

Community Structure and Diversity of Ladybugs in Baihualing of Gaoligong Mountain I

—Species Composition and Population Structure

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Abstract [Objective] The paper was to study the community structure and diversity of ladybugs in Baihualing of Gaoligong Mountain, and fill gaps in research about ladybugs in this region. [Method] Using sampling plot investigation method, the species composition and population structure of ladybugs in Baihualing of Gaoligong Mountain were surveyed. [Result] A total of 3 218 ladybugs specimens had been collected, belonging to 5 subfamilies, 20 genera, 56 species. Two species were new records for Yunnan Province. The species and number of Coccinellinae were the greatest, followed by Epilachninae and Aspidimerinae, while Coccidulinae and Scymninae were the least. The dominant species were *Coccinella septempunctata* L., *Harmonia eucharis* (Mulsant) and *Afissula hydrangeae* Pang et Mao. [Conclusion] The study laid foundation for further study on ladybugs in Baihualing of Gaoligong Mountain.

Key words Ladybug; Community structure; Gaoligong Mountain; China

Coccinellidae belongs to Cucujoidea, Polyphaga, Coleoptera, is a kind of important economic insect^[1]. A total of more than 5 000 species of ladybugs have been recorded throughout the world^[2], and 680 species of ladybugs have been recorded in China^[3]. The researches about community structure of ladybug at home and abroad are mainly developed in the habitats such as tea plantations, wheat fields, farmlands, sugarcane garden, coconut groves and orchards in agro-ecosystem, and predatory ladybug species are mostly investigated. The investigation of community structure of ladybugs in forest ecosystem has not been reported.

Baihualing section of Gaoligong Mountain is located in Mangkuan of Baoshan City in Yunnan Province. Monsoon evergreen broad-leaved forest is distributed between the altitude of 1 000 and 1 800 m; middle mountain moist evergreen broad-leaved forest is distributed between the altitude of 1 800 and 2 800 m; cool-temperate shrubs, *Tsuga dumosa* (D. Don) Eichler and summit mossy dwarf forest are distributed between the altitude of 2 700 and 3 100 m. Due to the impact of human logging and grazing, the vegetation below the altitude of 1 900 m has been hypergenic or transformed into plantation^[4]. The vegetation and climate in the section have pronounced vertical changes, so the section becomes the first choice for botany and entomology research. At present, there has no report about community structure of ladybug in Baihualing of Gaoligong Mountain. To this end, the author studied the community structure of ladybug within the section, so as to lay the foundation for further study on ladybug in Baihualing of Gaoligong Mountain.

1 Research Methods

1.1 Materials The ladybugs in Baihualing of Gaoligong Mountain were selected as the investigation object.

1.2 Methods

1.2.1 Sampling and investigation methods. According to the vegetation types in Baihualing of Gaoligong Mountain, the sampling belts were set with the interval of 300 m in vertical level of Baihualing, and a total of 7 sampling belts were selected. Three quadrats were set in each sampling belt with altitude interval of 100 m, and a total of 21 quadrats were set in vertical level. The size of quadrat was 20 m × 30 m. The investigation was carried out once every one month from April 2008 to February 2009, the species of ladybugs adopted the sum of each investigation, and the number of ladybugs adopted the average value of each quadrat.

The specific investigation methods were as follows: ① Investigation in small arbor layer. 20 plants were randomly selected in quadrat, the white cloth with the size of 2 m × 2 m was laid under the trees, and the ladybug specimens were collected using vibration method. ② Investigation in shrub layer and grass layer. Swept within quadrat for 120 times according to parallel line method (sweeping back and forth counted for one time), the specimens were collected after the ladybugs were poisoned. ③ Investigation in ground layer. Five quadrats with the size of 1 m × 1 m were set in quadrat according to five-point method, and the ladybug specimens were collected according to searching method.

1.2.2 Preparation and identification of specimen and statistical methods. The ladybug specimens was preserved by 75% alcohol in plastic container, labeled and taken back to the laboratory. The common species were made into specimens fixed with needle, and the individuals difficult to identify were continued to save in 75% ethanol solution for genital anatomy. The specimens were separately classified and identified using morphological taxonomy method, which were identified to species as far as possible, and those could

not be identified to species were counted with morphological species.

The determination of dominant species, common species and rare species referred to the method by XU Zheng-hui *et al.* who studied ants^[5]. When the proportion of the number of species was greater than 10%, it was dominant species, represented with A; when the proportion was between 1% and 10%, it was common species, represented with B; when the proportion was lower than 1%, it was rare species, represented with C.

2 Results and Analysis

2.1 Species composition of ladybug in Baihualing of Gaoligong Mountain A total of 3 128 ladybugs specimens had been collected, belonging to 5 subfamilies, 20 genera, 56 species. Thirty-one species belonged to Coccinellinae, 17 species belonged to Epilachninae, 6 species belonged to Aspidimerinae, and 1 species belonged to Coccidulinae and Scymninae, respectively. Among them, 45 species were already known, 2 species were new species distributed in Yunnan Province, and 11 species needed to be determined. The number of individuals belonging to Coccinellinae, Epilachninae, Aspidimerinae, Coccidulinae and Scymninae were 2 113, 1 027, 76, 1 and 1, respectively (Tab. 1).

The altitude difference in Baihualing of Gaoligong Mountain is large, and unique climatic condition and rich vegetation types are formed, so it becomes the distribution area of many animals, plants and rare species of macro-fungi, which is also the place that experts have discovered more new species. The richness of ladybug species depends on its host or prey, so rich host plants and prey in Baihualing of Gaoligong Mountain lead to the abundant species of ladybug in the area.

2.2 Population structure of ladybug in Baihualing of Gaoligong Mountain As shown in Tab. 1, a total of 31 species belonging to Coccinellinae were collected in the investigation, accounting for 55.36%; 17 species belonging to Epilachninae were collected, accounting for 30.36%; 6 species belonging to Aspidimerinae were collected, accounting for 10.70%; 1 species separately belonging to Coccidulinae and Scymninae were collected, accounting for 1.79%. Viewed from the individual number, 2 113 ladybugs belonging to Coccinellinae were collected, accounting for 65.67%; 1 027 ladybugs belonging to Epilachninae were collected, accounting for 31.91%; 128 ladybugs belonging to Aspidimerinae were collected, accounting for 2.36%; 1 ladybug separately belonging to Coccidulinae and Scymninae were collected, accounting for 0.03%. The species number of various subfamilies and the proportion of individual numbers in total number successfully were Coccinellinae > Epilachninae > Aspidimerinae > Coccidulinae = Scymninae.

Fifty-six species of ladybugs contained 3 dominant species, 13 common species and 40 rare species. According to the individual numbers, the sequence of 3 dominant species successfully was *Coccinella septempunctata* L. (20.45%) > *Harmonia eucharis* (Mulsant) (17.62%) > *Afissula hydrangeae* Pang et Mao (17.00%).

Tab. 1 The species composition of ladybugs in Baihualing of Gaoligong Mountain

Family	Genus	Scientific name	Number head	Proportion %
Coccinellinae			2 113	65.67
	<i>Illeis</i>	<i>Illeis koebeli</i> Timberlake	71	2.21
	<i>Macroilleis</i>	<i>Macroilleis hauseri</i> (Mader)	3	0.09
	<i>Halyzia</i>	<i>Halyzia sanscrita</i> Mulsant	1	0.03
	<i>Mealocaria</i>	<i>Mealocaria dilatata</i> (Fab.)	2	0.06
	<i>Alloneda</i>	<i>Alloneda dodecastima</i> (Hope)	1	0.03
	<i>Aiolocaria</i>	<i>Aiolocaria hexaspilota</i> Hope	3	0.09
	<i>Lemnia</i>	<i>Lemnia melanaria ncasura</i> (Crotch)	1	0.03
	<i>Lemnia</i>	<i>Lemnia saucia</i> Mulsant	19	0.59
	<i>Lemnia</i>	<i>Lemnia bissellata</i> (Mulsant)	50	1.55
	<i>Lemnia</i>	<i>Lemnia lushuiensis</i> Jing	1	0.03
	<i>Lemnia</i>	<i>Lemnia</i> sp.	1	0.03
	<i>Menochilus</i>	<i>Menochilus sexmaculatus</i> (Fab.)	178	5.53
	<i>Coccinella</i>	<i>Coccinella septempunctata</i> L.	658	20.45
	<i>Coccinella</i>	<i>Coccinella transversoguttata</i> Falderman	6	0.19
	<i>Coccinella</i>	<i>Coccinella luteopicta</i> Mulsant	1	0.03
	<i>Harmonia</i>	<i>Harmonia dimidiata</i> (Fab.)	35	1.09
	<i>Harmonia</i>	<i>Harmonia axyridis</i> (Pallas)	28	0.87
	<i>Harmonia</i>	<i>Harmonia eucharis</i> (Mulsant)	547	17.00
	<i>Harmonia</i>	<i>Harmonia sedecimnotata</i> (Fab.)	24	0.75
	<i>Oenopia</i>	<i>Oenopia kirbyi</i> Mulsant	171	5.31
	<i>Oenopia</i>	<i>Oenopia sauzeti</i> Mulsant	113	3.51
	<i>Oenopia</i>	<i>Oenopia chinensis</i> (Weise)	1	0.03
	<i>Oenopia</i>	<i>Oenopia degenensis</i> Jing	1	0.03
	<i>Oenopia</i>	<i>Oenopia quadripunctata</i> Kapur	3	0.09
	<i>Micraspis</i>	<i>Micraspis discolor</i> (Fab.)	7	0.22
	<i>Micraspis</i>	<i>Micraspis allardi</i> Mulsant	1	0.03
	<i>Calvia</i>	<i>Calvia muiri</i> (Timberlake)	54	1.68
	<i>Calvia</i>	<i>Calvia shiva</i> Kapur	1	0.03
	<i>Calvia</i>	<i>Calvia albida</i> Bielawski	2	0.06
	<i>Calvia</i>	<i>Calvia sicardi</i> Mader	1	0.03
	<i>Pania</i>	<i>Pania luteopustulata</i> (Mulsant)	128	3.98
Aspidimerinae			76	2.36
	<i>Cryptogonus</i>	<i>Cryptogonus guangdongiensis</i> Pang et Mao	1	0.03
	<i>Cryptogonus</i>	<i>Cryptogonus complexus</i> Kapur	15	0.47
	<i>Cryptogonus</i>	<i>Cryptogonus himalayensis</i> Kapur	53	1.65
	<i>Cryptogonus</i>	<i>Cryptogonus orbiculus</i> Gyllenhal	2	0.06
	<i>Cryptogonus</i>	<i>Cryptogonus</i> sp.	1	0.03
	<i>Platynaspis</i>	<i>Platynaspis bimaculata</i> Pang et Mao	4	0.12
Epilachninae			1 027	31.91
	<i>Epilachna</i>	<i>Epilachna macularis</i> Mulsant	21	0.65
	<i>Epilachna</i>	<i>Epilachna yongshanensis</i> Cao et Xiao	2	0.06
	<i>Epilachna</i>	<i>Epilachna concuogensis</i> Hoang	34	1.06
	<i>Epilachna</i>	<i>Epilachna</i> sp.1	84	2.61
	<i>Epilachna</i>	<i>Epilachna</i> sp.2	10	0.31
	<i>Epilachna</i>	<i>Epilachna</i> sp.3	1	0.03
	<i>Epilachna</i>	<i>Epilachna</i> sp.4	189	5.87
	<i>Epilachna</i>	<i>Epilachna</i> sp.5	1	0.03
	<i>Epilachna</i>	<i>Epilachna</i> sp.6	2	0.06
	<i>Henosepilachna</i>	<i>Henosepilachna vigintioctomaculata</i> (Motschulsky)	19	0.59
	<i>Henosepilachna</i>	<i>Henosepilachna vigintioctopunctata</i> (Fabricius)	29	0.90
	<i>Henosepilachna</i>	<i>Henosepilachna kaszabi</i> (Bielawski et Fursch)	1	0.03
	<i>Henosepilachna</i>	<i>Henosepilachna</i> sp.	13	0.40
	<i>Afissula</i>	<i>Afissula uniformis</i> Pang et Mao▲	37	1.15
	<i>Afissula</i>	<i>Afissula hydrangeae</i> Pang et Mao▲	567	17.62
	<i>Afissula</i>	<i>Afidentia misera</i> Weise	1	0.03
	<i>Afissula</i>	<i>Afissula</i> sp.	16	0.50
Coccidulinae			1	0.03
Scymninae	<i>Sumnius</i>	<i>Sumnius brunnei</i> Jing	1	0.03
	<i>Amida</i>	<i>Amida</i> sp.	1	0.03

Note: ▲ represents new species distributed in Yunnan Province.

According to the proportion of individuals in total numbers from high to low, the sequence of 13 common species successfully was *Epilachna* sp. 4, *Menochilus sexmaculatus* (Fab.), *Oenopia kirbyi* Mulsant, *Pania luteopustulata* (Mulsant), *Oenopia sauzeti* Mulsant, *Epilachna* sp. 1, *Illeis koebelei* Timberlake, *Calvia muiri* (Timberlake), *Cryptogonus himalayensis* Kapur, *Lemnia bisseolata* (Mulsant), *Afissula uniformis* Pang et Mao, *Harmonia dimidiata* (Fab.), *Epilachna concuonensis* Hoang. The other 40 species were rare species.

The species composition of various ladybugs in Baihualing of Gaoligong Mountain was shown in Fig. 1 and Fig. 2. A total of 2 116 predatory ladybugs belonging to 36 species, 1 027 phytophagous ladybugs belonging to 17 species, 75 fungivorous ladybugs belonging to 3 species were collected. Among predatory ladybugs, *C. septempunctata* L. and *A. hydrangeae* Pang et Mao were the dominant species; among phytophagous ladybugs, *Epilachna* sp. 4 and *H. eucharis* (Mulsant) were the dominant species; among fungivorous ladybugs, *I. koebelei* Timberlake was the dominant species. According to species number and proportion of individuals in total numbers from high to low, the sequence of various ladybugs was predatory ladybugs > phytophagous ladybugs > fungivorous ladybugs.

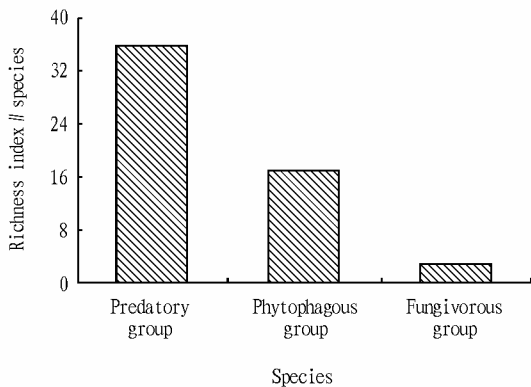


Fig. 1 Species composition of various ladybugs

3 Conclusions

A total of 3 218 ladybug specimens had been collected, be-

高黎贡山百花岭瓢虫群落结构及多样性研究 I

——物种组成与类群结构

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摘要 [目的]研究高黎贡山百花岭瓢虫群落结构及多样性, 填补高黎贡山瓢虫研究的空白。[方法]采用样地调查法调查了高黎贡山百花岭瓢虫物种组成与类群结构。[结果]共采集到瓢虫 5 亚科 20 属 56 种, 共 3 218 头, 其中 2 个云南新分布种。瓢虫亚科的种类和数量最多, 食植瓢虫亚科和隐脰瓢虫亚科次之, 红瓢虫亚科和小毛瓢虫亚科最少。七星瓢虫(*Coccinella septempunctata* L.)、奇斑瓢虫[*Harmonia eucharis* (Mulsant)]和八仙花崎齿瓢虫(*Afissula hydrangeae* Pang et Mao)为优势种。[结论]为进一步研究高黎贡山瓢虫奠定了基础。

关键词 瓢虫; 群落结构; 高黎贡山

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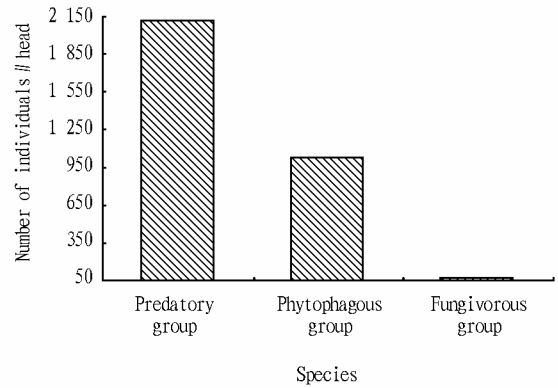


Fig. 2 Composition of individual numbers of various ladybug species

longing to 5 subfamilies, 20 genera, 56 species. Forty-five of them were already known, 2 of them were new species distributed in Yunnan Province, and 11 of them were the species needed to be further classified. Viewed from the species and number of each subfamily, Coccinellinae were the greatest, followed by Epilachninae and Aspidimerinae, while Coccidulinae and Scymninae were the least. When the feeding habits of ladybugs were considered, the species and number of predatory ladybugs were the largest, followed by phytophagous ladybugs, and fungivorous ladybugs were the least. *C. septempunctata* L., *H. eucharis* (Mulsant) and *A. hydrangeae* Pang et Mao were the dominant species.

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