

FOREST LANDSCAPE AND BIRD DIVERSITY IN MOUNTAIN REGION, XISHUANGBANNA, YUNNAN

Wang Zhijun (王直军)

*Department of Forest Ecology, Xishuangbanna Tropical Botanical Garden, the Chinese
Academy of Sciences, Kunming 650223, P. R. China*

Chris Carpenter

*Wildlands, Studies Program, San Francisco University, College of Extended Learning, C A 65421, U S A
(Received 21 October 1998)*

ABSTRACT: The degeneration of forest landscapes is mainly caused by human impact on the natural environment, which is posing a great threat to biodiversity. We studied the relationship between forest landscapes and birds in mountain regions of Xishuangbanna, Yunnan Province. In Jinuo ethnic region, forest landscape is degenerating, and bird diversity is reducing as a result of human influence. However, in Hani ethnic region of Mengsong area, a comparative study area, there are also traditional practices of agriculture and forestry. The traditional practices are dynamically adaptive to local geographic environment and social economic conditions. A great deal of biodiversity exists in the place where people have lived for many generations and use the resources of environment in a sustainable manner. Considering bird diversity and forest landscape of mountainous area, both economic and ecological benefits should be taken into account, which relate to land use and landscape protection. Biodiversity conservation, resource management and policy making should pay much attention to the best interconnection of land use and landscapes protection.

KEY WORDS: bird diversity, mountain forest landscape, Xishuangbanna

1 GENERAL SITUATION OF THE STUDIED AREA

1.1 Natural Environment

The study was conducted in the Jinuo Mountain ($20^{\circ}53'11'' - 22^{\circ}9'59''$ N, $100^{\circ}55'33'' - 101^{\circ}14'45''$ E, 550– 1691 m a. s. l.) and the Mengsong Mountain area ($21^{\circ}27' - 21^{\circ}34'$ N, $100^{\circ}25' - 100^{\circ}35'$ E, 800– 2000 m a. s. l.) of Xishuangbanna. There is a monsoon climate with dry season (November– April) and rain season (May – October). The annual rainfall is 1600– 1800 mm, the mean annual temperature is 18 – 19°C. Most of the natural vegetation are tropical monsoon evergreen broadleaf forest and mountain rainforest.

1.2 Traditional Human Practice

1.2.1 Swidden agroecosystem

In Xishuangbanna there are many ethnic tribes who have practised swidden cultivation for a long period of time to adapt the mountainous environmental conditions. The sustainable swidden practice needs advantageous biophysical environment, rich indigenous knowledge of swidden system management, less population pressure and enough forestland. This practice includes mosaic cultivation, crest forest covered cultivation and tree species preserved cultivation (Yin, 1994).

By traditional swidden cultivation, the land of Jinuo mountain is divided into more than 13 zones, each zone could have a 13-year fallow period at least.

After a fallow stage of a dozen years, the swidden land would be covered with forest. Now the agroecosystem is declining and biodiversity is threatened because of increasing population pressure, overuse of natural resources and decreasing of forest (Wang, 1997). Most of the slopes in the Jinuo mountain region have been deforested and put into cultivation with some trees, the primary forests can only be found on the crests of the mountain, which are considered as the sacred forests to be protected. The crest forests are very important to local climate, water and soil resources, as well as the cultivation. The traditional swidden agroecosystem landscape has been changed into the "forest island" on the crest of the mountain.

The traditional swidden cultivation of Mengsong study area belongs to the mosaic cultivation and tree species preserved cultivation. The indigenous agroecosystem of the Hani remains diverse fallow periods, from 6-year fallow period to 40-year fallow period with early to later stages of forest succession, some primary trees such as *Heliciopsis terminalis*, *Craetoxylon formosum*, *Schima wallichii*, and *Lindera metcalfeana* have been protected. Their social and religious system encourages people to act properly and live in harmony with natural environment.

1.2.2 Traditional forest system

Traditional community-protected forests, including timber-use protected forest, economic forest and rattan-use protected forest which are indigenous forest management systems in Mengsong. Hani people have combined different economic plants with different forests for sustainable use of different purposes. Hani people have also found some ways to increase productivity and sustainability of the forest systems, for instance they appropriately planted economic plants to make sustained systems. In the traditional tea forest we can find many economic trees and shrubs, such as *Pouteria grandifolia*, *Mangfera sylvatica*, *Toona ciliata*, *Paramichelia bailloni*, *Gmelina arborea*, *Garcinia cowa*, *Ficus* sp., *Castanopsis* sp., *Den-*

drocalamus giganteus, *Livistona speciosa*, etc., which make the forest present different layers. The forests as resources are well managed in a sustainable manner, at the same time the traditional protected forests consist of the beautiful landscape.

2 STUDY METHODS

This study focuses on line transect identification survey conducted in the different habitats. Data were analyzed using the Proportion of Interspecific Encounter formula (PIE):

$$PIE = \sum_{i=1}^s \left(\frac{n_i}{N} \right) \left(\frac{N - n_i}{N - 1} \right)$$

where S is the number of bird species in each habitat; N is the number of bird individuals, n_i is the number of individuals of the "i" species in the sample area. The result indicates the composition of birding community and bird diversity (Wang, 1995; 1997).

The coefficient of variation formula (C_v) were also used to analyse the variances of bird communities and bird diversity, as well as to compare the parameters relating to forest landscapes. The formula was calculated as:

$$C_v = \frac{V}{\bar{x}} \cdot 100\%$$

where V is the standard deviation and \bar{x} is the parameter average.

3 RESULTS

Bird surveys were carried out from 1994 to 1997 in the dry season (February, April, December) and the rain season (June, August, October). A total number of 148 species of birds which belong to 11 orders, 33 families and 4 subfamilies have been recorded in Mengsong. A total number of 107 species of birds which belong to 11 orders, 29 families and 4 subfamilies have been recorded in Jinuo. The data are shown in Table 1 and Table 2 and the capital letters of A - I represent the different habitats relating to forest landscapes.

Table 1 The comparison of the numbers of bird species, index of Proportion of Interspecific Encounter (*PIE*) and Coefficient of Variation (*C_v*) among different forests

	Mengsong					Jinuo M.t.				
	Number of bird species			<i>PIE</i>		Number of bird species			<i>PIE</i>	
	Total	Try	Rain	Try	Rain	Total	Try	Rain	Try	Rain
A	107	102	100	0.9290	0.9286	53	48	43	0.8423	0.8219
B	108	102	101	0.9291	0.9288					
C	112	104	102	0.9387	0.9358					
D	114	104	103	0.9485	0.9414					
E	114	105	104	0.9524	0.9508					
F	115	107	106	0.9617	0.9612	42	35	33	0.8237	0.8168
G	120	111	110	0.9725	0.9720					
H	121	113	114	0.9730	0.9732	85	80	82	0.8615	0.8660
I	123	114	116	0.9739	0.9770	87	83	86	0.9126	0.9194
<i>C_v</i> (%)	4.85	4.35	4.80	1.91	2.04	34.0	38.58	38.35	4.45	4.58

Note: A: 6-year fallow field, B: 10-year fallow, C: 20-year fallow, D: 30-year fallow, E: Traditional timber-use protected forest, F: Traditional economic forest, G: Rattan-use protected forest, H: Monsoon evergreen broadleaf forest, I: Mountain rainforest.

4 DISCUSSION AND CONCLUSION

The primary forest landscape was influenced by human activities, so there are different forest landscapes and structures of bird diversities in Xishuangbanna. A large natural forest landscape of Jinuo Mountain is changing into some isolated "forest islands" with shortening of fallow and breakdown of swiddening system. The study shows that there are lower numbers of bird species, lower value of the index of Proportion of Interspecific Encounter (*PIE*) and higher Coefficient of Variation (*C_v*) in Jinuo forests (Table 1). As the unbroken forest landscape goes, the bird species and the diversity of birds are also reducing (Table 2). From the comparative study it can be seen that in Hani ethnic region of Mengsong area, near Burmese border, there are also traditional practices of agriculture and forestry. The traditional practices are dynamically adaptive to local geographic environment and social economic conditions. This system can work well and does not degrade as long as human population density is low and there is abundant forest land. The Hani people had strong religious and cultural prohibitions against cutting the forest and overhunting. They can also manage the environment

and made ecotone habitats with mosaic diversity which is very important to maintain biological diversity (Martin, 1997; Thomas *et al.*, 1997). As shown by the traditional agroecosystems and forests of the Mengsong area, bird diversity in different habitats was obtained from old fallow fields and their community-protected forests, a great deal of biodiversity exists in the place where people have lived for many generations and use the resources of environment in a sustainable manner. Local people was practicing a traditional way of life in the land, with relatively little outside influence. Hani people kept some areas as traditional conserving forests, in which the natural resources with regeneration abilities were selectively used, they are also as better Analysis of bird diversity in landscape patterns showed that the compositional pattern of forest landscape and mosaic diversity affect the biodiversity. landscape diversity, as well as bird diversity.

The degeneration of forest landscapes is mainly caused by human impact on the natural environment, in addition, the nowadays problem is that the local people encounter outside influences and the market economy affects traditional societies in many ways, which is posing a great threat to biodiversity (Wang,

Table 2 Bird communities in different successional stages and primary forests of Mengsong and Jinuo, Xishuangbanna, Yunnan

Bird families	A*	B	C	D	E	F	G	H	I
1. Accipitriae	0- 2**	5	5	5	0- 4	4	4	0- 4	1- 4
2. Falconidae	0- 1	1	1	1					
3. Phasianidae	1- 1	3	3	3	0- 3	3	3	1- 3	1- 3
4. Columbidae	1- 1	1	3	3	1- 3	3	3	2- 3	2- 3
5. Cuculidae	4- 4	4	4	5	2- 5	5	5	3- 4	3- 4
6. Strigidae	0- 3	3	3	4	0- 3	3	3	1- 3	1- 3
7. Caprimulgidae	0- 1	1	1	1	0- 1	1	1	1- 1	1- 1
8. Apodidae	1- 1								
9. Trogonidae							2	2- 2	2- 2
10. Meropidae	1- 2								
11. Coraciidae	0- 1	1	1	1					
12. Upupidae	0- 1								
13. Capitonidae				1	2- 2	2	2	2- 2	2- 2
14. Picidae		1	1	1	1- 1	1	3	3- 3	3- 3
15. Eurykimidae	0- 1	1	1	1	2- 2	2	2	2- 2	2- 2
16. Pittidae									0- 1
17. Motacillidae	4- 4	4	4	4	1- 3	3	3	0- 3	0- 3
18. Campephagidae	4- 5	5	5	5	4- 6	6	6	6- 6	6- 6
19. Pynonotidae	1- 1	1	7	7	2- 6	5	5	6- 6	6- 6
20. Irenidae	1- 4	4	4	4	0- 4	4	5	3- 5	3- 5
21. Laniidae	1- 3	3	3	3	1- 3	3	3	0- 3	0- 3
22. Oriolidae	0	- 1	1	1	1	0- 1	1	1	0- 1
23. Dieruridae	1- 3	3	3	3	2- 2	2	2	2- 2	2- 2
24. Artamidae					0- 1	1	1	1- 1	1- 1
25. Corvidae					1- 1	1	1	1- 1	1- 1
26. Muscipidae									
Turdinae	3- 6	6	5	5	2- 6	6	7	3- 7	3- 7
Timalinae	4- 14	14	14	14	5- 16	16	16	10- 16	10- 16
Sylvinae	6- 10	10	10	10	4- 10	10	10	6- 9	7- 10
Muscicapinae	3- 11	11	11	11	3- 11	11	11	10- 11	10- 11
27. Paridae	1- 3	3	3	3	2- 3	2	2	3- 3	3- 3
28. Sittidae	1- 1	1	1	1	0- 2	2	2	1- 2	1- 2
29. Dicaeidae	4- 5	5	5	5	1- 5	5	5	5- 5	5- 5
30. Nectariniidae	2- 6	6	6	6	2- 6	6	6	5- 7	5- 7
31. Zosteropidae	3- 3	3	3	3	1- 3	3	3	3- 3	3- 3
32. Ploceidae	2- 3	3	2	1	1- 1	1	1	1- 1	1- 1
33. Fringillidae	4- 5	4	2	2	2- 2	2	2	2- 2	2- 2
Total	53- 107	108	112	114	42- 116	114	120	85- 121	87- 123

* The meaning of the capital letter are the same as those in Table 1.

** The data order is Jinuo- Mengsong; if there is only one datum, it is from the present habitat in Mengsong.

1997, 1991; Yang *et al.*, 1985; Yang *et al.*, 1987). Birds are the most dynamic and susceptible for the forest landscape structure, they are also more observable of the animals in the forest. This comparative study has indicated that the affinity of landscape patterns, mosaic diversity are related to biodiversity. There is lower bird diversity in the simpler landscape structure, however, the landscape with higher mosaic diversity and compositional pattern diversity has higher bird diversity. Considering bird diversity and forest landscape of mountain area, both economic and ecological benefits should be taken into account, which relate to land use and landscape protection. An integrated understanding of how human population growth and changes in agricultural practice interact with natural recovery processes and restoration ecology provides the hope for future of the environment. People can make decisions closely to combine compositional patterns of landscape diversity and conservation of species diversity, which can be as a way of the preservation of biodiversity. Biodiversity conservation, resource management and policy making should pay more attention to the best interconnection of landscapes.

REFERENCES

- Martin Enserink, 1997. Life on the edge: rainforest margins may spawn species. *Science*, 276: 1791– 1792.
- Thomas B. Smith *et al.*, 1997. A role for ecotones in generating rain forest biodiversity. *Science*, 276: 1855– 1857.
- Wang Zhijun, Chris Carpenter, 1997. The changing of forest environment and bird distribution in the Jinuo mountain. *Yunnan Geographic Environment Research*, 9(1): 85– 91. (in Chinese)
- Wang Zhijun, 1995. Bird diversity as a measure of decline in forest ecosystems. In: Pei Shengji (ed.). *Regional Study on Biodiversity: Concepts, Frameworks, and Methods*. Kunming: Yunnan University Press, 173– 181.
- Wang Zhijun, 1991. The relationship between birds and environment vicissitudes. *Yunnan Geographic Environment Research*, 3(2): 82 – 89. (in Chinese)
- Wang Zhijun, 1991. The structure of bird community in Xishuangbanna forest. *Zoological Research*, 12(2): 169– 174. (in Chinese)
- Yin Shaoting, 1994. *Forests are Pregnant with Cultivation Culture — Slash and Burn Cultivation in Yunnan*. Kunming: People's Press of Yunnan. (in Chinese)
- Yang Lan, Pan Ruliang, Wang Shuahan, 1885. Investigation on the birds of cultivated land of tea trees and rubber trees in Xishuangbanna, Yunnan Province. *Zoological Research*, 6(4): 353– 360. (in Chinese)
- Yang Yuanchang, Duan Yu, Xu Weizhang, 1987. On birds from Xishuangbanna. In: Xu Yongchun, Jiang Han qiao (eds.). *Investigation Report on Xishuangbanna Nature Reserve*. Kunming: Yunnan Science and Technology Press, 326– 349. (in Chinese)