Lung Worms of Wild Boars in the Western Region of Tokyo, Japan

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ABSTRACT. Prevalence of lung worms belonging to the genus *Metastrongylus* was surveyed on 42 Japanese wild boars (*Sus scrofa leucomystax*) captured officially for wildlife damage control in the western parts of Tokyo, Japan from April 2000 to April 2001. The number of parasites was the highest in the caudal lung lobes. Four species, *M. elongatus* (ME), *M. salmi* (MS), *M. asymmetricus* (MA) and *M. pudendotectus* (MP), were identified. All the boars were infected with 2 or more species, and 64.3% of the boars had all 4 species. The composition of species, ME:MS:MA:MP=1.3:3.4:1.0:1.4, was drastically different from the previous reports. The peak of the average number of the parasites was observed in the period of January to March 2001 because of the increase of MS.

KEY WORDS: Japanese Wildlife, *Metastrongylus* spp., *Sus scrofa leucomystax*.

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Studies on the prevalences of infectious diseases in wildlife are important to evaluate them as the sources of infectious agents to livestock and human, because the inhabiting area of some wild animals is near the suburbs. Although some cases of lung worm infections in the Japanese wild boars (*Sus scrofa leucomystax*) have been reported [1–3, 9, 10, 13, 14], the investigated regions were limited only in the western part of Japan before 1984 [3]. We investigated the prevalence of lung worms of the Japanese wild boars captured officially for wildlife damage control in the Metropolis of Tokyo, Japan throughout the year.

Forty-two wild boars including 4 yearlings were shot from April 2000 to April 2001 in the western region of Tokyo, where was surrounded in the points of 35°46'51 N 139°05'49 E, 35°40'11 N 139°15'50 E, 35°46'45 N 139°19'15 E and 35°47'51 N 139°08'39 E. All specimens showed macroscopical lung lesions such as marginal emphysema and consolidation. These lungs were excised, transported to the laboratory under 4°C or –20°C, separated to every lobes, and examined along the bronchial tubes for detection of lung worms. The parasites found were put into 70% (v/v) ethanol, immersed in lacto-phenol solution to transparentize, then identified according to the descriptions by Holló [5], Noda [9] and Jansen [6].

The number of the parasites in each boar was ranged 4 to 757 (average $\pm$ standard deviation=136 $\pm$ 147.1). The prevalence of the lung worms obtained in the present survey was 100% (42 positives/42 samples) as much as the values in the previous reports (61.5% (8/13) [2], 95.2% (20/21) [10] and 100% (2/2)[1]). The average ratio of the number of parasitized worms in each lung lobe against total worm number in each boar is shown in Fig. 1. Significantly higher numbers of the worms were detected in both sides of the caudal lung lobes, especially in the left caudal lobe, than in the remaining lobes ($p < 0.01$ in Tukey-Kramer's honestly significant difference test after ANOVA [7]). Four species of the genus *Metastrongylus*, *M. elongatus* (ME), *M. salmi* (MS), *M.*

asymmetricus (MA) and *M. pudendotectus* (MP), were identified (Table 1, Fig. 2), and the incidence of each species was 92.9, 100, 88.1 and 71.4%, respectively. All the wild

Fig. 1. Ratio of the number of parasitized worms in each lung lobe against total worm number in each boar. Cr., Ca., M., A., L. and R. under the X-axis are abbreviated names of the parts of lung lobe, meaning “cranial”, “caudal”, “middle”, “accessory”, “left” and “right”, respectively. Dots in the graph indicate the ratio of each boar. Bars indicate average and standard deviation. Different combinations of alphabets shown by every bar indicate significance ($p < 0.01$).

Table 1. Measurements of 4 species of the genus *Metastrongylus*

	<i>M. elongatus</i>	<i>M. salmi</i>	<i>M. asymmetricus</i>	<i>M. pudendotectus</i>
Male (n=10)				
Body length (mm)	10.5–18.5 (15.55 ± 2.72)	10.0–18.0 (13.9 ± 2.18)	11.5–18.5 (15.05 ± 2.65)	13.5–25.0 (18.0 ± 3.83)
Spicule				
Length (mm)	3.73–4.73 (4.08 ± 0.284)	2.05–2.56 (2.22 ± 0.160)	0.57–0.88 (0.68 ± 0.084)	1.07–1.24 (1.18 ± 0.065)
Barb of terminal	single	single	double	double
Gubernaculum length (μm)	ND	ND	30–45 (37.5 ± 6.45)	30–40 (36.25 ± 4.79)
Genital cone	Strongly developed, tip bent ventrally	Considerably developed	Weakly developed	Weakly developed
Cloaca	On median line of body	On median line of body	Shifted to left side of body	On median line of body
Bursa copulatrix				
Shape	Small and short	Small and elongated	Voluminous	Voluminous
Length (μm)	320–420 (357.1 ± 40.3)	470–540 (510 ± 23.1)	470–570 (533.8 ± 32.9)	480–590 (541 ± 38.1)
Width (μm)	290–250 (269.3 ± 16.9)	310–350 (325.7 ± 14.0)	320–450 (382.5 ± 48.9)	380–460 (433.3 ± 25.0)
Female (n=10)				
Body length	29.5–45.5 (38.55 ± 4.85)	24.5–32.0 (28.7 ± 2.20)	16.5–26.0 (21.8 ± 2.80)	22.5–30.5 (26.67 ± 2.53)
Vulva	Somewhat anterior to anus and postero-dorsal to prevulvar swelling	Somewhat anterior to anus and postero-dorsal to prevulvar swelling	On ventral base of prevulvar swelling	Near to anus and postero-dorsal to prevulvar swelling
Prevulvar cuticular dilatation	absent	absent	present	present
Prevulvar swelling	Hemispherical	Flattened- hemispherical	Set off sharply from body anteriorly	Set off sharply from body anteriorly
Tail length (μm)	50–100 (78 ± 15.85)	75–100 (88.5 ± 10.55)	135–210 (168 ± 21.11)	105–165 (142 ± 16.54)
Eggs in vagina				
Length (μm)	45.0–55.0 (49.75 ± 2.59)	46–55 (49.9 ± 3.06)	50–57 (53.0 ± 2.40)	54–66 (59.0 ± 4.1)
Width (μm)	33.5–38.0 (35.55 ± 1.44)	20.5–40 (34.0 ± 5.25)	29.0–42.5 (37.2 ± 4.20)	34.5–52.5 (40.9 ± 5.0)

* Numerical values present as range with average ± standard deviation in parentheses.

* ND: not detected.

boars were infected with 2 or more species, and the combination ratios of the appeared species were; all 4 species: 64.3%, 3 species: 23.8% (ME & MS & MA=16.7% and ME & MS & MP=7.1%) and 2 species: 11.9% (ME & MS=4.8% and MS & MA=7.1%). The other combinations were not found. The composition of the species, ME:MS:MA:MP = 1.3:3.4:1.0:1.4, was different from the previous reports (ME:MS:MA:MP = 4.4:2.6:1.0:0 [3]; = 4.8:2.4:1.0:0 [9]) in the points of the most frequent species (MS instead of ME) and a presence of MP. Although MP was already reported with MA in Japan [2], its incidence has not been presented. It is difficult to explain these differences because the dominant species of lung worms in the wild boars or cross-bred pigs vary depending on countries, e.g. MP in Germany [8], MS in Ghana [11] and ME in Florida [4] and Iran [12].

The seasonal change in the intensity of infection in each

species is shown in Fig. 3. The peak of the average number of the parasites was observed on the period of January to March 2001 because of the increase of MS, but there was no significant difference among the seasonal changes of each species by ANOVA. This seasonal analysis could not be compared with the other Japanese cases because no such information has been presented in Japan. However, Foster *et al.* [4] reported that the peak intensity in the feral swine in Florida was observed on the period of October to December because of the increase of ME among of the detected three species (ME, MS and MP). The difference between the results in the present survey and previous reports [2–4, 9, 10] would be attributed to the geographical and/or the temporal difference. More intensive and periodical investigation should be carried out to confirm the differences.

Fig. 2. Morphological features of the caudal end of 4 *Metastrongylus* spp. collected. a-c: *M. elongatus*, d-f: *M. salmi*, g-i: *M. asymmetricus* and j-l: *M. pudendotectus*. a, d, g and j: ventral view, b, e, h and k: lateral view of male. c, f, i and l: female lateral view with an arrow head indicating the vulval opening. Bar = 100 μ m.

Fig. 3. Seasonal changes in the average intensity of infection. ◆: all species, ■: *M. elongatus*, ▲: *M. salmi*, ×: *M. asymmetricus*, ●: *M. pudendotectus*. Bar = standard error of means. Numbers of examined animals on each season show in the parenthesis under the X axis. Seasonal differences are not significant statistically.

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