

## Small mammals of the Song Thanh and Saola Quang Nam Nature Reserves, central Vietnam

Ly Ngoc Tu\*, Bui Tuan Hai, Masaharu Motokawa, Tatsuo Oshida, Hideki Endo, Alexei V. Abramov, Sergei V. Kruskop, Nguyen Van Minh, Vu Thuy Duong, Le Duc Minh, Nguyen Thi Tham, Ben Rawson & Nguyen Truong Son\*

**ABSTRACT.** Field surveys in the Song Thanh and Saola Quang Nam Nature Reserves (Quang Nam Province, central Vietnam) were conducted in 2018 and 2019. In total, 197 individuals of small mammals were captured and studied in the field or collected as voucher specimens. Based on these data, an updated checklist of small mammals of Quang Nam Province is provided. A total of 78 species in 15 families and 6 orders is recorded from both reserves: viz., 57 species in the Song Thanh Nature Reserve and 39 species in the Saola Quang Nam Nature Reserve. Records of 20 species are new to the mammal checklist of Quang Nam Province.

How to cite this article: Tu L.N., Hai B.T., Motokawa M., Oshida T., Endo H., Abramov A.V., Kruskop S.V., Minh N.V., Duong V.T., Minh L.D., Tham N.T., Rawson B., Son N.T. 2019. Small mammals of the Song Thanh and Saola Quang Nam Nature Reserves, central Vietnam // Russian J. Theriol. Vol.18. No.2. P.120–136. doi: 10.15298/rusjtheriol.18.2.08

**KEY WORDS:** small mammals, checklist, Song Thanh, Saola Quang Nam, Vietnam.

Ly Ngoc Tu [ngoctu1890@gmail.com], Vu Thuy Duong [vuthuyduong.xd@gmail.com] and Nguyen Truong Son [truongsoniebr@gmail.com], Department of Vertebrate Zoology, Institute of Ecology and Biological Resources and Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam; Bui Tuan Hai [tuanhai@eulipotyphla.com], Department of Nature Conservation, Vietnam National Museum of Nature and Graduate University of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam; Masaharu Motokawa [motokawa.masaharu.6m@kyoto-u.ac.jp], the Kyoto University Museum, Kyoto University, Kyoto 606–8501, Japan; Tatsuo Oshida [oshidata@obihiro.ac.jp], Laboratory of Wildlife Biology, Obihiro University of Agriculture and Veterinary Medicine, West 2-11, Inada, Obihiro 080-8555, Japan; Hideki Endo [hendo@um.u-tokyo.ac.jp], The University Museum, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan; Le Duc Minh [le.duc.minh@hus.edu.vn] & Nguyen Thi Tham [thamnguyentlhp@gmail.com], Department of Environmental Ecology, Faculty of Environmental Sciences, Hanoi University of Science, Vietnam National University, 334 Nguyen Trai Street, Hanoi, Vietnam; Alexei V. Abramov [alexei.abramov@zin.ru], Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, Saint Petersburg 199034, Russia, and Joint Vietnamese-Russian Tropical Research and Technological Centre, Nguyen Van Huyen, Nghia Do, Cau Giay, Hanoi, Vietnam; Sergei V. Kruskop [kruskop@zmmu.msu.ru], Zoological Museum, Moscow State University, ul. Bolshaya Nikitskaya 2, Moscow 125009, Russia, and Joint Vietnamese-Russian Tropical Research and Technological Centre, Nguyen Van Huyen, Nghia Do, Cau Giay, Hanoi, Vietnam; Nguyen Van Minh [nguyenvanminh@hua.edu.vn], University of Agriculture and Forestry, Hue University, 102 Phung Hung str., Hue City, Vietnam; Ben Rawson [nomascus@yahoo.com.au], WWF-Vietnam, Nam Tu Liem District, Hanoi, Vietnam.

## Мелкие млекопитающие заповедников Сонгтхань и Саола Куангнам, центральный Вьетнам

Н.Е. Ли, Т.Х. Буй, М. Мотокава, Т. Ошида, Х. Эндо, А.В. Абрамов, С.В. Крусков, В.М. Нгуен, Т.Д. Ву, Д.М. Ле, Т.Т. Нгуен, Б. Роусон, Т.С. Нгуен

**РЕЗЮМЕ.** Полевые исследования в заповедниках Сонгтхань и Саола Куангнам (провинция Куангнам, центральный Вьетнам) были проведены в 2018 и 2019 годах. Было поймано 197 экземпляров мелких млекопитающих, выпущенных после осмотра или собранных в качестве ваучерных образцов. На основании этих данных был обновлен список мелких млекопитающих провинции Куангнам. Всего в обоих заповедниках провинции Куангнам зарегистрированы 78 видов, принадлежащих к 15 семействам и 6 отрядам. В частности, в природном заповеднике Сонгтхань обитает 57 видов, тогда как в природном заповеднике Саола Куангнам зарегистрировано 39 видов. Двадцать видов были новыми для списка видов мелких млекопитающих провинции Куангнам.

**КЛЮЧЕВЫЕ СЛОВА:** мелкие млекопитающие, чеклист, Сонгтхань, Саола Куангнам, Вьетнам.

\* Corresponding authors

## Introduction

The central Annamites possess one of the largest continuous natural forest areas in the mainland of Southeast Asia. This is part of the Annamite Range Moist Forests, one of the world's 200 ecoregions identified as the most important areas for global biodiversity conservation (Olson & Dinerstein, 2002). Within the Indochina Region, it is considered an important biodiversity corridor containing multiple key biodiversity areas within Quang Nam and Thua Thien-Hue Provinces (Tordoff *et al.*, 2012).

Quang Nam Province is located in the central Annamites, about 820 km S of Hanoi, with a total area of 10,574 km<sup>2</sup>. It borders with Thua Thien-Hue Province in the north, Quang Ngai and Kon Tum provinces in the south, Sekong Province, Lao PDR, in the west, and faces the East Sea in the east. Much of the province is covered by mountainous areas with rough topography, which have been known to support high levels of biodiversity and endemism, but also need further scientific investigation (Rundel, 1999; Averyanov *et al.*, 2003; Clements *et al.*, 2006). Several recent studies have discovered unique and endemic mammals in the central Annamites, including the saola *Pseudoryx nghetinhensis*, the large-antlered muntjac *Muntiacus vuquangensis*, the Truong Son muntjac *Muntiacus truongsonensis*, and the Annamite striped rabbit *Nesolagus timminsi*, as well as other species of high conservation value, such as the

northern buffed-cheeked gibbon *Nomascus annamensis* (Van Ngoc Thinh *et al.*, 2010) and the red-shanked douc langur *Pygathrix nemaeus* (Nadler *et al.*, 2007). Several new species and subspecies of small mammals have also been recorded from Quang Nam Province in recent years, such as: *Harpiola isodon* (Kruskop *et al.*, 2006), *Murina fionae* and *M. anamitica* (Francis & Eger, 2012), *M. lorelieae ngoclinhensis* (Vuong Tan Tu *et al.*, 2014), *M. kontumensis* (Nguyen Truong Son *et al.*, 2015), *Eurosaptor parvidens ngoclinhensis* (Zemlemerova *et al.*, 2016), *Kerivoula dongduongana* (Vuong Tan Tu *et al.*, 2018), and *Myotis anricola* (Kruskop *et al.*, 2018).

However, little is known about the small mammal fauna of the two protected areas in Quang Nam Province. To fill this gap, in 2008, 2018 and 2019, surveys of small mammals were conducted there by the Institute of Ecology and Biological Resources, the Worldwide Fund for Nature and the Joint Vietnamese–Russian Tropical Research and Technological Centre, with assistance of the staff of two nature reserves (Fig. 1).

## Material and methods

### Study site

The Song Thanh Nature Reserve (NR) is located in the southwestern part of Quang Nam Province, at the border region between Vietnam and Laos. It lies in Nam

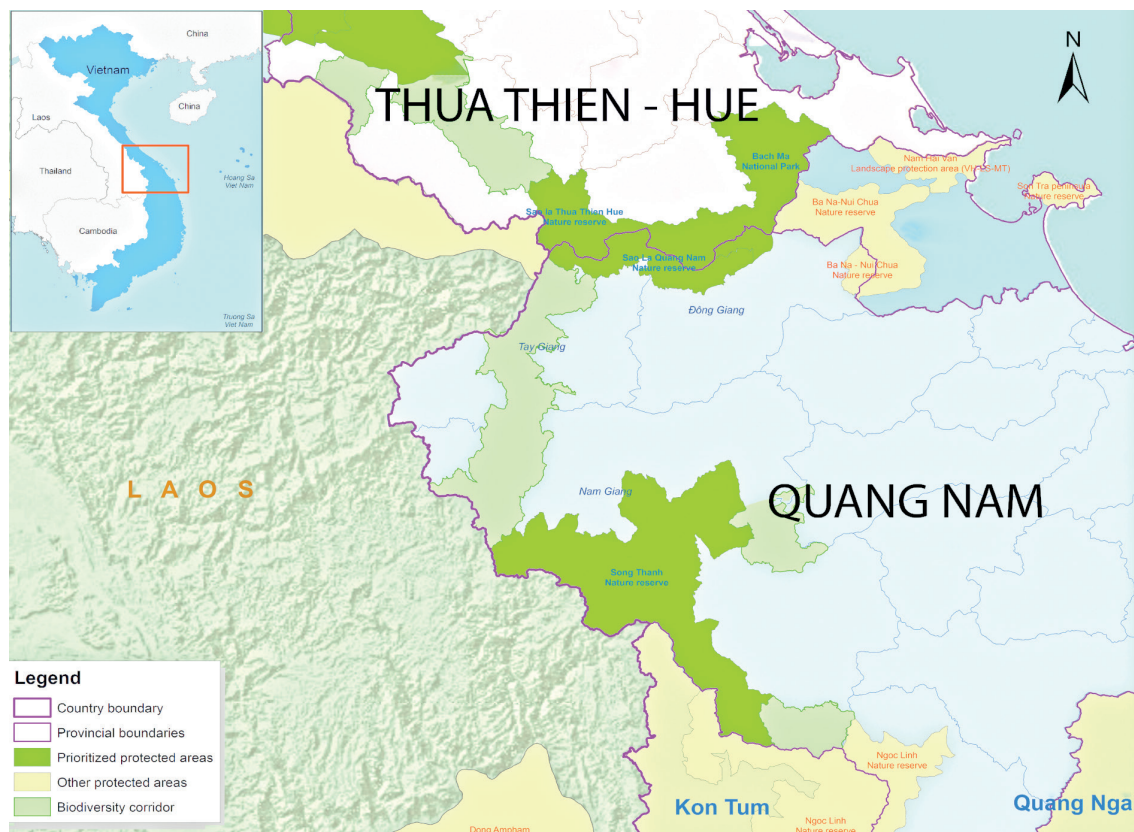
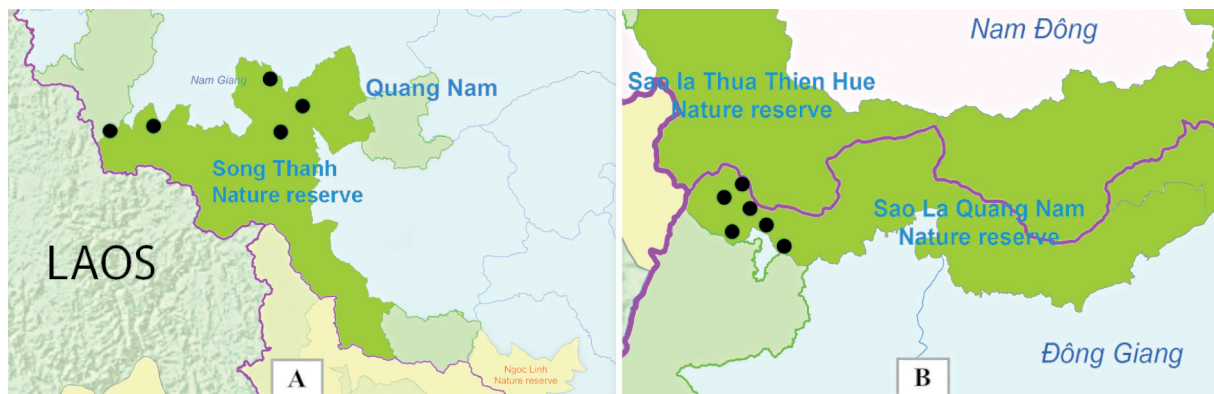


Fig. 1. Geographic locations of the studied sites (Song Thanh and Saola Quang Nam NRs) in Quang Nam Province.



**Fig. 2.** Maps showing the location and forest cover of the Song Thanh NR (A) and the Saola Quang Nam NR (B) in Quang Nam Province. Survey localities are shown by black dots.

Giang and Phuoc Son districts (Fig. 2A). Geographic coordinates of the reserve range from 15°12' to 15°41'N and 107°20' to 107°46'E. This NR was established in October 2000, through the governmental decision 3849/QĐ-UB, with a total protected area of 108,398 ha. The site consists of 93,249 ha of a strictly protected zone and 22,067 ha of an ecological regeneration zone.

The Saola Quang Nam NR is located between 17°56' to 18°05'N and 105°51' to 106°04'E, in the northwestern part of Quang Nam Province. The reserve lies within Dong Giang and Tay Giang districts (Fig. 2B). This NR was established in July 13, 2012, through the governmental decision 2265/QĐ-UBND, with a total protected area of 15,486.46 ha. The site consists of 13,805.13 ha of a strictly protected zone and 1,681.33 ha of an ecological restoration zone.

The survived sites are shown in Fig. 2.

### Methodology

Given the diversity of small mammal fauna in the area at hand, different methods were used to collect mammals. Individuals that could not be identified with a high level of confidence in the field were collected and brought back to the laboratory for further analyses. Clearly identified individuals were captured, photographed, measured, and then released immediately. During the survey, we conducted day and night time excursions and using specialized trap methods for small mammals. Few trap types were used:

- Three kinds of Sherman live-traps (3×3×10 cm; 5 × 5 × 18 cm; 7 × 7 × 30 cm) were used to catch medium-sized rodents and shrews. Tomahawk cage traps (20 × 20 × 60 cm) and local cage traps (15 × 15 × 25 cm) were used to large-sized rodents and squirrels. Baits for trapping must be odiferous enough to draw rodents into the traps from some distance, sticky enough to be fixed in the trap and stable enough to keep from rotting. Baits were changed every day after checking the traps.

- Two types of mole-traps – Japanese hand-made traps and Talpex traps. Mole-traps were set on the trails where mole tunnels were observed.

- Pitfall traps (plastic glasses and baskets) with a plastic drift-fence were used for small-sized rodents and shrews.

- Different types of mist nets (2 × 3 m, 5 × 3 m and 12 × 4 m), two-handle hand net (“flap-trap”), and harp trap (1.5 × 1.5 m) were used to live capture bats. The nets and traps were set to cross trails in the forest, over small ponds and streams in the forest or near forest edges, at openings at the forest edges and the entrances of caves. Flap-trap was used for active bat capture on the open places (roads and riverbeds).

All trapping was conducted in accordance with the guidelines recommended by the American Society of Mammalogists (Sikes *et al.*, 2011).

The external body measurements are as follows: head and body length (HB), tail length (TL), hind foot length (HF), ear length (E) and weight (Wt) were taken by tapeline and digital caliper. For bats, forearm (FA) and tibia (Tib) lengths also were measured (Kruskop, 2013).

The nomenclature of mammals follows Wilson & Reeder (2005) unless stated otherwise.

### Time and efforts survey

Fieldworks were conducted in the Song Thanh NR during 24–30 June, 2008 and 7–22 March, 2018 by the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology; and from 24 April to 11 May, 2019 by the Joint Vietnamese–Russian Tropical Research and Technological Centre. The survey area in 2008 and 2018 lied from the protected area’s head-quarter to Khe Vinh Forest Station, and from Khe Vinh to Ta Binh Commune of the Song Thanh NR. We also surveyed sites around La Bo B and La Dee villages of Cha Val Commune. The survey area in 2019 was located some 8 km SW of La Dee Village. Forests in the Song Thanh NR were identified as closed evergreen monsoon tropical forests. The forest consisted of regenerated trees with a diameter of about 50–80 cm, palms, bamboo and lianas with several small and medium streams.

Fieldworks in the Saola Quang Nam NR were conducted during 7–19 March, 2018 by the Institute of

Table 1. Total survey efforts in Quang Nam Province. D.O. – daytime observation (hours); MN – mist nets ( $m^2/n/h$ ); H – harp trap ( $m^2/n/h$ ); M – mole-traps (trap nights); P – pitfall traps (trap nights); S & C – Sherman and cage traps (trap nights); N.O. – nighttime observations (hours);  $n$  – number of captured specimens.

Site	Date of survey	D.O.	MN	H	M	P	S & C	N.O.	$n$
Song Thanh NR	07/03/2018	2.5	162	54	–	20	50	3.0	95
	08/03/2018	3.0	162	54	–	20	50	2.0	
	09/03/2018	3.0	135	54	–	20	50	3.0	
	10/03/2018	2.5	108	54	8	20	50	3.0	
	11/03/2018	6.0	108	54	8	40	80	6.0	
	12/03/2018	3.5	459	54	–	20	30	9.0	
	13/03/2018	4.0	–	27	–	–	20	3.0	
	24/04-11/05/2019	15.0	1820	–	50	211	716	46.0	24
	Efforts	35.5	2954	234	66	351	1046	75	119
Saola Quang Nam NR	14/03/2018	3.0	–	54	8	20	50	6.0	78
	15/03/2018	4.0	108	54	8	20	50	3.0	
	16/03/2018	6.0	324	–	8	20	80	6.0	
	17/03/2018	4.0	540	108	8	20	60	–	
	18/03/2018	4.0	270	54	–	–	40	–	
	19/03/2018	4.0	270	108	–	–	40	3.0	
	Efforts	29	1512	405	32	80	340	21	
Total		64.5	4466	639	98	431	1386	96	197

Table 2. Small mammals recorded in two nature reserves of Quang Nam Province. ST – Song Thanh NR; SLQN – Saola Quang Nam NR; C – captured (specimen); O – observed (individual). References: a – Long (2005); b – Van Ngoc Thinh *et al.* (2006); c – Kawada *et al.* (2009, 2012); d – Le Xuan Canh *et al.* (2011); e – Nguyen Truong Son & Vu Dinh Thong (2011); f – Bui Tuan Hai *et al.* (2015).

No.	Scientific name	This survey				Literature sources		Comments
		ST		SLQN		ST	SLQN	
		C	O	C	O			
1	<i>Dendrogale murina</i>		*				a	* Not collected, only calls were recorded
2	<i>Tupaia belangeri</i>	1	6	2	6	d	a, b	Common species
3	<i>Galeopterus variegatus</i>		1		3			The first record for Quang Nam Province
4	<i>Hylomys</i> sp.	2						The first record for Quang Nam Province
5	<i>Crocidura zaitsevi</i>	2						The first record for Quang Nam Province
6	<i>Crocidura tanakae</i>	3				f	f	
7	<i>Suncus murinus</i>	2		2		d		
8	<i>Chimarrogale varennei</i>				2			The first record for Quang Nam Province
9	<i>Euroscaptor parvidens</i>	2		7		d	c	
10	<i>Cynopterus sphinx</i>	1		7		d, e	a	Common species



11	<i>Cynopterus brachyotis</i>					d		Not detected
12	<i>Macroglossus sobrinus</i>	2		3			a	
13	<i>Megaerops niphanae</i>	1				d, e	a	
14	<i>Rousettus leschenaulti</i>	2						The first record for Quang Nam Province
15	<i>Sphaerias blanfordi</i>			1				The first record for Quang Nam Province
16	<i>Rhinolophus affinis</i>	10		8		d, e	a	Common species
17	<i>Rhinolophus chaseni</i>					d, e		Not detected
18	<i>Rhinolophus lepidus</i>	2					a	
19	<i>Rhinolophus cf. luctus</i>	1					a	
20	<i>Rhinolophus macrotis</i>	1				d, e		
21	<i>Rhinolophus malayanus</i>	1				d, e		
22	<i>Rhinolophus microglobosus</i>	2		3				The first record for Quang Nam Province
23	<i>Rhinolophus pearsonii</i>	1		1		d, e	a	
24	<i>Rhinolophus pusillus</i>	3		6		d, e		
25	<i>Rhinolophus shameli</i>					d, e		Not detected
26	<i>Coelops frithii</i>					d, e		Not detected
27	<i>Hipposideros armiger</i>			1				The first record for Quang Nam Province
28	<i>Hipposideros cineraceus</i>	1				d, e		
29	<i>Hipposideros galeritus</i>	2				d, e		
30	<i>Hipposideros grandis</i>	4		2		d, e	a	Previously reported as <i>H. larvatus</i>
31	<i>Hipposideros gentilis</i>	7		10		d, e	a	Common species. Previously reported as <i>H. pomona</i>
32	<i>Megaderma spasma</i>	1		1			a	
33	<i>Miniopterus pusillus</i>	1						The first record for Quang Nam Province
34	<i>Tylonycteris fluvida</i>	1				d, e		Previously reported as <i>T. pachypus</i>
35	<i>Tylonycteris malayana</i>	7		3		d, e	a	Previously reported as <i>T. robustula</i>
36	<i>Pipistrellus javanicus</i>	3						The first record in Quang Nam Province (except to Cu Lao Cham)
37	<i>Pipistrellus coromandra</i>			3				The first record for Quang Nam Province
38	<i>Scotomanes ornatus</i>			1				The first record for Quang Nam Province
39	<i>Myotis horsfieldii</i>	2				d		
40	<i>Myotis laniger</i>					e		Not detected

41	<i>Myotis ater</i>	3						The first record for Quang Nam Province
42	<i>Myotis muricola</i>						a	Not detected
43	<i>Myotis siligorensis</i>					d, e		Not detected
44	<i>Murina eleryi</i> (?)						a	Not detected, reported as <i>M. aurata</i>
45	<i>Murina cyclotis</i>	2				d, e	a	
46	<i>Murina feae</i>	2				d, e	a	
47	<i>Murina cf. fionae</i>	2						
48	<i>Kerivoula flora</i>						a	Not detected
49	<i>Kerivoula cf. dongduongana</i>	3		1				The first Record for Quang Nam Province
50	<i>Kerivoula hardwickii</i>	1				d, e	a	
51	<i>Kerivoula kachinensis</i>	1						The first record for Quang Nam Province
52	<i>Kerivoula titania</i>	1				e		
53	<i>Ratufa bicolor</i>		4		1	a, d	a, b	
54	<i>Hylopetes alboniger</i>		2		1	d	b	
55	<i>Petaurista philippensis</i>		2		2	d	a	
56	<i>Callosciurus erythraeus</i>	1	8	2	7	a	a	Common species
57	<i>Callosciurus finlaysonii</i>					d		Not detected
58	<i>Callosciurus inornatus</i>	2						The first record for Quang Nam Province
59	<i>Dremomys rufigenis</i>	1	2	2	4	a, d	a, b	Common species
60	<i>Menetes berdmorei</i>	2		1	2	d		
61	<i>Tamias maritimus</i>						b	Not detected
62	<i>Tamias rodolphii</i>	1	6	1	10	a, d	a	Common species
63	<i>Rhizomys pruinosus</i>		4		24	d		
64	<i>Bandicota indica</i>					d		Not detected
65	<i>Berylmys bowersi</i>	4		1				The first record for Quang Nam Province
66	<i>Dacnomys millardi</i>	1		1				The first record for Quang Nam Province
67	<i>Maxomys surifer</i>	4		2		d		
68	<i>Mus musculus</i>	1						
69	<i>Leopodamys cf. revertens</i>	7		6				The first record for Quang Nam Province
70	<i>Niviventer fulvescens</i>					d		
71	<i>Niviventer cf. huang</i>	5						
72	<i>Rattus exulans</i>	3						
73	<i>Rattus argentiventer</i>					d		Not detected

74	<i>Rattus rattus</i>					d		Not detected
75	<i>Rattus tanezumi</i>	1				d		
76	<i>Rattus nitidus</i>	1						The first record for Quang Nam Province
77	<i>Atherurus macrourus</i>		1		1	a, d	a, b	
78	<i>Hystrix brachyura</i>		1		1	d	a, b	

Ecology and Biological Resources, Vietnam Academy of Science and Technology. The survey area was from A Tep Station to Bhalee Village, and from A Tep Station to the border between Quang Nam and Thua Thien–Hue provinces, along Ho Chi Minh Highway. The site was dominated by monsoon tropical broad-leaf evergreen forests. Main habitats contained mostly secondary forests regenerating after cultivation. The forests had a number of large trees with a diameter over 1 m.

Total survey efforts are shown in Table 1.

## Results

In total, 197 individuals of small mammals (bats, rodents, moles and shrews) were captured in 2008, 2018 and 2019. The data obtained from collected specimens, direct observations in the field, the materials retrieved from local households, and a combination of previously published records show that the small mammal fauna of two protected areas in Quang Nam Province consists of 78 species. Of them, 54 species in 15 families and 6 orders were identified on the basis of the collected specimens. Specifically, the Song Thanh and Saola Quang Nam NRs have 57 and 39 species of small mammals, respectively. The present study adds 20 new species records to the mammal checklist of Quang Nam Province (Table 2).

### *Key small mammal species recorded from two protected areas*

#### ORDER SCANDENTIA

##### Family TUPAIDAE

*Dendrogale murina* (Schlegel, Müller, 1843)

The northern smooth-tailed tree shrew is widespread from the Central Highlands to southern Vietnam (Timmins *et al.*, 2003; Dang Ngoc Can *et al.*, 2008). In Quang Nam Province, this species was recorded from the Saola Quang Nam NR by Long (2005). In 2018–2019, we were unable to collect any specimens of this species. In May 2019, calls of *D. murina* were recorded by Dr. Igor Palko in the shrubbery alongside the small road, in the Song Thanh NR.

#### ORDER DERMOPTERA

##### Family CYNOCEPHALIDAE

*Galeopterus variegatus* (Audebert, 1799)

The Sunda flying lemur is known from Indochina (Vietnam, Laos and Cambodia), Thailand, Malaysia and Indonesia (Francis, 2008). In Vietnam, the species is distributed in central Vietnam and the Central Highlands (Dang Ngoc Can *et al.*, 2008), though there is also a doubtful sighting in the Cat Tien National Park (Polet & Ling, 2004). During our surveys, this species was directly observed in the Song Thanh NR (Fig. 3). All records were done after 19:00 pm only because the Sunda flying lemurs are only actives at night. Local interviews and retrieved skulls from local householders in La Boi Village, Cha Val Commune of Song Thanh NR confirm its occurrence in the survey areas. This is the first record of this species from Quang Nam Province. The species is listed as Endangered in the Vietnam Red Data Book (2007). Populations are in decline in most of distribution areas because of illegal hunting.

#### ORDER EULIPOTYPHIA

##### Family SORICIDAE

*Chimarrogale varennei* Thomas, 1927

In Vietnam, there are two water shrew species: viz., *Chimarrogale himalayica* (known from northern Viet-



**Fig. 3.** *Galeopterus variegatus*. Photographed by Nguyen Manh Ha.

nam) and *C. varennei* (known from southern Vietnam). The Varenne's water shrew *C. varennei* has been recorded only from Dak Lak, Lam Dong and Kon Tum provinces in the Central Highlands (Abramov *et al.*, 2017). During our surveys, the latter species was observed twice at night in areas along streams in the Saola Quang Nam NR. In addition, specimens of *C. varennei* were collected along streams in the Saola Hue NR (around the bordering zone with the Saola Quang Nam NR). These findings represent new records for central Vietnam. The current status of this species has not been evaluated yet. However, it is being threatened due to human activities. For example, electrofishing has strong impacts on this semi-aquatic species.

*Crociodura tanakae* Kuroda, 1938

A widespread and common species known throughout Vietnam (Abramov *et al.*, 2013), while a closely related Vietnamese species, *C. attenuata*, appears to occur only to the east of Red River, in northeastern Vietnam (Bannikova *et al.*, 2011; Abramov *et al.*, 2012), *C. tanakae* does not appear to be so restricted and has been recorded on both sides of the river in northern Vietnam and also in central and southern Vietnam (Bannikova *et al.*, 2011; Jenkins *et al.*, 2013). The genetically confirmed records are also known from Quang Nam Province (Esselstyn & Oliveros, 2010). During our surveys, a few specimens were collected from the Song Thanh and Saola Quang Nam NRs by pitfall traps.

*Crociodura zaitsevi* Jenkins, Abramov, Rozhnov, Makarova, 2007

This small-sized white-toothed shrew is widespread in central and southern Vietnam (Abramov *et al.*, 2013). In 2019, few specimens of *C. zaitsevi* were collected from the Song Thanh NR by pitfall traps. This is the first record for Quang Nam Province.

Family TALPIDAE

*Euroscaptor parvidens* (Miller, 1940)



Fig. 4. *Euroscaptor parvidens*. Photographed by Bui Tuan Hai.

Currently, four mole species of the genus *Euroscaptor* have been reported from Vietnam (Kawada *et al.*, 2009, 2012; Zemlemerova *et al.*, 2016). The status of endemic small-toothed mole *E. parvidens* was assessed by Kawada *et al.* (2009), and was recently re-evaluated by Zemlemerova *et al.* (2016) who described a new subspecies, *E. parvidens ngoclinhensis*, from the Kon Tum Plateau. The nominotypical subspecies *E. parvidens parvidens* is restricted to the Dalat Plateau, including the Chu Yang Sin National Park in Dak Lak Province (Kawada *et al.*, 2009) and the Bi Doup–Nui Ba National Park in Lam Dong Province (Abramov *et al.*, 2010; Zemlemerova *et al.*, 2016). During our surveys, three specimens were collected from the Song Thanh NR (Fig. 4) and seven from the Saola Quang Nam NR.

ORDER ERINACEOMORPHA

Family GALERICIDAE

Genus *Hylomys* Müller, 1840

Until recently, all the lesser gymnures of the genus *Hylomys* from the mainland of Southeast Asia, including Vietnam, were referred to as *Hylomys suillus* (Dang Ngoc Can *et al.*, 2008; Francis, 2008). A recent multilocus analysis of the phylogenetic relationships within *Hylomys* revealed that *H. suillus* sensu lato may represent a paraphyletic taxon of five to seven full species including an undescribed taxon from southern Vietnam, *Hylomys* sp. (Bannikova *et al.*, 2014). These authors also suggested that the name *H. suillus* should be applied to the Java population only, whereas the lesser gymnures from northern Vietnam could be treated as a distinct species *H. microtinus* Thomas, 1925. An unnamed southern taxon was found in Binh Phuoc, Dong Nai, and Dak Lak provinces of southern Vietnam (Bannikova *et al.*, 2014; Pavlova *et al.*, 2018). In 2018, one specimen of *Hylomys* sp. was collected by Sherman trap which was set up in the forest along a stream in the Song Thanh NR. In 2019, another gymnure specimen was found dead on a small road in the same nature reserve. Morphological identification of northern and southern taxa of lesser gymnures is difficult. Prior to a proper genetic investigation we are unable to make a correct species identification. Previous studies in Quang Nam Province did not record *Hylomys* species.

ORDER CHIROPTERA

Family PTEROPODIDAE

*Cynopterus sphinx* (Vahl, 1797)

The greater short-nosed fruit bat is common and widespread in Vietnam (Dang Ngoc Can *et al.*, 2008; Kruskop, 2013). This species is often observed feeding on forest edges and in areas of secondary growth with fruit trees and sometimes can be quite numerous there. As a result, they are usually caught in the net with large numbers. During the study, eight individuals of this species were caught by mist net set up along stream near the A Bok Patrolling House with secondary forest with bamboo undergrowth.



*Sphaerias blanfordi* (Thomas, 1891)

The Blandford's fruit bat was first recorded from Vietnam in 2001 (Vu Dinh Thong *et al.*, 2001), based on the specimens collected from the Pu Hoat NR (Nghe An Province). Recent surveys have expanded the species distribution in Vietnam (Dang Ngoc Can *et al.*, 2008). During our surveys, only one specimen was collected by mist net set up along a stream in a natural forest mixed with bamboos in the Saola Quang Nam NR. This is the first record of the species from Quang Nam Province.

## Family RHINOLOPHIDAE

*Rhinolophus cf. luctus* Temminck, 1834

Based on the results of morphological studies, there are up to 15 groups of more than 70 species in the genus *Rhinolophus* in the world (Csorba *et al.*, 2003). Kruskop (2013) argued that in Vietnam there are 19 species of the genus *Rhinolophus*. Hoang Trung Thanh (2017) evaluated and complemented the taxonomic information on this genus, with a total of 20 species. The great woolly horseshoe bat *R. luctus* is the largest species in the genus belonging to the 'trifolius' species group. In Vietnam, this bat has a wide distribution but is rare (Kruskop, 2013). In Quang Nam Province, this species was firstly recorded from the Ngoc Linh Quang Nam NR (Tordoff *et al.*, 2000) and later from the Saola Quang Nam NR (Long, 2005). During our survey, only one individual of this species was captured from over a small stream in a tall forest with lianas.

A similar species, *R. francisi*, was recently described from Borneo and Thailand (Soisook *et al.*, 2015). According to the latter study, it also occurs in Quang Nam Province of Vietnam. Although the two species could apparently be separated by size (FA = 65 mm or more in *R. luctus*, less than 60 mm in *R. francisi*), a variation in the latter species is poorly studied and thus an accurate identification requires genetic data.

*Rhinolophus affinis* Horsfield, 1823

This horseshoe bat has a wide distribution in South-east Asia (Kingsada *et al.*, 2011), and in Vietnam inhabits both primary and secondary forests at the elevations of ca. 200–1900 m asl (Kruskop, 2013). According to our previous studies, it is the most common *Rhinolophus* species in Vietnam, except for lowland forests. In 2019, in the Song Thanh NR, three specimens (two males and one female) were captured by mist nets set across small streams surrounded by primary forest.

## Family HIPPOSIDERIDAE

*Hipposideros cf. grandis* Allen, 1936

The grand leaf-nosed bat is common in southern Vietnam (Kruskop, 2013; Hoang Trung Thanh *et al.*, 2015). This species was hitherto considered a subspecies of *H. larvatus* sensu lato (see Koopman, 1994). However, the presence of several full species within

the 'larvatus' species complex was supported by both morphology and genetics (Kitchener & Maryanto, 1993; Thabah *et al.*, 2006; Kruskop, 2015), and a larger and brightly coloured form from southern Indochina indeed representing a species distinct from the 'typical' *H. larvatus* of Java, Sumatra and Malaysia. The name *grandis* Allen, 1936 is widely accepted as a valid one for this form, however, the subject requires further clarification (C. Francis, pers. comm.). During our surveys, several specimens of *H. cf. grandis* were captured in both studied areas. The external body measurements of this species are as follows: HB = 61.7–68.9 mm, TL = 31–37 mm, E = 23–24.4 mm, FA = 64.3–64.7 mm, Tib = 23.4–26 mm. The dorsal body part has three coloration zones: grayish pale hair bases, a dark brown zone and pale tips. This coloration resembles that of the darker mainland form, but the dark brown zone is narrower, with less abrupt contrast as compared to pale bases. Pale tips are very short, and are barely observable on stuffed skins. Ventral fur is monotonously grayish pale. Adult females seem to be more yellowish.

## Family MINIOPTERIDAE

*Miniopterus pusillus* Dobson, 1876

This small species of bent-winged bats has wide but sporadic distribution across Southeast Asia; in Vietnam, it was hitherto reported from six localities only (Kruskop, 2013). A single adult female of *M. pusillus* was captured in the Song Thanh NR into mist net set across a forest river, in front of the mouth of swampy ravine. It represents the first record of the species from Quang Nam Province. No other observations of bent-winged bats were made in the area, which may indicate the possible migratory status of the caught individual.

## Family VESPERTILIONIDAE

*Pipistrellus javanicus* (Gray, 1838)

The Javan pipistrelle is one of the most common *Pipistrellus* species in Vietnam, occurring widely across the country (Kruskop, 2013). Three adult females were captured in Song Thanh by nets set across forest rivers with sandy riverbeds. Numerous pipistrelles of presumably the same species were observed in open places over river shallows and nearby car road. Animals were seen foraging in the evening hours (soon after sunset) at about 6–15 meters from the ground. Though this species has a wide distribution, in Quang Nam Province it was hitherto recorded from the Cu Lao Cham Island only (Kuznetsov, 2000).

*Tylonycteris malayana* Chasen, 1940

This species was listed within *T. robustula* (Koopman, 1994) for a long time; under this name it has been reported from at least eleven provinces across Vietnam, including Quang Nam (Kruskop, 2013). Its species status has recently been confirmed by genetic data (Vuong Tan Tu *et al.*, 2017). A single female was netted in the

Song Thanh NR over a river backwater surrounded by tall forest.

*Tylonycteris fluvida* (Peters, 1872)

Although quite common in Vietnam, this species was listed within *T. pachypus* for a long time (see Koopman, 1994). Its species status was confirmed by genetic data (Vuong Tan Tu *et al.*, 2017). In Song Thanh, a single female was captured by hand net over a road, soon after sunset. Presumably, these bats were observed foraging over open places along with *Pipistrellus javanicus*.

*Scotomanes ornatus* (Blyth, 1851)

The Harlequin bat is a large species of the subfamily Vespertilioninae with a very recognizable appearance (Fig. 5). The species is an aerial hawker and thought to be mainly a tree-dweller, though it was also reported to roost in limestone caves. Therefore, it is mainly found in mountainous forested areas with mosaic landscapes and available water sources. Its main distribution range is situated in the Himalayas and mountainous areas of southern and south-central China (Csorba *et al.*, 2008). However, this bat penetrates along mountain ranges far to the south, in Vietnam reaching the Dalat Plateau in Lam Dong Province (Dang Ngoc Can *et al.*, 2008; Kruskop, 2013). This bat usually forages quite high above the ground (10 meters and more), therefore, it is difficult to capture it. In south-central Vietnam, the Harlequin bat was most recently recorded from Quang Ngai Province in 2016 (Nguyen Truong Son *et al.*, 2016b). During our surveys, an adult male was captured in the Saola Quang Nam NR while foraging along a small river valley.



Fig. 5. *Scotomanes ornatus*. Photographed by Nguyen Truong Son.

*Myotis ater* (Peters, 1866)

*Myotis* is the largest bat genus with more than 110 accepted species in the world fauna (Ruedi *et al.*, 2013), though its taxonomic structure and an actual species number have not been revised until now. Smaller species, known as the ‘whiskered bats morphogroup’, represent a huge complex of morphologically similar species with tangled relationships and sometimes uncertain species boundaries (Kruskop & Borisenko, 2013). The Malayan whiskered bat, *M. ater*, was reported from Vietnam in 1999 for the first time (Bates *et al.*, 1999) and since then has been found in several provinces across the country (Kruskop, 2013). Four individuals (all females, three adults and one immature) were captured by mist net set along a small forest stream in Song Thanh, probably representing the first record for Quang Nam Province. Identification was based on relatively large size (FA = 36.5 mm and more) and dark gray fur coloration.

*Murina cf. fionae* Francis, Eager, 2012

*Murina* is among the bat genera of which structure and composition undergone greatest changes in the last two decades. Fourteen species are currently recognized in Vietnam (Nguyen Truong Son *et al.*, 2015), of which five are known from Quang Nam Province. *M. fionae* is a relatively large tube-nosed bat related to the smaller *M. cyclotis*; in Vietnam, it was hitherto reported from seven provinces, including Quang Nam. In our study, a single male of *M. cf. fionae* was captured in Song Thanh by mist net in a narrow ravine covered with primary forest.

*Murina feae* (Thomas, 1891)

This bat was hitherto treated as part of *M. tubinaris* for a long time (see Koopman, 1994). Later, it was shown that small gray-colored tube-nosed bats from Southeast Asia represent a full species, separate from the typical *M. tubinaris* (Csorba *et al.*, 2011). This species was described as *M. cineracea* and referred to as such until its senior synonym, *M. feae*, was discovered (Francis & Eger, 2012). This small tube-nosed bat is reported from eighteen Vietnamese provinces (Nguyen Truong Son *et al.*, 2015), which makes it one of the most widespread *Murina* in the country. In our study, an adult female was captured in Song Thanh by mist net in a narrow ravine covered with primary forest.

*Kerivoula titania* Bates, Struebig, Hayes, Furey, Mya, Thong, Son, Harrison, Csorba, Francis, 2007

The species was described in 2007, based on the specimens collected from the Dakrong NR in Quang Tri Province (Bates *et al.*, 2007). The *Titania*’s woolly bat has a medium size as compared to other *Kerivoula* species (Nguyen Truong Son *et al.*, 2016a). It is widespread in Vietnam and often recorded in habitats between secondary and primary forests with bamboos and shrubs at the elevations of 300–800 m. During our

surveys, several individuals were captured in the Saola Quang Nam NR.

*Kerivoula kachinensis* Bates, Struebig, Rossiter, Kingston, Oo, Mya, 2004

The Kachin woolly bat belongs to the ‘*hardwickii*’ species complex, within which it stands out by its relatively large size and peculiar proportions of the skull (Nguyen Truong Son *et al.*, 2016a). In comparison to other *Kerivoula* species, this species was rarely observed or captured during surveys. It was firstly reported in Vietnam from the Chu Mom Ray NP in Kon Tum Province and Muong Muon area in Lai Chau Province (Vu Dinh Thong *et al.*, 2006). Also, the species was recorded from the Pu Huong NR in Nghe An Province (Dang Ngoc Can *et al.*, 2008) and from Bu Gia Map in Binh Phuoc Province (Kruskop, 2010). Due to the wide but sparse distribution, the origin of this species is difficult to associate with a certain territory. During our surveys, an adult male was captured by harp trap set up in a tall forest mixed with lianas in the Song Thanh NR.

*Kerivoula cf. dongduongana* Tu, Hassanin, Furey, Son, Csorba, 2018

The Indochinese woolly bat was a new species of bats described in 2018 on the basis of the samples collected from the Ngoc Linh NR, Kon Tum Province. Currently, this bat species is known from the Annamite Mts only (Vuong Tan Tu *et al.*, 2018). The biological, ecological and behavioral information of this species is still scarce. During our surveys, we collected four adult females of this species from the Saola Quang Nam NR, along a stream with regenerated small woody forests, lianas and bamboo forests. The external body measurements of this species are as follows: HB = 32.0–37.8 mm, TL = 39–44 mm, E = 12.4–14.3 mm, FA = 32.0–34.7 mm, Tib = 15.6–17.2 mm. *K. cf. dongduongana* is smaller than other large size species (*K. kachinensis*, *K. papillosa*, *K. lenis*, *K. titania*), but corresponds to the similar-sized species within the ‘*hardwickii*’ complex, such as: *K. hardwickii*, *K. depressa*, *K. furva* (Vuong Tan Tu *et al.*, 2015, 2017, 2018). Phylogenetic and echolocation call analyses are important to confirm the relationships between the specimens from the Saola Quang NR with other congeners.

*Kerivoula hardwickii* (Horsfield, 1824)

The Hardwicke’s woolly bat is a common species and small taxon within the ‘*hardwickii*’ complex (Nguyen Truong Son *et al.*, 2016a; Vuong Tan Tu *et al.*, 2018). It seems to also have a different echolocation call as an indirect result of allopatric speciation (Dounangboubpha *et al.*, 2015). This species also overlaps in its size with *K. dongduongana* and other species of the ‘*hardwickii*’ complex. It is widespread in Vietnam and often recorded in habitats between secondary and primary forests with



Fig 6. *Ratufa bicolor*. Photographed by Le Manh Hung.

bamboos and shrubs at the elevations of 200–1000 m asl. During the surveys in 2008 and 2018, 16 individuals were captured in the Saola Quang Nam and Song Thanh NRs.

#### ORDER RODENTIA Family SCIURIDAE

*Ratufa bicolor* (Sparman, 1778)

The black giant squirrel is widespread in Vietnam and often observed and captured in primary or regenerated forests with many large trees. Usually, it lives and moves in tall trees and is active during the daytime, especially in the early morning and late afternoon. During daytime surveys, a few individuals were observed in the Song Thanh NR in 2018 and 2019 (Fig. 6). This species is considered an indicator for good quality habitats (Modak *et al.*, 2016)

*Hylopetes alboniger* (Hodgson, 1836)

The particolored flying squirrel has a vast distribution range across Southeast Asia. Throughout its range, this squirrel is found at middle elevations in montane regions that are classified as either tropical or subtropical (Thorington *et al.*, 2012). During our surveys, we observed this species once in the Song Thanh NR and one individual was trapped by local people in the Saola Quang Nam NR (Fig. 7).

*Callosciurus inornatus* (Gray, 1867)

The inornate squirrel has a broad distribution in northern Vietnam (mainly, south of Red River) and penetrates to the central Vietnam, southward to Hai Van Pass (Dang Huy Huynh *et al.*, 2007; Dang Ngoc Can *et al.*, 2008). Two adult males (Fig. 8) of this squirrel were collected from the Song Thanh NR during our survey in 2018. They were caught by local cage live-traps set up in the secondary forest near an agricultural field. This is the first record of this species from Quang Nam Province.





**Fig. 7.** *Hylopetes alboniger*. Photographed by Nguyen Truong Son.

Genus *Tamiops* Allen, 1906

Asian striped squirrels of the genus *Tamiops* are widespread in Southeast Asia. Four species, *T. swinhoi*, *T. maritimus*, *T. maclellandii*, and *T. rodolphi*, are listed for Vietnam (Dang Ngoc Can *et al.*, 2008). Most of the *Tamiops* species are identified on the basis of external morphology (Chang *et al.*, 2011). In general, the genus *Tamiops* is not only complex in external morphology but also overlaps in terms of its distribution area (Francis, 2008). Previous studies in protected areas of Quang Nam Province revealed the presence of two species: *T. maritimus* and *T. rodolphi* (Long, 2005; Van Ngoc Thinh *et al.*, 2006; Le Xuan Canh *et al.*, 2011). During our surveys, we collected two specimens of *T. rodolphi* and observed *Tamiops* spp. up to sixteen times during excursions in both NRs. However, we did not record *T. maritimus*.



**Fig. 8.** *Callosciurus inornatus*. Photographed by Nguyen Truong Son.

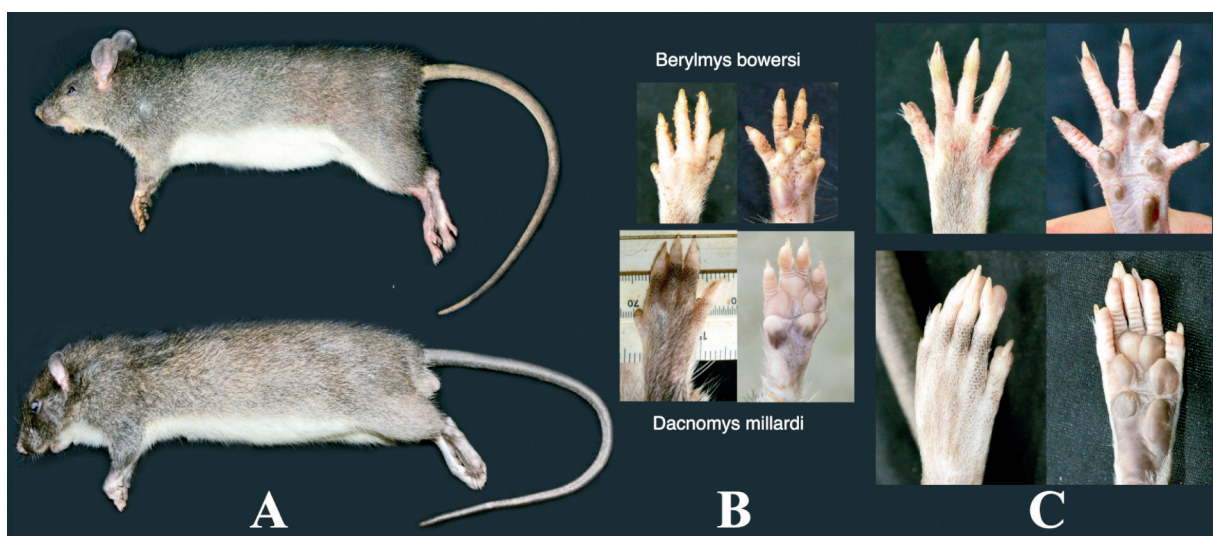
Family MURIDAE

*Berylmys bowersi* (Anderson, 1879)

The giant white-toothed rat is broadly distributed in Vietnam, and commonly found in dense primary forests, bamboo forests, rocky slopes and hills near forested areas (Dang Huy Huynh *et al.*, 2007). During our surveys, five specimens were collected (four from the Song Thanh NR and one from the Saola Quang Nam NR) by cage live-traps mostly along small streams (Fig. 9). Although it is a common species, it is surprising that most of the hitherto surveys in Quang Nam did not record it.

*Dacnomys millardi* Thomas, 1916

The Millard's giant rat *D. millardi* is a poorly-known species. It has been recorded from eastern Nepal, north-eastern India, southern China (south and west Yunnan) and from adjacent areas of Laos and Vietnam (Abramov *et al.*, 2017). This species was considered to be restricted to northern Vietnam only (Dang Ngoc Can



**Fig. 9.** *Berylmys bowersi* (top) and *Dacnomys millardi* (bottom). A – lateral view; B – palmar view of fore foot; C – plantar view of hind foot. Photographed by Ly Ngoc Tu & Bui Tuan Hai.



*et al.*, 2008). Nonetheless, recent studies show that its distribution extends to as far as Kon Tum Province in south-central Vietnam (Abramov *et al.*, 2017). During our fieldwork, one specimen of this species was collected from the Saola Quang Nam NR in 2018 and one specimen from the Song Thanh NR in 2019 (Fig. 9). This species has huge and swollen pads in both front and hindfeet (Fig. 9B). Musser *et al.* (2006) suggested that the size and protrusion of small mammal pads are dependent on their habitats. In the Saola Quang Nam NR, *D. millardi* was found in a small waterfall in between two cliffs of a rugged terrain (Fig. 10). All known Vietnamese specimens were collected in riparian habits, alongside small forest rivers and streams (Alexei Abramov, unpublished data).

*Leopoldamys cf. revertens* (Robinson, Kloss, 1922)

According to the earlier checklist (Dang Ngoc Can *et al.*, 2008), four species of *Leopoldamys* are recognized in Vietnam, namely *L. sabanus*, *L. edwardsi*, *L. milleti*, and *L. neilli*. A recent revision of the genus *Leopoldamys* based on molecular and morphological data (Balakirev *et al.*, 2013) listed a different set of four species for Vietnam: *L. revertens* (distributed in lowlands of eastern and central Indochina), *L. herberti* (western and central Indochina, northward to northern Vietnam), *L. edwardsi* (China and northern Vietnam, northward of 21°N), and *L. milleti* (endemic of Dalat Plateau, southern Vietnam). The true *L. sabanus* is restricted to Borneo Island only. Giant rats of the genus *Leopoldamys* were common in the studied area. We caught 13 specimens – seven in

the Song Thanh NR and six in the Saola Quang Nam NR – provisionally assigned to *L. revertens*. This is the first record of the species from Quang Nam Province.

*Niviventer cf. huang* (Bonhote, 1905)

Rats of the genus *Niviventer* are widespread throughout Southeast Asia. Most researchers recognized four species of *Niviventer* in Vietnam: *N. confucianus*, *N. tenaster*, *N. langbianis* and *N. fulvescens*. The latter species is listed for Quang Nam Province (Dang Ngoc Can *et al.*, 2008; Le Xuan Canh *et al.*, 2011). According to the recent taxonomic revision (Balakirev *et al.*, 2012), at least eight *Niviventer* species occur in Vietnam. The authors treated Vietnamese members of the '*Niviventer fulvescens* species complex' as two morphologically similar but genetically distinct species, *N. huang* and *N. fulvescens*. The first one is widespread throughout Vietnam to SE China, whereas *N. fulvescens* occurs at high elevations of the Himalayan mountain area and found only in north-western part of Vietnam. Few specimens *N. cf. huang* were caught in the Song Thanh NR in 2018 and 2019.

*Rattus exulans* (Peale, 1848)

This species occurs in many habitats and is widespread in Southeast Asia (Francis, 2008). In Vietnam, it has a vast distribution in southern parts of the country northward to Chu Lai in south-east of Quang Nam Province (Dang Ngoc Can *et al.*, 2008). In our surveys, three

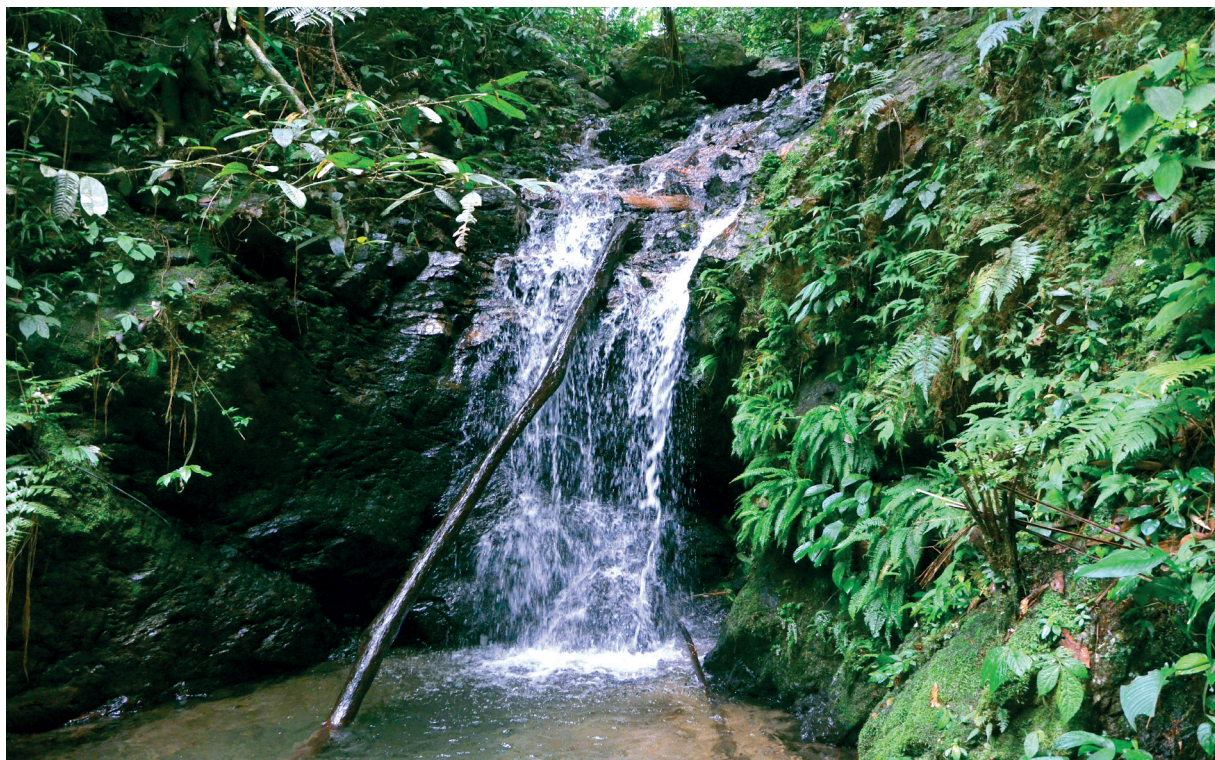


Fig. 10. Biotopes at A Bok Stream in Saola Quang Nam NR.

specimens were collected from the Song Thanh NR in 2018. All the specimens were caught by local cage live-traps set up in secondary forests near local households and agriculture fields.

*Rattus nitidus* (Hodgson, 1845)

The white-footed Indochinese rat is widespread throughout Southeast Asia (Francis, 2008). The species has been recorded from many types of forest habitats, croplands and around human settlements. One specimen was caught in the Song Thanh NR in 2019.

## Conclusion

A number of biodiversity studies were conducted in Quang Nam Province from 2005 to 2011 and most of them focused on the mammal fauna. According to the results of previous works, a total of 56 small mammals species was listed for Quang Nam Province (Long, 2005; Van Ngoc Thinh *et al.*, 2006; Kawada *et al.*, 2009, 2012; Le Xuan Canh *et al.*, 2011; Nguyen Truong Son *et al.*, 2011). Based on our results, the list of small mammals is expanded to 78 species. Certain changes in the list have resulted from novel taxonomic findings in several species complexes (e.g., *Leopoldamys*, *Niviventer*, *Hylomys*, *Crociodura*, *Hipposideros* etc.). However, during our surveys 20 small mammal species were recorded from Quang Nam Province for the first time (Table 2).

The small mammal fauna of Quang Nam Province is diverse and some species are abundant. Common species in the studied areas include *Rhizomys pruinosus*, *Callosciurus inornatus*, *Petaurista philippensis*, *Tupaia belangeri*, *Tamiops rodolphii*, *Leopoldamys revertens*, *Rhinolophus affinis*, *Tylonycteris malayana*, *Kerivoula titania*, *K. hardwickii*, and *Crociodura zaitsevi*. However, some dominant small mammal species in the central Annamites, such as *Hipposideros larvatus*, some *Myotis* species, *Niviventer* and *Rattus* rats, were not recorded. Among 78 recorded species, four species are included in the Vietnam Red Data Book (2007): viz., the Sunda flying lemur *Galeopterus variegatus* (Endangered), black giant squirrel *Ratufa bicolor* (Vulnerable), particolored flying squirrel *Hylopetes alboniger* (Vulnerable), and giant flying squirrel *Petaurista philippensis* (Vulnerable).

The present study has also contributed additional information on the distribution of some species having narrow ranges. For example, the inornate squirrel *Callosciurus inornatus* was hitherto recorded from northern Vietnam to Bach Ma Mountain only (Dang Ngoc Can *et al.*, 2008). Bach Ma Mt. was once considered a geographical barrier for some mammal species in Vietnam (Sterling *et al.*, 2006). However, in this study *C. inornatus* was found in Quang Nam Province (south of Bach Ma Mt.). So, the actual geographical boundary of this species is yet unclear. The Millard's giant rat *Dacnomys millardi* was recently found in the southern part of Kontum Plateau (Abramov *et al.*, 2017), some 1000 km to the south of the currently known limit of the species

range, and apparently has a continuous distribution along the Annamite Range. Our data have also clarified the geographic distribution of some insectivorous species, such as *Hylomys* sp., *Chimarrogale varennei*, *Crociodura zaitsevi*, and *Euroscaptor parvidens*.

The results of the present study confirm wealth and diversity of small mammals in this part of the central Annamites. Despite a high species diversity and abundance of large and small mammals in the studied area, some rodents have severely declined in recent years mainly due to illegal hunting and trapping activities. The majority of local communities in Quang Nam Province have a tradition of setting traps before the Lunar New Year, from October to December of the lunar calendar. We observed many mammal skulls and small mammals kept on the kitchen's upper parts in local households.

**ACKNOWLEDGMENTS.** We are grateful to the administration of the Song Thanh and Saola Quang Nam nature reserves for providing us with an opportunity to carry out the field surveys. We would like to express our sincere thanks to forest rangers and all expedition members for their support during the fieldworks. We are obliged to Dmitry V. Logunov (Manchester Museum) for improving the English of the final draft. This research was funded by National Foundation for Science and Technology Development (NAFOSTED) under grant No.106-NN.05-2016.14, VAST-JSPS (QTJP01.02/18-20), USAID, WWF, Vietnam, and the Ministry of Science and Higher Education of the Russian Federation (project AAAA-A19-119082990107-3). Bat study was in part supported by Russian Foundation for Basic Research (grant No. 17-04-00689a) and was performed in line with State theme No. AAAA-A16-116021660077-3.

## References

- Abramov A.V., Balakirev A.E. & Rozhnov V.V. 2017. New data on the distribution and intraspecific variation of the Millard's rat *Dacnomys millardi* (Mammalia, Rodentia) from Vietnam // Mammal Research. Vol.62. No.3. P.307–311.
- Abramov A.V., Bannikova A.A., Lebedev V.S. & Rozhnov V.V. 2017. Revision of *Chimarrogale* (Lipotyphla: Soricidae) from Vietnam with comments on taxonomy and biogeography of Asiatic water shrews // Zootaxa. Vol.4232. No.2. P.216–230.
- Abramov A.V., Bannikova A.A. & Rozhnov V.V. 2012. White-toothed shrews (Mammalia, Soricomorpha, *Crociodura*) of coastal islands of Vietnam // Zookeys. No.207. P.37–47.
- Abramov A.V., Dang Ngoc Can, Bui Tuan Hai & Nguyen Truong Son. 2013. An annotated checklist of the insectivores (Mammalia, Lipotyphla) of Vietnam // Russian Journal of Theriology. Vol.12. No.2. P.57–70.
- Abramov A.V., Kruskop S.V. & Shchinov A.V. 2010. Small mammals of the Dalat Plateau, southern Vietnam // Russian Journal of Theriology. Vol.8. No.2. P.61–73.
- Averyanov L.V., Phan Ke Loc, Nguyen Tien Hiep & Harder D.K. 2003. Phytogeographic review of Vietnam and adjacent areas of Eastern Indochina // Komarovia. Vol.3. P.1–83.



- Bannikova A.A., Abramov A.V., Borisenko A.V., Lebedev V.S. & Rozhnov V.V. 2011. Mitochondrial diversity of the white-toothed shrews (Mammalia, Eulipotyphla, *Crocidae*) in Vietnam // *Zootaxa*. No.2812. P.1–20.
- Bannikova A.A., Lebedev V.S., Abramov A.V. & Rozhnov V.V. 2014. Contrasting evolutionary history of hedgehogs and gymnures (Mammalia: Erinaceomorpha) as inferred from a multigene study // *Biological Journal of Linnean Society*. Vol.112. No.3. P.499–519.
- Balakirev A.E., Abramov A.V. & Rozhnov V.V. 2012. Taxonomic revision of *Niviventer* (Rodentia, Muridae) from Vietnam: a morphological and molecular approach // *Russian Journal of Theriology*. Vol.10 (for 2011). No.1. P.1–26.
- Balakirev A.E., Abramov A.V. & Rozhnov V.V. 2013. Revision of the genus *Leopoldamys* (Rodentia, Muridae) as inferred from morphological and molecular data, with a special emphasis on the species composition in continental Indochina // *Zootaxa*. Vol.3640. No.4. P.521–549.
- Bates P.J.J., Hendrichsen D.K., Watson J.L. & Hayes B. 1999. A review of the Mouse-eared bats (Chiroptera: Vespertilionidae: *Myotis*) from Vietnam with significant new records // *Acta Chiropterologica*. Vol.1. No.1. P.47–74.
- Bates P.J.J., Strubbig M.J., Hayes B.D., Furey N.M., Mya K.M., Vu Dinh Thong, Pham Duc Tien, Nguyen Truong Son, Harrison D.L., Francis C.M. & Csorba G. 2007. A new species of *Kerivoula* (Chiroptera: Vespertilionidae) from Southeast Asia // *Acta Chiropterologica*. Vol.9. No.2. P.323–337.
- Bui Tuan Hai, Nguyen Truong Son & Nguyen Quang Truong. 2015. A review of the genus *Crocidae* (Mammalia: Soricomorpha) in Northern Vietnam // *Proceedings of the 6<sup>th</sup> National Conference on Ecology and Biological Resources*, Hanoi. P.124–129 [in Vietnamese].
- Chang S.W., Oshida T., Endo H., Nguyen Truong Son, Nguyen Xuan Dang, Jiang X., Li Z.J. & Lin L.K. 2011. Ancient hybridization and underestimated species diversity in Asian striped squirrels (genus *Tamias*): inference from paternal, maternal and biparental markers // *Journal of Zoology*. Vol.285. No.2. P.128–138.
- Clements R., Sodhi N.S., Schilthuizen M. & Perter K.L.N.G. 2006. Limestone karsts of Southeast Asia: imperiled arks of biodiversity // *BioSciences*. Vol.56. No.9. P.733–742.
- Csorba G., Ujhelyi P. & Thomas N. 2003. Horseshoe Bats of the World (Chiroptera: Rhinolophidae). Bishop's Castle, Shropshire: Alana Books. 160 p.
- Csorba G., Bates P., Molur S. & Srinivasulu C. 2008. *Scotomanes ornatus* // *The IUCN Red List of Threatened Species*. e.T20058A9139959.
- Csorba G., Nguyen Truong Son, Saveng I. & Furey N.M. 2011. Revealing cryptic bat diversity: three new *Murina* and redescription of *M. tubinaris* from Southeast Asia // *Journal of Mammalogy*. Vol.92. No.4. P.891–904.
- Dang Huy Huynh, Hoang Minh Khien, Le Xuan Canh, Nguyen Xuan Dang, Vu Dinh Thong & Dang Huy Phuong. 2007. [Mammals of Vietnam. Morphology, Biology and Ecology of Some Species. Vol.1]. Hanoi: Science and Technics Publishing House. 232 p. [In Vietnamese].
- Dang Ngoc Can, Endo H., Nguyen Truong Son, Oshida T., Le Xuan Canh, Dang Huy Phuong, Lunde D.P., Kawada S.I., Hayashida A. & Sasaki M. 2008. [Checklist of Wild Mammal Species of Vietnam]. Hanoi: Institute of Ecology and Biological Resources. 400 p. [In Vietnamese].
- Douangboubpha B., Bumrungsri S., Satasook C., Wanna W., Soisook P. & Bates P.J.J. 2015. Morphology, genetics and echolocation calls of the genus *Kerivoula* (Chiroptera: Vespertilionidae: Kerivoulinae) in Thailand // *Mammalia*. Vol.80. No.1. P.21–47.
- Esselstyn J.A. & Oliveros C.H. 2010. Colonization of the Philippines from Taiwan: a multi-locus test of the biogeographic and phylogenetic relationships of isolated populations of shrews // *Journal of Biogeography*. Vol.37. P.1504–1514.
- Francis C.M. 2008. A Guide to the Mammals of Southeast Asia. Princeton and Oxford: Princeton University Press. 392 p.
- Francis C.M. & Eger J.L. 2012. A review of tube-nosed bats (*Murina*) from Laos with a description of two new species // *Acta Chiropterologica*. Vol.14. No.1. P.15–38.
- Hoang Trung Thanh. 2017. [Study on the family Rhinolophidae in Vietnam]. Hanoi: Vietnam Nature University of Science & Vietnam National University. 47 p. [In Vietnamese].
- Hoang Trung Thanh, Nguyen Truong Son, Nguyen Vu Khoi & Vu Dinh Thong. 2015. [Bat species composition in Ba Hon area, Hon Dat District, Kien Giang Province] // *Proceedings of the 6<sup>th</sup> National Conference on Ecology and Biological Resources*, Hanoi. P.866–871 [in Vietnamese].
- Jenkins P.D., Abramov A.V., Bannikova A.A. & Rozhnov V.V. 2013. Bones and genes: resolution problems in three Vietnamese species of *Crocidae* (Mammalia, Soricomorpha, Soricidae) and the description of an additional new species // *Zookeys*. No.313. P.61–79.
- Kawada S., Nguyen Truong Son & Dang Ngoc Can. 2009. Moles (Insectivora, Talpidae, Talpinae) of Vietnam // *Bulletin of the National Museum of Nature and Science*. Vol.35. No.2. P.89–101.
- Kawada S., Nguyen Truong Son & Dang Ngoc Can. 2012. A new species of mole of the genus *Euroscaptor* (Soricomorpha, Talpidae) from northern Vietnam // *Journal of Mammalogy*. Vol.93. P.893–850.
- Kingsada P., Douangboubpha B., Saveng I., Furey N., Sisook P., Bumrungsri S., Satasook C., Vu Dinh Thong, Csorba G., Harrison D., Pearch M., Bates P. & Thomas N. 2011. A checklist of bats from Cambodia, including the first record of the intermediate horseshoe bat *Rhinolophus affinis* (Chiroptera: Rhinolophidae), with additional information from Thailand and Vietnam // *Cambodian Journal of Natural History*. Vol.2011. No.1. P.49–59.
- Kitchener D.J. & Maryanto I. 1993. Taxonomic reappraisal of the *Hipposideros larvatus* species complex (Chiroptera: Hipposideridae) in the Greater and Lesser Sunda Islands, Indonesia // *Records of the Western Australian Museum*. Vol.16. P.119–173.
- Koopman K.F. 1994. Chiroptera: Systematics. Handbook of Zoology, Vol.8, Mammalia, part 60. New York: Walter de Gruyter. 217 p.
- Kruskop S.V. 2010. [Preliminary data on the bat fauna of Bu Gia Map National Park (Southern Vietnam)] // *Plecotus et al.* Vol.13. P.69–74 [in Russian].
- Kruskop S.V. 2013. Bats of Vietnam. Checklist and an Identification Manual. Moscow: Joint Russian–Vietnamese Sciences and Technological Centre & Zoological Museum of Moscow State University. 299 p.
- Kruskop S.V. 2015. Dull and bright: cryptic diversity within the *Hipposideros larvatus* group in Indochina (Chiroptera: Hipposideridae) // *Lynx, nová série (Praha)*. Vol.46. P.29–42.

- Kruskop S.V. & Borisenko A.V. 2013. A new species of South-East Asian *Myotis* (Chiroptera: Vespertilionidae), with comments on Vietnamese 'whiskered bats' // *Acta Chiropterologica*. Vol.15. No.2. P.293–305.
- Kruskop S.V., Kalyakin M.V. & Abramov A.V. 2006. First record of *Harpiola* (Chiroptera, Vespertilionidae) from Vietnam // *Russian Journal of Theriology*. Vol.5. No.1. P.13–16.
- Kruskop S.V., Borisenko A.V., Dudorova A.V. & Artyushin I.V. 2018. Description of a new Indochinese *Myotis* (Mammalia: Chiroptera: Vespertilionidae), with additional data on the "*M. annatessae*" species complex // *Russian Journal of Theriology*. Vol.17. No.1. P.17–31.
- Kuznetsov G.V. 2000. Mammals of coastal islands of Vietnam: zoogeographical and ecological aspects // Rheinwald G. (ed.). *Isolated Vertebrate Communities in the Tropics. Proceedings of 4<sup>th</sup> International Symposium, Bonn*. P.357–366.
- Le Xuan Canh, Dang Huy Phuong & Nguyen Truong Son. 2011. [Mammals observed in Chu Mom Ray National Park (Kon Tum Province) and Song Thanh Nature Reserve (Quang Nam Province)] // *Proceedings of the 4<sup>th</sup> National Conference on Ecology and Biological Resources, Hanoi*. P.47–55 [in Vietnamese].
- Long B. 2005. Identification of priority areas for integrated conservation management in Quang Nam Province, Vietnam. Thesis submitted for the degree of Doctor of Philosophy in Biodiversity Management. Durrell Institute of Conservation and Ecology, University of Kent.
- Musser G.G., Lunde D.P. & Nguyen Truong Son. 2006. Description of a new genus and species of rodent (Murinae, Muridae, Rodentia) from the Tower Karst Region of northeastern Vietnam // *American Museum Novitates*. No.351. P.11–13.
- Modak M., Dahanukar N., Ogale H & Padhye A. 2016. Ground foraging behaviour of Malayan giant squirrel (*Ratufa bicolor*) // *Current Science*. Vol.110. No.12. P.2223–2225.
- Nadler T., Vu Ngoc Thanh & Ulrike S. 2007. Conservation status Vietnamese primates // *Vietnamese Journal of Primatology*. Vol.1. P.7–26.
- Nguyen Truong Son & Vu Dinh Thong. 2011. [Recent bat survey in Chu Mom Ray National Park (Kon Tum Province) and Song Thanh Nature Reserve (Quang Nam Province)] // *Proceedings of the 4<sup>th</sup> National Conference on Ecology and Biological Resources, Hanoi*. P.314–318 [in Vietnamese].
- Nguyen Truong Son, Csorba G., Vuong Tuan Tu, Vu Dinh Thong, Wu Y., Harada M., Oshida T., Endo H. & Motokawa M. 2015. A new species of genus *Murina* (Chiroptera: Vespertilionidae) from Central Highlands of Vietnam with a review of subfamily Murinae in Vietnam // *Acta Chiropterologica*. Vol.17. No.2. P.201–232.
- Nguyen Truong Son, Motokawa M., Oshida T. & Endo H. 2016a. A morphological analysis of the skull size and shape of Kerivoulinae (Chiroptera: Vespertilionidae) from Vietnam // *Journal of Veterinary Medical Science*. Vol.78. No.2. P.187–198.
- Nguyen Truong Son, O'Shea T.J., Gore J.A., Garbo C., Vuong Tan Tu, Oshida T., Endo H. & Motokawa M. 2016b. Bats (Mammalia: Chiroptera) of the Southeastern Truong Son mountains, Quang Ngai Province, Vietnam // *Journal of Threatened Taxa*. Vol.8. No.7. P.8953–8969.
- Olson D.M & Dinerstein E. 2002. The Global 200: priority ecoregions for global conservation // *Annals of the Missouri Botanical Garden*. Vol.89. P.199–224.
- Pavlova S.V., Biltueva L.S., Romanenko S.A., Lemskaya N.A., Shchinov A.V., Abramov A.V. & Rozhnov V.V. 2018. First cytogenetic analysis of lesser gymnures (Mammalia, Galeridae, *Hylomys*) from Vietnam // *Comparative Cytogenetics*. Vol.12. No.3. P.361–372.
- Polet G. & Ling S. 2004. Protecting mammal diversity: opportunities and constraints for pragmatic conservation management in Cat Tien National Park, Vietnam // *Oryx*. Vol.38. No.2. P.1–11.
- Ruedi M., Stadelmann B., Gager Y., Douzery E.J.P., Francis C.M., Lin L.-K., Guillen-Servent A. & Cibois A. 2013. Molecular phylogenetic reconstructions identify East Asia as the cradle for the evolution of the cosmopolitan genus *Myotis* (Mammalia, Chiroptera) // *Molecular Phylogenetics and Evolution*. Vol.69. P.437–449.
- Rundel P.W. 1999. Forest Habitats and Flora in Laos, Cambodia, and Vietnam. Conservation Priorities in Indochina – WWF Desk Study. Hanoi: WWF Indochina Programme Office. 171 p.
- Sikes R.S., Gannon W.L. & the Animal Care and Use Committee of the American Society of Mammalogists. 2011. Guidelines of the American Society of Mammalogists for the use of wild mammals in research // *Journal of Mammalogy*. Vol.92. P.235–253.
- Soisook P., Struebig M.J., Noerfahmy S., Bernard H., Maryanto I., Chen S.-F., Rossiter S.J., Kuo H.-C., Deshpande K., Bates P.J.J., Sykes D. & Miguez R.P. 2015. Description of a new species of the *Rhinolophus trifolius*-group (Chiroptera: Rhinolophidae) from Southeast Asia // *Acta Chiropterologica*. Vol.17. No.1. P.21–36.
- Sterling E.J., Hurley M.M. & Le Duc Minh. 2006. Vietnam: A Natural History. New Haven and London: Yale University Press. 420 p.
- Thabah A., Rossiter S.J., Kingston T., Zhang S., Parsons S., Mya K.M., Akbar Z. & Jones G. 2006. Genetic divergence and echolocation call frequency in cryptic species of *Hipposideros larvatus* s.l. (Chiroptera: Hipposideridae) from the Indo-Malayan region // *Biological Journal of the Linnean Society*. Vol.88. No.1. P.119–130.
- Timmings R.J., Duckworth J.W., Robson C.R. & Walston J.L. 2003. Distribution, status and ecology of the mainland slender-tailed treeshrew *Dendrogale murina* // *Mammal Review*. Vol.33. No.3. P.272–283.
- Thorington R.W., Koprowski J.L., Steele M.A. & Wharton J.F. 2012. *Squirrels of the World*. Baltimore: Johns Hopkins University Press. 459 p.
- Tordoff A.W., Chan Minh Hieu, Tran Quang Ngoc, Sterling E., Ersts P., Sweet P., Chesser T., Kevin B.K., Eger J., Mitchell L., Lim B., Harder D., Nguyen Tien Hiep, Pham Trong Anh, Le Dinh Thuy, Pham Duc Tien, Nguyen Thi Do, Nguyen Huu Hien, Nguyen Quang Truong & Phan Ke Loc. 2000. A Feasibility Study for the Establishment of Ngoc Linh Nature Reserve, Quang Nam Province, Vietnam. Hanoi: Birdlife International Vietnam Programme. 74 p.
- Tordoff A.W., Baltzer M.C., Fellowes J.R., Pilgrim J.D. & Langhammer P.F. 2012. Key biodiversity areas in the Indo-Burma hotspot: process, progress and future directions // *Journal of Threatened Taxa*. Vol.4. P.2779–2787.



- Van Ngoc Thinh, Mootnick A.R., Vu Ngoc Thanh, Nadler T. & Roos C. 2010. A new species of crested gibbon, from the central Annamite mountain range // *Vietnamese Journal of Primatology*. Vol.4. P.1–12.
- Van Ngoc Thinh, Vu Ngoc Thanh, Do Tuoc, Minh Hoang, Le Trong Dat, Nguyen Manh Ha & Dickinson C. 2006. An Assessment of the Mammal Fauna of the Green Corridor Forest Landscape, Thua Thien Hue Province, Vietnam. Report No.6. Green Corridor Project. WWF Greater Mekong and Vietnam Country Programme and FPD Thua Thien Hue Province, Hue City.
- Vietnam Red Data Book. 2007. [Vietnam Red Data Book. Part 1. Animals]. Hanoi: Publishing House of Natural Science and Technology. 515 p. [In Vietnamese].
- Vu Dinh Thong, Bumrungsri S., Harrison D.L., Pearch M.J., Helgen K.M. & Bates P.J.J. 2006. New records of Microchiroptera (Rhinolophidae and Kerivoulinae) from Vietnam and Thailand // *Acta Chiropterologica*. Vol.8. No.1. P.83–93.
- Vu Dinh Thong, Pham Duc Tien & Cao Van Sung. 2001. [Blanford's fruit bat *Sphaerias blanfordi* (Thomas, 1891) first recorded in Vietnam] // *Journal of Biology*. Vol.23. No.1. P.17–20 [in Vietnamese].
- Vuong Tan Tu, Cornette R., Tuge R. & Hassanin A. 2014. First records of *Murina lorelieae* (Chiroptera: Vespertilionidae) from Vietnam // *Mammalia*. Vol.79. No.2. P.201–213.
- Vuong Tan Tu, Csorba G., Görföl T., Arai S., Nguyen Truong Son, Hoang Trung Thanh & Hassanin A. 2015. Description of a new species of the genus *Aselliscus* (Chiroptera, Hipposideridae) from Vietnam // *Acta Chiropterologica*. Vol.17. No.2. P.233–254.
- Vuong Tan Tu, Csorba G., Ruedi M., Furey N.M., Nguyen Truong Son, Vu Dinh Thong, Bonillo C. & Hassanin A. 2017. Comparative phylogeography of bamboo bats of the genus *Tylonycteris* (Chiroptera, Vespertilionidae) in Southeast Asia // *European Journal of Taxonomy*. Vol.274. P.1–38.
- Vuong Tan Tu, Hassanin A., Furey N.M., Nguyen Truong Son & Csorba G. 2018. Four species in one: multigene analyses reveal phylogenetic patterns within Hardwicke's woolly bat *Kerivoula hardwickii*-complex (Chiroptera: Vespertilionidae) in Asia // *Hystrix*. Vol.29. No.1. P.111–121.
- Wilson D.E. & Reeder D.M. (eds.). 2005. *Mammal Species of the World: Taxonomic and Geographic Reference*. Third edition. Vols.1–2. Baltimore: Johns Hopkins University Press. 2142 p.
- Zemlemerova E.D., Bannikova A.A., Lebedev V.S., Rozhnov V.V. & Abramov A.V. 2016. Secrets of the underground Vietnam: an underestimated species diversity of Asian moles (Lipotyphla: Talpidae: *Eurosaptor*) // *Proceeding of the Zoological Institute RAS*. Vol.320. No.2. P.193–220.