

GEOGRAPHIC DISTRIBUTION OF *GONGYLONEMA PULCHRUM* AND *GONGYLONEMA MACROGUBERNACULUM* FROM *MACACA FUSCATA* IN JAPAN

UNI S.*, KOBAYASHI S.**, MIYASHITA M.*, KIMURA N.**, KATO A.**, AIMI M.***, KIMATA I.*, ISEKI M.* AND SHOHO C.*

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 Yaku-shima (Island). Yaku-shima 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 Yaku-shima 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. 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 Yaku-shima, Japan, is a natural locality of *G. macrogubernaculum*.

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

Résumé . DISTRIBUTION GEOGRAPHIQUE AU JAPON DE *GONGYLONEMA PULCHRUM* ET *G. MACROGUBERNACULUM* CHEZ *MACACA FUSCATA*.

La langue, le pharynx, l'œsophage 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 Yaku-shima, île 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 île voisine et à Yaku-shima chez *M. fuscata yakui*. *G. macrogubernaculum* a été trouvé chez un *M. f. yakui* de Yaku-shima 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*. Yaku-shima. Japon

MOTS CLES : *Gongylonema pulchrum*. *Gongylonema macrogubernaculum*. *Macaca fuscata*. Yaku-shima. Japon

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 talapoin*) 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 mucosae 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

* Department of Medical Zoology, Osaka City University Medical School, Osaka 545, Japan.

** Japan Monkey Centre, Inuyama 484.

*** Primate Research Institute, Kyoto University, Inuyama 484.

Correspondence to: S. Uni

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 μ m long, and gubernaculum 68-83 μ m 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 \times 26-36 μ m.

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 μ m long, and gubernaculum 130-156 μ m long. An *en face* view of the head, observed

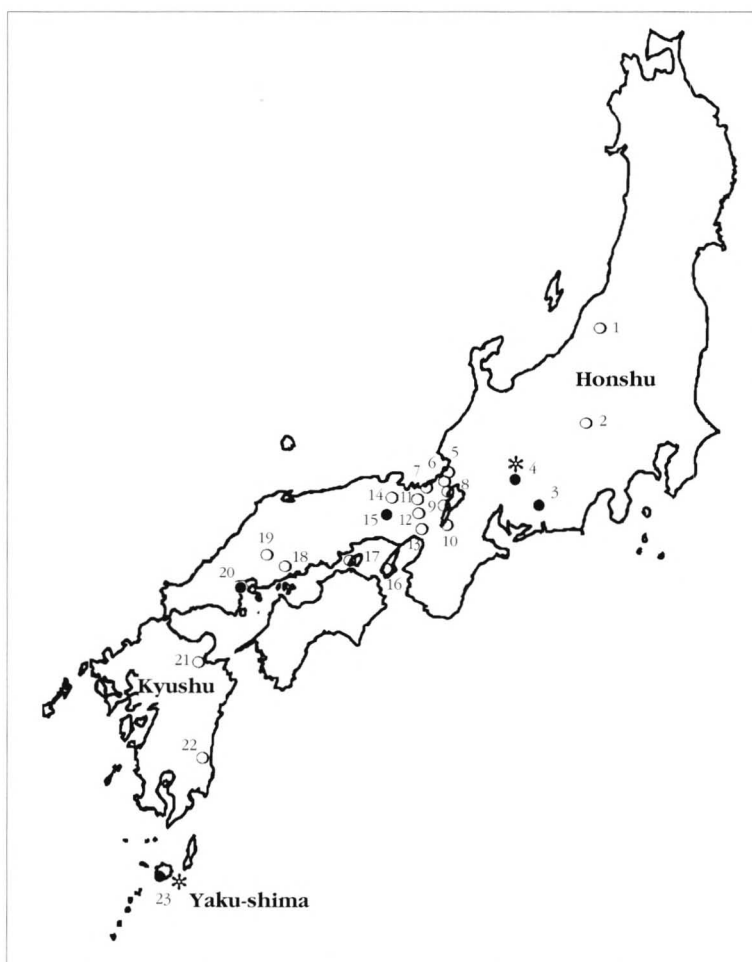
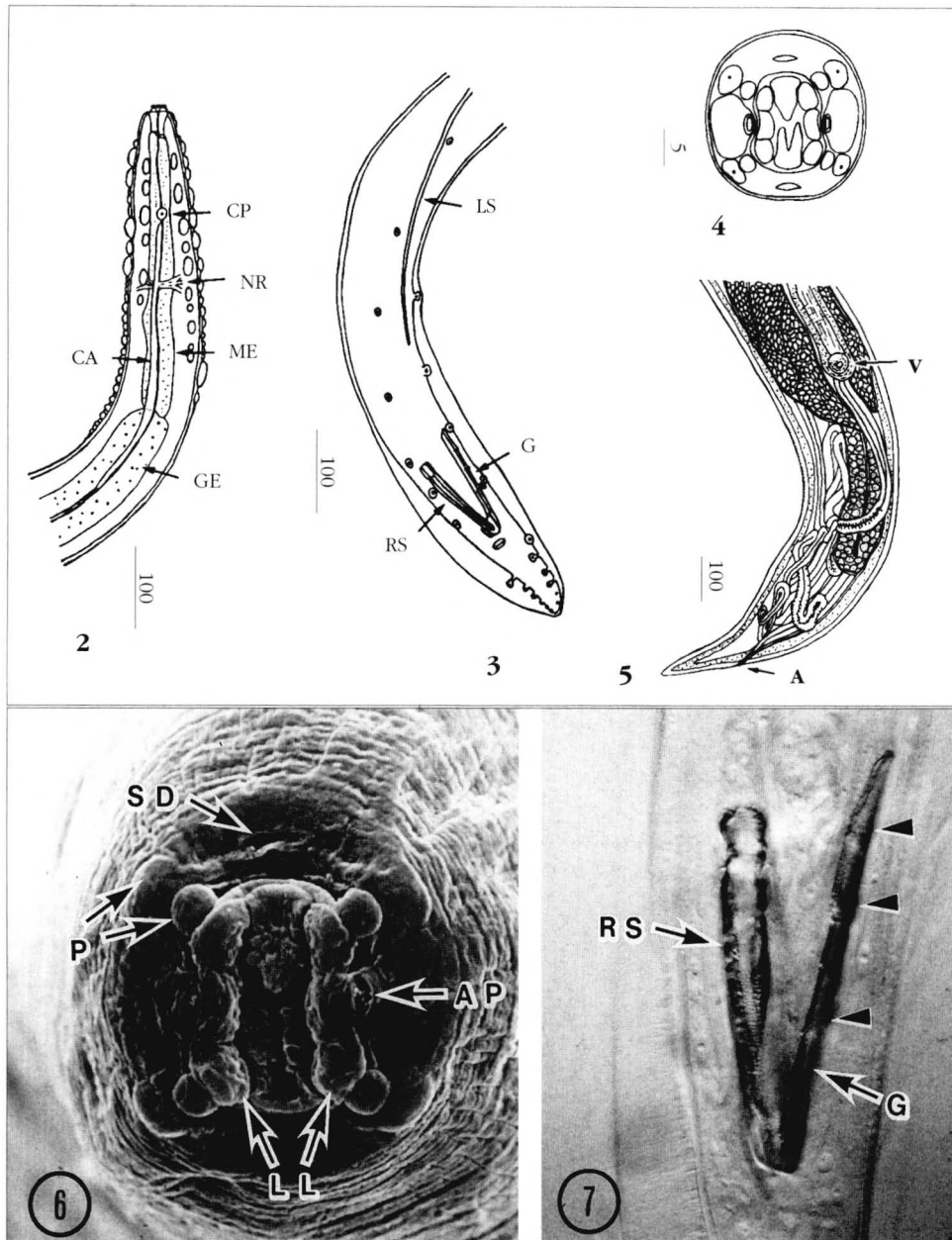


Fig. 1. – Geographic distribution of *Gongylonema pulchrum* (●) and *G. macrogubernaculum* (*) from Japanese macaques. Circles show collection sites: 1 Niigata, 2 Nagano, 3 Nukata, 4 Japan Monkey Centre, Inuyama, 5 Mikata, 6 Kanazu, 7 Wakasa, 8 Hiyoshi, 9 Ogura, 10 Wachi, 11 Ine, 12 Sasayama, 13 Mino, 14 Kasuga, 15 Nishiki, 16 Awaji-shima, 17 Shodo-shima, 18 Mihara, 19 Kake, 20 Miyajima, 21 Takasakiyama, 22 Miyazaki, 23 Yaku-shima.



Figs. 2-5. - *G. macrogubernaculum* from *M. fuscata yakui*. A anus, CA cervical ala, CP cervical papilla, G gubernaculum, GE glandular esophagus, LS left spicule, ME muscular esophagus, NR nerve ring, RS right spicule, V vulva. Scale bar units, micrometers. 2. Anterior of male. 3. Posterior of male. 4. *En face* view of head of male. Drawing based on SEM. 5. Posterior of female.

Fig. 6. - Cephalic extremity of male, *en face* view by SEM. AP amphidial pore, LL lateral labia, P papillae, SD semilunar depression. $\times 2,500$.

Fig. 7. - Interference contrast photomicrograph of posterior of male *G. macrogubernaculum*. Arrowheads showing bamboo-joint-like formations of gubernaculum (G). RS right spicule. $\times 400$.

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 preloacal

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 $43\text{-}44 \times 23\text{-}25 \mu\text{m}$. 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.

REFERENCES

- CAPPUCCI D.T. JR., AUGSBURG J.K., and KLINCK P.C. : Gongylonemiasis. In CRC Handbook Series in Zoonoses, Steele J.H. ed., Section C : Parasitic zoonoses, vol. II, CRC Press, Boca Raton, Florida, 1982, 181-192.
- GEBAUER O. : Beitrag zur Kenntnis von Nematoden aus Affenlungen. *Z. Parasitenk.*, 1933, 5, 724-734.
- KUDO N., OYAMADA T., ITO K. : Epizootiology of the gullet worm, *Gongylonema pulchrum* Molin, 1857, from cattle in Aomori Prefecture, Japan. *Jpn. J. Parasitol.*, 1992, 41, 266-273.
- LICHTENFELS J.R. : Morphological variation in the gullet nematode, *Gongylonema pulchrum* Molin, 1857, from eight species of definitive hosts with a consideration of *Gongylonema* from *Macaca* spp. *J. Parasitol.*, 1971, 57, 348-355.
- LUBIMOV M.P. : *Gongylonema macrogubernaculum* n. sp. (Nematode) from monkeys. *Parasitology*, 1931, 23, 446-448.
- LUCKER J.T. : *Gongylonema macrogubernaculum* Lubimov, 1931 from two new hosts. *J. Parasitol.*, 1933, 19, 243 (abstract).
- SUZUKI K., NAKAMURA K., TAKAHASHI K. and SEKI N. : *Gongylonema pulchrum* Molin, 1857 from cattle in Hokkaido. *J. Jpn. Vet. Med. Assoc.*, 1992, 45, 120-124.
- UNI S., ABE M., HARADA K., KANEDA K., KIMATA I., ABDELMAKSOU D N.M., TAKAHASHI K., MIYASHITA M. and ISEKI M. : New record of *Gongylonema pulchrum* Molin, 1857 from a new host, *Macaca fuscata*, in Japan. *Ann. Parasitol. Hum. Comp.*, 1992, 67, 221-223.
- YAMAGUTI S. : Systema Helminthum, vol. 3. The nematodes of vertebrates. Parts 1 and 2. Interscience Publishers, New York, 1961.
- YOKOHATA Y. and SUZUKI Y. : The gullet nematode, *Gongylonema pulchrum* from sika deer, *Cervus nippon* in Hyogo Prefecture, Japan. *Jpn. J. Parasitol.*, 1993, 42, 440-444.

Accepté le 2 mai 1994