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New Findings of Metacestodes and a Pentastomid from Rodents in Mongolia

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ABSTRACT: In this study, new findings of the immature-stage parasites of Mongolian rodents that require carnivorous mammals or birds of prey to complete their life cycle are reported. Six species of parasites, including metacestode stages of 5 cestodes (*Taenia mustelae, T. polyacantha, T. endothoracicus, Cladotaenia globifera,* and *Mesocestoides* sp.) and nymphs of 1 pentastomid (*Linguatula serrata*), were found. Of these, 2 species (*T. endothoracicus* and *L. serrata*) are reported for the first time in Mongolia. The new host records include *Microtus brandti* for *T. polyacantha, T. mustelae, C. globifera,* and *Mesocestoides* sp.; *M. mongolicus* for *T. mustelae; Meriones meridianus* for *T. endothoracicus*; and *M. unguiculatus* for *T. endothoracicus* and *L. serrata.* The geographic distribution, prevalences, and morphology of these parasites are reported.

KEY WORDS: Cestoda, Metacestodes, Mongolia, Pentastomida, Rodentia.

The helminths of predatory hosts include many parasites of environmental health, medical, or veterinary importance. Many of these parasitize rodents as intermediate hosts. A review of the literature (Schumakovich, 1936; Galbadrah, 1972; Danzan, 1978; Daschzeveg et al., 1982; Suhbat and Ganzorig, 1988; Baatar and Handaa, 1989) indicates that 28 species of helminths have been reported in wild and domestic carnivores in Mongolia. Of those, 12 species, *Alaria alata* (Goeze, 1782); *Taenia polyacantha* Leuckart, 1856; *T. mustelae* Gmelin, 1790; *T. laeniaeformis* Batsch, 1786; *T. crassiceps* (Zeder, 1880); *T. pisiformis* (Bloch, 1780); *Mesocestoides lineatus* (Goeze, 1782); *Spirometra erinacei-europaei* (Rudolphi, 1819); *Macracanthorhynchus catulinus* Kostylew, 1927; *Trichinella spiralis* (Owen, 1835); *Toxascaris leonina* (Linstow, 1902); and *Toxocara cati* (Schrank, 1788), occur in the rodent intermediate host. But, only *Mesocestoides lineatus* tetrathyridia were reported from rodents in Mongolia (Dubinin and Dubinina, 1951; Danzan, 1978). During 1994–1996, we conducted a field survey to determine the biodiversity of the helminths in Mongolia. Special attention was given to parasites that cause significant economic and public health problems. In the present paper, the results of the survey of the parasites that have environmental links to carnivorous mammals are reported.

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Materials and Methods

The hosts examined consisted of 1,524 rodents belonging to 34 species. Of those, immature stages of parasites were found in rodents of 10 species, including long-tailed souslik, *Spermophilus undulatus* Pallas, 1773 (Sciuridae); gray red-backed vole, *Clethrionomys rufocanus* Sundevall, 1846–1847; northern red-backed vole, *C. rutilus* Pallas, 1779; Mongolian vole, *Microtus mongolicus* Radde, 1861; Brandt's vole, *M. brandti* Radde, 1861 (all Arvicolidae); gray hamster, *Cricetulus migratorius* Pallas, 1773 (Cricetidae); Mongolian gerbil, *Meriones unguiculatus* Milne-Edwards, 1867; midday gerbil, *Meriones meridianus* (Pallas, 1773); great gerbil, *Rhombomys opimus* Lichtenstein, 1823 (all Gerbillinae); and Gobi jerboa, *Allactaga bullata* Allen, 1925 (Dipodidae). All were trapped or shot during field surveys in 1983–1992 and 1994–1996, in various places in Mongolia. The helminths from 9 *Microtus mongolicus* and 10 *Clethrionomys rutilus* were provided by Dr. H. Suhbat (National University of Mongolia) and Dr. B. I. Scheftel (Evolution, Morphology and Animal Ecology Institute named after A. N. Severtsov, Russian Academy of Sciences). The formalin-preserved carcasses of 160 *Microtus brandti* were made available to us by Dr. A. A. Tarakanovskii (Institute of General and Experimental Biology, Academy of Sciences, Mongolia). The host-sampling procedure was carried out in spring, summer, and autumn, but mostly in summer. Captured mammals were dissected and studied immediately for helminths or after fixation with 10% formalin. The digestive organs, lungs, body cavity, and subcutaneous tissues were checked for helminths. The parasites were fixed in 10% formalin or in 70% ethanol. They were cleared in glycerin or lactic

Table 1. Prevalence and intensity of larval parasites of Mongolian rodents.

Parasite species	Host (no. examined)	Prevalence	Intensity
Taenia mustelae	*Clethrionomys rufocanus* (31)	2 (6.45%)	7 and 15
	C. rutilus (58)	1 (1.7%)	30
	Microtus mongolicus (9)	1 (11.1%)	2
	M. brandti (525)	1 (0.19%)	2
T. polyacantha	*Microtus brandti* (525)	8 (1.52%)	1–19 (8.5)
	Cricetulus migratorius (6)	1	14
T. endothoracicus	*Meriones unguiculatus* (12)	1 (8.3%)	1
	M. meridianus (40)	1 (2.5%)	3
	Rhombomys opimus (25)	1 (4.0%)	1
Cladotaenia globifera	*Microtus brandti* (525)	2 (0.38%)	3 and 11
Mesocestoides sp.	*Spermophylus undulatus* (194)	1 (0.5%)	1
	Microtus brandti (525)	2 (0.38%)	1 and 46
	Meriones unguiculatus (12)	1 (8.3%)	8
	Alactaga bullata (2)	1	5
	Clethrionomys rufocanus (31)	1 (3.2%)	17
Linguatula serrata	*Meriones unguiculatus* (12)	1 (8.3%)	5

acid, after which a rostellum of each cestode was mounted in Hoyer's medium separately from the cyst. The nymphs of the pentastomid were fixed in 70% ethanol and cleared, using lactophenol. All measurements were made with a video micrometer. The measurements are in millimeters, with the range followed by the mean ± 1 standard deviation in parentheses. Drawings were made with the aid of a camera lucida. The specimens were deposited in the Department of Zoology of the National University of Mongolia (DZNUM) and in the Helminthological Collection of the Graduate School of Veterinary Medicine of the Hokkaido University (HKHU).

Results

A total of 6 species of parasites, including 5 metacestodes (*Taenia mustelae, T. polyacantha, T. endothoracicus, Cladotaenia globifera,* and *Mesocestoides* sp.) and nymphs of 1 pentastomid, *Linguatula serrata,* were found. Of the helminths previously recorded from predatory hosts in Mongolia, we have registered larval stages of *T. polyacantha, T. mustelae,* and *C. globifera.* All other helminths represent new geographic records. Some of their definitive hosts remain unknown in Mongolia. The parasites' prevalence and intensity are shown in Table 1. Brief descriptions are given for all species.

Family Taeniidae Ludwig, 1886
Taenia mustelae Gmelin, 1790

SYNONYM: *Taenia tenuicollis* Rudolphi, 1819; *Cysticercus talpae* Rudolphi, 1819.

DESCRIPTION: The size of formalin-fixed cysts (n = 30) recovered from livers of *C. rutilus* ranged from 2.46 to 5.74 (3.53 ± 0.86). Of the 54 cysticerci observed, only 1 (1.85%) contained 2 scolices. Scolex diameter 0.330–0.476 (0.392 ± 0.042). Suckers 0.092–0.198 (0.147 ± 0.024) in diameter. Rostellum diameter 0.082–0.156 (0.102 ± 0.017), armed with 2 rows of hooks not differing significantly in size. Hook number 44–52, with a mean of 46 in 22 scolices examined. Hooks (n = 609) 0.014–0.025 (0.018 ± 0.0019) in length. Base of hook 0.010–0.021 (0.015 ± 0.002) in length.

HOSTS: *Clethrionomy rufocanus, C. rutilus, Microtus mongolicus,* and *M. brandti.*

SITE OF INFECTION: Liver.

LOCALITY: Hanh and Jargalant Counties in Hovsgol Province, railway station Davaani zorlog near Ulaanbaatar city (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM and HKHU (No. 742).

REMARKS: Adult worms were found in steppen polecat, *Mustela eversmanni* Lesson, 1827, at the same locality in Hovsgol Province (Suhbat and Ganzorig, 1988).

Taenia polyacantha Leuckart, 1856 (Fig. 2)

SYNONYM: *Tetratirotaenia polyacantha* (Leuckart, 1856) Abuladze, 1964; *Armatetrathyridium polyacantha* (Leuckart, 1856) Abuladze, 1964.

DESCRIPTION: Total length of armatetrathyridia ranged from 4 to 19.5. Scolex armed with 2 rows of characteristic hooks, 66 to 78 (71.8) in number in specimens from *M. brandti.* Length of the large hook 0.169–0.209 (0.196 ± 0.007),

Figure 1. The sketch map of Mongolia with locations where parasites were found. Symbols: ■ *Taenia mustelae*; ● *T. polyacantha*; ▲ *T. endothoracicus*; ○ *Cladotaenia globifera*; ▼ *Mesocestoides* sp.; □ *Linguatula serrata*.

blade and handle 0.081–0.115 (0.099 ± 0.005) and 0.096–0.136 (0.117 ± 0.007), respectively. Length of small hook 0.093–0.130 (0.117 ± 0.005), 0.061–0.106 (0.087 ± 0.005), and 0.049–0.070 (0.058 ± 0.003), respectively. Specimens from *C. migratorius* differed in number and length of the hook. There were 62 to 68 (65.4) hooks. Total length 0.180–0.228 (0.208 ± 0.007) and 0.114–0.139 (0.130 ± 0.005) for large and small hooks, respectively. Dimensions of the large hook blade and handle 0.087–0.127 (0.102 ± 0.005) and 0.091–0.135 (0.120 ± 0.008). Small hook 0.061–0.095 (0.081 ± 0.008) and 0.047–0.077 (0.065 ± 0.005).

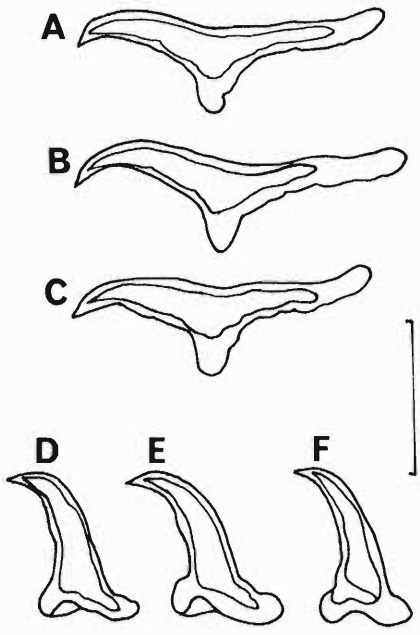
HOSTS: *Microtus brandti* and *Cricetulus migratorius*.

SITE OF INFECTION: Thoracic and peritoneal cavities.

LOCALITY: Bayan Ovoo County (Hentei Province), Zuil County and near waterfall Ulaan Tsutgalan (Ovorhangai Province), railway station Davaani zorlog near Ulaanbaatar city, Tsagaandelger County (Dundgov Province), Mt. Eej Hairhan in Transaltai Gobi (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM and HKHU (No. 739–741, 2981).

REMARKS: The size and shape of the armatetrathyridia varied considerably. The variation in the size of the armatetrathyridia apparently represented age-related modifications (see Rausch and Fay, 1988a). Beside that, specimens from *C. migratorius* were characterized by lower numbers of rostellar hooks (65.4 vs. 71.8) and greater length of large (0.208 vs. 0.196) and small (0.130 vs. 0.117 mm) hooks than those from *M. brandti* (Fig. 2). These differences were statistically significant at the 0.1% level. There were no significant differences in size of rostellar hooks in specimens obtained from thoracic and abdominal cavities of *M. brandti*. The mean length of the large hook in specimens obtained from thoracic and abdominal cavities were 0.197 and 0.198 mm, respectively. Those for small hooks were identical, 0.117 mm in length. The prevalence was generally low (1.52% of 525 voles), but varied from 0 to 3.57% at Davaany zorlog, where 71 to 84 voles were trapped during each of 3 yr. Strobilar-stage cestodes were recorded from the corsac fox, *Vulpes corsac* L., 1768, in Mt. Hasagt Hairhan in Gov Altai Province and Erdeneburen County in Hovd Province (Danzan, 1978).



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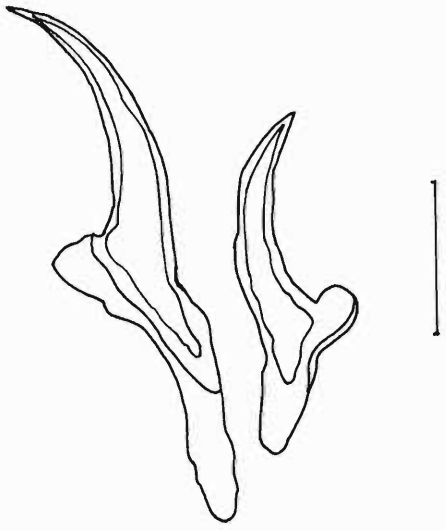

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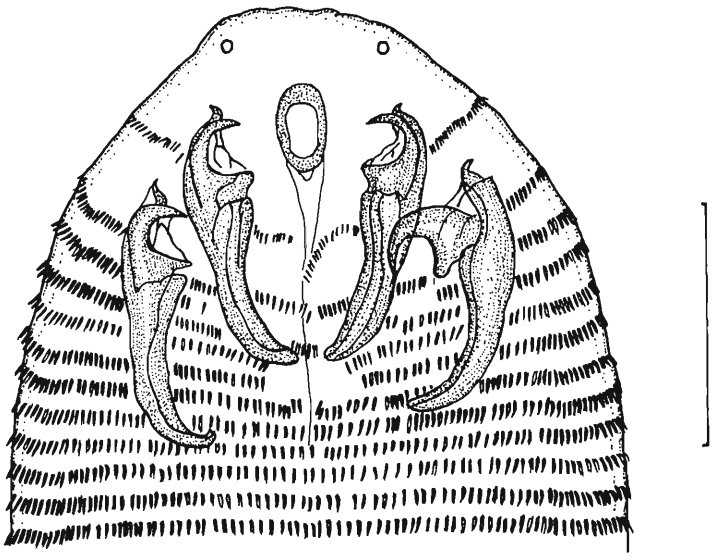

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Figures 2–4. 2. Large and small hooks of *Taenia polyacantha* from different hosts: A, D from *Vulpes corsac*, B, E from *Cricetulus migratorius*, C, F from *Microtus brandti*. Scale bar = 0.1 mm. 3. Large and small hooks of *Taenia endothoracicus* from *Meriones unguiculatus*. Scale bar 0.1 = mm. 4. Anterior end of *Linguatula serrata*. Scale bar = 0.5 mm.

Taenia endothoracicus (Kirschenblatt, 1948) (Fig. 3)

SYNONYM: *Multiceps endothoracicus* (Kirschenblatt, 1948); *Coenurus endothoracicus* Kirschenblatt, 1948.

DESCRIPTION: Only free coenuri were found. The number of scolices in 1 polycephalic metacestode varied from 6 to 10. Scolex 1.280–1.289 in diameter; rostellum 0.6 long, armed with a double row of 52 hooks. There were 4 suckers, 0.25 long by 0.47 wide. Length of large hooks 0.328–0.380 (0.354), blade and handle 0.144–0.198 (0.167) and 0.166–0.216 (0.193), respectively. Length of small hook 0.189–0.259 (0.221); blade length 0.106–0.140 (0.124); length of the handle 0.078–0.117 (0.103).

HOSTS: *Meriones unguiculatus, M. meridianus,* and *Rhombomys opimus.*

SITE OF INFECTION: Thoracic cavity.

LOCALITY: Borig Deliin Els in Uvs Province, Mt. Eej Hairhan, and oasis Shar Huls in Transaltai Gobi, Borzongiin Gobi in Omnogov Province (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM and HKHU (No. 743, 2982).

REMARKS: This is the first finding of *T. endothoracicus* in Mongolia. The definitive hosts in that country are unknown.

Family Paruterinidae Fuhrmann, 1907
Cladotaenia globifera Batsch, 1786

SYNONYM: *Cladothyridium globifera* Batsch, 1876.

DESCRIPTION: Metacestodes 0.7–1.3 in length; scolex armed with 46–52 characteristically shaped hooks. Length of large hooks 0.032–0.040 and of small hooks, 0.023–0.029.

HOST: *Microtus brandti.*

SITE OF INFECTION: Liver.

LOCALITY: Tumentsogt County of Suhbaatar Province (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM (209/70).

REMARKS: Adult-stage cestodes were found in upland buzzard, *Buteo hemilasius* Temminck and Schlegel, 1844, and marsh harrier, *Circus aeruginosus* L., 1758, in Tov Province of Mongolia (Danzan, 1964). Danzan also reported the occurrence of *Cladotaenia fania* Meggitt, 1933 in tawny eagle, *Aquila rapax* Temminck, 1833, but *C. globifera* is distinguished by its greater number of hooks and their length.

Family Mesocestoididae Fuhrmann, 1907
Mesocestoides sp.

SYNONYM: *Tetrathyridium* sp.

DESCRIPTION: The tetrathyridia found differed in size of body, and suckers as well. Tetrathyridia found in *A. bullata* measured 5.4 in length with maximal width 2.04. The suckers measured 0.465 × 0.207.

HOSTS: *Spermophilus undulatus, Clethrionomys rufocanus, Microtus brandti, Meriones unguiculatus,* and *Allactaga bullata.*

SITE OF INFECTION: Abdominal cavity, mesenteries, and liver.

LOCALITY: Hanh County in Hovsgol Province, Zuil County and near waterfall Ulaan Tsutgalan in Ovorhangai Province, Bayan Ovoo Country in Hentei Province, Delgerhangai County of Dundgov Province, railway station Davaani zorlog near Ulaanbaatar city (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM and HKHU (No. 745, 2983).

REMARKS: Previously, only *Mesocestoides lineatus* has been reported in Mongolia, the adult worms occurring in red fox, *V. vulpes* L., 1758; domestic cat, *Felis catus* L., 1758; northern three-toed jerboa, *Dipus sagitta* Pallas, 1773; and Mongolian hamster, *Cricetulus curtatus* Allen, 1925; and the tetrathyridia were in house mouse, *Mus musculus* L., 1758; Gobi jerboa, *A. bullata* (see Danzan, 1978); and Siberian marmot, *Marmota sibirica* Radde, 1862 (see Dubinin and Dubinina [1951]). Also, tetrathyridia were reported from multi-cellated racerunner, *Eremias multiocellata* Günther, 1872 (Reptilia: Lacertidae) (see Sharpilo, 1976). However, there is a clear-cut distinction between our material from *A. bullata* and *Mesocestoides lineatus* in the size of suckers, 0.128–0.192 × 0.115–0.166 in the latter (see Tschertkowa and Kosupko [1978]) and more than twice as large in the present larvae. Possibly, our specimens are closer to *Mesocestoides erschovi* Tschertkowa and Kosupko, 1975, but it is difficult to identify the species based on juvenile characters only.

Pentastomida

Family Linguatulidae Shipley, 1898
Linguatula serrata Fröelich, 1789 (Fig. 4)

DESCRIPTION: The nymphs possess an elongated body with 85 external annuli. Spines were present on the posterior border of each annulus.

Total length was 5.5–6.2; maximal width 1.175. The terminal segment 0.176 wide by 0.085 long. Mouth situated between the inner hooks, measuring 0.114 × 0.079. Two pairs of strong, double hooks arranged in an arc, measuring 0.481–0.500 in length.

HOST: *Meriones unguiculatus.*

SITE OF INFECTION: Thoracic and peritoneal cavity.

LOCALITY: Onjuul County of Tov Province (Fig. 1).

DEPOSITION OF VOUCHER SPECIMENS: DZNUM and HKHU (No. 744).

REMARKS: Excysted nymphs were removed from a large volume of bloody fluid that filled the body cavities. Our finding of the excysted nymphs may reflect postmortem migrations (see Riley, 1986). The present material was morphologically identical to the nymphs described by Rendtorff et al. (1962). Our finding constitutes a new host and distributional record.

Discussion

The results of the present study showed a low prevalence of parasites, and the material was not sufficient for analysis, except that from *M. brandti* and *S. undulatus.* Mongolia is located at the junction of 2 large floral regions: the Siberian taiga holarctic subregion, covering the northern part of the country, and the Central Asian desert-steppe and desert subregion of the Ancient Mediterranean (see Information Mongolia [1990]). In that country, one may expect to find parasites of Holarctic and Palaearctic origins. Of the parasites found, 2, *T. mustelae* and *T. polyacantha,* are Holarctic; 1, *T. endothoracicus,* is Palaearctic; and 2, *C. globifera* and *L. serrata,* are cosmopolitan (see Abuladze [1964]; Self [1982]). Morphology and systematics of the holarctic cestodes has been studied predominantly on the basis of material from Europe and North America. Previously, it has been shown that *T. mustelae* of European and North American origins differ in hook length and also in extent of asexual reproduction in the juvenile stage (Wardle and McLeod, 1952; Abuladze, 1964; Verster, 1969; Murai, 1982). However, Todd et al. (1978) and Langham et al. (1990) found in North America that the hooks of the juvenile stage measured 0.020–0.021 mm in length, the same as those of European specimens. Morphologically, the cysticerci of *T. mustelae* from Mongolian rodents were similar to those of rodents in Europe (Tenora and Vanek, 1969; Murai, 1982) and Japanese specimens of *T. mustelae* (Iwaki et al., 1995). But, in contrast to European specimens, the material from Mongolia had a bicephalic cysticerci. Such cysticerci have been also reported in Japan (Iwaki et al., 1995). Compared with North American material, where all types of polycephalic and uniscolex cysts have been reported (Freeman, 1956), the Mongolian and Japanese materials consisted predominantly of the cysticercus-type metacestode and of polycephalic metacestodes that had only 2 scolices.

Another holarctic cestode, *T. polyacantha,* is widespread in Mongolia, appearing to consist of 2 morphologically different groups. Previously, 2 subspecies of *T. polyacantha* were recognized by Rausch and Fay (1988b). According to them, *Taenia p. polyacantha* Rausch and Fay, 1988 is distributed in Eurasia to the south of the zone of tundra, and *T. p. arctica* Rausch and Fay, 1988 is present throughout the holarctic tundra. Morphologically, our material from *M. brandti* is similar to the nominal subspecies, *T. p. polyacantha.* However, the armatetrathyridia that were obtained in *C. migratorius* in western Mongolia were different from those found in central and eastern provinces of Mongolia. On the basis of hook number and hook length, the material from *C. migratorius* resembled *T. polyacantha* from Kazakhstan (see Abuladze [1964]). The difference between isolates of *T. polyacantha* from various rodent hosts has not been reported in the literature. Thus, we suppose that the difference between western and eastern materials is based on geographic character, and probably there are 2 suprapopulations or races of *T. polyacantha* in Mongolia. Also, we note that the hook number (see Rausch and Fay [1988b]) of the *T. p. polyacantha* increases from 55–66 in western Eurasia (Hungary, Norway, Germany) to 66–78 in East Eurasia (central and eastern parts of Mongolia, and Inner Mongolia) and may present a clinal alteration in the number of hook and their length.

Taenia endothoracicus has been reported from Georgia, Turkmenistan, Kazakhstan, Russia, Iran, and Morocco (Abuladze, 1964; Ryjikov et al., 1978). Others found were those of Khalil et al. (1979), which were registered as having Cheesman's gerbil, *Gerbillus cheesmani* Thomas, 1919, as intermediate host and red fox, *V. vulpes,* as definitive host in the State of Ku-

wait. Betterton (1977) reported that the taeniid metacestodes found in black rat, *Rattus rattus diardi* (Jentink, 1879), trapped in Malaysia closely resembled that of *T. endothoracicus* in number of hooks. However, that finding appears to represent metacestodes other than *T. endothoracicus,* since Kamiya et al. (1987) reported that bicephalic metacestodes found in the same host, and in the same country, are of a species different from *T. endothoracicus.* Thus, our finding significantly extends the eastern limit of the distribution of *T. endothoracicus.* The range of intermediate hosts was found to be only gerbils (Gerbillinae) (Abuladze, 1964; Ryjikov et al., 1978; Khalil et al., 1979), although Ryjikov et al. (1978) reported that steppe lemming, *Lagurus lagurus* Pallas, 1773, was also infected with the parasite. Thus, it may be suggested that *T. endothoracicus* is specific to gerbils, and the distribution of this parasite depends on the intermediate hosts.

Linguatula serrata is a cosmopolitan parasite of carnivorous mammals; its larval stage develops in herbivores (see Riley [1986]). The nymphs probably infect all members of the Lagomorpha and Artiodactyla (see Self [1982]). But the only record of *L. serrata* from rodents as intermediate hosts was that from the abdominal cavity of bandicoot rats (*Bandicota* sp.) in India (Raja, 1974). Thus, our case with *Meriones unguiculatus* is the second record in a rodent host. Of the parasites found, 2 species are medically important. Human cases with *M. lineatus* and *L. serrata* infections were reviewed by Riley (1986) and Tschertkowa and Kosupko (1978).

During the field investigation of rodents, considerable attention was given to the study of *Echinococcus multilocularis* Leuckart, 1863, because this medically important parasite occurs in the regions of Russia and China that border Mongolia. Distribution of *E. multilocularis* in neighboring Russia (Martynenko et al., 1988) and China (Tang et al., 1988; Craig et al., 1991) includes Tuva, Altaiskii krai, Buryatia, Xinjang, and Inner Mongolia, which border Mongolia on the north, northwest, southwest, and southeast. Moreover, almost every map on geographic distribution of *E. multilocularis* includes Mongolia (Matossian et al., 1977; McManus and Smyth, 1986; Schantz, 1986; Gemmel et al., 1987), but no official record of its occurrence in that country exists. We examined more than 1,500 rodents from different geographic localities, but no *E. multilocularis* was found. So, the occurrence of *E. multilocularis* in Mongolia is still an open question and needs further investigation.

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Literature Cited

Abuladze, K. I. 1964. Taeniata of animals and man and diseases caused by them. Nauka, Moscow. 530 pp. (In Russian.)

Baatar, T., and D. Handaa. 1989. Trichinellosis was found in wolf in Mongolia. Journal Hodoo aj ahui 1:50. (In Mongolian.)

Betterton, C. 1977. A curious *polycephalus* tapeworm larva from *Rattus rattus diardi* in an oil palm plantation. Southeast Asian Journal of Tropical Medicine and Public Health 8:420–421.

Craig, P. S., L. Deshan, and D. Zhaoxun. 1991. Hydatid disease in China. Parasitology Today 7:46–50.

Danzan, G. 1964. Helminths of the wild and domestic birds in Mongolia. Ph.D. Thesis, Moscow, VIGIS. (In Russian.)

———. 1978. Helminths of the wild mammals in Mongolia. D.Sc. Thesis, Moscow, VIGIS. (In Russian.)

Daschzeveg, G., N. Dambii, and D. Sugar. 1982. On study of helminthes in dog. Journal Hodoo aj ahui 4:42–43. (In Mongolian.)

Dubinin, V. B., and M. N. Dubinina. 1951. Parasite fauna of mammals in Daurian steppe. Materialy k poznaniyu fauny i flory SSSR (MOIP), Novaya Seriya 22:98–156. (In Russian.)

Freeman, R. S. 1956. Life history studies on *Taenia mustelae* Gmelin, 1790 and the taxonomy of certain taenioid cestodes from Mustelidae. Canadian Journal of Zoology 34:219–242.

Galbadrah, D. 1972. The epizootiology of the echinococcosis in Mongolia. Journal Hodoo aj ahui 2: 35–36. (In Mongolian.)

Gemmel, M. A., J. R. Lawson, and M. G. Roberts. 1987. Towards global control of cystic and alveolar hydatid diseases. Parasitology Today 3:144–151.

Information Mongolia. 1990. The comprehensive reference source of the People's Republic of Mongolia (MPR). Compiled and edited by the Academy of Sciences MPR. Pergamon Press, Oxford. 505 pp.

Iwaki, T., N. Abe, T. Shibahara, Y. Oku, and M. Kamiya. 1995. New distribution record of *Tae-*

nia mustelae Gmelin, 1790 (Cestoda) from the least weasel *Mustela nivalis* in Hokkaido, Japan. Journal of Parasitology 81:796.

Kamiya, M., H. K. Ooi, M. Ohbayashi, and C. K. Ow-Yang. 1987. Bicephalic larval cestode of Taeniidae from rats in Malaysia. Japanese Journal of Veterinary Research 35:275–282.

Khalil, L. F., O. Hassounah, and K. Behbehani. 1979. Helminth parasites of rodents in Kuwait with the description of a new species *Abbreviata kuwaitensis* (Nematoda: Physalopteridae). Systematic Parasitology 1:67–73.

Langham, R. F., R. L. Rausch, and J. F. Williams. 1990. Cysticerci of *Taenia mustelae* in the fox squirrel. Journal of Wildlife Diseases 26:295–296.

Martynenko, V. B., T. A. Loseva, T. F. Nikiforova, and N. N. Darchenkova. 1988. Echinococcosis distribution in the USSR. Communication 2: *Echinococcus multilocularis.* Meditsinskaya Parasitologiya i Parasitarnie bolezni 3:84–88. (In Russian.)

Matossian, R. M., M. D. Rickard, and J. D. Smyth. 1977. Hydatidosis: a global problem of increasing importance. Bulletin of The World Health Organization 55:499–507.

McManus, D. P., and J. D. Smyth. 1986. Hydatidosis: changing concepts in epidemiology and speciation. Parasitology Today 2:163–168.

Murai, E. 1982. Taeniid species in Hungary (Cestoda: Taeniidae). II. Larval stages of taeniids parasitizing rodents and lagomorphs. Miscellanea Zoologica Hungarica 1:27–44.

Raja, E. E. 1974. Parasitic infections in rodents, especially those communicable to man and animals. Cheiron 3:173–174.

Rausch, R. L., and F. H. Fay. 1988a. Postoncospheral development and cycle of *Taenia polyacantha* Leuckart, 1856 (Cestoda: Taeniidae). First part. Annales de Parasitologie Humaine et Comparée 63:263–277.

———, **and** ———. 1988b. Postoncospheral development and cycle of *Taenia polyacantha* Leuckart, 1856 (Cestoda: Taeniidae). Second part. Annales de Parasitologie Humaine et Comparée 63: 334–348.

Rendtorff, R. C., M. W. Deweese, and W. Murrah. 1962. The occurrence of *Linguatula serrata,* a pentastomid, within the human eye. The American Journal of Tropical Medicine and Hygiene 11: 762–764.

Riley, J. 1986. The biology of pentastomids. Advances in Parasitology 25:45–128.

Ryjikov, K. M., E. V. Gvozdev, M. M. Tokobaev, L. S. Schaldyrin, G. V. Matsaberidze, I. V. Merkusheva, E. V. Nadtochii, I. G. Hohlova, and L. D. Sharpilo. 1978. Key to the *Helminths of Rodents in USSR.* Nauka, Moscow. 232 pp. (In Russian.)

Schantz, P. M. 1986. Echinococcosis. CRC Handbook Series in Zoonoses: Parasitic Zoonoses 1: 231–277.

Schumakovich, E. E. 1936. Worm invasions and other parasitic diseases of domestic animals in the Mongolian People's Republic. Sowremennaya Mongolia 2:82–83. (In Russian.)

Self, J. T. 1982. Pentastomiasis. CRC Handbook Series in Zoonoses, Section C: Parasitic Zoonoses 3: 269–274.

Sharpilo, V. D. 1976. Parasitic worms of the reptilian faunà of the USSR; systematics, chorology, biology. Naukova Dumka, Kiev. 287 pp. (In Russian.)

Suhbat, H., and S. Ganzorig. 1988. The biology of *Mustela eversmanni* in Mongolia. Scientific Reports of the Mongolian State University 99:229–238. (In Russian.)

Tang, C. T., G. W. Cui, Y. C. Qian, S. M. Lu, and H. C. Lu. 1988. On the occurrence of *Echinococcus multilocularis* in Hulunbeier pasture, Nei Mongolian autonomous region. Acta Zoologica Sinica 34:172–179.

Tenora F., and M. Vanek. 1969. On the nomenclature of the larval stages of tapeworms *Taenia tenuicollis* Rudolphi, 1819 and *Taenia hydatigena* Pallas, 1766. Acta Societatis Zoologicae Bohemoslovacae 33:377–381.

Todd K. S., Jr., J. H. Adams, and J. H. Hoogeweg. 1978. The muskrat, *Ondatra zibethica,* as a host of *Taenia mustelae* in Illinois. Journal of Parasitology 64:523.

Tschertkowa, A. H., and G. A. Kosupko. 1978. Tetrabotriata and Mesocestoidata-tapeworm parasites of birds and mammals. Osnovy Cestodologii 9:118–229. (In Russian.)

Verster, A. 1969. A taxonomic revision of the genus *Taenia* Linnaeus, 1758. Onderstepoort Journal of Veterinary Research 36:3–58.

Wardle, R. A., and J. A. McLeod. 1952. The Zoology of Tapeworms. The University of Minnesota Press, Minneapolis. 781 pp.