Ants (Formicidae)

Authors: Zhenghui, Xu, and Alonso, Leeanne E.

Source: A Rapid Biological Assessment of three sites in the Mountains of Southwest China Hotspot, Ganzi Prefecture, Sichuan Province, China: 80

Published By: Conservation International

URL: https://doi.org/10.1896/054.052.0107

Chapter 2

Ants (Formicidae)

Xu Zhenghui and Leeanne E. Alonso

Summary

In total, 45 ant species belonging to 4 subfamilies and 17 genera were collected from the three sites: 16 species from Site 1 (Danba); 34 species from Site 2 (Kangding); and 14 species from Site 3 (Yajiang). Among the 45 ant species, 22 species (48.9%) have been positively identified while 23 species (51.1%), including many new species records for China and at least four species new to science, await final identification. The lowest elevation site (Kangding) had highest ant species richness, followed by the Danba site, and lastly the higher elevation Yajiang site. However in terms of ant community composition, the higher elevation Yajiang site with more pristine forests exhibited the highest stability and evenness in the ant community. Several species of the genus *Myrmica* species were found at all three sites. The genus *Formica* is also relatively rich in species and common in distribution. Colonies of the red wood ant (*Formica* sp.) contain thousands of workers and are an important natural enemy for pest insects in alpine conifer forest.

Introduction

Ants are an important group of social insects belonging to the Class Insecta, Order Hymenoptera, and Family Formicidae. Ants are species-rich and abundantly distributed; to date about 12,000 species have been described worldwide. Ants are found in every terrestrial ecosystem except for polar ecosystems and those found above snow-level. Ants comprise a huge amount of biomass and provide a multitude of ecosystem services such as improving soil, dispersing seeds, pollinating flowers, consuming small dead animals, and controlling pest insects. As such, ants are a beneficial group to survey and monitor in order to evaluate biodiversity and ecological quality.

No comprehensive work on ant species diversity has previously been carried out in western Sichuan Province, China. Thus the field is wide open for myrmecologists and much remains to be learned about the ants of this region. Bingham (1903), Wu et al. (1995) and Imai et al. (2003) are the most important references for the identification of ants from western Sichuan Province.

Methods

At RAP Site 1 (August 22-26, 2005; Kuiyong, Donggu Town, Danba County), we surveyed ants at elevations between 1810-3905 m using mostly search-collecting methods. Habitats sampled included alpine conifer forest, conifer-broadleaf mixed forest, oak forest, bamboo forest and grassland. The Winkler method (Agosti et al. 2000, see below) was also utilized at this site to sample ants from the litter layer of conifer-broadleaf forest and bamboo forest. At RAP Site 2 (August 29-September 3, 2005; Tongling, Pengta Town, Kangding County), we surveyed at elevations between 2125-2810 m using search-collecting in conifer-broadleaf mixed forest, secondary broadleaf forest, and Yunnan pine forest. We also used the Winkler method to sample ants from the litter layer of secondary broadleaf forest and Yunnan pine forest. At RAP Site 3 (September 6-9, 2005; Decha Town, Yajiang County), at 3600-4700 m, we used the search-collecting method to investigate alpine grassland, alpine shrub, alpine conifer forest, oak forest, and valley grassland, while ants from the litter layer of oak forest were surveyed using the Winkler method.

In the search-collecting method, a team of 1-4 people actively searched for ants nesting under stones, under or inside decayed wood and those foraging on ground, litter, tree trunks or plants. When ants were found, 20-30 individuals from a nest or 1-30 individuals from a foraging group were collected and preserved in a specimen container with absolute alcohol, and containers were labeled. In the Winkler method (Agosti and Alonso 2000), a sifter was used to first sift the leaf litter from ten 1m^2 quadrats along a transect through forest (quadrats spaced 10 m apart). Each sample of leaf litter was then transferred to a cotton mesh bag (mesh size 1 cm) and hung inside a "winkler sac", consisting of a large cotton bag with a collecting container (filled with alcohol) at the bottom. This method allows for the passive collection of ants and other arthropods as they move out of the leaf litter bag and fall down into the collecting container. Winkler sacs were hung under a tarp for 48 hours at each site.

In the laboratory, ant specimens were fixed with glue on the tips of triangular papers (12mm×3mm) and then mounted on insect pins. Collecting labels were placed below the specimens, and identification labels placed below the collecting labels. A morphological taxonomic method was used to identify each specimen.

Bolton's identification guide (1994) was used for determining the genera of ants. A more recent catalogue (Bolton 1995) gives complete information for the validity of ant genera. Bolton's synopsis (2003) lists detailed references for further taxonomic identification. The ant species diversity investigation method determined by Xu (2002) was used in the analysis of our results. Tang et al. (1995), Zhou (2001) and Xu (2002) are good references for ant taxonomy. Taxonomic research of Wilson (1955), Collingwood (1982), Seifert (1992), Xu (1995), Xu (1996), Bubois (1998), Radchenko et al. (2001), Wei et al. (2001), Zhou et al. (2003), Radchenko (2004), Xu and Zhou (2004), and Radchenko (2005) were also useful in the identification of specimens collected during the RAP survey.

We used the Shannon-Wiener formula, $H = -\sum_{i=1}^{s} P_i \ln P_i$, to calculate the species diversity index (*Pi=Ni/N*, *Ni* represents the number of individuals of species i, N represents the sum of all individuals in community S). Pielou's formula, *E=H*/ln*S*, was used to calculate an evenness index (H represents the Shannon-Wiener species diversity index, S represents species number). Simpson's formula, $C = \sum_{i=1}^{s} (P_i)^2$, was used to calculate the predominance index, incorporating richness and evenness (where *Pi*, *Ni* and *N* are as mentioned above). Jaccard's formula, *q=c/(a+b-c)*, was used to calculate similarity coefficients between ant communities (*a* represents species number of community A, *b* represents species number of community B, *c* represents the number of species in common between the two communities. A value of *q* between 0.00-0.25 shows extremely dissimilarity, values of *q* between 0.25-0.50 show moderate dissimilarity, values of *q* between 0.50-0.75 show moderate similarity, and values of *q* between 0.75-1.00 show extreme similarity).

Results

In total, 45 ant species belonging to 4 subfamilies and 17 genera were collected from the three surveyed sites. Among the 45 ant species, 22 species (48.9%) have been positively identified while 23 species (51.1%), including at least four species new to science, await final identification. The majority of ant genera (10) and species

Table 2.1. Number of ant species in each genus recorded from the three China RAP survey sites (Danba, Kangding and Yajiang).

Subfamily	Genera	Number of Species	Site, Elevation and Species Number		
			Danba 1810-3905m	Kangding 2125-2810m	Yajiang 3600-4285m
Ponerinae	*Pachycondyla*	1	0	1	0
Myrmicinae	*Strumigenys*	1	0	1	0
	Pyramica	1	0	1	0
	Crematogaster	2	0	2	0
	Myrmecina	1	0	1	0
	Stenamma	2	2	1	0
	Tetramorium	1	0	1	0
	Pheidole	1	0	1	0
	Leptothorax	5	0	5	0
	Aphaenogaster	3	1	1	2
	Myrmica	9	5	5	5
Dolichoderinae	*Tapinoma*	1	1	1	0
Formicinae	*Prenolepis*	1	0	1	0
	Lasius	4	1	4	1
	Paratrechina	3	1	3	0
	Camponotus	3	1	2	2
	Formica	6	4	3	4
Total Number of Species		**45**	**16**	**34**	**14**
Total Number of Genera		**17**	**8**	**17**	**5**
Total Number of Subfamilies		**4**	**3**	**4**	**2**

(26) collected during the RAP survey pertain to the the subfamily Myrmicinae. The subfamily Formicinae had representatives from 5 genera and 17 species. Few representatives from the subfamilies Ponerinae and Dolichoderinae were collected (one genus and one species each). Nine species of the genus *Myrmica* were recorded, with *Formica* following with six species, and *Leptothorax* and *Lasius* with four species each. We recorded one species for each of the following genera: *Pachycondyla, Strumigenys, Pyramica, Myrmecina, Tetramorium, Pheidole, Tapinoma*, and *Prenolepis* during the RAP survey (Appendix 2, Table 2.1).

Three subfamilies, 8 genera and 16 species were recorded from RAP Site 1 (Danba); 4 subfamilies, 17 genera and 34 species were recorded from RAP Site 2 (Kangding); and 2 subfamilies, 5 genera and 14 species were recorded from RAP Site 3 (Yajiang). Ants from the subfamily Ponerinae were recorded only at the lowest site, Kangding, while ants in the subfamily Dolichoderinae were found only at the two lower sites (not at RAP Site 3). Most genera of Myrmicinae were recorded only at the Kangding site. In contrast, genera within the Formicinae were commonly distributed at all three sites. Nine out of the 17 ant genera (52.9%) were recorded only from the Kangding site; three genera (17.6%) were found at both Kangding and Danba but not at Yajiang (Table 2.1).

Twenty-three ant species, representing about half of the total species number collected during the RAP survey, are taxonomically difficult to identify and thus still remain to be identified. These interesting species are valuable for the conservation of the RAP survey area because at least four species are possibly new to science and many of them are possibly new species records for China. Among the 11 genera of still undetermined species, most are in the genera *Myrmica* and *Leptothorax*. Of the three surveyed sites, the lowest site with respect to elevation (Kangding) was richest in undetermined species. From the site highest in elevation (Yajiang), we collected eight undetermined species, slightly higher than the lower Kangding site (Table 2.2).

Discussion

Ant species in the genus *Myrmica* are an important group in high elevation regions of China. This genus is important at all three sites, not only in terms of species richness, but also in terms of its wide distribution. The importance of *Formica* species is second to those of *Myrmica* (Table 2.1). *Formica* is relatively rich in species, common in distribution, and great in abundance. These factors combine to make ants in the genus *Formica* important natural enemies of pest insects in alpine conifer forest. The ant genera *Strumigenys, Pyramica, Myrmecina, Stenamma, Leptothorax, Aphaenogaster* and *Prenolepis* possibly contain new species or new species records for China (Table 2.2).

The greatest numbers of ant subfamilies, genera, and species were recorded at the lowest elevation site (Kangding). Slightly lower numbers were recorded at the middle elevation site (Danba), and lowest numbers at the highest site (Yajiang) (Table 2.1). These results conform well to the common rule for ant vertical distribution. In other words, the majority of ant species are found in warmer habitats, and most species are distributed at lower elevations.

From the point of view of ant community composition, at the site lowest in elevation (Kangding) we recorded the highest number of individuals and calculated the highest species diversity index and the lowest predominance index (Table 2.3). This may be due to the comparatively warmer conditions and the greater diversity of forest types, both conifer and broadleaf, found at this site. In contrast, the higher site (Danba) recorded the lowest number of individuals collected, the lowest species diversity index, and the highest predominance index. The highest site (Yajiang) has the highest evenness index, the median number of individuals collected, species diversity index and predominance index. These results are possibly related to the good state of the conifer forest and the colder conditions of the site. Our RAP data indicate that the Kangding site has the highest ant species diversity, but that the Yajiang site has the highest stability, and Danba site, rich in secondary forests, has the lowest ant species diversity.

Table 2.2. Number of still undetermined ant species recorded from the China RAP sites.

Subfamily	Genera	Number of Species	Site, Elevation and Species Number		
			Danba 1810-3905m	Kangding 2125-2810m	Yajiang 3600-4285m
Myrmicinae	*Strumigenys*	1	0	1	0
	Pyramica	1	0	1	0
	Myrmecina	1	0	1	0
	Stenamma	2	2	1	0
	Leptothorax	5	0	5	0
	Aphaenogaster	2	0	0	2
	Myrmica	6	4	2	4
Formicinae	*Prenolepis*	1	0	1	0
	Lasius	2	1	2	1
	Paratrechina	1	0	1	0
	Camponotus	1	0	0	1
Total Number of Species		**23**	**7**	**15**	**8**

Table 2.3. Indices and figures of ant communities from China RAP survey sites.

Indices & Figures	Danba	Kangding	Yajiang
Number of Individuals	1779	4252	3480
Diversity Index /*H*	2.0360	2.4296	2.1064
Evenness Index /*E*	0.7343	0.6890	0.7982
Predominance Index /C	0.1644	0.1240	0.1587

According to the Jaccard similarity coefficients, the two higher sites, Yajiang and Danba, are most similar in ant species composition (Table 2.4). Danba and Kangding are less similar while the Yajiang site and the Kangding site are least similar.

Table 2.4. Similarity Coefficients (q) between ant communities of China RAP survey sites in Danba, Kangding and Yajiang.

Site Name	Yajiang	Danba
Danba	0.3043	
Kangding	0.1429	0.2821

Conservation Recommendations

We were deeply impressed with both the state of the virgin forests and the consciousness of the local Tibetan people regarding environmental protection at Yajiang. Our survey results also show the highest stability of the ant community at this site. Therefore, we conclude that Decha has very high value and scientific significance for the sustainable protection of biodiversity.

Kangding has the highest species diversity and therefore significant protection value. However, this site has been heavily logged in the past, the population density of local people is high, and the forest is frequently disturbed (thus the condition of vegetation here is poor). We recommend proposing a plan to identify specific areas for protection with strengthened protection measures, and other areas for use by local people. Only through such measures will this site be valuable for the conservation of biodiversity.

Danba has had large-scale logging in the past. Thus, secondary forest is dominant today and the RAP survey data revealed lowest ant species diversity in this area. However, human population density here is quite low and since the cessation of logging, the succession of vegetation has steadily progressed, therefore this site can be of high value for the conservation of biodiversity.

References

Agosti, D. and L.E. Alonso. 2000. The ALL protocol: a standard protocol for the collection of ground-dwelling ants *In*: Agosti, D., J. Majer, L.E. Alonso and T.R. Schultz (eds.). Ants: Standard Methods for Measuring and Monitoring Biological Diversity. Smithsonian Institution Press. Washington, DC.

Agosti, D., J.D. Majer, L.E. Alonso and T.R. Schultz (eds.). 2000. Ants: Standard Methods for Measuring and Monitoring Biological Diversity. Smithsonian Institution Press. Washington, DC.

Bingham, C.T. 1903. The fauna of British India including Ceylon and Burma. Hymenoptera 2. Ants and cuckoo-wasps. Taylor and Francis. London. 506 pp.

Bolton, B. 1994. Identification guide to the ant genera of the world. Harvard University Press. Cambridge. 222 pp.

Bolton, B. 1995. A new general catalogue of the ants of the world. Harvard University Press. Cambridge. 504 pp.

Bolton, B. 2003. Synopsis and classification of Formicidae. Memoirs of the American Entomological Institute, 71: 1-370.

Collingwood, C.A. 1982. Himalayan ants of the genus *Lasius* (Hymenoptera: Formicidae). Systematic Entomology, 7(3): 283-296.

DuBois, M.B. 1998. A revision of the ant genus *Stenamma* in the Palaearctic and Oriental regions (Hymenoptera: Formicidae: Myrmicinae). Sociobiology, 32(2): 193-403.

Imai, H.T., M. Kihara, M. Kondoh et al. 2003. Ants of Japan. Gakken. Tokyo. 225 pp.

Radchenko, A.G. and G.W. Elmes. 2001. A taxonomic revision of the ant genus *Myrmica* Latreille, 1804 from the Himalaya (Hymenoptera, Formicidae). Entomologica Basiliensia, 23: 237-276.

Radchenko, A.G. 2004. A review of the ant genera *Leptothorax Mayr* and *Temnothorax* Mayr (Hymenoptera, Formicidae) of the eastern Palaearctic. Acta Zoologica Academiae Scientiarum Hungaricae, 50(2): 109-137.

Radchenko, A.G. 2005. A review of the ants of the genus *Lasius* Fabricius, 1804, subgenus *Dendrolasius* Ruzsky, 1912 (Hymenoptera: Formicidae) from east Palaearctic. Annales Zoologici, 55(1): 83-94.

Seifert, B. 1992. A taxonomic revision of the Palaearctic members of the ant subgenus *Lasius* s. str. (Hymenoptera: Formicidae). Abhandlungen und Berichte des Naturkundemuseums Goerlitz, 66(5): 1-66.

Tang, J., S. Li, E. Huang et al. 1995. Economic insect fauna of China. Fasc. 47 Hymenoptera: Formicidae (1). Science Press. Beijing. 134 pp.

Wei, C., S. Zhou, H. He et al. 2001. A taxonomic study of the genus *Myrmica* Latreille from China. (Hymenoptera: Formicidae). Acta Zootaxonomica Sinica, 26(4): 560-564.

Wilson, E.O. 1955. 1955. A monographic revision of the ant genus *Lasius*. Bulletin of the Museum of Comparative Zoology at Harvard College, 113: 1-201.

Wu, J. and C. Wang. 1995. The ants of China. China Forestry Publishing House. Beijing. 214 pp.

Xu, Z. 1995. Two new species of the ant genus *Prenolepis* from Yunnan China (Hymenoptera: Formicidae). Zoological Research, 16(4): 337-341.

Xu, Z. 1996. A taxonomic study of the ant genus *Pachycondyla* from China (Hymenoptera: Formicidae: Ponerinae). Zoological Research, 17(3): 211-216.

Xu, Z. 2002. A study on the biodiversity of Formicidae ants of Xishuangbanna Nature Reserve. Yunnan Science and Technology Press. Kunming. 181 pp.

Xu, Z. and X. Zhou. 2004. Systematic study on the ant genus *Pyramica* Roger (Hymenoptera, Formicidae) of China. Acta Zootaxonomica Sinica, 29(3): 440-450.

Zhou, S. 2001. Ants of Guangxi. Guangxi Normal University Press. Guilin. 255 pp.

Zhou, S. and Z. Xu. 2003. Taxonomic study on Chinese members of the ant genus *Strumigenys* F. Smith (Hymenoptera, Formicidae) from the mainland of China. Acta Zootaxonomica Sinica, 28(4): 737-740.