**Geographic Distribution of Gongylonema pulchrum and Gongylonema macrogubernaculum from Macaca fuscata in Japan**

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**Summary:**
After a first report on the gullet nematode, Gongylonema pulchrum Molin, 1857, being found in the Japanese macaque, Macaca fuscata, in Kyushu, Japan, the geographic distribution of the parasite, a causative agent of gongylonemiasis in cattle and man, was examined in 181 monkeys transferred to the Japan Monkey Centre from 23 sites in Japan, including Yakushima (Island). Yakushima is included in the World Natural Heritage List of the United Nations for its subtropical forests, which have an unusual variety of plant and animal species. G. pulchrum was found in M. fuscata yakui monkeys inhabiting Yakushima and M. fuscata fuscata monkeys inhabiting Honshu and an island near Honshu. G. macrogubernaculum was found in M. fuscata yakui monkeys. Comparison of the two kinds of parasite specimens obtained from the variety M. f. fuscata yakui confirmed that G. macrogubernaculum Lubimov, 1931 is a valid species. Thus, the finding of G. macrogubernaculum constitutes a record of a newly identified host, M. fuscata yakui, and shows that Yakushima, Japan, is a natural locality of G. macrogubernaculum.

**Résumé.** Distribution géographique au Japon de Gongylonema pulchrum et G. macrogubernaculum chez Macaca fuscata. La langue, le pharynx, l’oesophage et les poumons ont été examinés chez 181 macaques japonais Macaca fuscata transférés au "Japan Monkey Centre". Ces singes proviennent de 23 localités différentes dont Yakushima, ile remarquable par sa faune et sa flore subtropicales, située au sud de Kyushu. Gongylonema pulchrum (déjà signalé chez M. f. fuscata au Japon) a été retrouvé à Honshu et dans une ile voisine et à Yakushima chez M. fuscata yakui. G. macrogubernaculum a été trouvé chez un M. f. yakui de Yakushima et chez un descendant né en captivité. Les caractères différentiels entre G. pulchrum et G. macrogubernaculum sont précisés.

**KEY WORDS:** Gongylonema pulchrum, Gongylonema macrogubernaculum, Macaca fuscata, Yakushima, Japan

**MOTS CLES :** Gongylonema pulchrum, Gongylonema macrogubernaculum, Macaca fuscata, Yakushima, Japan

The gullet nematode, Gongylonema pulchrum, is parasitic in a wide range of mammals and occasionally causes gongylonemiasis in cattle and man (Cappucci et al., 1982). G. pulchrum was found in a previously unidentified host, Macaca fuscata, in Kyushu, Japan, and reported in our previous paper (Uni et al., 1992). A few reports on the incidence of the parasite in cattle and deer in Japan have been published (Suzuki et al., 1992, Kudo et al., 1992, Yokohata and Suzuki, 1993), but the geographic distribution of the parasite in Japanese macaques is not known.

This article deals with the distribution and comparison of G. pulchrum and G. macrogubernaculum in monkeys of Japan, including Yaku-shima off Kyushu. The highest mountain in the Nansei Shoto (Ryukyu Islands), Miyanoura-dake (1,935 m), which contains a nature preserve, is on Yaku-shima, which was added to the World Natural Heritage List of the United Nations in 1993 to encourage preservation of its forests with their wide diversity of plants and animals. The monkeys indigenous to the island are Macaca fuscata yakui, unlike from the Macaca fuscata fuscata inhabiting Kyushu, Honshu (the main island of Japan), and islands near Honshu. Japanese macaques are designated as part of the national heritage, and are studied in terms of ecology and preservation in the Japan Monkey Centre (JMC). Inuyama City, near Nagoya.

Six species of the genus Gongylonema from monkeys worldwide were listed by Yamaguti (1961), but the validity of some of the species has not been ascertained. G. macrogubernaculum was described by Lubimov (1931) from specimens found in imported monkeys (Macaca mulatta, Cebus capucinus, and Miopithecus talapoini) at the Moscow Zoopark. The only other published report about this species has been an abstract (Lucker, 1933). Natural localities of the parasite have been unknown. Here, Yaku-shima is reported to be one natural locality of G. macrogubernaculum.

Under a dissection microscope, the surface of the mucosa of the tongue, pharynx, esophagus, and trachea of 181 monkeys of the varieties Macaca fuscata fuscata and M. fuscata yakui that died in the JMC...
some time between 1961 and 1991 and were preserved in 10% formalin was examined. One hundred and ten of the monkeys were *M. fuscata fuscata*; 106 of them had been caught at 22 sites in Kyushu, Honshu, or islands (Awaji-shima, Shodo-shima, and Miyajima) in the Inland Sea, and the remaining four were born in the JMC. Seventy-one monkeys were *M. fuscata yakui*; 59 of them were transferred to the JMC from Yaku-shima and 12 of them were offspring of these monkeys. The methods used for drawing, measurement, and scanning electron microscopy (SEM) of the parasites were as reported previously (Uni et al., 1992).

*G. pulchrum* was found in five *M. fuscata fuscata* monkeys (5/110, or 5%) from Nukata, Nishiki, and Miyajima, and 13 *M. fuscata yakui* monkeys (13/71, or 18%) from Yaku-shima, including one born in the center (Fig. 1). Of the *M. fuscata yakui* monkeys infected with *G. pulchrum*, four died 26, 41, 58, or 60 days after their arrival in the center, and were probably already infected with the parasites while living on the island (the life cycle of the parasite is described in Cappucci et al., 1982). Male (14 intact specimens): Body length 17-27 mm. Left spicule 4.6-9.3 mm long, right spicule 91-124 µm long, and gubernaculum 68-83 µm long. Female (eight intact specimens): Body length 25-57 mm. Glandular esophagus 3.3-6.4 mm long, and vulva 2.5-3.6 mm from posterior end. Embryonated eggs in the uteri measured 52-62 × 26-36 µm.

*G. macrogubernaculum* was found in two *M. fuscata yakui* monkeys (2/71, or 3%); one died 108 days after arrival and was infected with *G. pulchrum* also, and the other was born in the center (Fig. 1). Male (four intact specimens, Figs. 2-4, 6, and 7): Body length 8.8-14.4 mm, left spicule 4.1-5.5 mm long, right spicule 99-135 µm long, and gubernaculum 130-156 µm long. An *en face* view of the head, observed

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**Fig. 1.** Geographic distribution of Gongylonema pulchrum (•) and *G. macrogubernaculum* (*) from Japanese macaques. Circles show collection sites: 1 Niigata, 2 Nagano, 3 Nukata, 4 Japan Monkey Centre, Inuyama, 5 Mikata, 6 Kanazawa, 7 Wakasa, 8 Hiyoshi, 9 Ogura, 10 Wachi, 11 Ine, 12 Sasayama, 13 Mino, 14 Kasuga, 15 Nishiki, 16 Awaji-shima, 17 Shodo-shima, 18 Mihara, 19 Kake, 20 Miyajima, 21 Takasakiyama, 22 Miyazaki, 23 Yaku-shima.
by SEM, is shown in Figure 6. The head seemed to be smaller than that of *G. pulchrum*, but the six lateral labia seemed to be more protuberant than those of *G. pulchrum* (Uni et al., 1992). The length of the gubernaculum exceeded that of the right spicule in all specimens. Four to seven pedunculate papillae with much space intervening between neighbors were arranged longitudinally at each side of the precloacal area (Fig. 3). Female (one intact specimen, Fig. 5) : Body length 23.0 mm, glandular esophagus 5.4 mm long, vulva 0.93 mm from posterior end. Embryonated eggs measured 43-44 × 23-25 μm. These dimensions were similar to those of *G. macrogubernaculum* described by Lubimov (1931).

The results of measurement of these two Gongylonema species obtained from *M. fuscata*...
yakui showed that *G. macrogubernaculum* could be distinguished from *G. pulchrum* by (a) sexually mature males and females being smaller than *G. pulchrum*; (b) the distance between neighboring precloacal papillae, and the structure and length of the gubernaculum in the male specimens; and (c) the position of the vulva, longer glandular esophagus, and smaller eggs in the female compared with the other species.

That two *M. fuscata yakui* monkeys born in the center harbored *G. pulchrum* or *G. macrogubernaculum* parasites suggested that monkeys could be infected by feeding on intermediate hosts (coprophagous beetles) in the center. Infection by *Gongylonema* spp. in the *M. fuscata yakui* colony in the JMC reflects the presence of the parasites in monkeys in Yaku-shima. There being parasites in Yaku-shima suggests that there are suitable intermediate hosts and perhaps a high rate of survivorship of parasite eggs in monkeys’ feces in the subtropical forests, which have the heaviest rainfall in Japan.

After the description of *G. macrogubernaculum* by Lubimov (1931), *G. microgubernaculum* was described by Gebauer (1933) based on one male specimen with a very short left spicule that was obtained from a monkey. Gebauer included *G. macrogubernaculum* in his description of *G. microgubernaculum* as a synonym in spite of the difference in the length of the gubernaculum. In a comparative study of *G. pulchrum* from various hosts and *Gongylonema* specimens from *Macaca* spp., Lichtenfels (1971) called the specimens from monkeys *G. microgubernaculum* because of the small ratio of the left spicule length to total body length, but he admitted that separation of *G. microgubernaculum* and *G. pulchrum* on the basis of the left spicule length only might be inadvisable. We were able to identify *G. macrogubernaculum* and *G. pulchrum* obtained from Japanese macaques. Thus, our finding of *G. macrogubernaculum* constitutes a record of a newly reported host, *M. fuscata yakui*, and shows that Yaku-shima, Japan, is a natural locality of *G. macrogubernaculum*.

ACKNOWLEDGEMENTS

We thank Drs. S. Kodera and M. Kawai for their helpful suggestions and kind permission to conduct this study at the Japan Monkey Centre, and C. Latta for editing the manuscript.

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Accepté le 2 mai 1994