[RESEARCH NOTE]

Three species of the genus *Heterakis* Dujardin, 1845 (Nematoda: Heterakidae) from a captive Satyr Tragopan (*Tragopan satyra*) (Aves) in a zoological garden

Naoto Ushigome[1], Tomoo Yoshino[1], Yuu Suzuki[2], Mutsuhiko Kawajiri[2] Kazushige Masaki[2], Daiji Endo[1] and Mitsuhiko Asakawa[1,*]

The current conservation initiative for an endangered pheasant, Satyr tragopan, has been ongoing since the early 1980's in Annapurna Conservation Area in Nepal (del Hoyo *et al.*, 1994); and the avian species is continuing to be kept in several zoos. In the present report, three species of the genus *Heterakis* Dujardin, 1845 (Nematoda: Heterakidae) are reported from the avian species in captivity in a Japanese zoological garden.

A Satyr tragopan that was hatched in January 1999 died suddenly in August 2009 in captivity at Kawasaki Yumemigasaki Zoological Park, Kanagawa Prefecture, Japan. Its carcass was taken to the Wild Animal Medical Center (WAMC) of Rakuno Gakuen University, Japan, and both post-mortem and helminthological examinations were performed. All visceral organs were examined under a dissecting microscope. Nematodes obtained were fixed in 70% ethanol and cleared in lacto-phenol solution for microscopic observation. Morphological drawings and measurements were recorded with a camera lucida. All nematode specimens were preserved in the WAMC.

A total of 424 individual nematodes belonging to different species of the Genus Heterakis were obtained from the bird's alimentary tract (Table 1). Among the male nematode individuals, according to the male morphological criteria described by Skrjabin *et al.* (1961), two species were identified as *Heterakis gallinarum* (Schrank, 1788) Madsen, 1950 and *H. bosia* (Lane, 1914). However, no positive, specific name could be given for the females. Furthermore, several males appeared to belong to a different, yet unnamed, morphological taxon *Heterakis* sp. The site and prevalence of the nematode individuals are shown in Table 1.

Table 1. Site and prevalence of each species belonging to the genus *Heterakis* obtained from the captive Satyr Tragopan

site	*Heterakis gallinarum* (Male)	*Heterakis bosia* (Male)	*Heterakis* sp. (Male)	Female
Esophagus	0	0	0	1
Stomach	0	0	0	2
Small intestine	0	0	2	174
Cecum	11	6	32	82
Colon	21	10	71	12
Total	32	16	105	271

[1] School of Veterinary Medicine, Rakuno Gakuen University, Ebetsu, Hokkaido 069-8501, Japan.
[2] Kawasaki Yumemigasaki Zoological Park, Kawasaki, Kanagawa 212-0055, Japan.
* Corresponding author, e-mail: askam@rakuno.ac.jp

Heterakis gallinarum:

Two unequal spicules, right nearly three times as long as left, with well-developed caudal papillae present, as described by Skrjabin *et al.* (1961). *Heterakis gallinarum* has been reported in the order Galliformes all over the world (Skrjabin *et al.*, 1961; Yoshino, 2008). The presence of heterakid reinfection within the same captive facility could cause highly pathogenic nodular typhlitis (Menezes *et al.*, 2003). Furthermore, the nematodes become transporters of *Histomonas meleagridis* (Smith, 1895) and thereby provocate blackhead disease (McDougald, 2005).

Heterakis bosia (Table 2; Fig. 1):

Slightly unequal spicules, left ca 0.9 mm in length with characteristic shape in its tip (Fig. 1A), right ca 1.4 mm in length tapered suddenly at the posterior part (Fig. 1B); 12 pairs of caudal papillae (Fig. 1C, D). *Heterakis bosia* has been found from a wild Satyr tragopan (Skrjabin *et al.*, 1961), but this is the first local record of this nematode species in Japan.

Heterakis sp. (Table 2; Fig. 2):

Slightly unequal spicules, left 0.83 to 1.05 mm in length with relatively thick and blunt tip (Fig. 2A), right 1.17 to 1.37 mm in length, gradually tapered to the posterior part with a sharp tip (Fig. 2B); 12 pairs of caudal papillae (Fig. 2C, D). Because there was no identical description by Skrjabin *et al.* (1961), Inglis *et al.* (1971), Vicente *et al.* (1993), an others, for the present specimens, no definitive name could be given at this time.

As mentioned above, the heterakids are regarded as a risk factor for captive avian species belonging to the order Galliformes. Therefore, monitoring of the parasitic nematode to assess its infection status has been conducted by the Zoological Park within the avian population. According to the comprehensive results of the fecal examination (Ushigome, unpublished data), heterakid eggs were detected from the other avian species including Palawan peacock pheasants, Burmese peacock pheasants, Vietnamese pheasants, Japanese pheasants, and Vultrine guineafowls.

Table 2. Measurements of male *Heterakis bosia* and *Heterakis* sp.

	Heterakis bosia (n=10)[1,2]	*Heterakis* sp. (n=10)[1,2]
Body length	7.76 - 8.9 (8.32 ± 0.37)	6.61 - 7.57 (7.12 ± 0.35)
Body width	0.38 - 0.48 (0.44 ± 0.03)	0.33 - 0.38 (0.36 ± 0.01)
Right spicule	1.34 - 1.55 (1.42 ± 0.06)	1.17 - 1.37 (1.26 ± 0.07)
Left spicule	0.87 - 1.03 (0.94 ± 0.05)	0.83 - 1.05 (0.93 ± 0.08)
Esophagus length	1.16 - 1.34 (1.28 ± 0.07)	0.94 - 1.2 (1.05 ± 0.07)
Nerve ring from head end	0.34 - 0.38 (0.36 ± 0.01)	0.33 - 0.46 (0.40 ± 0.09)
Excretory pore from head end	0.51 - 0.64 (0.57 ± 0.05)	0.49 - 0.82 (0.54 ± 0.10)
Sucker in diameter	0.106 - 0.122 (0.112 ± 0.007)	0.067 - 0.082 (0.072 ± 0.005)

[1] in mm
[2] Range (Mean ± SD)

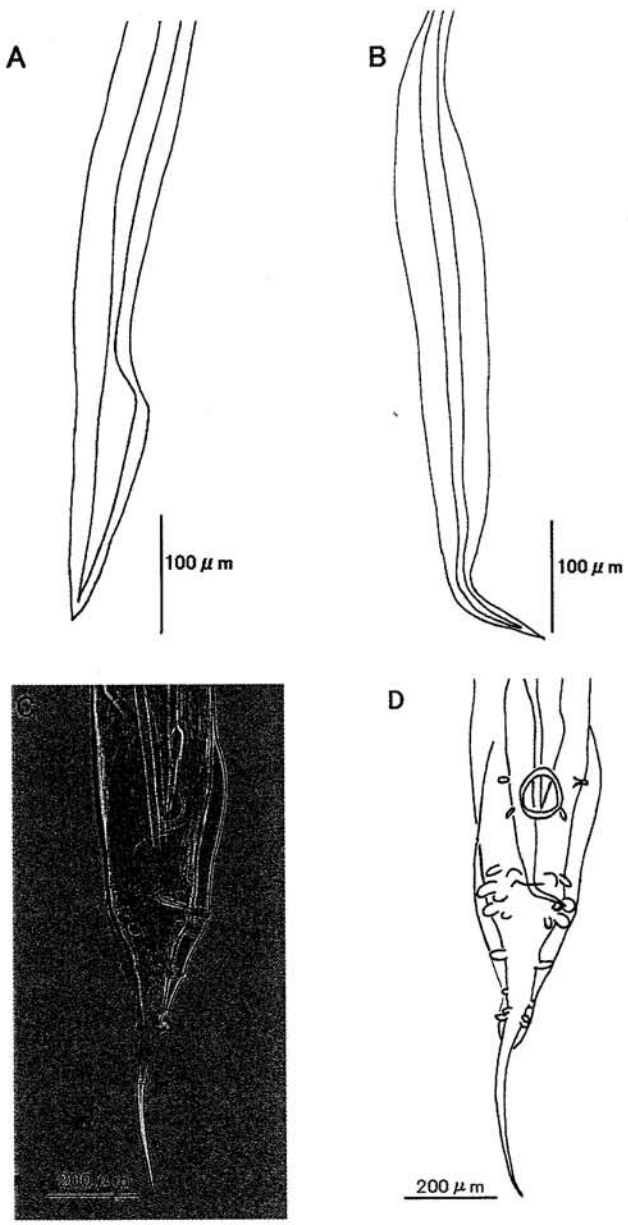

Fig. 1. *Heterakis bosia*.
A: distal end of left spicules; B: distal end of right spicules; C & D: posterior extremities of males

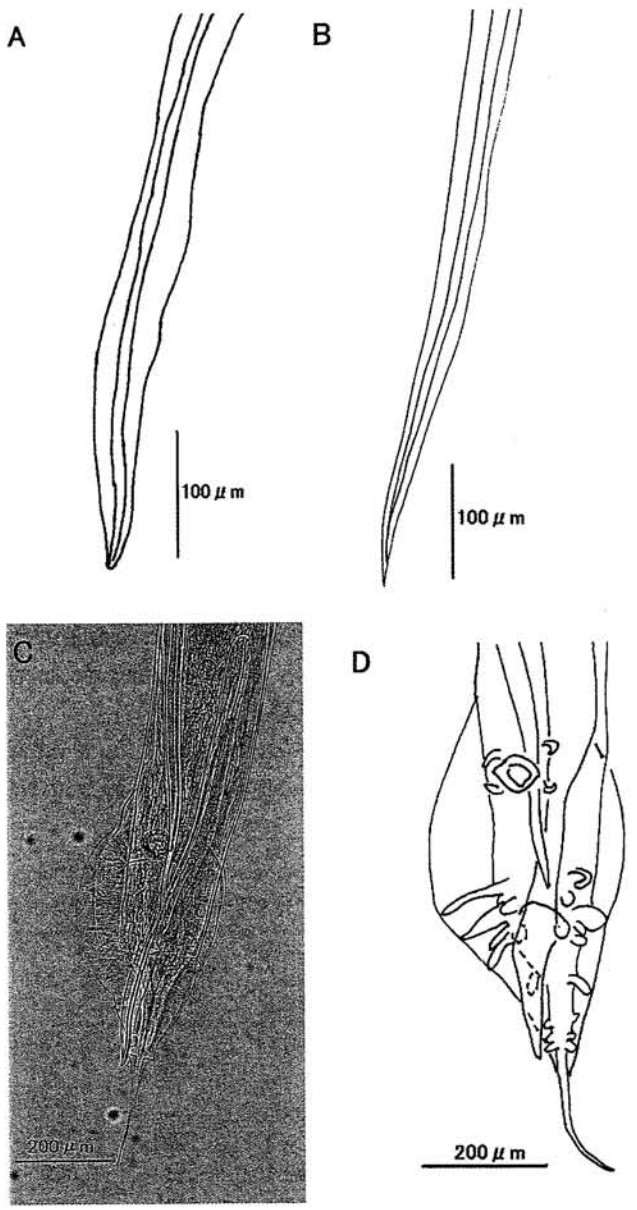

Fig. 2. *Heterakis* sp.
A: distal end of left spicules; B: distal end of right spicules; C & D: posterior extremities of males

Because these birds were kept in cages adjacent to the present Satyr tragopan, it seems that the heterakid eggs might have been transferred between cages.

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