Scanning electron microscopy of *Strongyluris calotis* (Nematoda: Ascaridida: Heterakidae) in the large intestine of agamid lizards in Asia

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⁵Vietnam National Museum of Nature, VAST

ABSTRACT

*Strongyluris calotis* is a heterakid nematode which dwells in the large intestine of agamid lizards from the Oriental region. Specimens collected from the Ryukyu tree lizard, *Japalura polygonata* (Agamidae), in the Ryukyu Islands, Okinawa, Japan; the Taiwan japalure, *Japalura swinhonis*, in the northern part of Taiwan; and the Emma Gray’s forest lizard, *Calotes emma* (Agamidae), in Singapore, were - for the first time - subjected to an intensive scanning electron microscopic observation of the head and caudal portion to clarify the arrangement and number of cephalic and caudal papillae. The worms had three lips offset from the body and distinct cuticular flanges extended from the upper part of the internal surface of each lip. For both sexes, the dorsal lip had a pair of cephalic papillae and each subventral lip had a cephalic papilla, an external labial papilla, and an amphid. Male worms had a posteriorly directed precloacal sucker bearing three pairs of papillae ventrally on both lateral sides, two pairs of small adcloacal papillae on both lateral sides of the cloacal opening, and two pairs of ventrolateral papillae on both sides around the level of the cloaca. In addition, near the posterior end around the terminal spike, three pairs of small papillae and a pair of phasmids were noted. However, the first and second pairs of postcloacal papillae were fused to form a united structure. Female worms had a pair of phasmids on the lateral sides of the posterior tail, which has been recorded as a pair of papillae in previous studies. Therefore, male *S. calotis* worms had 10 pairs of caudal papillae and a pair of phasmids; however, two pairs of postcloacal papillae were completely fused to form a pair of united papilla structures.

Keywords: *Strongyluris calotis*, lizard, *Japalura polygonata*, *Japalura swinhonis*, *Calotes emma*, Japan, Taiwan, Singapore, scanning electron microscopy (SEM).

1. INTRODUCTION

The genus *Strongyluris* Müller, 1894 is assigned to heterakid nematodes with lips offset from the body, notable cuticular flanges extending from each lip, a posteriorly directed precloacal sucker, two non-alate spicules of equal length and shape, and an obliquely truncate tail with a short terminal spike in male worms. Multiple stout pedunculated papillae support the caudal cuticular expansion of male worms. The type species of the genus is *S. brevicaudata* Müller, 1894 and currently more than 30 species have been recorded from the large intestine of lizards and, rarely, amphibians. Bursey et al. [3, 4] chronicled 32 nominal *Strongyluris* spp. recorded worldwide, including six species from the Oriental zoogeographic region. Inglis...
specifically expressed his concern regarding whether every nominal species at that time, also included in the latest list by Bursey et al. [4], could be differentiated from congeners based on descriptions by each research group, in which variable levels of morphological observations were conducted and recorded. In the present study, we employed scanning electron microscopy (SEM) to observe for the first time fine structures of the anterior and posterior ends of Strongyluris calotis Baylis et Daubney, 1923 from agamid lizards in Japan, Taiwan, and Singapore.

2. MATERIALS AND METHODS

Japanese isolates of S. calotis were collected from Ryukyu tree lizards, Japalura polygonata (Hallowell, 1861) (Agamidae), in the Ryukyu Islands, Okinawa Prefecture, Japan [see 9]. Other specimens were collected from Taiwan japalures, Japalura swinhonis (Günther, 1864), in the northern part of Taiwan [see 15]. These lizards from the Ryukyu Islands and Taiwan were collected by Prof. Hidetoshi Ota (formerly of the University of the Ryukyus and presently the University of Hyogo, Japan) and the third author (H.H.) between July 1981 and August 1986 [9, 15]. Similarly, S. calotis specimens from an Emma Gray’s forest lizard, Calotes emma (Agamidae), were collected by the fourth author (C.H.D.) in Singapore in 2000.

Morphological observations using a light microscope were conducted as described in an earlier study [19]. Measurements are in millimeters (mm), with the range followed by the mean in parentheses. Nematodes were deposited in the Meguro Parasitological Museum, Tokyo, Japan, under the specimen numbers MPM Coll. Nos. 21145-21160.

Individual male and female worms with different origins, stored in 70% alcohol or 10% neutral-buffered formalin solution, were cut into three longitudinally equal parts. The anterior and posterior one-third parts were used for SEM. They were washed three times in 0.2 M NaHPO₄-NaH₂PO₄-buffered solution (PB), pH 7.8, and immersed in 2.5% glutaraldehyde in PB overnight. The subsequent SEM processes were similar to those described previously [19].

3. RESULTS

Strongyluris calotis specimens examined in the present study were small-sized nematodes, ca. 7–12 mm in length, and had tapering anterior ends and stout posterior ends with a small terminal spike in both sexes. No lateral alae were observed. The cephalic end had three lips offset from the body and distinct cuticular flanges extended from the upper part of the internal surface of each lip. The cephalic papillae and amphids on the lips of male and female worms were arranged similarly as follows: a pair of large-sized cephalic papillae on the dorsal lip, whereas a large-sized cephalic papilla, a small-sized external labial papilla, and an amphid were present on each subventral lip (Fig. 1). A small pharyngeal tooth was situated at the center of the inner wall of each lip. The esophagus consisted of a

![Fig. 1. SEM view of the anterior end of S. calotis. (A) Male S. calotis in Japalura swinhonis from Taiwan; (B) male S. calotis in Japalura polygonata on Yonakuni Is., Okinawa, Japan; and (C) female S. calotis in Japalura polygonata from Kunigami, Okinawa Main Island, Japan. Photographs are at the same magnification and the scale is shown in B. Abbreviations: Am, amphid; cF, cuticular flange; chP, cephalic papilla; cvP, cervical papilla; DL, dorsal lip; elP, external labial papilla; phT, pharyngeal teeth; and SVL, subventral lip.](image-url)
corpus and a tri-valved posterior bulb. Male worms had a posteriorly directed precloacal sucker, two non-alate spicules of equal length and shape, but no gubernaculum. The caudal papillae of male worms were arranged symmetrically (Fig. 2). Around an obliquely truncate tail of male worms, seven pairs of stout pedunculated

Fig. 2. SEM view of the posterior end of male *S. calotis*. (A, B) Worm in *Japalura swinhonis* from Taiwan; (C, D) worm in *Japalura polygonata* on Yonakuni Is., Okinawa, Japan; (E, F) another worm in *Japalura polygonata* on Yonakuni Is., Okinawa, Japan; and (G, H) worm in *Japalura polygonata* from Kunigami, Okinawa Main Island, Japan. Photographs on the right side (B, D, F, H) are three times higher magnification of a part of each photograph on the left side (A, C, E, G), respectively. Photographs placed on the same side are at the same magnification and scales are shown in A and B. Abbreviations: adcP, adcloacal caudal papilla; CL, cloaca; Ph, phasmid; pocP, postcloacal caudal papilla around the terminal spike; precP, precloacal caudal papilla; Sc, precloacal sucker; Sp, spicule; tSK, terminal spike; and vlcP, ventrolateral caudal papilla around the cloaca. pocP-1/2 denotes united papillae.
papillae supported the caudal cuticular expansion: three pairs (precP-1 to 3 in Fig. 2), large, ventrally on the lateral sides of the precloacal sucker; two adcloacal pairs (adcP-1 and 2 in Fig. 2), smaller, at the levels of the anterior and posterior edges of the cloacal opening; and two pairs of ventrolateral papillae (vlcP-1 and 2 in Fig. 2) around the level of the cloaca or somewhat posteriorly. In addition, near the posterior end around the terminal spike, three pairs of small papillae (pocP-1/2 and 3 in Fig. 2) and a pair of phasmids (Ph in Fig. 2) were observed. The first and second postcloacal papillae formed a structure of fused papillae (pocP-1/2) slightly anterolateral to the caudal spike and pocP-3 was lateral or somewhat dorsal to the terminal spike in all the male worms studied. In total, male worms had 10 pairs of caudal papillae and a pair of phasmids. In female worms, a pair of phasmids was seen on the lateral sides of the posterior tail (Fig. 3). The morphometric values of the worms chosen arbitrarily and examined in the present study are compared with those detailed in previous reports (Table 1).

4. DISCUSSION

The specimens collected from the Ryukyu Islands and examined in the present study were similar to those previously examined by Hasegawa and Iwatsuki [9]. Originally described as ‘Ascaridia japalurae’ [20], they identified the specimens as Strongylurus japalurae (Yamaguti, 1935). The description by Yamaguti [20] of the arrangement of pedunculated papillae in the caudal portion of male worms is absolutely identical to that observed by light microscopy in the present study. Yamaguti [20] counted 10 pairs of caudal papillae in total. These morphological features, particularly the arrangement and number of caudal papillae in male worms, correspond to the specific definition of S. calotis by Baylis and Daubney [2], and thence Bursey et al. [3] listed A. japalurae as a junior synonym of S. calotis.

The number of caudal papillae of S. calotis differs among reports (Table 1). This inconsistency is due to the minute papillae assembled around the terminal spike that are frequently indiscernible by light microscopy. As shown by SEM in the present study, there were three pairs of small caudal papillae, two of which formed a structure of united papillae (pocP-1/2 in Fig. 2), and a pair of phasmids around the terminal spike in male worms. The phasmids resembled other caudal papillae under light microscopy, but were readily distinguished by SEM from their protrusion from a cavity and their tips being knob-shaped and larger than the terminus of the dendritic process of caudal papillae (Fig. 2). Similarly, a pair of phasmids was observed in the female tail by both light microscopy and SEM (Fig. 3). Also using SEM, Gibbons [7] named such structures in the female tail of S. brevicaudata as ‘papilla-like structures’.

According to Bursey et al. [4], with the addition of S. amazonicus by Santos et al. [16], 33 nominal Strongylurus spp. have currently been recorded worldwide. They
Table 1. Morphometric comparison of *Strongylurus calotis* in the present study and previous studies (measurement in millimeter)

<table>
<thead>
<tr>
<th>Host</th>
<th>Japalura polygonata donan</th>
<th>Japalura polygonata polygonata</th>
<th>Japalura swinhonis</th>
<th>Japalura polygonata</th>
<th>Calotes nigrilabris</th>
<th>Japalura splendida</th>
<th>Japalura swinhonis</th>
<th>Calotes sp.</th>
<th>Calotes sp.</th>
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<td>Locality</td>
<td>Japan (Ryukyu Islands; Yonakuni)</td>
<td>Japan (Ryukyu Islands; Kunigami)</td>
<td>Taiwan (Taipei)</td>
<td>Japan (Ryukyu Islands)</td>
<td>Sri Lanka</td>
<td>China (Sichuan)</td>
<td>Taiwan</td>
<td>India (West Bengal)</td>
<td></td>
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<tr>
<td>Reference</td>
<td>The present study (^a)</td>
<td>The present study (^a)</td>
<td>The present study</td>
<td>[8]</td>
<td>[2]</td>
<td>[9]</td>
<td>[19]</td>
<td>[17]</td>
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### Male

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<th>(n=5)</th>
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<tbody>
<tr>
<td>Worm length</td>
<td>6.7−8.1 (7.4)</td>
<td>91−108 (100)</td>
<td>6.6−7.0 (6.9)</td>
<td>9.0−102</td>
<td>8.9−111</td>
<td>115−134</td>
<td>86−91</td>
<td>126−140</td>
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<tr>
<td>Worm width</td>
<td>0.29−0.34 (0.32)</td>
<td>0.35−0.41 (0.37)</td>
<td>0.30−0.38 (0.35)</td>
<td>0.32−0.51</td>
<td>0.40−0.50</td>
<td>0.42−0.52</td>
<td>0.21−0.26</td>
<td>0.06−0.25</td>
</tr>
<tr>
<td>Pharynx length</td>
<td>0.17−0.20 (0.18)</td>
<td>0.18−0.22 (0.20)</td>
<td>0.16−0.19 (0.18)</td>
<td>0.20−0.22</td>
<td>0.17−0.23</td>
<td>0.21−0.23</td>
<td>0.17−0.18</td>
<td>0.27−0.30</td>
</tr>
<tr>
<td>Esophagus length</td>
<td>1.22−1.36 (1.28)</td>
<td>1.27−1.39 (1.33)</td>
<td>1.25−1.33 (1.29)</td>
<td>1.3−1.5</td>
<td>1.6−1.5</td>
<td>1.5−1.5</td>
<td>1.6−1.5</td>
<td>1.6−1.5</td>
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<tr>
<td>Bulb length</td>
<td>0.17−0.19 (0.18)</td>
<td>0.19−0.21 (0.20)</td>
<td>0.16−0.19 (0.17)</td>
<td>0.24−0.29</td>
<td>0.21−0.32</td>
<td>0.21−0.32</td>
<td>0.21−0.32</td>
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<tr>
<td>Bulb width</td>
<td>0.18−0.22 (0.20)</td>
<td>0.21−0.22 (0.21)</td>
<td>0.21−0.22 (0.21)</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
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<tr>
<td>Nerve ring from anterior end</td>
<td>0.37−0.42 (0.40)</td>
<td>0.38−0.42 (0.40)</td>
<td>0.36−0.41 (0.38)</td>
<td>0.34−0.49</td>
<td>0.40−0.50</td>
<td>0.40−0.50</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Excretory pore from anterior end</td>
<td>0.81−0.95 (0.89)</td>
<td>0.85−0.94 (0.88)</td>
<td>0.86−0.95 (0.86)</td>
<td>1.05−1.20</td>
<td>1.15−1.25</td>
<td>1.15−1.25</td>
<td>−</td>
<td>−</td>
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<tr>
<td>Spiculae Length</td>
<td>0.36−0.59 (0.57)</td>
<td>0.54−0.68 (0.61)</td>
<td>0.56−0.68 (0.62)</td>
<td>−</td>
<td>0.75−0.80</td>
<td>0.79−0.84</td>
<td>0.64−0.68</td>
<td>0.66−0.84</td>
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<tr>
<td>Tail length</td>
<td>−</td>
<td>−</td>
<td>0.085−0.103</td>
<td>−</td>
<td>0.080−0.084</td>
<td>0.075−0.081</td>
<td>0.09−0.112</td>
<td>0.09−0.114</td>
</tr>
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### Female

<table>
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<tr>
<th></th>
<th>(n=5)</th>
<th>(n=5)</th>
<th>(n=4)</th>
<th>(n=?)</th>
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<th>(n=5)</th>
<th>(n=3)</th>
<th>(n=?)</th>
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<tbody>
<tr>
<td>Worm length</td>
<td>7.9−9.2 (8.4)</td>
<td>11.3−12.1 (11.9)</td>
<td>7.1−8.8 (7.8)</td>
<td>9.7−149</td>
<td>11.0−1365</td>
<td>131−160</td>
<td>9.8−11.9</td>
<td>150−203</td>
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<tr>
<td>Worm width</td>
<td>0.31−0.38 (0.35)</td>
<td>0.46−0.56 (0.52)</td>
<td>0.35−0.45 (0.39)</td>
<td>0.39−0.69</td>
<td>0.55−0.75</td>
<td>0.65−0.97</td>
<td>0.38−0.30</td>
<td>0.06−0.084</td>
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<tr>
<td>Pharynx length</td>
<td>0.20−0.21 (0.20)</td>
<td>0.21−0.23 (0.22)</td>
<td>0.18−0.22 (0.20)</td>
<td>0.21−0.27</td>
<td>0.22−0.38</td>
<td>0.21−0.34</td>
<td>0.27−0.30</td>
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<tr>
<td>Esophagus length</td>
<td>1.57−1.68 (1.63)</td>
<td>1.46−1.62 (1.53)</td>
<td>1.40−1.51 (1.49)</td>
<td>1.4−2.1</td>
<td>1.75−2.25</td>
<td>15−19</td>
<td>15−15</td>
<td>15−15</td>
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<tr>
<td>Bulb length</td>
<td>0.18−0.22 (0.20)</td>
<td>0.21−0.22 (0.22)</td>
<td>0.20−0.22 (0.20)</td>
<td>0.27−0.36</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>0.03−0.03</td>
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<tr>
<td>Bulb width</td>
<td>0.22−0.25 (0.24)</td>
<td>0.22−0.25 (0.23)</td>
<td>0.24−0.25 (0.25)</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>0.23−0.27</td>
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<tr>
<td>Nerve ring from anterior end</td>
<td>0.38−0.42 (0.40)</td>
<td>0.42−0.46 (0.43)</td>
<td>0.42−0.47 (0.44)</td>
<td>0.39−0.54</td>
<td>−</td>
<td>0.40−0.47</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Excretory pore from anterior end</td>
<td>0.81−1.02 (0.90)</td>
<td>0.91−1.01 (0.97)</td>
<td>0.79−0.98 (0.92)</td>
<td>0.83−1.39</td>
<td>−</td>
<td>1.0−1.25</td>
<td>−</td>
<td>−</td>
</tr>
</tbody>
</table>

**Valva**

- Distance from anterior end | 4.8−5.7 (5.3) | 6.6−7.4 (7.1) | 4.3−5.5 (4.8) | 5.5−9.1 | 6.3−8.0 | 7.7−9.7 | − | 8.8−12.5 |
- Location | 60.66 (60.62) | 60.61 (60.62) | 55.45 (55.45) | 50.56 (50.56) | 50.67 (50.67) | 50.67 (50.67) | 50.67 (50.67) | 50.67 (50.67) |
- Tail length | 0.13−0.16 (0.14) | 0.14−0.16 (0.15) | 0.16−0.16 (0.16) | 0.16−0.22 | 0.22−0.25 | 0.22−0.28 | 0.23−0.28 | 0.16−0.18 |
- Egg length | 0.072−0.084 (0.080) | 0.076−0.084 (0.079) | 0.079−0.083 | 0.080−0.084 | 0.081−0.089 | − | − | − |
- Egg width | 0.040−0.044 (0.041) | 0.040 | 0.040−0.044 (0.041) | 0.088−0.084 | 0.080−0.083 | 0.081−0.089 | − | − |

\(^a\) S. calotis from *Japalura polygonata* in the Ryukyu Islands, Okinawa, Japan, examined in the present study are a part of specimens examined previously by Hasegawa and Iwatsuki \([8]\).

\(^b\) Total in number (precloacal : adcloacal : ventrolateral : terminal).

\(^c\) Shown data are based on light microscopic observation, but according to SEM examination two of six terminal papillae were phasmids.

\(^d\) The original records provide only that male worms had 6 precloacal and 14 postcloacal papillae in the caudal region.

\(^e\) Distance between anterior end and vulva / worm length.
Table 2. Morphometric comparison of Strongylurus spp. with Oriental distribution (measurements in millimeters)\textsuperscript{a,b,}\textsuperscript{a}

<table>
<thead>
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<tr>
<td>Host</td>
<td>Chamaeleo vulgaris; Cophotis ceylanica; Ceratophora stoddarti; Calotes versicolor</td>
<td>Calotes nigripennis</td>
<td>Calotes sericeicolor</td>
<td>Calotes versicolor</td>
<td>Bufo melanostictus</td>
<td>Japalura sumomotonis formosensis</td>
<td>Calotes versicolor</td>
</tr>
<tr>
<td>Locality</td>
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<td>Sri Lanka</td>
<td>India (Calcutta)</td>
<td>India (Bombay)</td>
<td>Taiwan (Taipei)</td>
<td>Taiwan (Taichung)</td>
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<td>Reference</td>
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<td>[2]</td>
<td>[6]</td>
<td>[13]</td>
<td>[21]</td>
<td>[12]</td>
<td>[14]</td>
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<td>Male</td>
<td>( (n=1) )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
<td>( (n=4) )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
</tr>
<tr>
<td>Worm length</td>
<td>6.3</td>
<td>8.9−11.1</td>
<td>9.0−11.5</td>
<td>16.0−18.6</td>
<td>5.8−7.8</td>
<td>7.8−12.7</td>
<td>7.9−11.1</td>
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<td>Worm width</td>
<td>0.50</td>
<td>0.40−0.50</td>
<td>0.36−0.47</td>
<td>1.05−1.10</td>
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<td>0.25−0.30</td>
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<td>Pharynx length</td>
<td>0.18−0.22</td>
<td>1.75−220</td>
<td>0.15−0.22</td>
<td>0.17−0.20</td>
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<td>Esophagus length</td>
<td>( \text{ca. 11} )</td>
<td>( \text{ca. 11} )</td>
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<td>1.35−1.41</td>
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<td>1.15−1.69</td>
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<td>Bulb length</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>0.15−0.22</td>
<td>–</td>
<td>–</td>
<td>0.15−0.25</td>
<td>0.17−0.22</td>
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<tr>
<td>Bulb width</td>
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<td>( \text{ca. 0.20−0.25} )</td>
<td>0.11−0.18</td>
<td>0.19−0.20</td>
<td>0.19−0.21</td>
<td>0.20−0.24</td>
<td>0.23−0.29</td>
</tr>
<tr>
<td>Nerve ring from anterior end</td>
<td>–</td>
<td>–</td>
<td>0.30−0.63</td>
<td>0.42−0.04</td>
<td>0.36−0.41</td>
<td>0.36−0.48</td>
<td>–</td>
</tr>
<tr>
<td>Excretory pore from anterior end</td>
<td>–</td>
<td>–</td>
<td>1.1−1.5</td>
<td>1.04−1.11</td>
<td>ca. 1.0</td>
<td>–</td>
<td>0.90−0.91</td>
</tr>
<tr>
<td>Spicule length</td>
<td>11</td>
<td>0.75−0.80</td>
<td>0.76−0.03</td>
<td>0.57−0.59</td>
<td>0.57−0.63</td>
<td>0.50−0.76</td>
<td>0.35−0.75</td>
</tr>
<tr>
<td>Tail length</td>
<td>0.18</td>
<td>–</td>
<td>0.09</td>
<td>–</td>
<td>–</td>
<td>0.03−0.068</td>
<td>0.15−0.19</td>
</tr>
<tr>
<td>Female</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
<td>( (n=1) )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
<td>( (n=?* )</td>
</tr>
<tr>
<td>Worm length</td>
<td>8.4−8.8</td>
<td>11.0−117</td>
<td>14.0−150</td>
<td>23</td>
<td>79−91</td>
<td>84−121</td>
<td>87−115</td>
</tr>
<tr>
<td>Worm width</td>
<td>0.30−0.70</td>
<td>0.55−0.075</td>
<td>0.57−0.66</td>
<td>1.13</td>
<td>0.3−0.4</td>
<td>0.27−0.35</td>
<td>0.45−0.52</td>
</tr>
<tr>
<td>Pharynx length</td>
<td>0.18−0.22</td>
<td>1.75−225</td>
<td>0.20−0.27</td>
<td>0.36</td>
<td>0.20−0.21</td>
<td>0.22−0.23</td>
<td>0.21−0.28</td>
</tr>
<tr>
<td>Esophagus length</td>
<td>( \text{ca. 14} )</td>
<td>( \text{ca. 14} )</td>
<td>13−15</td>
<td>1.70</td>
<td>1.3−1.5</td>
<td>1.73−2.15</td>
<td>1.44−1.86</td>
</tr>
<tr>
<td>Bulb length</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>0.22−0.27</td>
<td>–</td>
<td>–</td>
<td>0.23−0.26</td>
<td>0.26−0.25</td>
</tr>
<tr>
<td>Bulb width</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>( \text{ca. 0.20−0.25} )</td>
<td>0.18−0.25</td>
<td>0.25</td>
<td>0.21−0.23</td>
<td>0.25−0.25</td>
<td>0.21−0.30</td>
</tr>
<tr>
<td>Nerve ring from anterior end</td>
<td>–</td>
<td>–</td>
<td>0.40−0.45</td>
<td>0.5</td>
<td>0.27−0.44</td>
<td>0.40−0.46</td>
<td>–</td>
</tr>
<tr>
<td>Excretory pore from anterior end</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1.34</td>
<td>0.9−1.0</td>
<td>–</td>
<td>0.95−1.03</td>
</tr>
<tr>
<td>Vulva</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
<td>( \text{Distance from anterior end} )</td>
</tr>
<tr>
<td>Position( ^e )</td>
<td>0.62−0.064 (0.63)</td>
<td>0.53−0.062 (0.38)</td>
<td>0.69</td>
<td>0.60</td>
<td>0.62−0.63</td>
<td>0.65−0.68 (0.67)</td>
<td>0.59−0.65 (0.62)</td>
</tr>
<tr>
<td>Tail length</td>
<td>0.30</td>
<td>0.22−0.25</td>
<td>0.22</td>
<td>0.18</td>
<td>0.16−0.18</td>
<td>0.19−0.24</td>
<td>0.15−0.19</td>
</tr>
<tr>
<td>Egg length</td>
<td>0.007</td>
<td>0.008−0.009</td>
<td>0.006−0.014</td>
<td>0.007−0.008</td>
<td>0.009−0.008</td>
<td>0.006−0.006</td>
<td>0.005−0.008</td>
</tr>
<tr>
<td>Egg width</td>
<td>0.005</td>
<td>0.005−0.005</td>
<td>0.006−0.006</td>
<td>0.005−0.005</td>
<td>0.006−0.006</td>
<td>0.004−0.005</td>
<td>0.003−0.004</td>
</tr>
</tbody>
</table>

\( ^a \) In addition to six nominal Strongylurus spp. with Oriental distribution \[4] , 'Strongylurus manipurensis' described by Lakshmipyari et al. \[14\], which we consider to be poorly characterized as an independent species, is shown for reference only.

\( ^b \) Total number (precloacal : adcloacal : ventrolateral : terminal).

\( ^c \) The original records provide only that male worms had 6 precloacal and 14 postcloacal papillae in the caudal region.

\( ^d \) Distance between anterior end and vulva / worm length.
are divided into five groups of different zoogeographical distribution, with six species being recorded from the Oriental region, namely, *S. chamaeleonis* [1], *S. calotis* [2], *S. bengalensis* [3], *S. karawirensis* [13], *S. bufonis* [21], and *S. japalurae* [12]. Except for *S. bufonis*, all species were recorded from lizards. Based on morphological features at the level of light microscopy, such as body size, length of esophagus or its proportion to body length, spicule length or its proportion to male body length, number and arrangement of caudal papillae of male worms, vulval position, and egg size, these nominal species were characterized as independent species by combinations of several morphological differences [1, 2, 6, 9, 10, 12-14, 18, 20, 21]. For reference, the morphometrics of these *Strongyluris* spp. with Oriental distribution are summarized in Table 2.

In the present study, measurements of *S. calotis* specimens collected at three different localities (one in Taiwan and two on different islands of Okinawa, Japan) (Table 1) were considerably variable by their origin or arbitrary but artificial grouping. Furthermore, microscopic observation of the arrangement and number of caudal papillae in the obliquely truncate posterior end of male worms is often difficult and can result in varying degrees of recording accuracy. Fundamentally, however, different species or different isolates of Oriental *Strongyluris* spp. had 10 or nine pairs of caudal papillae depending on different numbers of postcloacal caudal papillae around the terminal spike, i.e. three or two pairs, in male worms. Currently, it is unclear whether previous studies excluded a pair of phasmids from postcloacal caudal papillae. As mentioned above, in contrast to SEM, under light microscopy it is very difficult to differentiate the phasmids from small-sized caudal papillae near the end of male worms (Fig. 2). Furthermore, our SEM study also demonstrated that the anterior pairs of postcloacal papillae were fused and this morphological character was consistently detected in all the *S. calotis* specimens we examined.

Baylis and Daubney [2] described *S. calotis* concisely as a new species from the rectum of *Calotes nigrilabris* in Sri Lanka in 1923 and reported 10 pairs of caudal papillae in male worms – three at the sides of the precloacal sucker and seven postcloacal – without morphological drawings. This species has been recorded from a wide spectrum of lizards in the Oriental region from the Far East to Turkey including East Asia and India [8, 9, 22]. It would be of great interest to examine *S. calotis* specimens from different hosts and geographical origins to determine whether the SEM morphological characters observed in this study are consistent in all of them.

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bengalensis n. sp. with a note on the genus. Z. Parasitenk. 8 : 542-545.

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アジア産キノボリトカゲの大腸に寄生する
Strongyluris calotis (Nematoda: Ascaridida: Heterakidae)
の走査電子顕微鏡による観察

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2山口大学 大学院畜獣医学研究科 寄生虫学教室
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要 約

Strongyluris calotis は東洋地域に分布するキノボリトカゲ科爬虫類の大腸に寄生する盲腸虫科線虫である。国内の琉球列島産のキノボリトカゲ (Japalura polygonata)、台湾北部産のスインホーキノボリトカゲ (Japalura swinhonis)、シンガポール産エンマカロテス (Calotes emma) から得た S. calotis 標本について、その頭部および尾部の乳頭の配列と数を確認することを目的に本格的な走査顕微鏡観察を行った。虫体は体部から突出する3つの口唇をもち、また、各口唇の内面上部からクチクラ性の膜が伸っていた。雌雄虫体ともに、背唇には2つの頭部乳頭が左右対称に位置し、亜腹唇それぞれに頭部乳頭、外口唇乳頭、アンフィド各1つが配されていた。雄虫後部腹面には、後方に向かう肛前吸盤が観られ、その両側に3組の有茎乳頭が位置するとともに、総排泄孔周辺乳頭の左右に2組の総排泄孔周辺乳頭、総排泄孔のレベルで左右の側腹面に2組の乳頭が観察された。加えて、後端部突起周辺部において左右対称に、3組の小さな乳頭および1組のファスミッドが配されていた。後端部突起周辺の乳頭3組のうち2組の乳頭は融合し、1つの構造物を形成していた。雌虫尾部の左右側面には各1つのファスミッドが観察されたが、これは、従来の研究では乳頭と表記されてきたものである。これらの観察結果から、S. calotis 雄虫は10組の尾部乳頭と1組のファスミッドをもつことが確認できたが、虫体後端に近い尾部乳頭2組は融合して1組の融合乳頭構造となっていることが新たに判明した。

Keywords: Strongyluris calotis, キノボリトカゲ, スインホーキノボリトカゲ, エンマカロテス, 日本, 台湾, シンガポール, 走査電子顕微鏡 (SEM).