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ANTS FROM NORTHWESTERN CHINA (HYMENOPTERA, FORMICIDAE)

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ABSTRACT

An ecological survey of the ant fauna of the southern part of the Junggar Basin and adjacent mountains, Xinjiang, China, revealed 46 species of which 27 (59%) were new records for China. Most of the species are widespread and no endemics were found. A largely boreal fauna occupies the spruce forest zone at high elevations of the Tien-shan Mountains, giving way, lower down, in elm forest, to a mixed, but primarily mesic temperate fauna. Loess desert and degraded steppe at mid-elevations and in the foothills are overgrazed and have only a few species that elsewhere occur in temperate mesic and/or steppic habitats. The sandy deserts and poplar woodlands of the arid Junggar Basin have a fauna characteristic of deserts and steppes. The salt desert fauna has a strange mixture of a number of elements.

INTRODUCTION

The ant fauna of northwestern China is poorly known. Consequently, during an ecological study in the Junggar (Dzungar; Zhungel; Kzungar) Basin, Xinjiang Uygur Autonomous Region (Fig. 1), in the summer of 1991, the junior author collected ants over a range of habitats at a variety of elevations. The present paper reports on that

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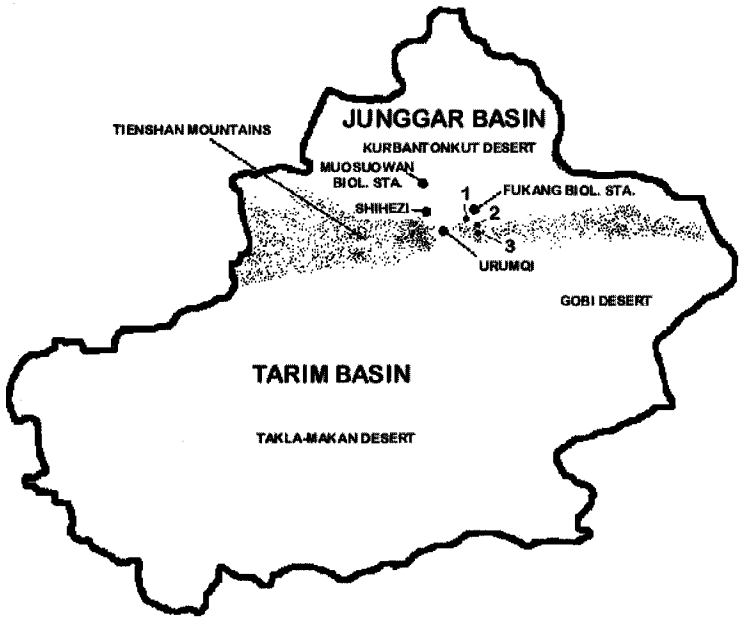

Fig. 1. Map of Xinjiang Uygur Autonomous Region, western China, showing location of the principal study areas. 1, Loess Desert; 2, Sangong River; 3, Tien-Chi (Heavenly Lake). There were a number of habitats studied at Muosuowan Biological Station and Fukang Biological Station, and opportunistic collections were made at various sites in the vicinity of Shihezi and Urumqi.

collection. A later publication, now in preparation, will treat the ecology of the region's ants.

In the following account, supplementary distributional data, unless accompanied by literature citations, are based on locality data from specimens examined by the senior author in various museum collections.

Some of the voucher specimens from the present study were retained in the senior author's collection. The remainder were deposited at the following institutions: the Xinjiang Institute of Biology, Pedology and Desert Research, Urumqi, China; the Museum of Comparative Zoology at Harvard University; the Department of Entomology at North Carolina State University.

Study Area

Xinjang Province lies in the western part of the Gobi-Taklamakan Desert complex and contains two large, arid basins encircled by moun-

tains. The Junggar Basin, in which most of the present work was carried out, is the most northern of the two, and is separated from the southern Tarim Basin by the Tienshan (Tian Shan) Mountains. The characteristics of the area have been described by Walter et al. (1983), Chen (1988) and Zhang (1990) and were summarized in publicity brochures published by the Xinjiang Institute of Biology, Pedology and Desert Research (XIBPDR) and the Chinese Academy of Sciences. The following description relies heavily on those sources as well as on personal communications from Professor Zhang Li Yun of XIBPDR.

The basin encompasses 50,000 km^2 and contains the second largest sandy desert in China, the Kurbantonkut (Gurbantüggüt) Desert. The floor of the basin lies below 500 m elevation. Proceeding toward the Tienshan Mountains and up the northern slopes, one passes through a series of progressively more mesic vegetation types. Historically, there was a belt of poplar woodland (*Populus euphractica diversifolia*) fringing the desert (Zhang, personal communication), but human influence has reduced it to a few scattered remnants. Between 1,020 and 1,600 m elevation are steppes, now heavily overgrazed and degraded. Above 1,600 m are forests, first elm and then spruce, leading finally to the treeline and thence to perpetual snow.

Alluvial fans and loess deposits spread out at the base of the mountains in some localities. In the desert there are local areas of halophytic vegetation on salty soils.

Where there is irrigation, natural vegetation gives way to cotton and a variety of vegetable crops. Moister conditions than those of the basin floor generally occur in valleys, on river banks and where groundwater from the mountains raises the watertable.

The fringe of the desert near the mountains has higher humidities, greater rainfall, more subsurface water, greater run-off and a greater diversity and cover of vegetation, than occurs deeper in the basin. The wooded areas at lower elevations have been influenced heavily by humans. About 1958 approximately 50% of the natural forests of elms and poplars were destroyed and grass planted in an attempt to extend grazing lands (Zhang 1990).

The principal study sites were located in various desert and steppic habitats in the southern part of the Junggar Basin (Muosuowan and Fukang biological stations) and up the northern slopes of the Tienshan Mountains, through mesic forests to Tien-Chi (Tianchi) (Heavenly Lake) near treeline. In these areas, ants were collected by baited transects, using sardines for bait, supplemented at some sites by pitfall traps, examination of the stomach contents of insectivorous vertebrates,

and opportunistic collections. In order to obtain species with different activity rhythms, the transects were attended four times per day, morning, mid-day, afternoon and night. In addition, incomplete, opportunistic collections were made in the environs of the cities of Shihezi and Urumqi (Urumchi; Wulumuchi) and in two desert sites on the southern side of the Tienshan Mountains. Localities from which specimens were collected are shown in Fig. 1. A brief description of the collecting sites follows.

Western Junggar Basin

1. Muosuowan Biological Station

Transects were used for a comprehensive collection in various habitats at the Muosuowan Biological Station, located approximately 200 km northwest of Urumqi near the terminus of a 100-km irrigation canal draining runoff from the Tienshan Mountains into the desert. The station grounds lie at an elevation of 335-350 m above sea level. The region is characterized by stabilized dunes, partly stabilized dunes, and flat interdune plains. The average annual precipitation is about 115 mm. In the open, air temperature one meter above the ground reaches as high as 37°C in the summer. Wind is a common event. The vegetation is of scattered perennial shrubs. In spring often there are ephemeral and ephemeroid plants, but these dry up by summer.

The habitats studied were: (1) tops of sand dunes, (2) slopes of sand dunes, (3) natural interdune plains and (4) interdune plains on which plantations of shrubs had been established.

2. Vicinity of Shihezi

Small opportunistic collections were made in: (1) salt desert east of Shihezi, (b) subdesert 47 km north of Shihezi, (c) overgrazed *Artemisia* desert south of Shihezi on the foothills of the Tienshan Mountains at 1600 m elevation, and (d) a nearby sheep farm at 1650 m.

3. Urumqi City and Vicinity

Ants were collected opportunistically: (1) at various places in the city of Urumqi, (2) in micro-shrub desert near the Urumqi Reservoir, 10 km south of Urumqi at an elevation of 1,100 m, and (3) in a shrubby part of the Gobi Desert on the southern side of the Tienshan Mountains, 33 km south-southeast of Urumqi.

Eastern Junggar Basin

1. Fukang Biological Station

The Fukang Biological Station covers a large area (lat. 43° 50' to 44° 30' N; long. 87° 45' to 88° 05' E) west of the city of Fukang and 76 km northeast of Urumqi. Mean annual precipitation is 164 mm, but annual evaporation is approximately 2,000 mm. Maximum temperatures in summer reach 42.6°C and winter minima descend to -41.6°C.

Except for shrub plantations on interdune plains, the habitats occurring at the Muosuowan Biological Station also are represented at Fukang, as well as some additional ones. There are dune tops, dune slopes, interdune plains, salt desert, poplar woodland on sand, poplar woodland on clay, irrigated crops, and plantations of trees used for windbreaks. The habitat diversity results from the location being near the limit of runoff from the Tienshan Mountains and consequently there is a mixture of arid habitats toward the interior of the basin and more mesic ones toward the mountains.

Transects were employed in each of these habitats.

Northern Slopes of the Tienshan Mountains

A series of habitats was examined for ants, beginning in the foothills at the edge of the desert in the Junggar Basin and extending upward through progressively more humid altitudinal zones to near treeline at Tien-Chi. They are described below in order of increasing elevation. Baited transects were used at all elevations.

1. Loess Desert, elevation 800 m

Located 40 km northeast of Urumqi and 29 km south of the Fukang Biological Station are foothills of the Tienshan Mountains. These hills are covered by a mixture of glacial gravels and boulders, and clay deposits of loess origin. Precipitation averages about 200 mm annually. The vegetation is a mixture of small shrubs, herbs and grasses; the area is heavily overgrazed.

Transects were established on both northern and southern slopes of these foothills.

2. Sangong (San-Gong) River, elevation 1250 m

Two sites were studied at this location: (1) riverine woodland of elm trees (*Ulmus pumila*), now left as a park-like remnant in a village

on the northern bank of the Sangong River and (2) a steppe of herbs, grasses and small shrubs desertified through overgrazing and soil compaction.

The combination of higher elevation and proximity to the river resulted in moister conditions in the woodland than the mean annual precipitation of 250 mm would suggest. Furthermore, winter temperatures are milder here than either in the basin, into which cold air drains, or further up-slope where altitudinal effects become evident. The degraded steppe, being farther from the river was drier.

3. Tien-Chi, elevation 1900 m

The lake Tien-Chi was formed by glaciers and reaches depths of 160 m. It is surrounded by spruce forest (*Picea schrenkiana* var. *tianshanica*). There are also poplar trees (*Populus tremula*) and shrubs (*Rosa*) in the area. Mean annual precipitation is over 500 mm.

Annotated Species List

Myrmicinae

Genus *Myrmica* Latreille 1804

Myrmica angulinodis Ruzsky 1905

Locality: Tien-Chi 26.viii.91.

This species was taken at only one site: prepared upland pasture fringing spruce forest. In common with other *Myrmica* species, *M. angulinodis* is a general scavenger but may also attend extrafloral nectaries and other sugar sources including aphid honeydew. This species was described from Siberia and has been recorded from Mongolia (Pisarski 1969). Wu and Wang (1995) list eight species of *Myrmica* from China, including *M. angulinodis*; they indicate its distribution as Inner Mongolia, Japan, Korea and Siberia. The present collection constitutes a first record from Xinjiang.

Genus *Messor*, Forel 1890

Heatwole et al. (1992) described the foraging behavior and habitats of *Messor* species in the Junggar Basin. Ants of this genus are seed gatherers in semi-arid to arid habitats. Consequently, where large colonies are established, these ants may affect seed-dispersal and may regulate the size of the seed-pool of particular plants. In the area studied, however, members of this genus only occurred at 8% of collection sites.

Wu and Wang (1995) list only one species of *Messor* from China (*M. aciculatus*).

Messor aralocaspius Ruzsky 1902

Locality: Fukang 8.viii.91, 25.viii.91, 27.viii.91.

This species may develop large crater nests in favorable situations. It is distributed through southern Russia to the Arabian highlands and also has been recorded from Mongolia and from near Kandahar, Afghanistan at 950 m (12.I.53, leg. H. Klapperich).

Messor orientalis Emery 1898

Localities: Fukang 17.viii.91, 19.viii.91, 21.viii.91, 23.viii.91; Sangong riverside 25.viii.91, 27.viii.91; Urumqi 28.viii.91.

This species occurred in a variety of habitats and was collected at 13 sites incuding dune slopes, salt desert, loess desert, steppe, riverside, and city precincts. It has a wide range through Central Asia, southern Russia, Cyprus, Turkey and the Middle East.

Messor perantennatus Arnoldi 1969

Locality: Fukang 20.viii.91, 21.viii.91.

This species was described from Turkmenistan and southern Russia.

Messor subgracilinodis Arnoldi 1969

Localities: Muosuowan 2.viii.91; Fukang 8.viii.91.

This species has a similar range to that of *M. perantennatus*.

Genus *Cardiocondyla* Emery 1869

Cardiocondyla species are very small ants that live by general scavenging. Often, surface-active workers are seen only when the ground is damp after irrigation or rain. Both of the following species were generally abundant in sandy areas in the neighborhood of trees, shrubs and buildings. Some individuals also were recovered from the stomachs of lizards and small mammals.

Wu and Wang (1995) listed two species of *Cardiocondyla* from China, not including either of the two species below.

Cardiocondyla elegans Emery 1869

Localities: Muosuowan 2.viii.91; Tien-Chi 6.viii.91; Fukang 9.viii.91, 13.viii.91, 14.viii.91, 17.viii.91.

This is a wide-ranging southern European species, also common on the Mediterranean coast of the Near East.

Cardiocondyla stambuloffi Forel 1892

Localities: Fukang 5.viii.91, 9.viii.91, 10.viii.91, 12.viii.91, 13.viii.91, 17.viii.91.

This species was known previously from southwestern Russia, the southeastern Balkans, Turkey and Mongolia.

Genus *Monomorium* Mayr 1855

Monomorium lindbergi Pisarski 1967

Locality: Fukang 21.viii.91.

Two workers were among *Solenopsis* specimens collected in a salt desert habitat. This is a brown, large-eyed species (ommatidia in the longest dimension 0.36 x head width).. The specimens nearly corresponded in size, color and general appearance to Pisarski's (1967) original description of specimens from Tang Sayed, northern Afghanistan, but the eyes were larger and the head more rectangular than appears to be true from Pisarski's description (although he gave no measurements). A simple pair of hairs are present on the pronotum and on the first gastric tergite. This species was previously known only from Afghanistan.

Genus *Solenopsis* Westwood 1840

Wu and Wang (1995) recorded two species of *Solenopsis* from China, but not *S. orientalis*.

Solenopsis orientalis Ruzsky 1905

Locality: Fukang 10.viii.91, 11.viii.91.

This species was collected on soil in a poplar windbreak. Like all boreo-palearctic *Solenopsis*, this is a small but aggressive and predatory ant, feeding on arthropods and on the brood of other (usually larger) ant species. *S. orientalis* also has been recorded from Siberia, Mongolia and Turkestan. The present paper represents the first Chinese record of this species under its own name. However, it is likely that Wheeler's (1930-31) record of the European species *S. fugax* Latreille from Foochow, China, was actually based on *S. orientalis* which has more diffuse sculpture and fewer body hairs.

Genus *Crematogaster* Mayr 1861

Crematogaster subdentata Mayr 1877

Locality: Fukang 5.viii.91, 9.viii.91, 23.viii.91.

This was the only species collected of this large world-wide genus. The ants were taken in the neighborhood of poplars and on rocky

slopes fringing loess desert. *C. subdentata* nests in the soil but like most species of *Crematogaster* is very dependent on homopteran honeydew on trees and shrubs. This ant prevously was known from Turkestan, Afghanistan, the Caucasus, Iran and in China from the Tienshan foothills. Wu and Wang (1995), however, did not include it on their list of 11 species of Chinese *Crematogster.*

Genus *Tetramorium* Mayr 1855

All of the following *Tetramorium* species have similar habits. They are general scavengers but also frequently collect and store small seeds. Members of this genus outnumbered all other Myrmicinae and were present at 33% of the collecting sites.

Tetramorium caespitum (Linnaeus 1758)

Localities: Muosuowan 2.viii.91; Fukang 8.viii.91, 9.viii.91, 10.viii.91, 17.viii.91; Sangong riverside 27.viii.91. This species was collected mainly in irrigated pasture and along river banks.

This is a common and abundant Eurasian ant. Wheeler (1930-31) and Wu and Wang (1995) distinguished the Chinese form of this species as *T. jacoti* and Pisarski (1969) used that name for *Tetramorium* collected in many places in Mongolia. However, this is a wide-ranging and variable species and the complex of forms has not been sufficiently characterized.

Wu and Wang (1995) included *Tetramorium jiangxiense*, recorded from eastern China, in the synonomy of *T. caespitum.*

Tetramorium diomedaeum Forel 1920

Localities: Fukang 9.viii.91, 21.viii.91, 23.viii.91; Sangong riverside 27.viii.91.

This is a pale, relatively unsculptured ant with a wide petiole node. It was previously known from the eastern Mediterranean and southern Balkans and on the Maltese Islands.

Tetramorium ferox Ruzsky 1903

Locality: Fukang 21.viii.91.

This coarsely sculptured species with strong propodeal spines was described from southern Russia and also has been recorded from Afghanistan and Mongolia (Pisarski 1967, 1969).

Tetramorium inerme Mayr 1877

Locality: Fukang 21.viii.91

In this species the propodeal spines are reduced to very short denticles. It was described from Turkestan and also occurs in Mongolia.

Tetramorium nitidissimum Emery 1925

Locality: Fukang 17.viii.91.

This species was previously known from the Caspian region.

Tetramorium sahlbergi Finzi 1936

Localities: Muosuowan 3.viii.91; Fukang 9.viii.91, 10.viii.91, 12.viii.91, 13.viii.91, 17.viii.91, 19.viii.91, 21.viii.91, 23.viii.91.

This small black *Tetramorium* was often among the stomach contents of gerbils and lizards. The species is known from Syria and Palestine and these records from the Junggar Basin considerably extend its range northeastward.

Tetramorium sarkissiani Forel 1911

Localities: Fukang 9.viii.91, 12.viii.91, 20.viii.91, 23.viii.91; Sangong riverside 25.viii.91.

These ants occurred mainly in open sites in loess desert and on clay interdune plains. During the present study ants of this species were observed in intraspecific battles. Hostile workers tug at each other, often in chains, but seem to do little damage. Such engagements may continue for several days. *T. sarkissiani* is one of the less well known species. It is distinguished by its smooth dorsal profile and strong sculpture. This species was described from Turkey and also was known previous to this study from the Balkans (leg. B. Poldi and C. A. Collingwood).

Tetramorium striativentre Mayr 1877

Localities: Muosuowan 2.viii.91; Fukang 8.viii.91, 12.viii.91, 13.viii.91, 17.viii.91; Sangong riverside 27.viii.91.

Tetramorium striativentre is a characteristic denizen of warm steppic environments and previously was known from Turkestan and parts of Afghanistan and Iran. It is slightly larger than its congeners and also is distinguished by the finely striated first tergite of the gaster.

Tetramorium taurocaucasicum Arnoldi 1967

Localities: Fukang 10.viii.91, 11.viii.91, 12.viii.91, 14.viii.91, 23.viii.91; Sangong riverside 27.viii.91.

This species was collected mostly in steppic environments near Fukang and above the Sangong River. It was described from southern Russia and also occurs in Iran. It resembles a somewhat larger *T. caespitum*, which it evidently replaces in drier sites. *Tetramorium taurocaucasicum* has weak reticulate sculpture on the first gastric tergite, and the petiole and postpetiole are more sculptured than in *T. caespi-*

tum. T. taurocaucasicum is sometimes considered a junior synomym of *T. forte* Forel 1904 (Bolton 1995).

FORMICINAE

Genus *Plagiolepis* Mayr 1861

Plagiolepis manczshurica Ruzsky 1905

Localities: Muosuowan 2.viii.91, 3.viii.91; Fukang 8.viii.91, 10.viii.91, 12.viii.91, 13.viii.91, 14.viii.91, 23.viii.91.

This is a small, somewhat cryptic species nesting in rock crevices and in leaf litter where there is moisture and some shade. It was mostly collected at sites around field stations and among poplar trees. Species of this genus mostly prey upon small arthropods in the soil. *P. manczshurica* was described from Manchuria and occurs throughout Mongolia, and widely in central China and in areas around Beijing (Wheeler 1930-31) and in North Korea (Collingwood 1976). Wu and Wang (1995) report this species from Xinjiang.

Plagiolepis sp. indet.

Locality: Fukang 22.viii.91.

This species was collected from loess desert as a single pale specimen that could not be identified.

Genus *Lepisiota* Santschi 1926 (*Acantholepis* Mayr actt.)

Ants of this genus are surface-active and fast-moving, usually found in open areas near water and along sea coasts.

Lepisiota sp. indet.

Locality: Fukang 14.viii.91.

A single damaged specimen recovered among the stomach contents of an agamid lizard at Fukang could not be identified to species. At least four species of *Lepisiota* are known from Afghanistan and Turkestan. The occurrence of this genus was previously recorded for China by Wu and Wang (1995), who reported *L. rothneyi* (as *Plagiolepis rothneyi*) from southern China.

Genus *Lasius* Fabricius 1804

Both of the following are small robust species mainly dependent on honeydew from root-feeding and foliage aphids. These ants are common holarctic species but their taxonomy and nomenclature in Central Asia are subject to revision.

Lasius niger (Linnaeus 1758)

Locality: Sangong riverside 27.viii.91.

Lasius obscuratus Stitz 1930

Localities: Sangong riverside 25.viii.91, 27.viii.91; Tien-Chi 26.viii.91. This species was known previously from the Caucasus.

Genus *Camponotus* Mayr 1861

Camponotus species depend mostly on arboreal aphid honeydew and do not usually occur far from trees or shrubs. Many of the larger species are nocturnal and more likely to be caught in pitfall traps than seen in full daylight.

Camponotus fedtschenkoi Mayr 1877

Localities: Muosuowan 3.viii.91; Fukang 13.viii.91, 17.viii.91.

Small pale workers of this species were collected from pitfall traps. Its previously known range was Turkestan and Afghanistan.

Camponotus kurdistanicus Emery 1898

Localities: Fukang 17.viii.91; Sangong riverside 27.viii.91.

This is a reddish species related to *C. fallax* of western Europe. Its distribution is Central Asia, including Afghanistan.

Camponotus sachalinensis Forel 1904

Locallity: Tien-Chi 26.viii.91

This is a black relative of *C. herculeanus* (Linnaeus) which it replaces in the spruce forests of northeastern Asia. All present specimens were taken among spruce.

Camponotus semirufus Emery 1925

Locality: Fukang 5.viii.91.

Camponotus semirufus was collected among poplar trees. It was described from Turkestan and is also present in Afghanistan, taken at Scham Shir Kandahar 22.v.52 (leg. H. Klapperich), as a new record for that country. It is related to *C. lateralis* (Olivier) of southern Europe.

Camponotus turkestanicus Emery 1887

Locality: Fukang 9.viii.91.

This is another Central Asian species and was taken in sandy ground among poplar trees. It has an unsually strong development of long curved subcephalic hairs characteristic of several desert-adapted species in diverse genera. This species occurs in Russian Turkestan, Afghanistan and in Mongolia (Pisarski 1969).

Camponotus turkestanus Andre 1882

Locality: Fukang 16.viii.91, 24.viii.91.

This species was taken in salt desert and on a dune slope. It has been recorded previously from Mongolia and the mountains of Szechuan, China (leg. Werner).

Genus *Formica* Linnaeus 1758

Formica cunicularia Latreille 1798

Localities: Near Urumqi 30.vii,91; Shihezi 1.viii.91; Tien-Chi 6.viii.91; Fukang 2.viii.91.

This species occurs in central and western Europe. Wu and Wang (1995) give its distribution as Europe, North Africa, and northeastern and southern China, but do not mention Xinjiang.

Formica fusca Linnaeus 1758

Localities: Tien-Chi 26.viii.91; Sangong riverside 25.viii.91.

This is a common, widely ranging holarctic species. The specimens from Tien-Chi do not appear typical of the species and seem to be the same as the form described by Kuznetsov-Ugamsky (1926) from Tian Shan and the Pamirs as *Formica fusca* var. *pallipes*, which like the present specimens have yellowish red legs and antennae. Wheeler (1930-31) recorded typical *F. fusca* from Szechuan Province at 2000 m. Wu and Wang (1995) also report this species from Xinjiang.

Formica glauca Ruzsky 1896

Locality: Tien-Chi 26.viii.91.

Formica glauca is widely distributed through the steppes of central Asia. It is recorded from Afghanistan and Mongolia and in China is known from Beijing, Shantung, Kiauchow, Tiang Tsin, and Shanhaikwan (Wheeler 1930-31; Dlussky 1967). Wu and Wang (1995) reported it from Xinjiang, Mongolia and Russia. It extends westward as far as Turkey and Bulgaria. Where *F. glauca* and *F. cunnicularia* are sympatric, they are easily distinguished by the brighter alitrunk and pronotal hairs of *F. glauca*. Pronotal hairs normally are absent in the more somber-colored *F. cunicularia*. However, populations of *F. cunicularia* in western Europe may have bright coloration and also pronotal hairs. Dlussky (1967) treated *glauca* as a subspecies of *F. cunicularia* but Agosti and Collingwood (1987) raised it to a full species because of the clear distinction between the two forms in their zones of overlap.

Formica pratensis Retzius 1783

Localities: Sangong riverside 27.viii.91; Tien-Chi 6.viii.91.

A large nest mound, consisting of twigs, of this conspicuous species was seen among saplings near the Sangong river. Workers also were collected on open ground near spruce forest at Heavenly Lake. These ants form trails to an aphid source and also freely attack other insects. *Formica pratensis* was recorded from Mongolia by Pisarski (1969) and from China (Xinjiang and Inner Mongolia) by Wu and Wang (1995), but the occurrence of this European species is not well known east of the Ural mountains.

Formica rufibarbis Fabricius 1793

Localities: Fukang 8.viii.91, 11.viii.91; Sangong riverside 25.viii.91.

Examples from these three collections were typical of this European species. Wheeler (1923) distinguished specimens from Shantung, China, as a variety subsequently renamed var. *orientalis* by Emery (1926) but it is doubtful whether the eastern Chinese species is really distinct from the wide-ranging European *F. rufibarbis* and the two are treated here as synonyms.

Formica sanguinea Latreille 1798

Localities: Fukang 8.viii.81, 11.viii.81; Sangong riverside 25.viii.91.

This species raids nests of *F. fusca, F. cunicularia* and *F. rufibarbis* and transports their pupae to be reared by auxilliary workers in the *F. sanguinea* nest. *Formica sanguinea* is a Eurasian species; in Asia it was previously recorded from Japan, Korea, Mongolia and Afghanistan. Wu and Wang (1995) previously recorded it from China.

Formica subpilosa Ruzsky 1902

Localities: Muosuowan 2.viii.91; north of Shihezi 1.viii.91; Fukang 5.viii.91, 9.viii.91, 12.viii.91, 13.viii.91, 17.viii.91, 27.viii.91; Turpan 28.viii.91.

This was by far the most abundant *Formica* species taken, accounting for 50% of all collections of the genus. Most individuals were taken among poplar trees. This is an eastern, but quite distinct, representative of the *F. cinerea* Mayr species-group which characteristically nest along riversides and are often in the vicinity of aphid-bearing poplar trees. *Formica subpilosa* is an effective predator on other arthropods in addition to being aphidicolous.

Formica subpilosa is known from China, Mongolia, Afghanistan, Kashmir and southeastern Russia.

Formica truncorum Fabricius 1804

Locality: Tien-Chi 6.viii.91.

Four queens of this species were collected in spruce forest. *Formica truncorum* has an interesting range from the European Alps to Hokkaido, Japan, but is replaced on the other Japanese islands and in Korea by the similar, but quite distinct, *F. yessensis* Forel and in Chinese montane forests east of the Gobi by *F. sinensis* Forel; Wu and Wang (1995) extended the known range of *F. yessensis* into northeastern and central China.

Genus *Proformica* Ruzsky 1903

Proformica coriacea Kuznetsov-Ugamsky 1927

Locality: Near Shihezi on a sheep farm 31.vii.91.

Proformica dolichocephala Kuznetsov-Ugamsky 1927

Localities: Muosuowan 3.viii.91; Fukang 5.viii.91, 8.viii.91; near Urumqi 31.viii.91.

This species was described from Russian Turkestan. It also has been recorded from China (Dlussky 1967) although Wu and Wang (1995) do not include it in their account of Chinese ants. It is easily recognized by the reddish alitrunk contrasting with dark head and gaster.

Proformica mongolica Emery 1901

Locality: Sangong riverside 25.viii.91. In addition, there were minute workers of *Proformica* from Fukang (5.viii.91, 13.viii.91, 17.viii.91) that could not be identified with certainty but which may be this species.

This species is widely recorded from Mongolia and also from Tibet (Dlussky 1967).

The above *Proformica* species were all known previously from Central Asia. They are typical denizens of steppic grassland. They are polymorphic with a range of sizes and allometrically variable structures. These ants forage singly and are general scavengers but also prey upon other arthropods.

Proformica splendida Dlussky 1965

Locality: Fukang 13.viii.91.

This species was described from Tienshan and Russian Turkestan. It is characterized by a long head with rounded occiput, long antennae, sparse body hairs and superficial head sculpture.

Proformica striaticeps Forel 1911

Locality: Muosuowan 2.viii.91.

This species ranges into the southern Balkans and Turkey.

Other species of this genus known from China include *P. flavosetosa* Viehmeyer from Szechuan, *P. jacoti* Wheeler from Beijing and *P. levefrei* Wheeler from Shantung (Wheeler 1930-31; Wu and Wang 1995).

Genus *Cataglyphis* Fòerster 1850

Cataglyphis pallidus Mayr 1877

Localities: Muosuowan 2.viii.91; Fukang 17.viii.91, 19.viii.91; Sangong riverside 25.viii.91.

This small, pale, ghost-ant is a characteristic inhabitant of the Central Asian deserts and probably does not occur elsewhere.

Cataglyphis rockingeri Forel 1911

Localities: Urumqi 30.vii.91; Shihezi 31.vii.91, 3.viii.91; Muosuowan 2.viii.91, 3.viii.91; Fukang 5.viii.91, 6.viii.91, 9.viii.91, 13.viii.91, 15.viii.91, 16.viii.91, 17.viii.91, 22.viii.91, 24.viii.91, 27.viii.91; Sangong riverside 27.viii.91.

This species was the most abundant diurnally foraging ant; it occurred at over 17% of all collecting sites. It outnumbered, in terms of individuals collected, all other ant species in the area. It was present at four locations where *Formica subpilosa* also was numerous, suggesting that these two diurnal species are not in direct competition. *Cataglyphis* species are mainly carnivorous scavengers whereas *Formica* species are both direct predators and aphid tenders. This species has been widely recorded from Mongolia (Pisarski 1969). Previous records from China were from Tianshan and Shantung (Chapman and Capco 1951).

This species is considered by some to be a subspecies of *C. aenescens* (see Bolton 1995); Wu and Wang (1995) list *C. aenescens* from northern China, including Xinjiang, as well as India, Russia, and Afghanistan; they do not give a subspecific designation.

Cataglyphis sp. (*albicans* group)

Locality: Muosuowan 2.viii.91; Fukang 9.viii.91.

Two workers were collected. They closely resemble examples of a species of the *C. albicans* group taken in Yemen and to be described elsewhere. They are characterized by a highly pitched petiole having the antero-dorsal face sloping steeply forward.

Results and Discussion

There were 46 species collected from the whole area (Table 1). Of these, 27 species (59%) constituted new records for China. Three species identified only to genus might also be new records. Wu and Wang (1995) reported 230 species of ants from China; with the addition of the 27 new records reported here, and a new species of *Brachyponera* described by Zenghui (1994) and not included in the list by Wu and Wang (1995), the total known Chinese ant fauna becomes 258. It is likely that many more species remain to be recorded from China. Wu and Wang (1995) listed eight species from Xinjiang that were not encountered in the present study. They were: *Camponotus herculaneum, C. itoi, C. yiningensis, Formica gagatoides, F. aquilonia, F. polyctena, F. sinae, Hypoclinea sibiricus*, and *Lasius flavus*, for a total known ant fauna from Xinjiang of 54 species.

For the habitats subjected to baited transects in the present study, most of the common species probably were obtained. The most common genera were *Tetramorium* (collected in all major habitats except spruce forest and at 33% of individual sites), *Cataglyphis* (represented in all major habitats but spruce forest and in 20% of the sites) and *Formica* (five major habitats and 11% of sites); all other genera were collected at 8% or less of the sites although *Messor* occurred in most major habitats.

Although a number of the species reported upon here were found in human-affected habitats such as city parks, crop fields, sheep farms and planted wind-breaks, only two species were found only as a commensal of humans (*Proformica coriacea* from a sheep farm and *Myrmica angulinodis* from a pasture cleared from spruce forest). This suggests either that disturbed habitats mostly were colonized directly from local sources, rather than by tramp species from outside the region, or that exogenous species became well established in natural as well as in modified habitats. Xinjiang has been a major trade route for centuries; the Silk Route passed through it, and semi-nomadic herdsmen still travel extensively within the area. It is likely that species of ants subject to human transport would have been widely distributed long since.

Table 1. Ant fauna of different natural habitats in and around the Junggar Basin, Xinjiang Autonomous Region, China.

	HABITATS											
							Dune Desert					
SPECIES	Spruce Forest	Elm Wood-land	Degraded Steppe	Salt Desert	Loess Desert S	Loess Desert C	Dunes F	Dunes M	Interdune F	Interdune M	Poplar Woodland S	Poplar Woodland C
§*Myrmica angulinodis*												
**Messor aralocaspius*							+	+				
**Messor orientalis*		+	+	+		+	+		+		+	
**Messor perantennatus*				+								
**Messor subgracilinodis*										+		
**Cardiocondyla elegans*							+	+		+	+	
**Cardiocondyla stambouloffi*												+
**Monomorium lindbergi*				+								
**Solenopsis orientalis*				+					+			
Crematogaster subdentata							+	+	+		+	+
[*Tetramorium caespitum*]								+		+		+

S = sand; C = clay; F = Fukang; M = Muosuowan.
§ = found only associated with humans (pasture, sheep farm) and did not occur in any of the habitats listed.
* = new record for China.

Table 1. (Continued.)

SPECIES	HABITATS											
							Dune Desert					
	Spruce Forest	Elm Wood-land	Degraded Steppe	Salt Desert	Loess Desert S	Loess Desert C	Dunes F	Dunes M	Interdune F	Interdune M	Poplar Woodland S	Poplar Woodland C
**Tetramorium diomedaeum*		+	+	+	+							
**Tetramorium ferox*				+								
**Tetramorium inerme*				+								
**Tetramorium nitidissimum*		+		+							+	
**Tetramorium sahlbergi*				+	+	+	+	+			+	
**Tetramorium sarkissiani*		+				+			+			+
**Tetramorium striativentre*								+		+	+	
**Tetramorium taurocaucasicum*		+	+	+			+		+		+	+
Plagiolepis manczshurica					+	+	+	+	+	+		
† *Plagiolepis* sp. indet.					+					+		
†*Lepisiota* sp. indet.							+					
Lasius niger		+										
**Lasius obscuratus*	+	+										

S = sand; C = clay; F = Fukang; M = Muosuowan.
* = new record for China.
† = not known whether new record or not.

Table 1. (Continued.)

SPECIES	HABITATS											
							Dune Desert					
	Spruce Forest	Elm Wood-land	Degraded Steppe	Salt Desert	Loess Desert S	Loess Desert C	Dunes F	Dunes M	Interdune F	Interdune M	Poplar Woodland S	Poplar Woodland C
**Camponotus fedtschenkoi*							+	+				
**Camponotus kurdistanicus*		+					+					+
**Camponotus sachalinensis*	+											
**Camponotus semirufus*											+	
**Camponotus turkestanicus*							+				+	+
Camponotus turkestanus				+			+					
Formica cunicularia				+								
Formica fusca	+	+										
Formica glauca	+											
Formica pratensis	+	+										
Formica rufibarbis		+										
Formica sanguinea				+								
Formica subpilosa											+	+

S = sand; C = clay; F = Fukang; M = Muosuowan.
* = new record for China.

Table 1. (Concluded.)

SPECIES	HABITATS											
							Dune Desert					
	Spruce Forest	Elm Wood-land	Degraded Steppe	Salt Desert	Loess Desert		Dunes		Interdune		Poplar Woodland	
					S	C	F	M	F	M	S	C
**Formica truncorum*	+											
**§Proformica coriacea*												
Proformica dolicocephala							+			+		+
Proformica mongolica		+										
Proformica splendida									+	+	+	
**Proformica striaticeps*								+				
**Cataglyphis pallidus*		+					+	+		+		
Cataglyphis rockingeri			+	+	+	+	+	+	+	+	+	+
**Cataglyphis* sp. (*albicans* group)										+	+	
TOTAL SPECIES	6	13	4	14	5	5	15	11	8	11	13	10
					7		18		16		18	
NO. GENERA	3	7	3	6	3	4	9	8	7	6	8	7

S = sand; C = clay; F = Fukang; M = Muosuowan.
§ = found only associated with humans (pasture, sheep farm) and did not occur in any of the habitats listed.
* = new record for China.

Each species was categorized as to whether its extralimital range occurred primarily in boreal regions, mesic temperate areas, steppes, deserts or was spread over a range of different habitats (eurytopic). Then the proportion of species of these ecological types were calculated for the ant fauna of each habitat in the Junggar region (Table 2).

Most of the species from the spruce zone are boreal elsewhere; no species are shared with other local habitats except for two species that extend to the altitudinally adjacent elm woodland. One of these (*Formica pratensis*) probably invaded the spruce zone from the elm zone below; although collected in the spruce zone, it did not actually occur in the forest itself, but rather in an open area near the forest. Boreal species only occur in two other habitats, a small proportion each in elm woodland and, oddly, salt desert.

The greatest proportion of the elm forest species occur in mesic temperate areas extralimitally, but a number also occupy steppes. Degraded steppe and loess desert both are heavily overgrazed, and perhaps for that reason have low numbers of species. In both habitats, the few species that were present characteristically are found in steppes and mesic temperate areas elsewhere.

The composition of the ant fauna of the salt desert was surprising in that it was exceptionally diverse in terms of extralimital habitats. Steppic species predominated and boreal and mesic temperate species were included; desertic species were not well represented. This desert is located near the base of the mountains where there is considerable ground-water and the desertic character of this habitat may be influenced more by high salt than by scarce water.

Table 2. Extralimital habitats of the ants from different study areas in the Junggar region. Only species identified to species level are included. Those with insufficient data on extralimital habitat are excluded.

	NUMBER (%) OF SPECIES THAT EXTRALIMITALLY ARE:				
HABITAT	Boreal	Temperate Mesic	Steppic	Desertic	Eurytopic
Spruce Forest	3 (50)	1 (17)	1 (17)	0	1 (17)
Elm Woodland	1 (8)	4 (33)	3 (25)	2 (17)	2 (17)
Degraded Steppe	0	1 (25)	3 (75)	0	0
Salt Desert	1 (8)	3 (25)	6 (50)	2 (17)	0
Loess Desert	0	3 (50)	3 (50)	0	0
Dune Desert	0	3 (14)	9 (41)	8 (36)	2 (9)
Poplar Woodland	0	2 (12)	7 (41)	6 (35)	2 (12)

The remnants of poplar woodland occur on and among dunes and on interdune plains; the low vegetation of dunes and poplar woodlands is similar. This ecological similarity is reflected in practically identical proportional representation of overall habitat preferences of their ant faunas. Most species are steppic and desertic.

Although there are some exceptions, the altitudinal distributions of ants in the Junggar region generally reflect the ecological conditions in the ants' wider zoogeographic ranges. The ant faunas of particular habitats appear to have originated mainly from distant, but ecologically similar habitats and there seems to have been little radiation from local stock into the diverse environments available. Most of the species are widespread and many overlap zoogeographic boundaries to include the Middle Eastern, Mediterranean, southern European or boreal regions in their ranges. Only fourteen species seem to be exclusively Central Asian. No species in the present study is known to be endemic to the study area, Xinjiang, or even to China. No previously undescribed species were found although the possibility remains that the three species with inadequate material for identification might prove to be new. Several taxonomic/nomenclatural problems, mentioned in the annotated list, remain to be resolved.

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