs were deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM): Fukushima Prefecture LACM 141442; Kanagawa Prefecture 141247-141251; 141426-141440; 141443-141447; 141916; 141918-141920; Shizuoka Prefecture 141441; 141917. Helminths were deposited in the U.S. National Parasite Collection (Beltsville, Maryland 20705): *Cylindrotaenia japonica*, 85329; *Acanthocephalis lucidus*, 85333; *Cosmocerca japonica*, 85330; *Oswaldocruzia socialis*, 85332; *Rhabdias nipponica*, 85331. Terminology usage is in accordance with Margolis et al. (1982).

Results and Discussion

Twenty two of 32 (69% prevalence) frogs were infected by helminths (Table 1): 19 of 25 males (76% prevalence) and 3 of 7 females (43% prevalence). However, there was no significant difference for prevalence of infection between males and females (Chi-square statistic = 0.58, 1 df, $P > 0.05$). None of these parasites are unique to *R. t. tagoi.*

Cylindrotaenia japonica (Yamaguti, 1938) Jones, 1987, a parasite of the small intestine, has been reported only from anurans of the Japanese Archipelago. Although nothing is known of its life cycle, Joy-

Table 1. Helminth parasites of Tago's brown frog, Rana tagoi tagoi, from Japan.

Parasite	Prevalence (%)	Mean intensity (range)	Location
Cestoda			
Cylindrotaenia japonica	25	3.4 (1-6)	a
Nematoda			
Cosmocerca japonica	53	3.1 (1-8)	b
Oswaldocruzia socialis	3	1.0	a
Rhabdias nipponica	22	2.9 (1-8)	c
Acanthocephala			
Acanthocephalus lucidus	22	4.7 (2-8)	b

* a = small intestine, b = large intestine, c = lungs.

eux (1924) considers the life cycle of *Cylindrotaenia americana* Jewell, 1916 to be direct with infection ocurring when a contaminated fecal pellet is swallowed by a frog. Other hosts include *Hyla japonica, Rana japonica, Rana ornativentris, Rhacophorus schlegelii* and *Rhacophorus viridis* (Goldberg et al., 1994; Jones, 1987; Uchida, 1975).

Cosmocerca japonica Yamaguti, 1938, a parasite of the rectum, has been reported in amphibians from the Palearctic biogeographic realm. Hasegawa (1989) suggested a synonymy of *Cosmocerca japonica* with *C. ornata* (Dujardin, 1845) Diesing, 1861, which has been found in all biogeographic realms except the Nearctic and Australian; but further review is necessary before this synonymy can be accepted. The life cycle of *C. japonica* is not known; however, the life cycle of *Cosmocerca commutata* (Diesing, 1851) Diesing, 1861 was studied by Fotedar and Tikoo (1968). Eggs hatched in 2-4 hours. Larvae penetrated the skin of the host and migrated through the viscera to reach the lungs 3 days postinfection and the rectum 10-14 days postinfection. Other hosts include *Buergeria japonica, Bufo japonicus, Bufo melanostictus, Cynops ensicauda, Hyla japonica, Microhyla ornata, Polypedates leucomystax, Rana ishikawae, Rana japonica, Rana limnocharis, Rana narina, Rana nigromaculata, Rana ornativentris, Rana rugosa* from Japan (Goldberg et al., 1994; Hasegawa, 1989; Uchida, 1975; Yamaguti, 1938; 1954); *Bufo biporcatus, Limnonectes macrodon, Phrynoglossus laevis, Rana cancrivora, Rana limnocharis,* from the Philippines (Schmidt and Kuntz, 1969); *Bufo bufo, Bufo melanostictus* from Taiwan (Yamaguti and Mitunaga, 1943; Myers and Kuntz, 1970); *Rana limnocharis* from Okinawa (Hasegawa, 1984); *Rana kuhlii, Rana limnocharis, Rana rugulosa* from North Viet Nam (Moravec and Sey, 1985).

Oswaldocruzia socialis Morishita, 1926, a parasite of the small intestine, is apparently restricted to Japan. Travassos (1937) synonymized *O. insulae* Morishita, 1926 and *O. socialis* with *O. filiformis* (Goeze, 1782) Travassos, 1917 which has wide distribution in Europe; but further review is necessary before this synonymy can be accepted. The life cycle of *O. insulae* is not known, however Baker (1978) reported that *Oswaldocruzia pipiens* Walton, 1929, development to infective larvae occurred in fecal pellets with transmission to new hosts by skin penetration. Other hosts include *Rana japonica, Rana nigromaculata* (Uchida, 1975).

Rhabdias nipponica Yamaguti, 1935, a parasite of the lungs, is known from Japan, South China and Viet Nam. The life cycle of *Rhabdias nipponica* is not known, but Baker (1979) has studied the life cycle of *Rhabdias americanus*. Development of larvae to the infective third stage was by matricidal endotoky. Infection occured by skin penetration followed by migration through tissue to body cavity and lungs.

Adults appeared 7-9 days postinfection. Other hosts include *Rana nigromaculata, Rana rugosa* from Japan (Uchida, 1975); *Rana guentheri, Rana limnocharis, Rana nigromaculata* from South China (Kung and Wu, 1945; Wang et al., 1978); *Rana rugulosa* from Viet Nam (Moravec and Sey, 1985).

Acanthocephalus lucidus, a parasite of the small intestine, is apparently restricted to Japan. The life cycle of *Acanthocephalus lucidus* has not been studied, but infection is most likely acquired by consumption of an intermediate host, probably an insect (Petrochenko, 1956). Other hosts include *Bufo japonicus, Buergeria buergeri, Rana japonica, Rana nigromaculata, Rana ornativentris, Megalobatrachus japonicus* (Petrochenko, 1956; Uchida, 1975).

Uchida (1975) lists 15 anurans from Japan harboring on average 7.7 species of helminths; helminth diversity ranges from a minimum of 1 species in *Hoplobatrachus tigerinus* to 26 species in *Rana nigromaculata*. With 5 helminth species present, *R. t. tagoi* is near the lower end of the diversity scale for Japanese frogs. Subsequent examinations of *R. t. tagoi* will be needed before the full extent and impact of helminth parasitism in this species is known.

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Literature Cited

Baker, M. R. 1978. Development and transmission of *Oswaldocruzia pipiens* Walton, 1929 (Nematoda: Trichostrongylidae) in amphibians. Canadian Journal of Zoology 56:1026-1031.

Baker, M. R. 1979. The free-living and parasitic development of *Rhabdias* spp. (Nematoda: Rhabdiasidae) in amphibians. Canadian Journal of Zoology 57:161-178.

Fotedar, D. N., And R. Tikoo. 1968. Studies on the life cycle of *Cosmocerca kashmirensis* Fotedar, 1959, common oxyurid nematode parasite of *Bufo viridis* in Kashmir. Indian Science Congress Association Proceedings 55:460.

Goldberg, S. R., C. R. Bursey, And I. Ramos. 1994. Gastrointestinal helminths of the Japanese treefrog, *Hyla japonica* (Anura: Hylidae), from Japan. Journal of the Helminthological Society of Washington 61:225-227.

Hasegawa, H. 1984. Helminth fauna of five Okinawan amphibian species. Biological Magazine Okinawa 22:11-22.

Hasegawa, H. 1989. Nematodes of Okinawan amphibians and their host-parasite relationship. Pp. 205-217. In M. Matsui, T. Hikida, and R. C. Goris, eds. Current Herpetology in East Asia. Herpetological Society of Japan, Kyoto.

Heyer, W. R., M. A. Donnelly, R. W. Mcdiarmid, L. C. Hayek, And M. S. Foster (Editors). 1994. Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution Press, Washington, D.C. 364 pp.

Jones, M. K. 1987. A taxonomic revision of the Nematotaeniidae Lühe, 1910 (Cestoda: Cyclophyllidea). Systematic Parasitology 10:165-245.

Joyeux, C. E. 1924. Récherchés sur le cycle évolutif des *Cylindrotaenia*. Annales de Parasitologie Humaine et Comparée 2:74-81.

Kung, C. C., And H. W. Wu. 1945. Parasitic nematodes of amphibians from Pehpei Szechwan, China. Sinensia 16:73-83.

Maeda, N. And M. Matsui. 1990. Frogs and toads of Japan. Bun-Ichi Sogo Shuppan Co., Ltd. Tokyo, Japan. 207 pp.

Margolis, L., G. W. Esch, J. C. Holmes, A. M. Kuris, And G. A. Schad. 1982. The use of ecological terms in parasitology (report of an ad hoc committee of the American Society of Parasitologists). Journal of Parasitology 68:131-133.

Moravec, F., And O. Sey. 1985. Some nematode parasites of frogs (*Rana* spp.) from North Viet Nam. Parasitologica Hungarica 18:63-77.

Myers, B. J., And R. E. Kuntz. 1970. Nematode parasites of amphibians taken on Taiwan (Formosa). Srivastava Communications p. 151-154.

Petrochenko, V. I. 1956. Acanthocephala of domestic and wild animals. Vol. 1. Translated from Russian by Israel Program for Scientific Translations, Jerusalem, 1971. 465 pp.

Schmidt, G. D., And R. E. Kuntz. 1969. Nematode parasites of Oceania. VI. *Foleyella confusa* sp. nov., *Icosiella hoogstraali* sp. nov. (Filarioidea), and other species from Philippine amphibians. Parasitology 59:885-889.

Travassos, L. 1937. Revisão da familia Trichostrongylidae Leiper 1912. Monographias do Instituto Oswaldo Cruz 1:1-512.

Uchida, A. 1975. Check list of the helminth parasites of Japanese amphibians. Bulletin of the Azabu Veterinary College 30:63-81.

Wang, P. Q., Y. Zhao, And C. Chen. 1978. [On some nematodes from vertebrates in South China.] Fujian Shida Xuebao 2:75-90. (In Chinese).

Yamaguti, S. 1938. Studies on the helminth fauna of Japan. Part 23. Two new species of amphibian nematodes. Japanese Journal of Zoology 7:603-607.

Yamaguti, S. 1954. Helminth fauna of Mt. Ontake. Part 1. Nematoda and Acanthocephala. Acta Medica Okayama 8:386-392.

Yamaguti, S., and Y. Mitunaga. 1943. Intestinal helminths from *Bufo melanostictus* of Formosa. Transactions of the Natural History Society of Taiwan 33:142-154.