The first finding of a bat flea *Myodopsylla trisellis* (Siphonaptera: Ischnopsyllidae) on *Myotis gracilis* (Chiroptera: Vespertilionidae) in Japan

Mamoru TAKAHASHI^{*, 1)}, Hitoko MISUMI¹⁾, Kuniko KAWAI^{2), 3)} and Masahiko SATO⁴⁾

* Corresponding author: m.takahashi@wish.ocn.ne.jp

¹⁾ Department of Anesthesiology, Saitama Medical University,
Moroyama-machi, Iruma-gun, Saitama 350-0495, Japan

²⁾ Field Science Center for Northern Biosphere, Hokkaido University,
Kita11-Nishi10, Kitaku, Sapporo, Hokkaido 060-0811, Japan

³⁾ Environmental Education Center, Miyagi University of Education,
Aramaki 149, Aza-Aoba, Aoba-ku, Sendai City, Miyagi 980-0845, Japan

⁴⁾ Rishiri Town Museum, Senhoshi, Rishiri Is., Hokkaido 097-0311, Japan

(Received: 21 November 2014; Accepted: 18 November 2015)

Abstract: We report, to our knowledge, the first record of a bat flea (*Myodopsylla trisellis* Jordan, 1929) in Japan. On July 13, 2008, a single female specimen of the flea was found on a Ussuri whiskered bat (*Myotis gracilis* Ognev, 1927) collected in a deserted house located in Komaba, Otofuke-cho, Kato-gun, Hokkaido, Japan, at an altitude of 110 m. This is also the first known record of *Md. trisellis* parasitizing *Mt. gracilis*. On the basis of the results of our study, we update the record of fleas found in Japan to a total of 75 species.

Key words: first record, geographical distribution, flea fauna, description

INTRODUCTION

Although bat fleas (family Ischnopsyllidae) are found exclusively on bats, members of this family do not always parasitize the same bat species. Two of the authors, Sato and Kawai, caught several flea species from 4 different bat species, including *Myotis gracilis* Ognev, 1927 in 2008, 2012, and 2013. The fleas were collected from various habitat types in Hokkaido. All fleas except for one unidentified female were known species in Japan (Sato and Takahashi, 2014). Fortunately, this unidentified specimen was preserved, and we were able to fully examine all aspects of its morphology for identification purposes. We noticed two key traits: the shape of the pale submarginal band of the frons and the presence of false combs only on the abdominal terga I through III. Based on these characteristics, this female flea was distinguished from all genera and species of the family Ischnopsyllidae known from Japan and was identified as *Myodopsylla trisellis* Jordan, 1929.

The present study deals with a brief morphological description of the *Md. trisellis* specimen found in Japan and includes the collection details. We also discuss the current geographical distribution of *Md. trisellis* throughout the world, concluding with an updated summary of all known Japanese flea fauna.

MATERIALS AND METHODS

One female of *Md. trisellis* was collected from an Ussuri whiskered bat (*Mt. gracilis* adult female) on

July 13, 2008. The bat was captured at a deserted house located in Komaba, Otofuke-cho, Kato-gun, Hokkaido, Japan at an altitude of 110 m (N43°3'50", E143°9'50"). The female *Md. trisellis* was deposited in 70% ethanol upon collection and subsequently mounted in Canada balsam for morphological investigations under a photomicroscope. The specimen (NSMT-I-Siph 1) is currently stored in the collection of the Department of Zoology, National Museum of Nature and Science, Tsukuba.

The abbreviations and terminology in this study are consistent with those used by Hopkins and Rothschild (1971), with some modifications.

RESULTS

Morphology of a female of bat flea *Myodopsylla trisellis* Jordan, 1929 new to Japan
Jordan, 1929. Novit. Zool. 35: 162, pl.10, figs. 23, 26 (*Myodopsylla*.)

Head (Fig. 1): Pale rugulose area narrow, though not particularly conspicuous, possessing many micropores. Clear area, pale band conspicuous, bearing a row of 11 minute setae. Ocular setae well developed, eye vestigial. A preoral tuber (an internal sclerotization) well defined, sinuous, and located just above oral angle. First spine of genal comb about 3/4 length of second spine, bluntly rounded at the apex. Second spine gradually tapered to a rounded point. Preantennal region of the head with 1 medium and 1 submedium sized setae, as well as 9 short setae, in addition to 2 ocular bristles. Occiput

Fig. 1. Head and prothorax of a female of *Myodopsylla trisellis* Jordan, 1929.

ant.fo. (antennal fossa); c.lnk.pl. (cervical link-plate); f.c. (fore coxa); fr. (frons); gen.cb. (genal comb); gen.pro. (genal process); lab.pa. (labial palp); mx. (maxilla); mx.pa. (maxillary palp); oc. (occiput); oc.br. (ocular bristle); or.ang. (oral angle); patch of spf.br. (patch of spiniform bristles); p.b. (pale band); pr.cb. (pronotal comb); prn. (pronotum); pr.st. (prosternosome); p.o.tub. (preoral tuber); rug. (rugulose area); tro. (trochanter)

Fig. 2. Abdominal terga I-IV of a female of *Myodopsylla trisellis* Jordan, 1929.

fl. cb. (false comb); t. I (tergum I); t. II (tergum II); t. III (tergum III); t. IV (tergum IV)

with 2 groups of setae on the posterior portion: one group consists of 7 long and stout setae, while the other consists of small and spiniform setae. The postantennal region with 3 rows of bristles of different sizes: 6 long bristles near pronotum; 1 long and 4 short setae plus 5 short setae near scapus, of antenna; a row of 7 short setae along the caudal margin of antennal fossa. Scapus with a patch of 5 small setae. Pedicellus with a row of small, fine setae extending to flagellar segment IV. Maxilla with truncate apex. Labial palpus 5-segmented and slightly longer than maxillary palpus.

Thorax (Figs. 1, 2): Pronotum about 2.1 times as long as the longest spines in pronotal comb, with 3

Fig. 3. Tarsal segment V of metathoracic leg of a female of *Myodopsylla trisellis* Jordan, 1929.

Fig. 4. Abdominal segments of a female of *Myodopsylla trisellis* Jordan, 1929.

a.pyg.br. (antepygial bristle); an.sty. (anal stylet); b.c. (bursa copulatrix); b.g. (bulga); d.a.l. (dorsal anal lobe); hi. (hilla of spermatheca); sens. (sensillum); spir. (spiracle); spir. VIII (spiracle of tergum VIII); st.VII (sternum VII); st.VIII (sternum VIII); st.IX (sternum IX); t.VI (tergum VI); t.VII (tergum VII); t.VIII (tergum VIII); v.a.l. (ventral anal lobe).

major rows of setae. Pronotal comb of 16 sharply pointed spines per side. Cervical link-plate slender and articulating posteriorly in a slight sinus near the dorsal margin of the prosternosome. Forecoxa covered on its outer surface with 86 setae that were graded in size, the shortest being at proximal angle and longest along the nearly posterior apical margin. Mesonotum about 2 times as long as pronotum. Two somewhat thickened pseudosetae under metanotal collar. Mesonotum with 4 full rows of setae that are graded in size, 10 short setae at anterior margin and the longest setae spaced along the posterior margin. Metanotum with 3 full rows of setae, of which 6 setae of the posterior row on each

side are somewhat lengthened, thickened, and crowded together, resembling a small false comb. Mesepisternum with about 9 setae and mesepimeron with about 3 setae, the latter becoming progressively longer caudally. Metepisternum with 2 setae and metasternum with 2 short setae. Metepimeron with well-defined striarium and with 8 setae roughly scattered.

Legs (Fig. 3): Tarsal segment V of all legs with 5 pairs of lateral plantar setae, 1 pair of plantar hairs, 1

pair of short and stout pre-apical plantar bristles, and 1 pair of fine and long pre-apical lateral hairs arranged as illustrated. Of particular note, the first pair of lateral plantar setae are strongly shifted onto the plantar surface, so that they arise between the bases of the second pair of plantar bristles. All tarsal segments shorter than segment I of metathoracic legs. Tarsal segment I of prothoracic legs equal in length to segment II, segment III shorter, and IV shortest. Tarsal segment I

Table 1. Collection records of *Myodopsylla trisellis* Jordan, 1929, localities, hosts and sources.

	Locality	Host	Source
1	China (Charithun Heilongjiang, Manchuria)	<i>Pipistrellus</i> sp.	Jordan, 1929
2	China (Inner Mongolia: Chifeng, Tongliao)	<i>Myotis mystacinus</i> .	Yang et al., 2008
3	China (Eastern Plateau Subregion of Yunnan)	Chiroptera sp.	Zhang et al., 2008
4	China (Altai mountains, Heilongjiang province, Jilin province, Sichuan province, Yunnan province)	<i>Myotis mystacinus</i> , <i>Pipistrellus pipistrellus</i>	Li et al., 1986
5	Finland (Rautalampi)	<i>Myotis mystacinus</i>	Smit, 1969
6	Latvia	<i>Myotis dasycneme</i> <i>Myotis brandtii</i> <i>Myotis mystacinus</i>	Jaunbauere et al., 2008
7	Russia (Middle Urals: Sysertskiy district, Kamenskiy district, Perm region)	<i>Myotis dasycneme</i> <i>Myotis daubentonii</i> <i>Myotis brandtii</i>	Orlova, 2011
8	Russia (Eastern and north eastern Kazakhstan)	<i>Myotis mystacinus</i> <i>Myotis brandtii</i>	Medvedev and Polkanov, 1997 Vashchonok, V. S. 1996
9	Russia (Middle Urals)	<i>Myotis dasycneme</i> <i>Myotis daubentonii</i> <i>Myotis brandtii</i>	Orlova and Pervushina, 2010
10	Russia (Ural)	<i>Myotis dasycneme</i>	Vinarskaya and Orlova, 2012
11	Russia (Urals)	<i>Myotis daubentonii</i>	Orlova and Orlov, 2011
12	Russia (Far East): Smidovichskiy district, Kamchatskaya region, Ayano-Mayskiy district, Amur district, Magadan region,	<i>Myotis brandtii</i> <i>Myotis daubentonii</i> <i>Myotis ikonnikovi</i> <i>Plecotus auritus</i>	Medvedev et al., 1991
13	Pribaltic: Maard (Estonia), Piuza (Estonia), Kabli (Estonia), Pusha (Latvia), Malta (Latvia)	<i>Myotis nattereri</i> <i>Myotis brandtii</i> <i>Myotis dasycneme</i> <i>Myotis daubentonii</i> <i>Eptesicus nilssoni</i>	Medvedev and Mazing, 1987 Vashchonok, 1996
14	Russia (HMAO: North of Western Siberia)	<i>Myotis</i> sp.	Bernikov and Starikov, 2010
15	Russia (South Siberian Mountains)	Chiroptera sp.	Siberian Zoological Museum, 2002
16	Russia (Udmurtia)	<i>Myotis dasycneme</i> <i>Myotis daubentonii</i> <i>Pipistrellus nathusii</i>	Orlova et al., 2011
17	Baltic countries. Russia (Novosibirsk Regions, Krasnoyarsk Territory, Irkutsk, Chita, Magadan Regions, Volonezh, Saratov Regions, Kazakhstan, Khabarovsk, Kamchatka, Primorsky territories)	<i>Myotis brandtii</i> , <i>Myotis dasycneme</i> , <i>Myotis daubentonii</i> , <i>Myotis ikonnikovi</i> , <i>Myotis mystacinus</i> , <i>Myotis nattereri</i> , <i>Plecotus auritus</i> , <i>Pipistrellus nathusii</i> , <i>Vespertilio murinus</i>	Medvedev, 1989
18	Komaba, Otofuke-cho, Kato-gun, Hokkaido, Japan	<i>Myotis gracilis</i>	Present study

of mesothoracic legs about equal in length to segments II and III combined, segments III and V nearly equal, segment IV shortest. Tarsal segment I of metathoracic legs about equal in length to segments II through IV combined. The length of tarsal segments in micrometers are as follows. Prothoracic legs: Segment I(88), II(88), III(70), IV(51), V(94). Mesothoracic legs: Segment I(230), II(139), III(87), IV(47), V(90). Metathoracic legs: Segment I(304), II(143), III(108), IV(55), V(112).

Abdomen (Figs. 2, 4): Abdominal tergum I with 12 short setae at 2/3 area per side from anterior margin, 3 long and stout setae near posterior margin, and especially prominent dorsal 6 setae crowded together in a well-developed false comb, becoming progressively thicker and shorter. Tergum II with 11 short setae, 5 long and stout major setae below the dorsal margin, and dorsal 4 setae slightly short, stout, and crowded together in a false comb per side. Tergum III with approximately 9 short setae, 6 long and stout major setae, and dorsal 3 setae long, stout, and crowded together in a false comb per side. The distal rows of terga IV, V, and VI bearing 7, 6, and 6 major setae, respectively, with none of them modified. Both sides of tergum VII bearing 6 major setae and a single, long, unmodified antepygial bristle on a conspicuous pedestal, with 1 or 2 microsetae at the base of each pedestal. Tergum VIII with 16 bristles from below spiracle to the level of lura of bursa ulatrix; 5 short and 3 somewhat short, spiniform bristles, plus 3 long and 5 medium sized bristles somewhat thickened, dark, and subspiniform apically. Sensillum with 20 sensory pits per side. Anal stylet with 1 long, apical seta and 2 shorter setae beneath it. Dorsal anal lobe angular, covered with 11 dorsal bristles, including 3 minute setae. Ventral anal lobe covered with 3 short and 3 long stout bristles. Sternum VII with 7 major setae per side and with the posterior margin shallowly sinuate. Sternum VIII provided with a nearly straight caudal margin, lacking subspiniform setae. Sternum IX with 2 long bristles and 1 short one. Spermatheca of the usual form; length of hilla approximately 3 times as long as length of bulga.

Body length. One female, 2.33 mm.

DISCUSSION

There are now 12 recognized species in the genus *Myodopsylla*. This genus is represented by 4 species in the Neotropical region, 7 species in the Nearctic region, and 1 species (*Md. trisellis*) in the Palearctic region (Lewis, 1978; Mendez and Lemke, 1979; Medvedev, 1996; Medvedev et al., 2005). Three of the 12 presently known species of the genus *Myodopsylla* possess false combs on tergum I through III. These are *Md. globata* Holland, 1971, *Md. setosa* Johnson, 1956, and *Md. trisellis* Jordan, 1929. Although *Md. trisellis* is closely related to *Md. setosa*, *Md. trisellis* is distinguished by the shape of the preoral tuber and the number of bristles forming false combs on tergum III. The false comb on

tergum III in female specimen of *Md. setosa* consists of only three or four flattened bristles on the two sides together, but that of *Md. trisellis* consists of six bristles.

The type locality of *Md. trisellis* is Charithun, near Nunkiang, Heilongjiang Province, located in the northeastern part of the People's Republic of China. The specimens were collected from *Pipistrellus* sp. on July 1928 by H. Jettmar (Jordan, 1929). The original range of *Md. trisellis* was thought to be bounded to the north and east by Russia, along the Amur River and the Ussuri River. Later, however, this species was recorded from many localities (Table 1) and is now known to be widely distributed. The current range of *Md. trisellis* is as follows (see also Fig. 5). The western extent of its range reaches Finland and the Baltic countries. It is also found in the Voronezh and Saratov Regions of Russia and in eastern Kazakhstan. In the north, *Md. trisellis* is distributed throughout Russia, spanning the Krasnoyarsk Territory and the Novosibirsk, Irkutsk, Chita, and Magadan Regions. In the south, it is found as far as the eastern plateau subregion of Yunnan Province in the People's Republic of China. Finally, its original eastern range reached the Khabarovsk, Primorsky, and Kamchatka Territories of Russia. The specimen reported in this study now extends the eastern distribution of *Md. trisellis* to Hokkaido in northern Japan.

Across its geographical distribution, *Md. trisellis* has been collected from 12 host species, consisting of the genus *Myotis* (7 species), *Pipistrellus* (2), *Eptesicus* (1), *Plecotus* (1), and *Vespertilio* (1). Based on these data, the main hosts of *Md. trisellis* are considered to be the bats of the genus *Myotis*, as shown in Table 1. *Myotis gracilis* is recorded as a host of *Md. trisellis* for the first time in the present study.

The flea fauna of Japan were originally described in monographs (Sakaguti, 1962; Sakaguti and Jameson, 1962) that published data on 67 species of fleas. In these descriptions, *Ceratophyllus gallinae dilatatus* Dudolkina, 1946 was incorrectly treated as a junior synonym of *Ceratophyllus tribulus* Jordan, 1926 (Lewis and Lewis, 1989; Yoshino et al., 2012). Additional research later expanded the number of Japanese flea fauna to include

Fig. 5. Geographical distribution of *Myodopsylla trisellis*. Arrow: Hokkaido, the area in northern Japan recorded in the present study.

7 additional species: *Neopsylla specialis* Jordan, 1932, *Frontopsylla setigera* Smit, 1964, *Ischnopsyllus obscurus* (Wagner, 1898), *Ischnopsyllus dictena* (Kolenati, 1856), *Megabothris kubotai* Uchikawa, 1975 (synonym of *Megabothris rhipisoides rhipisoides* Li and Wang, 1964), *Ceratophyllus olsuffevi* Scaloni and Violovich, 1961, and *Nycteridopsylla sakagutii* Jameson and Suyemoto, 1955 (Uchikawa and Suzuki, 1984; Uchikawa, 1975; Ono, 1963, 1965; Smit, 1964; Ohno et al., 2008 and 2014). With the addition of *Md. trisellis* from this present study, we now update the count of flea fauna from Japan to a total of 75 species.

REFERENCES

- Bernikov, K. A. and Starikov, D. G. 2010. Biology of bats in the north of Western Siberia. *Plecotus* et al., 13: 42–43 (In Russian with English abstract).
- Hopkins, G. H. E. and Rothschild, M. 1971. An illustrated catalogue of the Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural history). Volume V. Leptopsyllidae and Ancistropsyllidae. VIII+530 p.+30 Pls. University Press, Cambridge, London.
- Jaunbauere, G., Salmann, I. and Spungis, V. 2008. Occurrence of bat ectoparasites in Latvia. *Latvijas entomologs*, 45: 38–42.
- Jordan, K. 1929. On fleas collected by Dr. H. M. Jettmar in Mongolia and Manchuria in 1927 and 1928. *Novit. Zool*, 35: 155–164.
- Lewis, R. E. 1978. A new species of *Myodopsylla* Jordan and Rothschild 1911, from northern United States, with a key to the genus (Siphonaptera: Ischnopsyllidae). *J. Parasitol.*, 64: 524–527.
- Lewis, R. E. and Lewis, J. H. 1989. A catalogue of invalid or questionable genus-group and species-group names in the Siphonaptera (Insecta). 263 pp. Koeltz Scientific Books, Koenigstein, Germany.
- Li, G., Wang, D. and Xie, B. 1986. Ischnopsyllidae. In: Fauna Sinica, Insecta, Siphonaptera (eds. Liu, Z. et al.), pp. 621–661, Science Press, Beijing, China (in Chinese).
- Medvedev, S. 1989. Ecological peculiarities and distribution of the fleas of the family Ischnopsyllidae (Siphonaptera). *Parazitologicheskii Sbornik; Zoolologicheskii Institut. Akademiya Nauk SSSR*, 36: 21–43 (In Russian with English abstract).
- Medvedev, S. 1996. Fleas of the family Ischnopsyllidae (Siphonaptera) of the fauna of Russia and adjacent countries. *Entomol. Rev. (Engl. Transl.)*, 76: 480–493.
- Medvedev, S., Lobanov, A. and Lyangouzov, I. 2005. World Database of Fleas. <http://www.zin.ru/Animalia/Siphonaptera>
- Medvedev, S. and Mazing, M. V. 1987. Fleas of the family Ischnopsyllidae (Siphonaptera) from Pribaltic. *Parazitologiya*, 21: 459–466 (In Russian with English abstract).
- Medvedev, S. and Polkanov, A. Y. 1997. On the flea fauna of the family Ischnopsyllidae (Siphonaptera) from the middle Asia and Kazakhstan. *Parazitologiya*, 31: 13–23 (In Russian with English abstract).
- Medvedev, S., Stanyukovich, M. K., Tiunov, M. P. and Farafonova, G. V. 1991. Ectoparasites of bats from the far east of the USSR. *Parazitologiya*, 25: 27–38 (In Russian).
- Mendez, E. and Lemke, T. O. 1979. Description of a new species of bat fleas from Colombia (Siphonaptera: Ischnopsyllidae). *Proc. Entomol. Soc. Wash.*, 81: 657–662.
- Ohno, M., Tomioka, Y. and Goto, J. 2008. First record of *Nycteridopsylla dictena* (Kolenati) in Japan, *Proceeding of the 68th Annual Meeting of Entomological Society of Japan*, 29 (In Japanese).
- Ohno, M., Sato, A. and Katsuta, S. 2014. First record of a bat flea, *Nycteridopsylla sakagutii*, in Japan. *51th Meeting of the Kanto Chapter of the Entomological Society of Japan*. Program, p. 3 (In Japanese).
- Ono, Z. 1963. Supplemental notes on the studies of Japanese fleas, Part (3) Fleas collected from nests of the Japanese house-martin, *Delichon urbica dasypus*, in Hokkaido. *Jpn. J. Sanit. Zool.*, 14: 208–212 (In Japanese with English abstract).
- Ono, Z. 1965. Supplemental notes on the studies of Japanese fleas, Part (6) On four bat-fleas from Hokkaido. *Jpn. J. Sanit. Zool.*, 16: 99–103 (In Japanese with English abstract).
- Orlova, M. V. 2011. Ectoparasite associations of bats from the Urals (Russia). *Hystrix It. J. Mamm.*, 22: 105–110.
- Orlova, M. V., Kapitonov, V. I., Grigor'ev, A. K. and Orlov, O. L. 2011. Bat ectoparasites in Kama-Vyatka interfluvium. *Bull. Udmurt Univ. Biol. Earth Sci.*, 2: 134–138 (In Russian with English abstract).
- Orlova, M. V. and Orlov, O. L. 2011. Ectoparasites of the pond bat *Myotis dasycneme* (Boie, 1825) (Chiroptera, Vespertilionidae) in the Urals. *Eurasian Entomol. J.*, 10: 517–521 (In Russian with English abstract).
- Orlova, M. V. and Pervushina, E. M. 2010. Ectoparasites of bats in the Middle Urals. *Plecotus* et al., 13: 83–87 (In Russian with English abstract).
- Sakaguchi, K. 1962. A monograph of the Siphonaptera of Japan. 255 pp., The Nippon Printing and Publishing Co. Ltd., Osaka, Japan.
- Sakaguti, K. and Jameson, E. W. 1962. The Siphonaptera of Japan. Pacific Insects Monograph 3. 169 pp., Entomology Department, Bernice P. Bishop Museum, Honolulu, Hawaii, U. S. A.
- Sato, M. and Takahashi, M. 2014. Records of bat fleas from Hokkaido. *Rishiri Studies*, 33: 73–75 (In Japanese with English abstract).
- Siberian Zoological Museum 2002. Siphonaptera collection of Siberian Zoological Museum.
- Smit, F. G. A. M. 1964. A new bird-flea from Japan. *Entomol. Ber. (Amst.)*, 24: 34–38.
- Smit, F. G. A. M. 1969. A catalogue of the siphonaptera of Finland with distribution maps of all Fennoscandian species. *Ann. Zool. Fenn.*, 6: 47–86.
- Uchikawa, K. 1975. Notes on fleas collected from bird-nests (II) Description of *Megabothris kubotai* spec. nov. (Siphonaptera: Ceratophyllidae). *Jpn. J. Sanit. Zool.*, 26: 101–103.
- Uchikawa, K. and Suzuki, H. 1984. Medico-zoological studies in Tokara Archipelago, Kagoshima Prefecture, Japan—Records of Acari and Fleas found on an *Apodemus* mouse on Nakanoshima Island comprising the Archipelago. *Trop. Med.*, 26: 17–25.
- Vashchionok, V. S. 1996. Check list of fleas (Siphonaptera) of the north-west of Russia. *Parazitologiya*, 30: 410–424 (In Russian with English abstract).
- Vinarskaya, N. and Orlova, M. 2012. Ectoparasites of the pond bats (*Myotis dasycneme* Boie, 1825) and parti-coloured bats (*Vespertilio murinus* Linnaeus, 1758 non Schreber, 1775) in the Middle Urals. *J. Scientific dialogue*, 2: 23–30.
- Yang, X., Wang, J., Liu, J. and Liu, Y. 2008. Inner major parasitic fleas and flea host regional distribution. *Chin. J. Vector and Control*, 19: 345–347 (In Chinese).
- Yoshino, T., Nakada, T. and Asakawa, M. 2012. A case report of postmortem examination on an Eurasian wryneck (*Jynx torquilla*) with special reference to the collection record of fleas, *Ceratophyllus tribulus* (Ceratophyllidae: Siphonaptera). *J. Hokkaido Vet. Med. Assoc.*, 56: 45–47 (In Japanese).
- Zhang, S. Y., Guo, X. G., Gong, Z. D., Zhang, L. Y., Wu, D. and Wang, Z. K. 2008. Flea fauna and distribution characteristics in Yunnan, S. W. China. *Acta Entomol. Sin.*, 51: 967–973 (In Chinese with English abstract).