ISSN 2959-409X

The Influence of Environmental Factors on Various Insects in Xishuangbanna Rainforest

Yingjian Wei

International Department, Beijing Bayi School, Beijing, 100080, China
Corresponding author: yingjian.wei@bayims.cn

Abstract:

Environmental conditions have an intuitive and important impact on biological diversity. As one of China's most distinctive ecological landscapes, Xishuangbanna Forest's biological population diversity has always attracted much attention. Therefore, this paper takes the Xishuangbanna tropical rainforest as the research object and discusses the influence of environmental factors on various insects. Through field investigation and observation, it is found that the unique geographical and climatic conditions of the Xishuangbanna tropical rain forest have formed a rich and diverse insect population. This paper analyzed the influence of temperature, humidity, light, and other environmental factors on the survival and reproduction of insects and revealed the relationship between insect population distribution and ecological environment. The results of this study are helpful to further understanding the importance of insect species diversity and environmental protection in tropical rainforest ecosystems and provide a scientific basis for the sustainable development of tropical rainforests in Xishuangbanna.

Keywords: Environmental factors; Xishuangbanna rainforest; insects.

1. Introduction

Xishuangbanna is located in the south of Yunnan Province, China. It is located in the south of the Tropic of Cancer. It has a typical tropical climate and has the most preserved tropical rainforests in China. It has a rich and diverse ecosystem, including lush rainforests, and is known as one of China's most valuable ecological treasures. The region's rainforest environment supports various insects, which play a vital role in its ecosystem.

The research of this paper refers to a large number of scientific research literature, among which the research objects include orthoptera, hymenoptera, hemiptera and other insects [1]. Based on various references, the author conducted research according to population classification, integrated and summarized the literature contents, cross-compared different references, analyzed and summarized the experimental data, and finally reached a conclusion.

This paper aims to study the influence of environmental factors on various insects in the Xishuangbanna rainforest. The study will explore the impact of climate, vegetation, topography, and other key environmental factors in the rainforest on insect species, distribution, and behavior.

The study's results will help better understand the ecological status of insect communities in the Xishuangbanna rainforest and provide a strong scientific basis for protecting and managing this valuable ecosystem. In addition, by conducting an in-depth study of insect response to the environment, we can obtain information about climate change and ecological balance and predict future changes in the ecological environment in the region [2].

This study will contribute to ecological research in Xishuangbanna and provide important information for improving rainforest conservation and ecosystem management on a global scale. By exploring the complex relationship between the rainforest environment and insects, we hope to find new ways to protect this precious natural resource [3]. At the same time, mastering the changing trends and rules of the regional environment will help in selecting and planning environmental conditions such as agricultural planting, industrial production, and infrastructure construction in the region.

2. The Distribution of Orthoptera Insects

A study was carried in August and October 2019, the transverse-line survey method was used to sample the diptera insects in Jinghong, Menghai and Mengla counties and cities in Xishuangbanna. The vegetation situation within the transverse line was recorded in detail, and different habitats were divided according to the proportion of

the length of tree forest, plantation forest, and farmland. As shown in Figure 1, four habitat types were identified: natural forest-based complex system (NS), rubber forest-based complex system (RS), tea tree-based complex system (TS), and farmland-based complex system (FS). Natural forest: the ecosystem mainly composed of evergreen broad-leaved forest and natural secondary forest; Rubber forest complex system: mainly planting rubber, scattered farmland around the complex ecosystem; Tea tree complex system: the tea tree mainly, surrounding scattered natural forest and farmland complex ecosystem; Farmland system: An ecosystem dominated primarily by agricultural land [4].

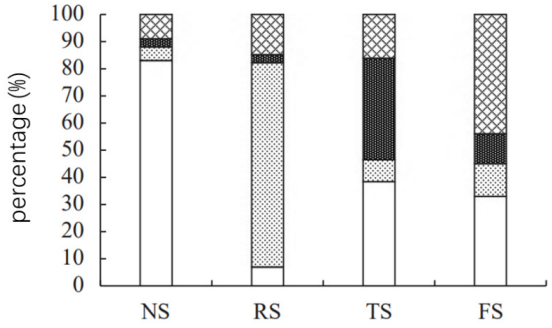

Fig. 1 Different habitats division based on the proportion of transect lines vegetation [4].

After identification and statistics, 1624 orthoptera insect specimens belonging to 21 families, 62 genera, and 169 species were collected during the two systematic surveys. Among different habitat types, a total of 169 orthoptera species were collected at the state level in Xishuangbanna, and there were significant differences between the species richness of orthoptera ($F = 3.032$, $P = 0.031$) and the estimated Chao−1 ($F = 2.673$, $P = 0.049$). NS is the highest in species richness, RS is the highest in Chao−1 estimate, and TS is the lowest in both. 102 orthoptera species were collected in the Jinghong area at the county scale, with no significant difference. A total of 82 orthoptera insects were collected in the Menghai area. There was no significant difference in species richness but a significant difference between NS and TS. Significant differences exist in the Chao−1 estimates ($F = 2.791$, $P = 0.048$). 104 orthoptera insects were collected in the Mengla area, with no significant difference [4].

As shown in Table 1, habitat structure and quality have an important impact on species distribution and maintenance, and forest habitats are more conducive to conserving insect diversity. The results of this study show that at the variable regional scale, the species richness and abundance of orthoptera insects in different habitat types are in the order of NS > RS > FS > TS. At the same time, the estimated value of Chao−1 is RS > NS > FS > TS. Species richness and abundance decreased first and then increased in the four different habitat types. The insect diversity of Orthoptera was significantly different in habitat types with different habitat structures and habitat quality, and the insect diversity of NS with better habitat quality was higher than that of other habitats, which was similar to the results of the study of Orthoptera insect diversity on grassland by Marini et al.. Compared with NS, human disturbance existed in the other three habitat types, and the diversity of orthoptera insects decreased in the larger habitat types caused by human disturbance, the main reason was the disturbance and habitat loss caused by human disturbance, especially after complex habitats were transformed into simple ones.

The diversity of ptera is seriously threatened. Human disturbance leads to changes in biological habitats, which impact the maintenance mechanism of species diversity, community structure composition, community renewal, etc., thus affecting the stability of orthoptera insect communities. In addition, herbaceous plants can provide better plant resources for orthoptera insects, and the related changes in vegetation structure and microclimate provide more suitable microhabitats for orthoptera insects, which may be the reason why the diversity of orthoptera insects in FS is higher than that in TS.

Table 1. Number of butterfly collection transect lines in different habitats in Xishuangbanna, Yunnan in 2019 [5].

Habitat types	Areas			
	Xishuangbanna	Jinghong	Menghai	Mengla
Natural forest	30	10	9	11
Secondary forest	45	14	15	16
Complex habitat	41	12	10	20
Artificial forest	62	27	10	25
Farmland	29	6	19	4
Total	208	69	63	76

The second area studied for butterfly species is Yunnan's Xishuangbanna Autonomous Prefecture, which borders Myanmar and Laos. Xishuangbanna belongs to the tropical humid area south of the Tropic of Cancer. The average annual temperature in the whole state is above 20℃, and the average annual rainfall is 1 500 ~ 2 000 mm. Tropical cash crops in this region mainly include rubber, tea and sugarcane Saccharum officinarum. In contrast, food cash crops mainly include rice Oryza sativa, dry rice, corn Zeamays, soybean Glycine max and banana Musa nana. The forest vegetation is mainly tropical rainforest plants, tropical monsoon rain forest, and subtropical monsoon evergreen broad-leaved forest, and the land use types mainly include forest land, rubber forest, tea garden, paddy field, and dry land [5].

Before the survey, based on the principles of comprehensiveness, representativeness, and accessibility, the map of Xishuangbanna was planned into a 10 km × 10 km survey grid. Typical habitats in each grid were selected to be set up with 1 to 2 splines. 40 splines were set up in each county and city for each survey, totaling 240. The spacing of some transect lines is less than 10 km. According to the vegetation situation within the transect, different habitats were divided according to the proportion of forest, plantation, and farmland. Finally, five habitats were identified: natural forests, secondary forests, composite habitats, planted forests, and farmland.

Studies have shown that habitat type and quality have important effects on species distribution, and maintenance of forest habitats is more conducive to conserving insect diversity. In this study, butterfly species richness, abundance, and estimated species richness of Chao 1 showed a trend of secondary forest > natural forest > compound habitat > farmland > plantation forest; butterfly community diversity showed significant differences in different habitats with changes in habitat type and quality, and insect diversity in forest habitats with good habitat quality was better than that in other habitats, which was consistent with the result of Miao et al. study on butterfly diversity in different habitat types. Compared with natural forests and secondary forests, butterfly diversity decreased significantly in habitats with greater human disturbance, suggesting that simplifying habitat structure caused by excessive human disturbance greatly reduced butterfly diversity. Therefore, butterfly diversity in natural and secondary forest habitats was higher than in the other three habitats [6].

3. The population distribution of mud bees

The third research was located in the Tropical Botanical Garden of the Chinese Academy of Sciences, Menglun Town, Mengla County, Dai Autonomous Prefecture, Xishuangbanna, Yunnan Province, and He Kai Village, Mengni Town, Menghai County (the linear distance between the two places is 82 km, both of which belong to tropical monsoon climate). As follows, four different cash crop planting areas were selected [7].

Plot I: The ornamental and planting area is located in the Menglun-Town Tropical Botanical Garden plant zone. Many vegetation species include Heveabrasiliensis, Theobroma cacao, Arecacatechu of Arecacatechu, and Camellia sinensis of Pu ,er tea [8]. The ground cover plants are mainly composed of grasses such as Digitaria sanguinalis. The leaf litter is thin, the sun is abundant, and the ground cover is close to the road.

Plot II: Teak forest area, located in Menglun Tropical Botanical Garden, vegetation species are relatively simple, mainly teak Tectona grandis, Pterocarpus indicus; Less ground cover vegetation; Thick leaf litter, sunny, near the curb, moderate human disturbance.

Plot III: The ancient tea forest area, located in Hekai Village, Mengli Town, is a single type of ancient tea forest area, mainly with Pu ,er tea tree Camellia sinensis [9]. The vegetation is relatively simple, the weeds are less, the deciduous layer is thinner, and the human interference is greater during the tea picking season.

Plot VI: The farmland area, located in Hekai Village, Mengli Town, is mixed farmland with diverse crops, mainly sugarcane Saccharumofficinarum, peanut Arachis hypogaea, corn Zea mays, and other crops. In the ridge area, herbs are abundant, sunlight is sufficient, and human interference is relatively large.

According to the analysis of the overall situation of the survey area in Xishuangbanna, a total of 1 187 mudbees were collected in the area, which belonged to 3 families, 15 families, 27 genera, and 110 species. Among them, Mudbees included 3 families, 5 genera, 7 species and 13 heads. Periplaneta includes 47 heads of 8 species, 3 genera, 2 families. This family comprises 10 families, 19 genera and 95 species, with 1 127 heads, the dominant family in this area [10].

4. Conclusion

For the distribution of orthoptera insects, temperature, altitude and habitat quality are important environmental factors to maintain the species richness and abundance of orthoptera insects. Temperature and habitat quality significantly positively affected species richness and species abundance of orthoptera insects. Most orthoptera insects require higher ambient temperatures for optimal growth and development. Therefore, a warm but not too hot mi-

croclimate is favorable for the growth and development of orthoptera. In addition to favorable climatic conditions, adequate food resources and favorable habitats contribute to the species richness and abundance of orthoptera. Changes in land use patterns and intensity lead to changes in environmental factors, which also hurt the diversity of orthoptera. Environmental factors, in general, and climate change in particular, may hurt habitat change and degradation, leading to decreased biodiversity at all levels.

For the distribution of butterfly populations, rainfall, elevation gradient, and temperature are important environmental factors to maintain the richness and abundance of butterfly species. There was a negative correlation between rainfall and butterfly species richness and abundance, which decreased with increasing altitude. The impact of habitat type on species was greater than that of climate change, which highlighted the important impact of habitat type change on butterfly diversity. The interaction between habitat types and environmental factors in literature studies can explain the effects of habitat types and environmental factors on butterfly diversity. In addition, a large number of studies have also shown that environmental factors, especially climatic factors (such as light, temperature, rainfall, wind speed, and humidity), not only hurt habitat quality but also directly and indirectly affect the composition and distribution of butterfly communities, and lead to the decline of biodiversity at all levels.

For the population distribution of mud bees, time changes such as air humidity and temperature are important factors affecting the diversity of mud bees. The number of dominant species of mud bees varies with time in different regions. The changes of dominant species of different crops are greatly different, and the changes of dominant species are complementary to the flowering time of plants in the region. The main plant species are different, and the plant community composition is greatly different, which leads to great changes in the composition of the herbivorous insect community; thus, the colony composition of mud bees as natural enemies is significantly different. Adult mud bees mainly feed on nectar and are one of the pollinating insect groups. As mentioned above, due to the different main plant species in different cropping areas, the flowering and occurrence periods of different mud bee dominant species are different. Therefore, the flowering period of plants provides food for the mud bee dominant species that also occur in the same period, and the population number of mud bee dominant species increases correspondingly. The vegetation difference in different habitats is an important factor affecting the colony similarity of mudbees. In addition to the great difference in plant community composition in the habitat, the degree of human disturbance and other environmental factors also affect the composition and dynamics of mud bee colonies, which needs further study and discussion.

References

[1] Song ZY, Zhao YL, Wang SH, et al. Classification and evaluation of ecological tourism resources in Xishuangbanna. Forestry Survey and Planning, 2022, 47(05): 67-71.

[2] Zhang X, Lu Z X, Wang Q, et al. The impact of habitat specificity on insect diversity in regional landscapes - taking Xishuangbanna as an example. Chinese Journal of Ecological Agriculture (Chinese and English), 2021, 29(05): 771-780.

[3] Du Z Z, Chen YZ, Mao BY, et al. A new species of the genus Tetratoma in Yunnan, China. Entomotaxonomia, 2023, 45(01):1-5.

[4] He W Q, Zhang X, Gao S T, Li Q & Chen Y Q. Effects of habitat types and environmental factors on the diversity of Orthoptera insects at different regional scales. Journal of Southwest Forestry University (Natural Science) 2023, 03,87-95.

[5] Zhang X, Gao S T, Lu Z X & Chen Y Q. Effects of different habitat types and environmental factors on butterfly diversity in Xishuangbanna, China. Journal of insect. 2022, (01), 73-83.

[6] Xu Z H, Yang B, Hu G. . Community study of Myrmecidae in fragmented mountain rainforest of Xishuangbanna. Zoological Research. 1999 ,(04).

[7] Zhang X, Lu Z, Wang Q Gao S, Tang C, et al. Effects of habitat specificity on insect diversity in a regional landscape: a case study of Xishuangbanna. Journal of Chinese ecological agriculture (both in English and Chinese) 2021, (05), 771-780.

[8] He W Q. Effects of human disturbance on orthoptera diversity in Xishuangbanna. (in Chinese) Southern Agriculture 2021, (36),21-26.

[9] Xu Z H. Floristic analysis of myrmecidae in Xishuangbanna tropical rain forest. Zoological Research 1999, (05),379-384.

[10] Shi XZ, Wang JX, Zhao L, et al. Research on the relationship between species diversity and different habitats of Mud Wasp in Xishuangbanna. Journal of Yunnan Agricultural University (Natural Science), 2021, 36(03): 417-423.