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Siphonaptera of Mongolia and Tuva: Results of the Mongolian- German Biological Expeditions since 1962 – Years 1999-2003

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Siphonaptera of Mongolia and Tuva: Results of the Mongolian-German Biological Expeditions since 1962 – years 1999-2003¹

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Abstract

This report provides an overview of flea species and the corresponding hosts in Mongolia and Tuva during 1999-2003. The taxonomical development of this vector group of great medical importance covers more than a century of flea research in Mongolia, resulting in the current number of 162 species known from this area.

Key words: Siphonaptera, Mongolia, Tuva, distribution, host-vector relations, medical importance

Introduction

Interest in ectoparasites, their corresponding hosts, and natural plague foci in Mongolia have a long tradition reaching far beyond the last century. In 1893 the then ruler of Mongolia banned the hunting of marmots after 30 people died of plague in the somon Uliastai. Even at this early date, the Mongolian people realized the role of hosts and vectors, the names of cities, rivers, mountains, and territories in Mongolia like Tarvagtai = marmot (*Marmota* sp.), Unegtei = fox (*Vulpes vulpes*), Zuramtai = ground squirrel (*Spermophilus* sp.), Hachigt = tick (Ixodidae), Yalaat = fly (Diptera), and shumuilt = mosquito (Culicidae) are inspired by historical incidents related to zoonotic outbreaks (CHULUNBATOR 1976).

Dangerous diseases with dramatic impacts on human populations also resulted in the development of a strange nomenclature of localities like Bulay = ugly, Balagtai = dangerous (bad luck), Bulshit = grave, Heregsuur = graveyard. The most important disease at the present time in Mongolia is plague, named har gedes or by NEKIPELOV (1959) Suman delju = black belly. One of the first mentions of fleas from Mongolia was made by TUCK WU LIEN TEN (1913), indicating the possibility of plague transmission by fleas and ticks from marmots to humans in Mongolia, and China. The relevant vector in this transmission cycle was *Ceratophyllus (Oropsylla) silantiewi* acquired 120 km in the North of the Dalai-nuur (lake).

The first specific citation of fleas from Mongolia is mentioned in the work from SKORODUMOV (1928). JORDAN (1929) analyzed the collection of Jettmar from the area around Ulaanbaatar. Of eight species known up to that time, three new subspecies were described including: *Frontopsylla luculenta parilis*, *Ophthalmopsylla praefecta pernix* and *Amphipsylla primaria mitis*. The species *Paradoxopsyllus conveniens*, *Nosopsyllus (Gerbillophyllus) laeviceps ellobii*, *Ctenophthalmus dolichus* and *Amphipsylla dumalis* were described by WAGNER (1932) from the collections of Kozlov acquired in the Changaj, southern and northern Gobi Altai, Orog-nuur, and the Area around the Zogoo-nuur on the border of Inner Mongolia. From the material acquired by Formozov and Kiritschenko (1929) in the area around Orog Nuur lake, the Kara tesh Gol river and Kadyskh lake, Wagner 1932 described the species *Ophthalmopsylla kiritschenkoi*. DARSKAYA (1950) described the species *Ceratophyllus farreni* and *C. maculatus* from the nests of *Delichon urbica* in Uljasutay based on the collection of Formozov from 1929. These contributions represent the first phase of flea analysis in Mongolia.

¹ Results of the Mongolian-German Biological expeditions since 1962, No. 316.

The systematic character of the collections from Mongolia started to increase around 1940. The main focus of this was material collected concerning natural foci of plague, and especially important were the collections of Tarasov from the years 1945-1947 and Skalon from the years 1944-1947, among many others. Based on this material a key to the identification of fleas from Siberia, the Far East (including the adjacent regions) and Mongolia was developed (IOFF & SKALON 1954). A total of 72 species and subspecies of fleas were described and an additional 21 species were added by SCALON (1966).

Thanks to the Mongolian-German Biological Expeditions of Stubbe and Piechocki, research on mammals and birds as well as their corresponding parasites progressed rapidly from the 1960s through the last century. These flea collections were analyzed by SMIT (1967, 1980) and KIEFER et al. (1984). Also important were the collections from Kaszab, analysed by SMIT (1966, 1972), and the collections of Mészáros, also analyzed by SMIT (1975). BAVAASAN et al. (1977) identified a total of 130 flea species and subspecies in Mongolia. Starting in 1970 a Soviet Academic Expedition worked in Mongolia and the collections were analyzed by KIEFER (1979) and KIEFER et al. (1984). In 1974 the Chövsgöl-Mongolian-Soviet expeditions started, including participants from the Komensky University Bratislava (KIEFER 1979). The collections acquired were analyzed by KIEFER et al. (1984) and KIEFER et al. (1990) and in these publications they recorded the history of research on fleas in the country along with a bibliography of research on fleas in Mongolia reporting a total of 157 species.

From the 1980's until the end of the last century, the NCIDNF (National Centre for Infectious Diseases with Natural Foci) and the Academy of Medical Sciences of Mongolia has focused great attention on the topic of host-vector relations and corresponding taxonomy. Their scientific findings are presented annually at the scientific conference of the NCIDNF and also published in the Scientific Journal of the National Centre for Infectious Diseases with Natural Foci (Ulaanbaatar). GALDAN et al. (2009, 2010) summarized the history of plague research in Mongolia and included a bibliography and discussion of plague distribution relative to the dependence of corresponding hosts and vectors.

Beginning in 2000 research on the Mongolian fauna intensified with studies expanding to include the parasite fauna and parasite-host interactions. Many foreign institutions from the USA, England, and China participated in this process. Members of the anti-plague Institute Huhot Inner Mongolia participate on a regular basis in the research of the zooparasitological situation in China and Mongolia in cooperation with the NCIDNF (HAO GUANGFU et al. 2008, WANG LIN et al. 2009). KIEFER et al. (2006-2011) investigated the medical importance, evolution, and distribution of fleas and ticks in Mongolia as well as correlations with factors related to climate. Host complexes based on dominance indices (KIEFER et al. 2009) and the distribution of siphonaptera in bird nests as well as the medical importance of these associations (KIEFER et al. 2011) was described in these investigations.

SCHEFFLER et al. (2010) analyzed the collection of the Mongolian-German Biological Expeditions (2005-2008) reporting 5 species of fleas from bats, of which two, *Ischnopsyllus comans* and *I. petropolitanus*, haven't been reported in Mongolia so far.

On behalf of the 80th anniversary of the Mongolian state, the NCIDNF (National Centre for Infectious Diseases with Natural Foci) produced an Atlas of Vectors, Hosts, and Diseases of human medical importance in Mongolia, reporting on a total of 159 flea species from Mongolia. Flea species of veterinary medical importance like the Vermipsyllidae *Dorcadia dorcadia*, *Dorcadia ioffi* and *Vermipsylla alacurt* are not part of this listing (ATLAS-Mongolia 2011).

List of collection localities in Mongolia

Table 1: Collecting localities and dates in Mongolia and Tuva (see also fig. 1, map A)

Nr.	aimag	locality	geographic coordinates	date
1	Chovd	Čonocharajchijn-gol between lakes Char-nuur and Char-us-nuur	48°15' N / 93°00' E	26.08.-27.08.2002
2	Chovd	Bulgan-gol	46°08' N / 91°00' E	26.08.-27.08.2002
3	Zavchan	Tes-gol, Bajan Tes	49°12' N / 98°26' E	31.08.-03.09.2002
4	Khentii	Minž-gol	49°15' N / 108°10' E	24.07.-27.07.2002
5	Bayanchongor	Orchon	47°12' N / 101°40' E	26.07.1999
6	Ömnögov	Camp 4	43°11'7.00" N / 100°23'7.1" E	25.09.2003
7		Camp 5	42°55'00" N / 99°26'3.5" E	26.09.2003
8		Camp 6	42°58'36.9" N / 100°42'37.5" E	27.09.2003
9		Ömnögov	42°28' N, 105°15' E	01.07.2001 & 21.07.-31.07.2001
10		Camp 10	42°33'28.1" / N 107°2'18.5" E	11.07.2002
11	Suchbaatar	Suchbaatar	46°45' N / 114°00' E	11.07.2002
12	Tuva	rivers Kara-tesh and Azas; lake Kadysh	52°26' N / 96°36' E	18.08.-07.09.2000 & 12.08.-17.08.2003

Publications concerning the distribution of fleas and vector-host relations in Mongolia

Atlas-Mongolia (2011), BATSAIKHAN et al. (2010), BAVAASAN (1974), BAVAASAN (1978), BAVAASAN et al. (1977), CYPRICH et al. (2001), CHINBOLT et al. (1980), COSTA LIMA & HATHAWAY (1946), DARSKAYA et al. (1988), DOVCHIN & TSEVELMA (1978), EMELYANOVA (1957), EMELYANOVA et al. (1957), EMELYANOVA et al. (1970), GONCHAROV et al. (1989), GUND (1980), IOFF & SKALON (1954), IOFF et al. (1965), KIEFER et al. (1983), KIEFER et al. (1984), KIEFER et al. (1990), KIEFER (1993), KOZVOLSKAYA & KHAMAGANOV (1980), LABUNETS (1967 a, b), LABUNETS (1971-1990), LEWIS (1972-1975), LIU YUN (2006, 2009), LIU ZHIYING (1986), SKALON (1956, 1966, 1981), SMIT (1966 a, b; 1967, 1972 a, b; 1975, 1980), TSEVELMA et al. (1978a,b), VASILYEV et al. (1975), VIOLOVICH (1976), ZHOVYJ & ROMASCHEVA (1977), YU XIN et al. (1990).

Distribution and host spectrum of the recorded flea species

Amphipsylla anceps Wagner, 1930

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Cricetulus spec.*
 Ömnögov Aimag: Camp 6 27.09.2003 *Cricetulus sokolovii.*

Distribution: Having a relatively broad distribution in Central Asia reaching from the mountain areas in Afghanistan to the East through the Pamir-Altai and Xinjiang in China (IOFF et al. 1965, LEWIS 1974, SCALON 1966, VIOLOVICH 1976). The distribution in Mongolia covers the aimags Chovd, Bayanchongor, and Ömnögov in the desert area.

Hosts: Main host is *Cricetulus migratorius*, also described on *Allactaga sibirica* and *Phodopus roborovskii* (KIEFER 1979, 1984); see table 1; fig. 1, map H.

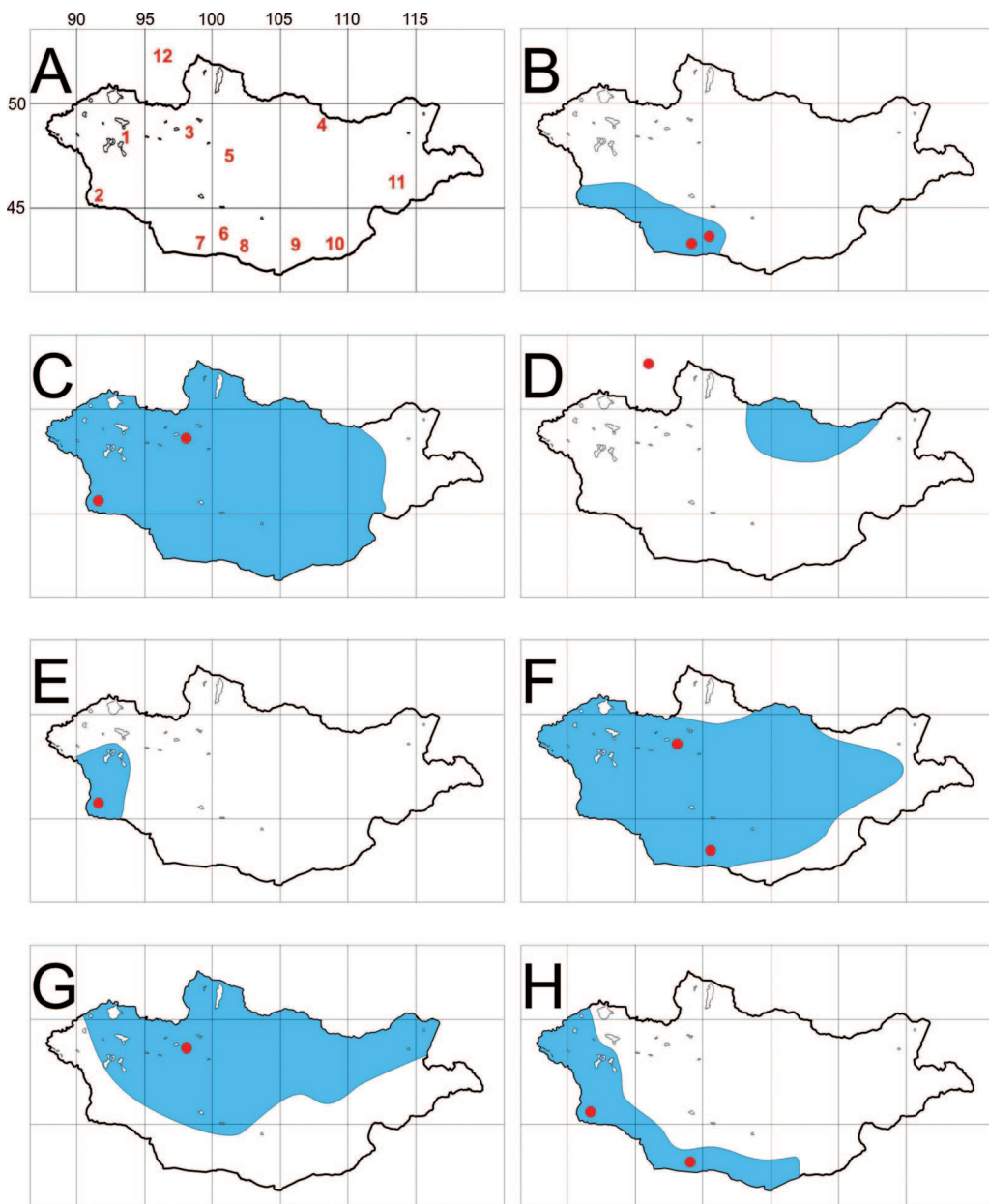


Fig. 1: Collecting localities and Mongolia and Tuva, distribution (blue) and recording localities (red points) of different flea species. **A** - collecting localities in Mongolia and Tuva; **B** - *Leptopsylla* (*Pectinoctenus*) *lauta*, Rothschild, 1915; **C** - *Leptopsylla* (*P.*) *pavlovskii* Ioff, 1928; **D** - *Peromyscopsylla* *ostsibirica* (Scalon, 1936); *Palaeopsylla* *soricis* *starki*. Wagner, 1930; **E** - *Monopsyllus* *sciurorum* *asiaticus* (Ioff, 1936); **F** - *Paramonopsyllus* *scalonae* (Vovchinskaya, 1950); **G** - *Corrodopsylla* *birulai* (Ioff, 1928); **H** - *Amphipsylla* *anceps* Wagner, 1930.

***Amphipsylla primaris primaris* Jordan et Rothschild, 1915**

Ömnögov Aimag; Camp 4: 25.09.2003 *Cricetulus sokolovi*.

Distribution: The subspecies *A. primaris primaris* occurs in Tjan-shan, Pamir, and Central Kazakhstan. The distribution in Mongolia covers the western and north-western parts of the country. According to IOFF & SCALON (1954), the occurrence of hybrids of the subspecies *A. primaris primaris* and *A. primaris mitis* in the Cis Baikal area and western Mongolia hampers the proper determination to a high degree, forcing many authors to stay on the species level.

Hosts: Occurs on many mammals, also on the species of the Aves genus *Eremophila* (KIEFER et al. 2011). See fig. 2, map I.

***Amphipsylla primaris mitis* Jordan, 1929**

Ömnögov Aimag: Ömnögov 21.07. -31.07.2001 *Phodopus roborovskii*
Khentii Aimag: Minž-gol 24.07. -27.07.2002 *Sorex spec.*

Distribution: This is an eastern form, occurring in the steppes and mountain ranges of Asia, Jakutsk, and the surrounding area of the lake Baikal, Tuva, Tjan-shan, Pamir, and China. Occurs throughout Mongolia excepted the South.

Hosts: This nest flea occurs throughout the year on a broad spectrum of hosts, including *Microtus brandti*, *Meriones unguiculatus*, *Microtus sp.*, *Cricetulus sp.*, *Alticola sp.* as well as Aves *Motacilla alba*, *Passer montanus* and *Pica pica* (BAVAASAN et al. 1977, IOFF & SCALON 1954, LABUNETS 1967a, b; SMIT 1966, 1967, 1972). Extremely abundant on *Microtus brandti* and *Meriones unguiculatus* in Central and eastern Mongolia. Fig. 2, map J.

***Amphipsylla vinogradovi* Ioff, 1928**

Suchbaatar Aimag: Suchbaatar 11.07.2000 *Cricetulus barabensis*

Distribution: This steppe species (IOFF et al. 1954, SCALON 1966) occurs in Novosibirsk, Altai, Tuva, Khakassia, Cis Amur area, Manchuria, and all of Mongolia.

Hosts: Its main host is the genus *Cricetulus*. Also described on *Phodopus sungorum*, *Mustela eversmanni*, *Microtus brandti*, *Clethrionomys rutilus*, and *Ochotona dauurica* (LABUNETS 1967, SMIT 1966, 1967, 1975; DOVCHIN et al. 1978). Fig. 2, map K.

***Catallagia dacenkoi dacenkoi* Ioff, 1940**

Zavchan Aimag: Tes-gol, Bayan-tes 31.08. - 03.09.2002 *Clethrionomys rufocanus*
Tuva: river Kara-tesh, lake Kadysh, 12.08. - 17.08.2003 *Sorex spec.*, *Sicista betulina*.
river Azas

Distribution: Occurs in Alaska, Yukon, Kamchatka, north-western Manchuria, Cis Amur area, Jakutsk, Baikal area, Khakassia, Tuva reaching from Altai to the Urals. The species *C. dacenkoi* comprises two subspecies *C. dacenkoi dacenkoi* and *C. dacenkoi fulleri*. *C. dacenkoi fulleri* occurs in Alaska and Yukon territory, Canada. *C. dacenkoi dacenkoi* occurs in the whole Palearctic (IOFF et al. 1954, SCALON 1966, SMIT 1965). In Mongolia this species covers the Changaj, Khentii, Chövsgöl and the basin of the Great Lakes near Chovd.

Hosts: *Clethrionomys rutilus*, *Myopus schisticolor* (BAVAASAN et al. 1977; SCALON 1966; SMIT 1967) *Microtus limnophilus*, *Clethrionomys rufocanus* (KIEFER et al. 1984, 1993). Fig. 2, map M.

***Corrodopsylla birulai* (Ioff, 1928)**

Zavchan Aimag: Tes-gol, Bayan-tes 31.08. - 03.09.2002 *Neomys fodiens*.

Distribution: Occurs from Scandinavia to Kazakhstan, Kyrgyzstan, and to Japan (IOFF et al. 1954, 1965). In Mongolia this species was reported from south-western Changaj in the nests of *Delichon urbica* (DARSKAYA 1950, LABUNETS 1967a, b; LEWIS 1977), from Töv Aimag on *Sorex ceacutiens* (SMIT 1966), from the Bulgan and Uvs Aimags (SMIT 1972) and from the Dornod Aimag (EMELYANOVA 1970).

Hosts: *Sorex ceacutiens*, *Mustela eversmanni*, *Alticola spec.* (KIEFER 1984). Fig. 1, map G.

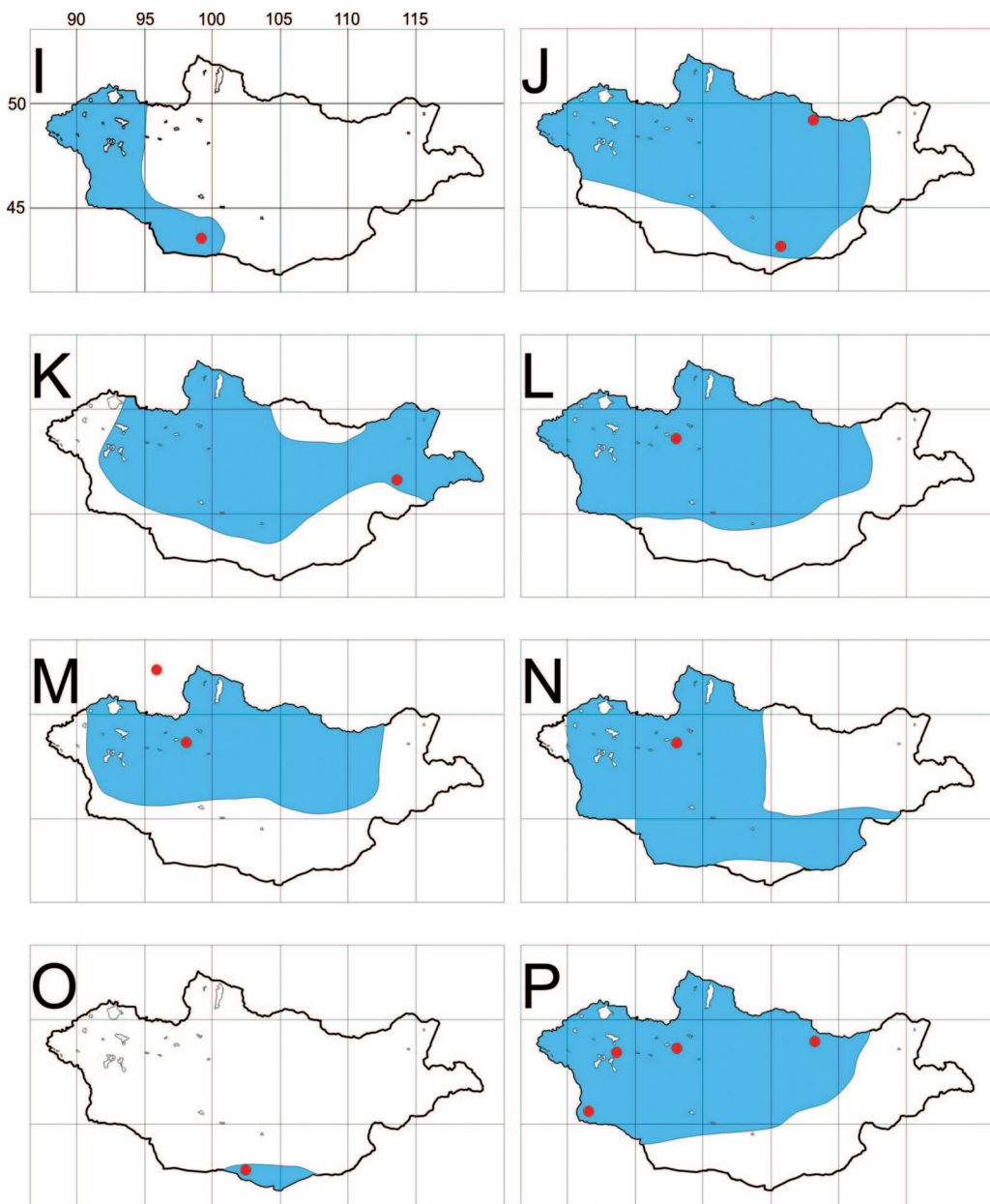


Fig. 2: Distribution (blue) and recording localities (red points) of different flea species. **I** - *Amphipsylla primaris primaris* Jordan et Rothschild, 1915; **J** - *Amphipsylla primaris mitis* Jordan, 1929 ; **K** - *Amphipsylla vinogradovi* Ioff, 1928; **L** - *Frontopsylla (F.) hetera* Wagner, 1933; **M** - *Catallagia dacenkoi dacenkoi* Ioff, 1940; **N** - *Paradoxopsyllus dashidorszhii* Scaloni, 1953; **O** - *Paradoxopsyllus teretifrons* (Rothschild, 1913); **P** - *Megabothris rectangularis* (Wahlgren, 1903).

***Coptosylla lamellifer ardua* Jordan et Rothschild, 1915**

***Coptosylla lamellifer formozovi* Darskaya, 1988**

Ömnögov Aimag: Camp 6 27.09.2003 *Meriones meridianus*

Distribution: *Coptosylla lamellifer ardua* advanced from Central Asia to Mongolia, resulting in the new subspecies *Coptosylla lamellifer formozovi*. The distribution of this species is still unknown. The subspecies *Coptosylla lamellifer formozovi* shows massive divergences compared to the new subspecies *Coptosylla lamellifer tarimensis* described for Dzungaria (DARSKAYA et al. 1988, KIEFER 1979, 1984).

Hosts: *Rhombomys opimus* and *Meriones meridianus* in China are most likely. Fig. 3, maps Q, R.

***Frontosylla (F.) hetera* Wagner, 1933**

Zavchan Aimag: Tes-gol, Bayan-tes 31.08.-03.09.2002 *Cricetulus* spec.

Distribution: The steppe species *Frontosylla hetera* occurs in the Cis Baikal area, the Chita area, Tuva, south-eastern Altai, Central Asia and China (IOFF & SCALON 1954, KIEFER 1979, 2010; KIEFER et al. 1984, SCALON 1966). In Mongolia it occurs throughout the country except in the East. Imagines occur from May up to October.

Hosts: Mammal hosts include *Meriones unguiculatus*, *Phodopus roborovskii*, *Allactaga sibirica*, *Spermophilus undulatus*, *Microtus brandti* among others, ground nesting birds of the genus *Oenanthe* and many other bird species. Fig. 2, map L.

***Leptosylla (Leptosylla) segnis* (Schönherr, 1811)**

Tuva: rivers Kara-tesh and Azas, 12.08.-17.08.2003 *Mus musculus* L.
Lake Kadysch

Distribution: Cosmopolitan.

Hosts: *Mus musculus* (see COSTA LIMA et al. 1945, HOPKINS et al. 1971). In Mongolia reported for the first time by BAVAASAN et al. (1977) from the Dornod Aimag on *Rattus norvegicus*, *Mus musculus*, *Meriones unguiculatus*, and *Myospalax aspalax*. TSEVELMA et al. (1978a) reported this species occurring in Ulaanbaatar and DOVCIN et al. (1978) in the Bajan Ulgij Aimag on *Dipus sagitta* and *Phodopus roborovskii*. Fig. 3, map V.

***Leptosylla (Pectinoctenus) lauta* Rothschild, 1915**

Ömnögov Aimag: Camp 4 25.09.2003 *Cricetulus sokolovi*
Camp 5 26.09.2003 *Cricetulus sokolovi*

Distribution: Occurs in Dzungaria, Transaltai of Kazakhstan and Kyrgyzstan, Tarbagatay in eastern Kazakhstan, east Balkhash and China. In Mongolia it occurs on mammals of the Mongolian Altai and the Transaltai-gobi.

Hosts: *Cricetulus migratorius*, *Meriones meridianus* (see KIEFER 1979, 1984; SMIT 1980). Fig 1, map B.

***Leptosylla (P.) pavlovskii* Ioff, 1928**

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Cricetulus* spec.
Zavchan Aimag: Tes-gol, Bajan-tes 31.08.-03.09.2002 *Cricetulus* spec.,
Phodopus campbelli

Distribution: Reported from western Siberia, Tuva, Trans Baikal, Altai, Inner Mongolia, and north-western Dzungaria (IOFF et al. 1954, SKALON 1966, SMIT 1965). In Mongolia it occurs on rodents in the Khentii mountain range as well as the Gobi and eastern Gobi desert (KIEFER 1979, KIEFER et al. 1984).

Hosts: Parasites on the Genus *Phodopus*, reported from *Phodopus roborovskii* in Tuva. Fig. 1, map C.

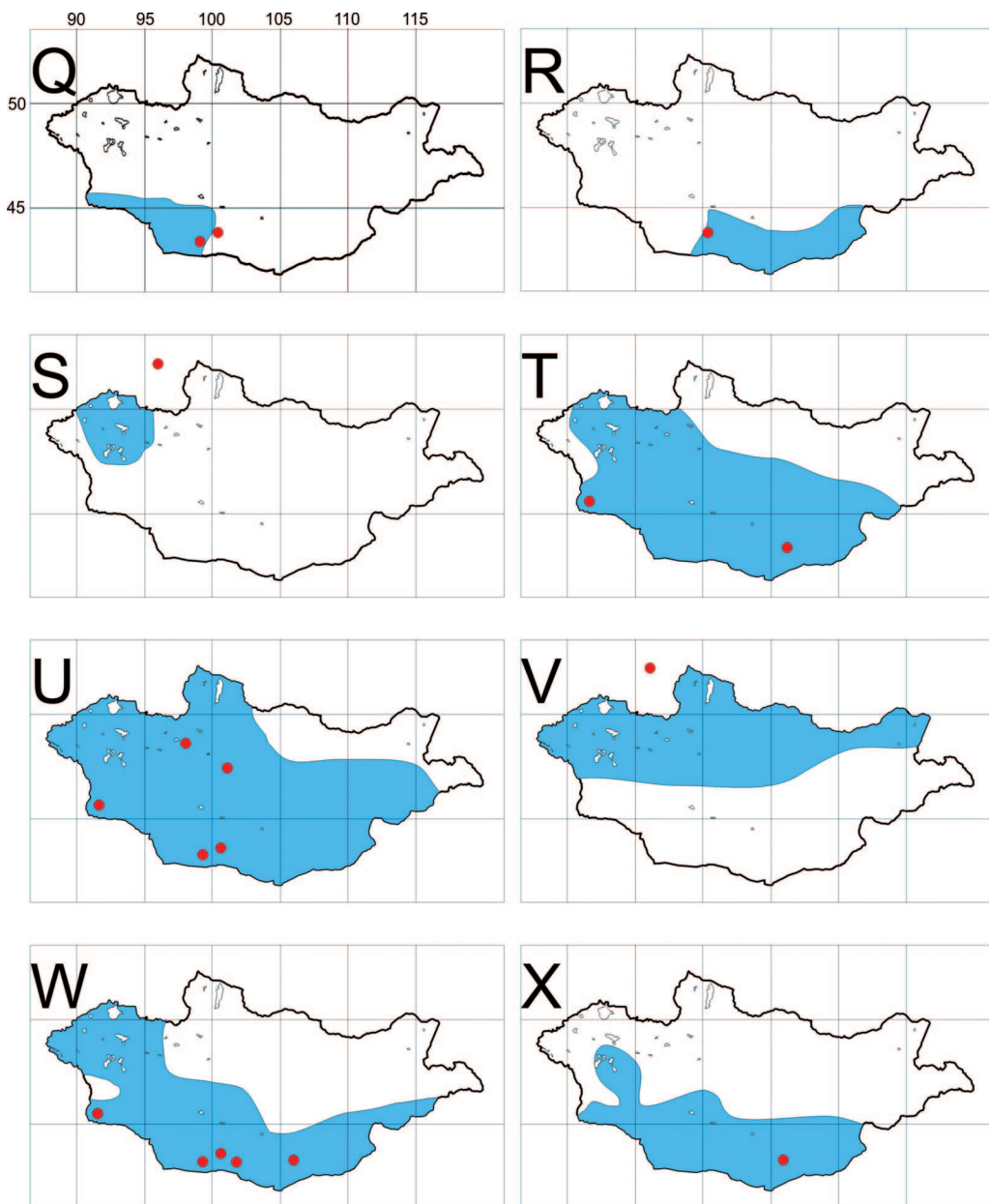


Fig. 3: Distribution (blue) and recording localities (red points) of different flea species. **Q** - *Coptopsylla lamellifer ardua* Jordan et Rothschild, 1915, *Coptopsylla lamellifer formozovi* Darskaya, 1988; **S** - *Mesopsylla tuschkan andruschkoi* Argyropulo, 1946; **T** - *Mesopsylla hebes clara* Smit, 1980; **U** - *Neopsylla pleskei orientalis* Ioff et Argyropulo, 1934; **V** - *Leptopsylla segnis* (Schönherr, 1811); **W** - *Nosopsyllus laeviceps ellobii* Wagner, 1908; **X** - *Xenopsylla skrjabini* (Ioff, 1928), *Xenopsylla c.conformis* (Wagner, 1933).

***Monopsyllus sciurorum asiaticus* Ioff, 1936**

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Dryomys nitedula*

Distribution: Occurs in Europe, Ural Mountains, Central Asia, the Irkutsk area, Afghanistan and northern Xinjiang, China. Two subspecies are known, *Monopsyllus sciurorum sciurorum* and *M. sciurorum asiaticus*. The known geographic distribution of *Monopsyllus sciurorum sciurorum* stretches from Europe to Central Asia. *M. sciurorum asiaticus* is limited to Central Asia. In Mongolia it covers the Hovd Aimag.

Hosts: The main host is *Dryomys nitedula* (see IOFF et al. 1954, LEWIS 1973, 1975; SKALON 1966). Described on *Mustela erminea* (Mongolia, Uljasutay-gol) (SMIT 1980, Kiefer 1979, KIEFER et al. 1984). Fig. 1, map E.

***Megabothris rectangulatus* (Wahlgren, 1903)**

Chovd Aimag: Čonocharajchijn-gol 28.06.-29.06.1982 *Phodopus roborovskii*

Dzabhan Aimag: Tes-gol, Bayan-tes 31.08.-03.09.2002 *Cricetulus spec.*,
Neomys fodiens

Khentii Aimag: Minž-gol 24.07.-27.07.2002 *Microtus spec.*

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Microtus spec.*

Distribution: Covers a distribution area from the British Isles to Trans Baikal, with east Transbaikalia marking the eastern border of its distribution. In Mongolia it occurs in the Changaj, Khentii and on the northern and western parts of the Mongolian Altai (IOFF et al. 1954, SKALON 1966, KIEFER 1979, KIEFER et al. 1984).

Hosts: representatives of the Microtinae and numerous other rodents. Fig. 2, map P.

***Mesopsylla tuschkan andruschkoi* Argyropulo, 1946**

Tuva: rivers Kara-tesh & Azas,
lake Kadysk 12.08.-17.08.2003 *Sorex spec.*, *Sicista betulina*

Distribution: Three Asian subspecies of *Mesopsylla tuschkan* occur from the Caucasus and Iran to the East of Kazakhstan. The subspecies *Mesopsylla tuschkan andruschkoi* occurs in Kazakhstan, the Zaysan valley and in the western and northern Balkhash. SKALON (1966) and EMELYANOVA et al. (1963) described it in Tuva. In Mongolia it was described by SMIT (1967) on *Allactaga sibirica* in the Uvs Aimag for the first time.

Hosts: *Allactaga elater*, *Allactaga sibirica*, *Ochotona dauurica*, *O. pallasi*, *Spermophilus*, *Alactagulus pumilio*, *Scirtopoda telum* (SMIT 1967, KIEFER 1979, 1993; KIEFER et al. 1984). Fig. 3, map S.

***Mesopsylla hebes clara* Smit, 1980**

Ömnögov Aimag: Borzongijn-gobi 21.07.-31.07.2001 *Dipus sagitta*,
Alactagulus pygmaeus

Borzongiin-gobi 01.07.-15.07.2002 *Dipus sagitta*

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Cricetulus spec.*, *Microtus spec.*,
Dryomys nitedula, *Allactaga sibirica*

Chovd Aimag: Čonocharajchijn-gol 26.08.-27.08.2002 *Dipus sagitta*, *Allactaga sibirica*

Distribution: Three subspecies of *Mesopsylla hebes* occur from the Crimea in the East to Mongolia across northern China. *Mesopsylla hebes clara* occurs in Mongolia in the South and the Valley of the Great Lakes near Chovd.

Hosts: Dipodidae, Gerbilidae, *Phodopus roborovskii* and *Microtus brandti* (see SMIT 1980, KIEFER 1979, 1993; KIEFER et al. 1984). Fig. 3, map T.

***Neopsylla pleskei orientalis* Ioff et Argyropulo, 1934**

Bayanchongor Aimag: Orchon	26.07.1999	<i>Eptesicus nilssonii</i>
Chovd Aimag: Bulgan-gol	09.08.-20.08.2002	<i>Cricetulus</i> spec.
Zavchan Aimag: Tes-gol, Bajan-tes	31.08.-03.09.2002	<i>Cricetulus</i> spec.
Ömnögov Aimag : Camp 4	25.09.2003	<i>Cricetulus sokolovi</i>
Camp 5	26.09.2003	<i>Cricetulus sokolovi</i>

Distribution: East Asia and the whole Mongolian area. It is the main parasite of *Microtus (Lasiopodomys) brandti*, in eastern Mongolia also the main parasite of *Meriones unguiculatus*. The reproduction period occurs in the warm summer months (SKALON 1966, ZHOVTYJ 1966, 1971).

Hosts: *Meriones unguiculatus*, *Ochotona* spec., *Spermophilus* spec., *Meriones meridianus*, *Marmota sibirica*, *Allactaga sibirica*, *Cricetulus* spec., *Lagurus lagurus*, *Passer montanus*, *Riparia riparia*. Fig. 3, map U.

***Nosopsyllus (Gerbillophilus) laeviceps ellobii* Wagner, 1908**

Ömnögov Aimag: Borzongijn-gobi	21.07.-31.07.2001	<i>Phodopus roborovskii</i> , <i>Meriones meridianus</i>
Camp 4	25.09.2003	<i>Cricetulus sokolovi</i> , <i>Meriones meridianus</i>
Camp 5	26.09.2003	<i>Cricetulus sokolovi</i>
Camp 6	27.09.2003	<i>Cricetulus sokolovi</i>
Chovd Aimag: Bulgan-gol	09.08.-20.08.2002	<i>Cricetulus</i> spec.

Distribution: Along the Caucasus and on the south-eastern and eastern shoreline of the Caspian Sea the group *Nosopsyllus G. laeviceps* developed (KUCHERUK & DARSKAYA 1981). *Nosopsyllus laeviceps abramovi* is mostly known from Kyrgyzstan and also occurs in Mongolia. In the southern Balkhash lake the subspecies *Nosopsyllus laeviceps consors* developed from the subspecies *Nosopsyllus laeviceps laeviceps*, and it is very closely related to *Nosopsyllus laeviceps kuzenkovi* from southern Mongolia and the Valley of the Great Lakes, Zaysan, Kazakhstan and the Zcheche lake in China. *Nosopsyllus laeviceps consors* shows some morphological characters placing this subspecies close to *Nosopsyllus laeviceps ellobii* from Tuva, China and Mongolia (BAVAASAN et al. 1977, SMIT 1967, KIEFER 1979, 1984). *Nosopsyllus (Gerbillophilus) laeviceps ellobii* occurs in Mongolia in the South and the Valley of the Great Lakes.

Hosts: *Rhombomys opimus*, the genus *Meriones*. Fig. 3, map W.

***Peromyscopsylla ostsibirica* (Scalon, 1936)**

Tuva: rivers Kara-tesh & Azas, lake Kadysh	18.08.-07.09.2000	<i>Sorex araneus</i> , <i>Microtus</i> <i>agrestis</i> , <i>Clethrionomys rutilus</i>
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Distribution: occurs in Siberia, Alaska and the Far East. In Mongolia it was described in the Khentii and Bulgan Aimags, mostly in autumn (SMIT 1966, 1967; KIEFER 1979).

Hosts: The genus *Clethrionomys*, *Sorex caecutiens*. Fig. 1, map D.

***Palaeopsylla soricis starki* Wagner, 1930**

Tuva: rivers Kara-tesh & Azas, lake Kadysh	18.08.-07.09.2000	<i>Sorex caecutiens</i>
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Distribution: Occurs in Europe and Asia, ranging from the British islands to Tjan san, Altai and the western Transbaikalian area. Two subspecies are known, *P. soricis soricis* in West Europe and *P. soricis starki* in the area of the former Commonwealth of Independent States (SCALON 1966).

Hosts: Species of the genus *Sorex*. Fig. 1, map D.

***Ophthalmopsylla (O.) praefecta pernix* Jordan, 1929**

Chovd Aimag: Bulgan-gol 09.08.-20.08.2002 *Cricetulus* spec., *Alactagulus pygmaeus*, *Allactaga sibirica*
Ömnögov Aimag: Camp 10 01.10.2003 *Allactaga sibirica*

Distribution: Occurs in Central Asia, Tibet, Central-, southern and eastern Siberia, Transbaikal area and Mongolia. In 1929 it was described by Jordan on *Allactaga sibirica* and *Ochotona dauurica* from the area around Ulaanbaatar. There are four subspecies of *O. praefecta* described in Mongolia; their distribution area covers the whole country.

Hosts: The main host seems to be *Allactaga sibirica*. *Cricetulus barabensis*, *Spermophilus undulatus* and *Ochotona dauurica* are also known hosts (KIEFER 1979, 1984).

***Paramonopsyllus scalonae* (Vovchinskaya, 1950)**

Zavchan Aimag: Tes-gol, Bayan-tes 31.08.-03.09.2002 *Alticola* spec.
Ömnögov Aimag: Camp 4 25.09.2003 *Cricetulus sokolovi*

Distribution: Occurs in Tuva and Mongolia. This species is the most abundant one in montane areas of west Mongolia, the basin of the Great Lakes, Mongolian and Gobi Altai, Changaj and Khentii region. Highest abundance is reached in the dens of its primary hosts of species of *Ochotona* (BAVAASAN 1974, EMELYANOVA ET AL. 1963, LABUNETS 1967, SMIT 1967; KIEFER 1979, 1984).

Hosts: *Ochotona dauurica*, *Ochotona pallasi*, *Alticola* spec., *Spermophilus* spec., *Microtus brandti*, *Meriones meridianus*, *Vulpes vulpes*, *Mustela eversmanni*, *Oenanthe* spec. Fig. 1, map D.

***Paradoxopsyllus teretifrons* (Rothschild, 1913)**

Ömnögov Aimag: Camp 6 27.09.2003 *Meriones meridianus*

Distribution: Occurs in a broad spectrum of desert areas in Central Asia including Turkmenistan, Uzbekistan, Kazakhstan and Kyrgyzstan and is also known from Dzungaria in China (IOFF et al. 1954, LEWIS 1974). In Mongolia it was described in the Ömnögov Aimag.

Hosts: *Rhombomys opimus* and other rodents (BAVAASAN 1974, BAVAASAN et al. 1977, KIEFER 1979, 1984). Fig. 2, map O.g

***Paradoxopsyllus dashidorzhii* Scalon, 1953**

Zavchan Aimag: Tes-gol, Bayan-tes 31.08.-03.09.2002 *Cricetulus* spec.

Distribution: Occurs in Tuva and the Altai, often together with *Paradoxopsyllus scorodumovi* and *Paradoxopsyllus integer*. In Mongolia it covers the North and the West, the Gobi Altai and the mountain and desert steppes of the Changaj.

Hosts: *Ochotona dauurica*, *Ochotona pallasi*, *Marmota sibirica*, *Meriones unquiculatus*, *Allocricetulus curtatus*, *Lagurus lagurus*, *Spermophilus undulatus*, *Microtus brandti*, *Hirundo rustica*, *Oenanthe* spec. (DOVCHIN & TSEVELMA 1978, BAVAASAN et al. 1977, KIEFER 1979, 1984). This species occurs mainly on representatives of the genus *Ochotona*. Reproduction takes place from August through the first part of November. Fig. 2, map N.

***Xenopsylla skrjabini* Ioff, 1930**

Ömnögov Aimag: Borzongijn-gobi 21.07.-31.07.2001 *Meriones meridianus*

Distribution: It occurs in the northern distribution area of *Rhombomys opimus* from the foothills of the Urals to the Gobi desert. The 45°-latitude line forms the southern border of its distribution. This species wasn't recorded in Mongolia until 1965, and based on the material of the Bavarian State Collection of Zoology in Munich its distribution area in Mongolia covers in the South of the country mainly deserts and semideserts and the basin of the Great Lakes.

Hosts: *Rhombomys opimus*, *Meriones* spec. (IOFF & SCALON 1954, LABUNETZ 1959, KIEFER 1979, 1984). Fig. 3, map X.

Conclusion

Up through 1966 most projects in parasitology and parasite surveys in Mongolia focused on natural plague foci thus showing a very limited picture of the siphonapterofauna of this country. From this year on, a much broader spectrum of ecotopes and areas in general was covered, thus increasing greatly the knowledge base of the flea fauna of the region. This fact is mainly the credit of Mongolian-German Biological Expeditions (Stubbe, Piechocki), expanding the investigation areas throughout the whole country. The resulting flea collections were analysed by SMIT (1966, 1967, 1972 b, 1980) and KIEFER et al. (1984). Accordingly, the number of known flea species in Mongolia has been increasing yearly. BAVAASAN et al. (1977) catalogued 130 flea species from the country, including a complete listing of the corresponding hosts and the distribution areas. Seven years later KIEFER et al. (1984) expanded the number of flea species and subspecies known from Mongolia to 159, based on their own collections as well as collections from the Mongolian colleagues N. Chotolchuu, R. Samyia, R. Sumyia, A. Dawaa and A. Bourinbair.

In cooperation with the NCIDNF, many aspects of the medical importance of fleas in Mongolia were elucidated and new projects initiated. The new atlas of hosts, vectors and pathogens of Mongolia is a crucial reference for any zoogeographical and epidemiological approach in this country. Based on the material from the National University of Mongolia and the NCIDNF, 162 flea species and subspecies are described in Mongolia so far.

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