

ASSESSING SPECIES DIVERSITY OF RODENTS (Rodentia) IN HOANG LIEN NATIONAL PARK, SA PA, LAO CAI, VIETNAM

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ABSTRACT: Twenty two rodent species were collected in 5,644 traplights in 22 transects in Hoang Lien National Park during two years (2014-2015). Some were common to include *Niviventer confucianus*, *N. fulvescens*, *N. bukit* and *Tamiops* sp., but many species, such as *Ratufa bicolor*, *Petaurista* sp., *Callosciurus* sp., *Dremomys* sp., *Hytrix* sp. and *Typhlomys chapensis* were rare to be collected. There varied the number of species among forest strata. The overstorey mainly contained the flying squirrels (*Petaurista* sp.) and tree squirrels of *Callosciurus* sp. and *Ratufa* sp., while the understorey and shrubs layer contained the large number of species in *Callosciurus*, *Tamiops*, *Dremomys*, *Niviventer*, *Rattus* and *Hytrix*. *Rhizomys* species having their own habitat preference under the ground, where bamboo roots are their food. Three collected species, *Typhlomys chapensis*, *Micromys minutes* and *Callosciurus inornatus* were listed in 2013 IUCN Red List of threatened animals. *T. chapensis* distributed very narrowly. This species was found only in primary forests at >2,400 m elevation. Relative abundance of the rodent species was very low. Reduced and fragmented habitats together with hunting pressure threatened to most animals in the park. Our data indicated that population sizes of all squirrels, porcupines were heavily reduced in relation to high hunting pressure and their disturbed habitats.

Keywords: Habitats, relative abundance, rodents, species conservation, Hoang Lien National Park.

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INTRODUCTION

High heterogeneity of biogeographic mosaic leads to increase habitat. Highly complex habitats allow to increase the number of species in relation to niche differentiation and resource partition (Adler, 1995). This partition decreases intra-population competition or between species with similar ecological characteristics. In tropical forests, the combination of complex structure between horizontal heterogeneity and vertical stratification of vegetation is reflected to the diversity of rodents. The Hoang Lien National Park is lying on the part of the Vietnam - Laos geosynclines tending northwest to southeast, and contains temperate and sub temperate forests which cover the Hoang Lien Son mountain range. This national park lies at the confluence of two biogeographic zones (Tien, 1985) and, therefore, provides habitat for

a variety of rodents. Many of these are found only in the northwest Vietnam.

In the previous survey in the Hoang Lien area implemented by the Kelley-Roosevelt and Delacour Asian expedition in 1929 (Osgood, 1932), twenty three rodents species were recorded including the first description of Chinese pygmy dormouse (*Typhlomys chapensis*). This species was found only in Hoang Lien National Park. Based on the specimens collected in 1934, 1941-1943, 1956 and 1963, Tien (1985) described 3 rodent species. During 1994-1998, Frontier-Vietnam Forest Research Programme had conducted 6 expeditions to Hoang Lien (Tordoff et al., 1999), but they collected only three common rats using traps. Although Vietnam-Russian Tropical Centre conducted several expeditions to the Fansipan mountain during 1996-1997, no

significant information was added on rodents (Korzun et al., 1998).

Obviously, cumulative data of the previous studies is not enough to elucidate the status of rodent fauna, especially species conservation like Chinese pygmy dormouse, porcupines and squirrels. Due to insufficient information, it is difficult for managers to give measures to protect species diversity, especially threatened species. This paper provides information on the current status of rodents in the Hoang Lien National Park to promote the biodiversity towards sustainable management of biological resources in the protected area.

MATERIALS AND METHODS

The surveys were carried out in the areas, O Quy Ho (22°21'N-103°41'E, elevation of 1,909 m), Cat Cat (22°18'N-103°49'E, 1890 m) and Sin Chai (22°17'N - 103°48'E, 2,323-2,610 m) during 2014-2015 (fig. 1).

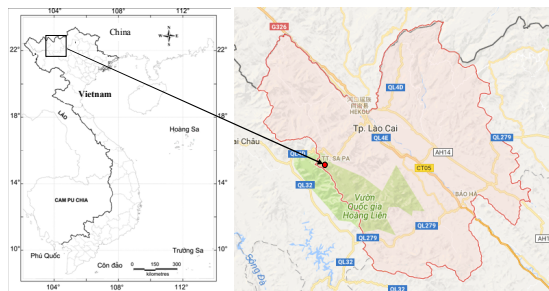


Figure 1. Hoang Lien National Park

● Study area

Trapping: Three types of traps, live traps, snap traps and the Sherman aluminum live traps were used to sample rodents. Snap traps and Sherman traps were available and useful for inventorying species. A number of traps used are 100 live traps, 100 snaps and 20 Sherman traps. Transects of 19-36 trap points with 10 m intervals between points were established at each site. Traps were set at each transect for 6 nights 7 consecutive days and were checked every morning. Each trap was baited with seeds of maize or cut apple. Each rodent captured by live traps was toe-clipped and weighed. Reproductive data including abdominal or scrotal tests in males and vaginal perforation,

active lactation tissue or pregnancy in females were recorded. Based on pelage of captured rodents, juvenile, sub-adult or adult was also determined. After recording, rodents were immediately released at the captured point. Some individuals for each species were killed to identify exact taxonomic names. Some dead individuals in live traps in relation to climate or snap traps were made specimens. Parameters for each specimen were measured.

Observation: The trip transects were surveyed in the national park. The data obtained were the number of squirrels seen within transects.

Interviews: Local people in the three studied communes were interviewed about their jobs, incomes in relation to products in the national park. Forest guards were also interviewed about species status and their conservation in the national park. Nine local hunters in the three communes described characteristics of hunted animals and showed colour photographs of specimens to help their identification during survey.

RESULTS AND DISCUSSION

Number and status of rodents. The heterogeneity of biogeographical mosaic supports the large number of rodent species of ground and arboreal life. In the national park, the stratification is one of the important characteristics to result in a large amount of niche and habitat on the ground, where rodents can exploit and utilize. Moreover, the numerous plant species provide diversity on food type, activity pattern and domicile for rodents' utilization. Including the rodent species reported in the past, 30 rodent species were found in total in this national park (table 1). Of these, 22 species were recorded. Some were common species such as *Niviventer confucianus*, *N. fulvescens*, *N. bukit* and *Tamiops* sp., but some species such as *Ratufa bicolor*, *Petaurista* sp., *Callosciurus* sp., *Dremomys* sp., *Hystrix* sp., and *Taphlomys chapensis* were rare to be collected in this national park. Some other species such as *Rattus rattus*, *Mus musculus* and *M. pahari* living in the area of cultivation and

settlements are listed in the table 1, but are not included in the number of rodent species recorded in the protected area. The results indicated that each rodent species has its own particular habitat and many niches were utilized. The number of rodent species in each stratum is variable from each other. The overstorey mainly contained the flying squirrels (*Petaurista* sp.) and tree squirrels of *Callosciurus* sp. and *Ratufa* sp., while the understorey and the shrubs layer contained the large number of species in the genera *Callosciurus*, *Tamiops*, *Dremomys*, *Niviventer*,

Rattus and *Hystrix*. *Rhizomys* species has their own habitat preference under the ground, where bamboo roots were their food. The niches of some different species, such as *C. inornatus* and *C. erythraeus* or species in *Dremomys* or *Tamiops* overlap each other in relation to food, space time and domicile. The present results together with the previous reports of the Pu Mat reserve (Tam, 1998) and the Kon Ha Nung forests (Sung et al., 1993) suggested that the utilization of vertical strata of rodents in tropical forest is essentially similar.

Table 1. List of rodent species in the Hoang Lien National Park

Order	Species	No. of specimen			
		Osgood, 1932	Tien, 1985	Tordoff et al., 1999	This study
	Hystriidae				
1	<i>Atherurus macrourus</i>	3			i
2	<i>Hystrix brachyura</i>			i, o	
	Rhizomyidae				
3	<i>Rhizomys pruinosus</i>	4	2	i	i
4	<i>Rh.sumatraensis</i>				1
	Pteromyidae				
5	<i>Petaurista petaurista</i>	1	2		i
6	<i>P. elegans</i>	1			i
	Sciuridae				
7	<i>Callosciurus erythraeus</i>	2		o	i,
8	<i>C. inornatus</i>	6		i	i
9	<i>Dremomys gularis</i>	20			3
10	<i>D. rufigenis</i>	11		i, o	i
11	<i>Tamiops maritimus</i>	11		i	10
12	<i>T. swinhoei</i>	10			6
13	<i>Ratufa bicolor</i>				i
	Cricetidae				
14	<i>Eothenomys melanogater</i>	5			
	Platacanthomyidae				
15	<i>Typhlomys chapensis</i>	7			3
	Muridae				
16	<i>Chiromyscus chiropus</i>	1			
17	<i>Chiropodomys gliroides</i>				5
18	<i>Micromys minutus</i>	2			
19	<i>Leopoldamys edwardsi</i>	8		o	
20	<i>Berylmys bowersii</i>	10		s	1
21	<i>Niviventer bukit</i>				20
22	<i>N. confucianus</i>	7		s	33
23	<i>N. fulvescens</i>	33		s	47
24	<i>N. langbianis</i>	2			22

25	<i>N. tenaster</i>	28			5
26	<i>Rattus rattus</i>	45	3	s	2
27	<i>R. remotus</i>			s	
28	<i>R. nitidus</i>	1			
29	<i>Mus pahari</i>	8			
30	<i>M. musculus</i>			s	i

o: observation; s: specimen; i: interview

When original vegetation is modified, there is a change in species composition and their abundance. Along with the vegetation changes, some species disappear but others adapt to new living conditions and replace them. The removal of niches results in the disappearance of the species that occupied. When primary vegetation is cleared it was replaced by cultivation and settlements. Selected logging of commercially valuable indigenous trees altered the vegetation structure. Many species were unable to live in these altered and disturbed habitats. Destruction and degradation of the forest had deleterious effects on the size of rodent population. Some species, such as *Callosciurus* sp., *Dremomys* sp and *Tamiops* sp. may move into adjacent cultivation and shrubs. Commensal species, such as *Rattus rattus*, *Mus musculus* and *M. pahari* may survive close to human settlements in the national park. In the remaining forest patches, hunting pressure clearly suppressed the individual number per species. The most of species in Hystricidae and Sciuridae except for *Tamiops* sp. in the national park had very low number of individuals.

Relative abundance. An index of relative abundance of each rodent population was obtained in the field, based on the number of captured individuals on a trapping transect. The living traps set at each transect for 6 consecutive nights and days were used for the estimation of this index. The index reflects information about the size of rodent population in this national park. The current status of rodent populations was assessed as well. With a total of 5,644 trap nights in 22 transects (19-36 trap points per transect), 179 individuals were captured. They belonged to 12 rodent species and one grey shrew (*Crocidura attenuata*, Insectivora). *Niviventer fulvescens* was trapped

at 13 transects (table 2) and is the commonest species distributed widely in this study area. *Niviventer confucianus* were mostly trapped at 7 transects below 2,000 m elevation in the primary and secondary forests in O Quy Ho and Cat Cat. *N. bukit* distributed widely in the national park, but was only predominant in Cat Cat forests with the relative abundance of 0.28 per trapped point. *Niviventer tenaster* and *N. langbianis* were captured with less frequency at 3 transects and 6 transects, respectively. *Chiropodomys gliroides* was found at low frequency captured on the trees at 3 transects in Cat Cat primary forests. This species was also captured by box traps (Sherman traps) set on the ground in O Qui Ho secondary forests. The endemic species, *Typhlomys chapensis* was very rarely encountered and captured once on the ground and once on the tree at 2 transects in the primary forests with above 1,900-2,400 m elevation. *Dremomys gularis* was also endemic in Vietnam and was captured with low abundance of 0.1 at 2 transects in the forests of Sin Chai above 2,300 m elevation. Two species of mouse squirrels, *Tamioips maritimus* and *T. swinhoei* were captured on the trees and on the ground with low frequency at 5 transects and 3 transects, respectively. Data also indicated predominant species for each study area. *Niviventer confucianus* was predominant in O Qui Ho and Cat Cat forests, whereas *Niviventer fulvescens* predominated in Sin Chai forests. Relative abundance of all rodents in transects differed from 0.9 (transect C) in Cat Cat; and from 0.2 (transect M) to 0.47 (transect D) in Sin Chai. The total number of rodent species varied from 2 (transect B and C) to 4 (transect A and D) in O Qui Ho; from 4 (transect D) to 6 (transect B) in Cat Cat; and from 1 (transect A) to 4 (transect D and E) in Sin Chai.

Table 2. Relative abundance of the captured rodents in the Hoang Lien National Park

Transect, elevation	Points	Trapnights	Abundance										
			nc	nf	nb	nt	nl	cg	tc	dg	tm	ts	Total
O Qui Ho:	117	1050	0.71	0.45	0.04	0.03	0.11	-	-	-	0.07	-	
A, 2000 m	36	324	0.55	0.22	-	-	0.03	-	-	-	0.03	-	0.83
B, 2100 m	24	216	0.04	0.17	-	-	-	-	-	-	-	-	0.21
C, 2200 m	33	294	-	0.06	-	0.03	-	-	-	-	-	-	0.09
D, 2260 m	24	216	0.12	-	0.04	-	0.08	-	-	-	0.04	-	0.28
Cat Cat:	95	774	0.43	0.27	0.38	0.05	0.14	0.15	0.05	-	-	0.13	
A, 1449 m	20	180	0.2	0.05	0.1	-	-	0.05	-	-	-	0.05	0.45
B, 1600 m	19	168	0.1	0.1	0.05	-	-	0.05	0.05	-	-	0.05	0.35
C, 1750 m	21	192	0.09	0.09	0.09	0.05	0.14	0.05	-	-	-	-	0.62
D, 1900 m	26	234	0.04	0.04	0.04	-	-	-	-	-	-	0.08	0.2
Sin Chai:	121	1192	-	1.0	0.19	-	0.25	-	0.5	0.1	0.25	-	
A, 2379 m	21	192	-	0.4	-	-	-	-	-	-	-	-	0.38
B, 2420 m	20	180	-	0.38	-	-	0.15	-	0.05	0.05	-	-	0.27
D, 2356 m	21	192	-	0.02	0.09	-	0.05	-	-	-	0.05	-	0.47
E, 2317 m	20	180	-	0.28	0.05	-	0.05	-	-	-	0.15	-	0.35
G, 2531 m	19	168	-	0.1	-	-	-	-	-	-	0.05	-	0.21
M, 2560 m	20	180	-	0.16	0.05	-	-	-	-	0.05	-	-	0.2

nc: *Niviventer confucianus*; nf: *N. fulvescens*; nb: *N. bukit*; nt: *N. tenaster*; nl: *N. langbiansis*; cg: *Ch. gliroides*; dg: *Dremomys gularis*; tc: *T. chapensis*; tm: *T. maritimus* ts: *T. swinhoei*.

Priority of conservation

Based on biogeographical viewpoint and locally endemic species, the Hoang Lien National Park has highly significant potential for biodiversity conservation. Fansipan mountain in this national park is the highest mountain in Vietnam with 3,143 m elevation and contains a great number of rodent species. This national park is a home to many rodent species that are not seen anywhere else in Vietnam. For example, the following species only seen in Hoang Lien National Park are *Dremomys gularis*, *Petaurista elegans*, *Typhlomys chapensis*, *Eothenomys melanogaster* and *Micromys minutes*. Also, this national park is located on the northeastern slope of the Hoang Lien Son mountain range with unique climate compared with other regions of Vietnam. Not only animals but also plants in this national park are of great biological significance. Many of endemic species are found only in this region. It is estimated that about 24% of Vietnam's endemic plants (Tordoff et al., 1999; Thin, 1998) are growing in this area, and 15 globally threatened species of birds and mammals were recorded

(Tordoff et al., 1999). The Hoang Lien National Park is a unique protected area to be established for biodiversity conservation in northwestern Vietnam. To establish the conservation area, national and global priorities for conservation should be initially determined. Of course, protection should be effective and successful for the long term. Assessment of the current status of species and their habitats in the national park should be done accurately and urgently.

The remaining natural forest patches on the eastern slope of the Fansipan mountain at above 1800 m elevation in this national park have the highest importance and priority for habitat conservation, because such habitats support a suite for *Typhlomys chapensis* and many of squirrels, especially flying squirrel of *Petaurista elegans*. Two species *Typhlomys chapensis* and *P. elegans* were found only in the northwest Vietnam.

To date, common hunting has serious and deleterious effects on the most of squirrels, although some occur in other protected areas of Vietnam. Protection and determination of significance of them has a very high priority (table 3).

Table 3. Threatened status and priority of conservation in the Hoang Lien National Park

Species	Threatened status		Priority of conservation
	RDB (2007) [9]	IUCN (2013) [10]	
<i>Atherurus macrourus</i>	*		High
<i>Hystrix subcrista</i>	*		High
<i>Petaurista petaurista</i>	E		High
<i>P. elegans</i>	E		Vey high
<i>Dremomys gularis</i>	*		Mid high
<i>Callosciurus erythaeus</i>	*		High
<i>C. inornatus</i>		VU	High
<i>Ratufa bicolor</i>	R		High
<i>Micromys minutus</i>		LR?	?
<i>Eothenomys melanogaster</i>	*		?
<i>Rattus remotus</i>		VU	Mid
<i>Typhlomys chapensis</i>		CR	Very high

* species are also included because of threatened in the region. R: rare, E: threatened and VU: vulnerable.

Presence of globally threatened species like *T. chapensis* and *C. inornatus* reflect the reduction of the size of remaining natural habitats. This suggests that the size of national park is a considerably significant factor for conservation. In addition, it should be reminded that a substantial part of this significance is based on the continuity of habitat towards west slope of the Fansipan mountain.

Recommendations for the conservation

In order to carry out conservation duties properly, the staffs and equipment for this and other national parks need to be increased. Guard stations should be built up and consolidated at Cat Cat, Y Linh Ho, Sin Chai, Ta Trung Ho and Seo Mi Ti. Each station should have a minimum number of staffs of about five game-wardens. They can carry out regular and irregular food patrols in the interior of the national park and can conduct effective monitoring. To implement successfully, proper equipments for service in the field and operation plan prepared monthly by the national park authority is needed. They can empower the villagers to play an active role and take responsibility in relation to programs for forest protection, management and reforestation. Training courses for biodiversity can be held for the national park staffs to improve their better understanding of biodiversity in the national park and of forest protection regulations.

Biodiversity education should be implemented to villagers to raise awareness about threats to wildlife and to introduce practical conservation measures.

Monitoring and assessing the biodiversity management could be initiated.

Hunting activity should be completely banned. The villagers are not allowed to bring their guns and traps into the national park. At present, the most of mammals are threatened. Their population sizes are reducing considerably, especially of flying squirrels such as *Petaurista elegans* and *P. petaurista*, tree squirrels (*Callosciurus erythraeus*, *C. inornatus*) and porcupines (*Atherurus macrourus*). Funding for infrastructure, forestry and administration should be raised for the national park. This will cover forest protection, extension together with education activities.

Tourist activity in the national park will continue to be concentrated with its attractions on climate and landscape and culture of ethnic minority people. In future, a wider range of attractions will be made available by further development with countryside and a wealth of wildlife in the national park. At present, one of the funding sources from tourist service can be contributed for improvement on protection and management of the national park.

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ĐÁNH GIÁ ĐA DẠNG LOÀI Gặm NHẮM (Rodentia) Ở VƯỜN QUỐC GIA HOÀNG LIÊN, SA PA, LÀO CAI, VIỆT NAM

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TÓM TẮT

Tổng số 22 loài gặm nhấm đã được thu thập từ 5644 lượt bẫy đêm ở Vườn quốc gia Hoàng Liên trong năm 2014 và 2015. Có bốn loài phổ biến gồm chuột khổng từ *Niviventer confucianus*, chuột hươu bé *N. fulvescens*, chuột rừng *N. bukit* và sóc chuột *Tamiops* sp.. Tuy nhiên, một số loài rất ít gặp như sóc đen *Ratufa bicolor*, sóc bay lớn *Petaurista* sp., sóc cây *Callosciurus* sp., sóc má đào *Dremomys* sp., đặc biệt 2 loài nhím nhám khác nhau. Ở tầng tán rừng chủ yếu là các loài sóc bay (*Petaurista* sp) và sóc cây *Callosciurus* sp. và sóc đen *Ratufa* sp., trong khi đó ở tầng dưới tán và cây bụi chủ yếu là các loài thuộc giống sóc cây *Callosciurus*, sóc chuột *Tamiops*, sóc má đào *Dremomys*, và các giống chuột *Niviventer*, *Rattus* và nhím nhám *Hytrix*. Giống dúi *Rhizomys* xuất hiện ở dưới mặt đất và ăn rễ tre. Ba loài gặm nhấm *Typhlomys chapensis*, *Micromys minutes* và *C. inornatus* nằm trong danh sách Đỏ của IUCN cần phải được bảo vệ. Các loài này chỉ gặp trong rừng nguyên sinh ở độ cao trên 2.400 m. Mật độ gặm nhấm khá thấp. Nơi sống của chúng bị suy giảm và sự phân cắt cùng với áp lực săn bắn là nguyên nhân đe dọa các loài gặm nhấm ở Vườn quốc gia Hoàng Liên. Dẫn liệu của chúng tôi chỉ ra kích thước quần thể của các loài sóc và nhím đang bị suy giảm nghiêm trọng có liên quan đến áp lực săn bắn và nơi sống của chúng bị đe dọa.

Từ khóa: Bảo tồn loài, gặm nhấm, nơi sống, Vườn quốc gia Hoàng Liên