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THE CURRENT DISTRIBUTION AND THREATS OF SOME SMALL MAMMALS WITH HIGH CONSERVATION VALUE FROM THE ORDERS Eulipotyphla, Chiroptera AND Rodentia IN VIETNAM

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ABSTRACT

Vietnam is recognized as one of the world's biodiversity hotspots. Recent studies have uncovered numerous new mammal species, highlighting the significant biodiversity of Vietnam not only within the region but globally. However, these new species, along with established ones, are currently affected by climate change and human activities, which have led to the decline of certain populations and placed some species at risk of extinction. Since 2001, our surveys and assessments of the current status and distribution of small mammals from the orders Eulipotyphla, Chiroptera, and Rodentia have identified 48 species that are prioritized for conservation with varying conservation levels based on their actual status, especially those with less individual numbers in population, narrow distribution ranges, and those still affected by human activities. The research has identified 17 priority sites for habitat conservation, including two in the Northeast, three in the Northwest, four in the North Central region, three in the Central Highlands, and five in the Mekong Delta.

Keywords: Distribution status, conservation species, Eulipotyphla, Chiroptera, Rodentia.

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INTRODUCTION

The Check list of Wild mammals' species of Vietnam reported 295 species and subspecies of terrestrial mammals, belonging to 37 families and 13 orders (Dang et al., 2008). This checklist includes 95 species that require conservation attention, as listed in the Vietnam Red Data Book, the IUCN Red List, Government Decree 32/2006/NĐ-CP, and CITES 2006. Within Vietnam's mammal fauna, small mammals account for approximately 68% of the total recorded mammal species, including species from the order Erinaceomorpha (2 species), Soricomorpha (20 species), Chiroptera (110 species), and Rodentia (68 species) (Dang et al., 2008). The small mammal species of these orders are widely distributed across the country in various types of habitats, with some species being characteristic of specific zoogeographical regions or habitat types (Dang et al., 2008). However, the assessment of the conservation attention of the species within these three orders remains limited due to a lack of information on their status and distribution.

Recent studies have confirmed the diversity of small mammal species, revealing many new species and records from Vietnam. Specifically, the order Eulipotyphla now includes 34 species, Chiroptera includes 130 species, and Rodentia includes 71 species, bringing the total number of mammal species in Vietnam to 333—an increase of 36 species since the latest checklist by Dang et al. (2008) (Wilson & Mittermeier, 2016, 2017, 2018, 2019; Bui et al., 2019, 2020, 2022, 2023; Nguyen, 2020; Vu et al., 2021). However, the mammalian fauna including small mammals is facing significant impacts that are leading to population declines. Many species are experiencing shrinking distribution ranges or are no longer recorded after their initial discovery, primarily due to habitat loss caused by climate change and human activities. These populations will continue to decline if sustainable habitat management solutions are not implemented. To establish a basis for assessing the conservation value of small mammals in the orders Eulipotyphla, Chiroptera, and Rodentia, long-term studies have been conducted to update species distribution data and assess their population status. This will inform sustainable management strategies for wildlife resources, aiming to minimize the impact on declining populations, especially those at high risk of extinction.

MATERIALS AND METHODS

Materials and research timeline

The study was conducted through surveys from 2001 to 2024 across 85 locations, including national park (NP), nature reserve (NR), protected area for habitat and species (PA),... in 43 provinces of seven of zoogeographic area (Northeast, Northwest, North Centre Coast, South Centre Coast, Central Highlands, Southeast, and Mekong Dental) and offshore islands (Fig. 1).

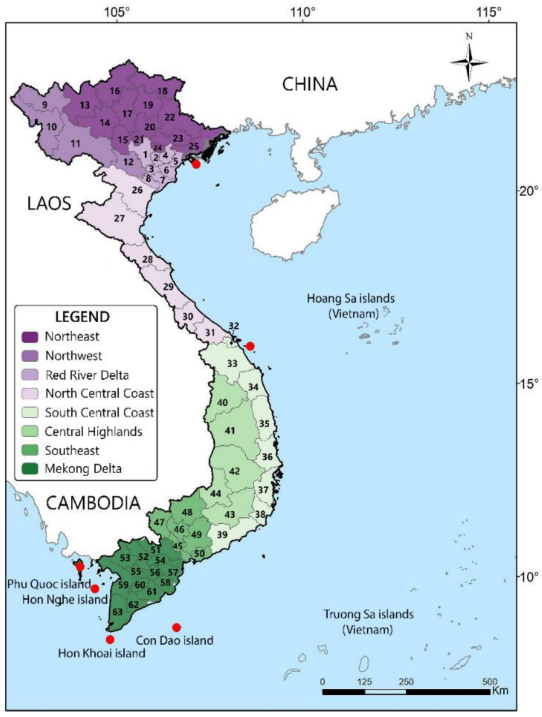
Methods

Besides field surveys, we reviewed published information sources on the distribution and status of species belonging to the orders Eulipotyphla, Chiroptera, and Rodentia at locations within NRs, NPs, PAs for species and habitats, and offshore islands. Mist nets, harp traps, and bat detectors were used to collect the data on bats while Sherman traps, cage traps, pitfalls and tunnel traps were employed to capture rodent and insectivorous species without affecting their survival (Sikes et al., 2016; Bui, 2022). After collecting, morphological measurements were taken from the specimens: for bats, as described in Kruskop (2013) and Francis (2019); and for rodent, shrew and mole species following Corbet & Hill (1992), Francis (2019) and Bui et al. (2019, 2022, 2023). Individuals of bats, rodents, shrews, and moles identified in the field were immediately released back into the wild. Specimens that could not be identified on-site were preserved and prepared as research specimens following standard methods (Nguyen, 2020) and later analyzed in the laboratory for species identification. Transect surveys were also conducted for mammal observations. For squirrels, surveys typically took place from early morning to late afternoon for tree squirrels, and from evening

until early the next morning for flying squirrels (Nguyen, 2020).

The proposals for species to be prioritized for conservation (as high conservation value species) are based on assessments and listings in the Vietnam Red Data Book (VRDB, MoST & VAST, 2007), the IUCN Red List 2024-1 (IUCN, 2024), Decree No. 84/ND-CP/2021 (Decree 84, Vietnamese Government, 2021), and Notification No. 25/TB-CTVN (Notification 25, dated February 17, 2023) from the CITES Vietnam Management Authority. Our assessments partly comply with the IUCN Red List Categories and Criteria Version 3.1 Second edition. Additionally, species with conservation values that are not yet listed in the above documents were also assessed and identified.

The references used for species identification include Corbet & Hill (1992), Dang et al. (2008), Francis (2019), Kruskop (2013), Nguyen (2020), Vu (2021), Wilson & Mittermeier (2016, 2017, 2018, 2019) & Bui (2022). Zoogeographic regions were determined according to Le et al. (2015) & Dang et al. (2008).



Red River Delta
1. Ha Noi
2. Hung Yen
3. Ha Nam
4. Hai Duong
5. Hai Phong
6. Thai Binh
7. Nam Dinh
8. Ninh Binh

Northwest
9. Lai Chau
10. Dien Bien
11. Son La
12. Hoa Binh

Northeast
13. Lao Cai
14. Yen Bai
15. Phu Tho
16. Ha Giang
17.Tuyen Quang
18. Cao Bang
19. Bac Kan
20.Thai Nguyen
21. Vinh Phuc
22. Lang Son
23. Bac Giang
24. Bac Ninh
25. Quang Ninh

North Central Coast
26. Thanh Hoa
27. Nghe An
28. Ha Tinh
29. Quang Binh
30. Quang Tri
31. Thua-Thien Hue

South Central Coast
32. Da Nang 33. Quang Nam
34. Quang Ngai
35. Binh Dinh
36. Phu Yen
37. Khanh Hoa
38. Ninh Thuan
39. Binh Thuan

Central Highlands
40. Kon Tum
41. Gia Lai
42. Dak Lak
43. Lam Dong
44. Dak Nong

Southeast
45. Ho Chi Minh
46. Binh Duong
47. Tay Ninh
48. Binh Phuoc
49. Dong Nai
50. Ba Ria-Vung Tau

Mekong Delta
51. Long An
52. Dong Thap
53. An Giang
54. Tien Giang
55. Can Tho
56. Vinh Long
57. Ben Tre
58. Tra Vinh
59. Kien Giang
60. Hau Giang
61. Soc Trang
62. Bac Lieu
63. Ca Mau

Figure 1. Map showing the provinces of the zoogeographic area and Offshore islands

RESULTS AND DISCUSSION

Recommended species for conservation attention

A total of 23 species of high conservation value have been recorded in the VNRB (11 species), IUCN Red List 2024 (11 species), Decree No. 84 (6 species), and Notification No. 25 (3 species). These species need to continue being prioritized for conservation in Vietnam due to threats such as hunting, trapping, habitat loss, and climate change (Table 1). The species recommended for conservation attention are those with narrow distribution ranges, very low individual numbers in the wild, and are distributed in habitats that are severely impacted and gradually shrinking due to various human activities, such as forest land encroachment, land-use change, habitat loss from abnormal natural events, and hunting. We found a total of 48 small mammal species - accounting for

approximately 20.33% of the small mammal species currently recorded in Vietnam - have been assessed and recommended for conservation priority to be added to the Vietnam Red Book. These include 5 species from 3 families in the order Eulipotyphla, 30 species from 5 families in the order Chiroptera, and 13 species from 4 families in the order Rodentia (Table 2).

Nineteen species with narrow distribution ranges have only been recorded in one zoogeographic area. These include: four species in the Northeast (*Neohylomys hainanensis*, *Blarinella quadraticauda*, *Chodsigoa caovansunga* and *Hipposideros khaokhouayensis*); three species in Northwest (*Uropsilus fansipanensis*, *Barbastella darjelingensis*, *Plecotus homochrous*, *Tokinomys daovantieni*, *Typhlomys taxuensis* and *Typhlomys chapensis*), three species in North Central Coast (*Hipposideros scutinares*, *Laonastes aenigmamus* and *Saxatilomys paulinae*), three species in Central Highlands (*Murina kontumensis*, *Murina harpioloides* and *Murina lorelieae*), and four species in Mekong Delta (*Pteropus hypomelanus*, *Pteropus lylei*, *Pteropus vampyrus* and *Callosciurus honkhoaiensis*). Five species with small population size (based on the frequency of species records during survey periods) and few recorded localities (fewer than five) include: *Neohylomys hainanensis* (recorded at only one locality in the Northeast), *Hipposideros swinhoei* (recorded at three localities across two zoogeographic areas), *Harpiola isodon* (recorded at two localities across two zoogeographic areas), *Murina beelzebub* (recorded at four localities across two zoogeographic areas), and *Thainycteris aureocollaris* (recorded at four localities across four zoogeographic areas) (Table 2). Fifteen species with the typical habitat of the cave and limestone ecosystems (Table 2) include: *Neohylomys vietnamensis*, *Rhinolophus episcopus*, *Rhinolophus marshalli*, *Rhinolophus siamensis*, *Coelops frithii*, *Hipposideros khaokhouayensis*, *Hipposideros alongensis*, *Hipposideros griffini*, *Hipposideros lylei*, *Ia io*, *Harpiocephalus harpia*, *Thainycteris aureocollaris*, *Saxatilomys paulinae*, *Tokinomys daovantieni*, and *Laonastes aenigmamus.* Eight species were characteristic of high mountain ecosystems and evergreen closed forests at elevations above 1,000 m a.s.l. (Table 2) include: *Chodsigoa caovansunga*, *Blarinella quadraticauda*, *Harpiola isodon*, *Murina kontumensis*, *Murina lorelieae*, *Murina harpioloides*, *Barbastella darjelingensis*, and *Plecotus homochrous*. Five species with wide distribution across zoogeographic areas, characteristic of evergreen closed forest ecosystems but with declining populations due to hunting or habitat loss (Table 2), include: *Cynopterus brachyotis*, *Scotomanes ornatus*, *Ratufa bicolor*, *Petaurista elegans*, and *Petaurista philippensis.*

Important locations (by zoogeographic area) identified as conservation priorities, where many species proposed for conservation have been recorded (Table 1 & Fig. 2), include: Northeast: The highest number of species is Cat Ba NP (Hai Phong), with nine bat species (*Rhinolophus marshalli*, *Rhinolophus siamensis*, *Coelops frithii*, *Hipposideros khaokhouayensis*, *Hipposideros alongensis*, *Hipposideros griffini*, *Harpiocephalus harpia*, *Myotis pilosus*, and *Phoniscus jagorii*). Tay Con Linh NR (Ha Giang) recorded 7 species (*Blarinella quadraticauda*, *Chodsigoa caovansunga*, *Rhinolophus rex*, *Ratufa bicolor*, *Belomys pearsonii*, *Petaurista elegans*, and *Petaurista philippensis*). Northwest: Hoang Lien NP (Lao Cai) recorded the highest number of species, with 21 species (*Uropsilus fansipanensis*, *Crocidura sapaensis*, *Episoriculus macrurus*, *Episoriculus umbrinus*, *Micromys erythotis*, *Blarinella quadraticauda*, *Rhinolophus episcopus*, *Rhinolophus siamensis*, *Rhinolophus rex*, *Hipposideros swinhoei*, *Barbastella darjelingensis*, *Ia io*, *Harpiocephalus harpia*, *Harpiola isodon*, *Plecotus homochrous*, *Scotomanes ornatus*, *Ratufa bicolor*, *Belomys pearsonii*, *Petaurista elegans*, *Petaurista philippensis*, and *Typhlomys chapensis*). Xuan Son NP (Phu Tho)

recorded 8 species (*Rhinolophus episcopus*, *Rhinolophus siamensis*, *Rhinolophus rex*, *Ia io*, *Phoniscus jagorii*, *Ratufa bicolor*, *Belomys pearsonii*, and *Petaurista philippensis*). Xuan Nha NR (Son La) recorded 4 species (*Rhinolophus marshalli*, *Ratufa bicolor*, *Petaurista elegans*, and *Petaurista philippensis*). North Central: Phong Nha - Ke Bang NP (Quang Binh) recorded the highest number of species, with 13 species (*Euroscaptor subanura*, *Cynopterus brachyotis*, *Rhinolophus episcopus*, *Rhinolophus siamensis*, *Rhinolophus rex*, *Hipposideros scutinares*, *Ia io*, *Harpiocephalus harpia*, *Myotis pilosus*, *Scotomanes ornatus*, *Ratufa bicolor*, *Petaurista philippensis*, *Saxatilomys paulinae*, and *Laonastes aenigmamus*). Pu Mat NP (Nghe An) recorded 7 species (*Cynopterus brachyotis*, *Rhinolophus marshalli*, *Rhinolophus rex*, *Coelops frithii*, *Myotis pilosus*, *Ratufa bicolor*, and *Petaurista philippensis*). Bac Huong Hoa and Dakrong NR (Quang Tri) recorded 5 species (*Cynopterus brachyotis*, *Rhinolophus siamensis*, *Hipposideros scutinares*, *Ratufa bicolor*, and *Petaurista philippensis*). Central Highlands: Ngoc Linh NR (Kon Tum) recorded the highest number of species, with 12 species (*Crocidura sokolovi*, *Euroscaptor ngoclinhensis*, *Rhinolophus marshalli*, *Harpiocephalus harpia*, *Harpiola isodon*, *Murina beelzebub*, *Murina kontumensis*, *Murina lorelieae*, *Ratufa bicolor*, *Hylopetes alboniger*, and *Petaurista philippensis*). Bidoup-Nui Ba NP (Lam Dong) recorded 11 species (*Rattus osgoodi*, *Leopoldamys milleti*, *Euroscaptor parvidens*, *Crocidura indochinensis*, *Hipposideros swinhoei*, *Harpiocephalus harpia*, *Murina harpioloides*, *Phoniscus jagorii*, *Scotomanes ornatus*, *Ratufa bicolor*, *Hylopetes spadiceus*, and *Petaurista philippensis*). Chu Yang Sin NP (Dak Lak) recorded 3 species (*Euroscaptor parvidens*, *Hylopetes alboniger*, and *Petaurista philippensis*). Mekong Delta: U Minh Thuong NP (Kien Giang) and U Minh Ha NP (Ca Mau) recorded 4 species (*Pteropus vampyrus*, *Pteropus lylei*, *Pteropus hypomelanus*, and *Kerivoula picta*). Islands: Cat Ba Island (Hai Phong) recorded 9 species (*Rhinolophus marshalli*, *Rhinolophus siamensis*, *Coelops frithii*, *Hipposideros khaokhouayensis*, *Hipposideros alongensis*, *Hipposideros griffini*, *Harpiocephalus harpia*, *Myotis pilosus*, and *Phoniscus jagorii*). Phu Quoc Island (Kien Giang) recorded 8 species (*Crocidura phuquocensis*, *Cynopterus brachyotis*, *Pteropus hypomelanus*, *Pteropus lylei*, *Pteropus vampyrus*, *Ratufa bicolor*, *Hylopetes spadiceus*, and *Hylopetes alboniger*). Con Dao Island (Ba Ria-Vung Tau) recorded 5 species (*Pteropus hypomelanus*, *Pteropus lylei*, *Pteropus vampyrus*, *Ratufa bicolor*, and *Hylopetes spadiceus*).

The species recorded in the VRDB, IUCN Red List 2024, Decree 84, and Notification 25, as well as the species recommended for conservation in montane areas (distributed between 200–600 m and 800–1,500 m), highlight mammal diversity hotspots for conservation prioritization. These findings indicate that habitats and caves at these altitudes need to be prioritized for conservation, and efforts should be made to minimize the impacts that alter the current status of these habitats. The most important conservation sites for preserving natural ecosystems and caves inhabited by valuable or endemic species include Hoang Lien NP (16 species, found at 1,200–1,800 m a.s.l.), Phong Nha-Ke Bang NP (14 species, 400–800 m a.s.l.), Ngoc Linh NR (10 species; 900–1,800 m a.s.l.), Cat Ba NP (9 species, 200–400 m a.s.l.), Xuan Son NP (8 species; 1,200–1,800 m a.s.l.), Tay Con Linh NR (7 species; 600–1,200 m and 1,530–2,100 m a.s.l.), Pu Mat NP (7 species; 400–1,000 m a.s.l.), Bidoup-Nui Ba NP (7 species; 400–1,800 m a.s.l.), Bac Huong Hoa and Dakrong Nature Reserves (5 species, 270–600 m a.s.l.), Chu Yang Sin NP (3 species; 400–1,000 m a.s.l.), U Minh Thuong NP and U Minh Ha NP (4 species, found at 100–170 m a.s.l.), Phu Quoc NP (7 species, 200–540 m a.s.l.), Con Dao NP (5 species, found at 200–440 m a.s.l.), and Hon Khoai Island (1 species, found at 50–130 m a.s.l.).

Table 1. List of species with high conservation value recorded in 2024

No.	Common name	Scientific name	VRDB (1)	IUCN (2)	Decree 84 (3)	Noti. 25 (4)
	BAT	CHIROPTERA Blumbach, 1779				
	Pteropodidae	Pteropodidae Gray, 1821				
1	Lesser Dog-faced Fruit Bat	*Cynopterus brachyotis* (Müller, 1838)	VU	-	-	-
2	Island Flying Fox	*Pteropus hypomelanus* Temminck, 1853	-	-	IIB	II
3	Lyle's Flying Fox	*Pteropus lylei* K. Andersen, 1908	-	-	IIB	II
4	Large Flying-Fox	*Pteropus vampyrus* Linnaeus, 1758	-	-	IIB	II
	Horseshoe Bat	Rhinolophidae	-			
5	King Horseshoe Bat	*Rhinolophus rex* G.M. Allen, 1923	VU	EN	-	
	Leaf-nosed bats	Hipposideridae Lydekker, 1891				
6	Tail-less Leaf-nosed Bat	*Coelops frithii* Blyth, 1848	-	NT	-	-
7	Phou Khao Khouay Leaf-nosed Bat	*Hipposideros khaokhouayensis* Guillen-Servent and Francis, 2006	-	VU	-	
8	Ha Long Leaf-nosed Bat	*Hipposideros alongensis* Bourret, 1942	-	EN	-	
9	Griffin's Leaf-nosed Bat	*Hipposideros griffini* Thong et al., 2012	-	EN	-	
10	Shield-nosed Leaf-nosed Bat	*Hipposideros scutinares* Robinson, Jenkins, Francis, Fulford, 2003	-	EN	-	-
	Vespertilionidae	Vespertilionidae Gray, 1821				
11	Great Evening Bat	*Ia io* Thomas, 1902	VU	NT	-	
12	Rickett's Big-footed Myotis	*Myotis pilosus* (Peters, 1869)	DD	-	-	
13	Lesser Hairy-winged Bat	*Harpiocephalus harpia* (Temminck, 1840)	VU	-	-	-
14	Beelzebub Tube-nosed Bat	*Murina beelzebub* Son, Furey, Csorba, 2011	-	DD	-	-
15	Dalat Tube-nosed Bat	*Murina harpioloides* Kruskop, Eger, 2008	-	EN	-	-
16	Lorelie Tube-nosed Bat	*Murina lorelieae* Eger, Lim, 2011	-	DD	-	-
	RODENTS	RODENTIA Bowdich, 1821				

No.	Common name	Scientific name	VRDB (1)	IUCN (2)	Decree 84 (3)	Noti. 25 (4)
	Squirrel	Sciuridae Fischer de Waldheim, 1817				
17	Black Giant Squirrel	*Ratufa bicolor* (Sparrman, 1778)	VU	-	IIB	
18	Hairy-footed Flying Squirrel	*Belomys pearsonii* (Gray, 1842)	CR	-	-	
19	Particolored Flying Squirrel	*Hylopetes alboniger* (Hodgson, 1836)	VU	-	-	
20	Indochinese Flying Squirrel	*Hylopetes phayrei* (Blyth, 1859)	VU	-	-	
21	Spotted Giant Flying Squirrel	*Petaurista elegans* (Müller, 1840)	EN	-	IIB	
22	Indian Giant Flying Squirrel	*Petaurista philippensis (*Elliot, 1839)	VU	-	IIB	
	EULIPOTYPHLANS	EULIPOTYPHLA Waddell et al., 1999				
	Brown-toothed Shrew	Soricidae (G. Fischer, 1814)				
23	Asiatic Short-tailed Shrew	*Blarinella quadraticauda* (Milne-Edwards, 1872)		NT		
	Total		11	11	6	3

Notes: (1) VNRB: CR: Critically Endangered, EN: Endangered; VU: Vulnerable; DD: Data Deficient; (2) IUCN Red List (2024): EN: Endangered, VU: Vulnerable, NT: Near Threatened; (3) Decree 84, Group IIB: Forest wildlife that are not yet endangered but are at risk of becoming threatened if not strictly managed, with restrictions on exploitation and use for commercial purposes; (4) Notification 25.

Table 2. List of species from the orders Eulipotyphla, Chiroptera, and Rodentia proposed for conservation priority

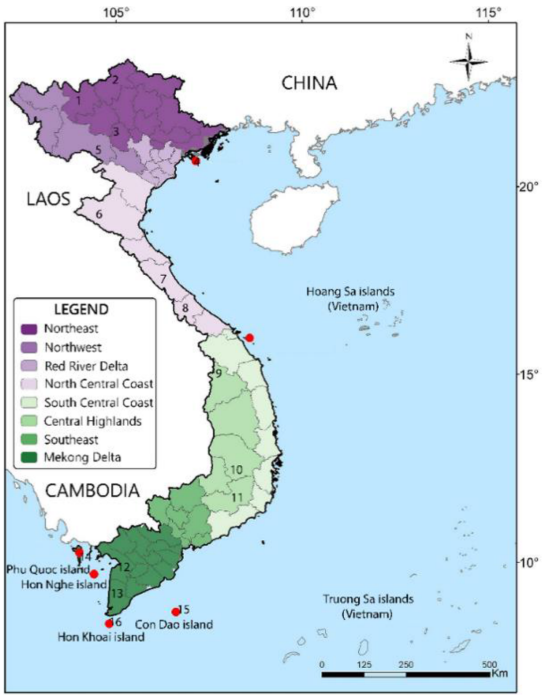
No.	Common name	Scientific name	Total of recorded in locations/provinces	Zoogeographic area	Elevation (m a.s.l.)
	I. EULIPOTYPHLA	EULIPOTYPHLA Waddell et al., 1999			
	1. Erinaceidae	Erinaceidae G. Fischer, 1814			
1	Vietnamese Gymnure	*Neohylomys Neohylomys vietnamensis* Bannikova, Lebedev, Gorchkhanov, Fei, Dinh, Bui, Kruskop, Rozhnov & Abramov, 2024	1/1	NE	300–700
	2. Soricidae	Soricidae G. Fischer, 1814			
2	Asiatic Short-tailed Shrew	*Blarinella quadraticauda* Milne-Edwards, 1872	4/3	NE, NW	700–2,900

No.	Common name	Scientific name	Total of recorded in locations/provinces	Zoogeographic area	Elevation (m a.s.l.)
3	Van Sung's Shrew	*Chodsigoa caovansunga* Lunde, Musser, Nguyen, 2003	2/1	NE	1,300–2,000
	3. Talpidae	Talpidae G. Fischer, 1814			
4	Small-toothed Mole	*Euroscaptor parvidens* (Milner, 1940)	7/5	CH, SCC	378–1,400
5	Vietnamese Mole	*Euroscaptor subanura* Kawada, Dang, Nguyen, 2012	7/7	NE, RRD, NCC	250–570
	II. BAT	CHIROPTERA Blumbach, 1779			
	4. Megabats	Pteropodidae Gray, 1821			
6	Lesser Dog-faced Fruit Bat	*Cynopterus brachyotis* (Müller, 1838)	20/12	NE, NW, RRD, NCC, CH, SCC, SE, MD	300–700
7	Island Flying Fox	*Pteropus hypomelanus* Temminck, 1853	11/5	MD	< 100
8	Lyle's Flying Fox	*Pteropus lylei* K. Andersen, 1908	11/5	MD	< 100
9	Large Flying-Fox	*Pteropus vampyrus* Linnaeus, 1758	11/3	MD	< 100
	5. Horseshoe bat	Rhinolophidae Gray, 1825			
10	Episcopus Horseshoe Bat	*Rhinolophus episcopus* G. M. Allen, 1923	6/6	NE, NW, NCC	400–1,200
11	Marshall's Horseshoe Bat	*Rhinolophus marshalli* Thonglongya, 1973	14/13	NE, NW, NCC, CH	300–1,200
12	Thai Horseshoe Bat	*Rhinolophus siamensis* Gyldenstolpe, 1917	12/11	NE, NW, NCC	250–1,400
13	King Horseshoe Bat	*Rhinolophus rex* G.M. Allen, 1923	15/12	NE, NW, RRD, NCC	300–1,200
	6. Leaf-nosed bats	Hipposideridae Lydekker, 1891			
14	Tail-less Leaf-nosed Bat	*Coelops frithii* Blyth, 1848	7/7	NE, RRD, NCC, CH	300–700
15	Phou Khao Khouay Leaf-nosed Bat	*Hipposidceros khaokhouayensis* Guillen-Servent and Francis, 2006	3/3	NE	50–1,570
16	Ha Long Leaf-nosed Bat	*Hipposideros alongensis* Bourret, 1942	5/5	NE, RRD	300–370
17	Griffin's Leaf-nosed Bat	*Hipposideros griffini* Vu, Puechmaille, Denzingger, Dietz, Csorba, Bates, Teeling, Schnitzler, 2012	4/4	NE, CH	< 500

No.	Common name	Scientific name	Total of recorded in locations/provinces	Zoogeographic area	Elevation (m a.s.l.)
18	Shield-faced Leaf-nosed Bat	*Hipposideros lylei* Thomas, 1913	4/4	NE, RRD	300–600
19	Shield-nosed Leaf-nosed Bat	*Hipposideros scutinares* Robinson, Jenkins, Francis, Fulford, 2003	2/2	NCC	< 400
20	Swinhoe's roundleaf Bat	*Hipposideros swinhoei* (Peters, 1871)	3/3	NW, CH, SE	300–1,200
	7. Vesper Bats	Vespertilionidae Gray, 1821			
21	Eastern Barbastelle	*Barbastella darjelingensis* Hodgson, 1855	1/1	NW	1,000
22	Painted Woolly Bat	*Kerivoula picta* (Pallas, 1767)	6/5	NW, NE, NCC, SCC, MD	< 300
23	Great Evening Bat	*Ia io* Thomas, 1902	10/9	NW, NE, NCC	300–1,200
24	Lesser Hairy-winged Bat	*Harpiocephalus harpia* (Temminck, 1840)	11/11	NW, ĐT, NCC, CH	
25	Golden-tipped Tube-nosed Bat	*Harpiola isodon* Kuo, Fang, Csorba, Lee, 2006	3/2	NW, NE, NCC	1,200–1,600
26	Rickett's Big-footed Myotis	*Myotis pilosus* (Peters, 1869)	6/6	NE, NCC	200–500
27	Beelzebub Tube-nosed Bat	*Murina beelzebub* Nguyen, Furey, Csorba, 2011	4/4	NCR, CH, SCC	400–1,750
28	Dalat Tube-nosed Bat	*Murina harpioloides* Kruskop, Eger, 2008	1/1	CH	1,500–1,700
29	Kon Tum Tube-nosed Bat	*Murina kontumensis* Nguyen, Csorba, Vuong, Motokawa, 2015	1/1	CH	1,750
30	Lorelie Tube-nosed Bat	*Murina lorelieae* Eger, Lim, 2011	1/1	CH	1,500–1,750
31	Peters's Trumpet-eared Bat	*Phoniscus jagorii* (Peters, 1866)	5/5	RRD, NE, CH, SE	200–600
32	Hodgson's Long-eared Bat	*Plecotus homochrous* Hodgson, 1847	1/1	NW	1,950–2,200
33	Harlequin Bat	*Scotomanes ornatus* (Blyth, 1851)	12/12	NW, NE, RRD, NCC, SCC, CH	250–600
34	Collared Sprite	*Thainycteris aureocollaris* Kock and Storch, 1996	4/4	NE, NCC	300–700
	8. Free-tailed bats	Molossidae Gervais in de Castelnau, 1855			
35	Wrinkle-lipped Free-tailed Bat	*Mops plicatus* (Buchannnan, 1800)	7/7	NE, RRD, NCC, SE	200–500
	III. RODENTS	RODENTIA Bowdich, 1821			

No.	Common name	Scientific name	Total of recorded in locations/provinces	Zoogeographic area	Elevation (m a.s.l.)
	9. Squirrel	Sciuridae Fischer de Waldheim, 1817			
36	Black Giant Squirrel	*Ratufa bicolor* (Sparrman, 1778)	59/32	NW, NE, NCR, SCC, CH, SE, MD	250–2,000
37	Hairy-footed Flying Squirrel	*Belomys pearsonii* (Gray, 1842)	16/11	NW, NE, RRD, NCC	400–1,800
38	Particolored Flying Squirrel	*Hylopetes alboniger* (Hodgson, 1836)	13/11	NE, NCC, CH, MD	350–1,700
39	Indochinese Flying Squirrel	*Hylopetes phayrei* (Blyth, 1859)	3/3	NW, CH	500–1,500
40	Red-cheeked Flying Squirrel	*Hylopetes spadiceus* (Blyth, 1847)	8/5	CH, MD	200–1,200
41	Spotted Giant Flying Squirrel	*Petaurista elegans* (Müller, 1840)	10/6	NE, NW	700–1,800
42	Indian Giant Flying Squirrel	*Petaurista philippensis (*Elliot, 1839)	24	NW, NE, NCC, CH, SCC, SE	> 800
43	Hon Khoai squirrel	*Callosciurus honkhoaiensis* Nguyen, Oshida, Dang, Bui and Motokawa, 2018	2/1	MD	< 200
	10. Oriental dormice	Platacanthomyidae Alston, 1876			
44	Sort-furred Tree Mouse	*Typhlomys chapensis* Osgood 1932	1/1	NW	1,400
	11. Murids	Muridae Illiger, 1811			
45	Lesser Marmoset Rat	*Hapalomys delacouri* Thomas, 1927	3/3	NE, NCC, CH	1,200–1,500
46	Paulina's limestone rat	*Saxatilomys paulinae* Musser, Smith, Robinson, Lunde, 2005	1/1	NCC	400–600
47	Daovantien's limestone rat	*Tokinomys daovantieni* Musser, Lunde, Son, 2006	4/3	NE	370–700
	12. Diatomyidae	Diatomyidae Mein & Ginsburg, 1997			
48	Laotian rock rat	*Laonastes aenigmamus* Jenkins, Kilpatrick, Robinson and Timmins, 2005	1/1	NCC	300–500

Notes: (NE) - Northeast; (NW) - Northwest; (RRD) - Red River Delta; (NCC) - North Central Coast; (CH) - Central Highlands; (SCC) - South Central Coast; (SE) - Southeast; (MD) - Mekong Delta.



Note:
1. Hoang Lien NP (Lao Cai)
2. Tay Con Linh NR (Ha Giang)
3. Xuan Son NP (Phu Tho)
4. Cat Ba NP (Hai Phong)
5. Xuan Nha NR (Son La)
6. Pu Mat NP (Nghe An)
7. Phong Nha-Ke Bang NP (Quang Binh)
8. Bac Huong Hoa and Dakrong NRs (Quang Tri)
9. Ngoc Linh NR (Kon Tum)
10. Chu Yang Sin NP (Dak Lak)
11. Bidoup-Nui Ba NP (Lam Dong)
12. U Minh Thuong NP (Kien Giang)
13. U Minh Ha NP (Ca Mau)
14. Phu Quoc NP (Kien Giang)
15. Con Dao NP (Ba Ria-Vung Tau)
16. Hon Khoai Island (Ca Mau)

Figure 2. Priority Conservation Localities (NP: National Park, NR: Nature Reserve)

Detailed information on the current distribution status of species from the orders Eulipotyphla, Chiroptera, and Rodentia proposed for conservation priority of species

EULIPOTYPHLA

Vietnamese Gymnure *Neohylomys vietnamensis* (Fig. 3a): Abramov et al. (2018a) discovered a population in Phia Oac - Phia Den NP (Cao Bang Province) and identified it as the Hainan gymnure (*N. hainanensis*). However, Bannikova et al. (2024), based on these specimens and others from Na Hang NR (Tuyen Quang province) and Ba Be NP (Bac Kan province), revised the classification and described *N. vietnamensis* as a species endemic to Vietnam. The species has been recorded in evergreen mixed forests at elevations between 300 and 700 m a.s.l., occurring in forest habitats on limestone and mountainous areas in the Northeast region. Its habitat is currently being reduced, fragmented, and degraded due to encroachment on natural forest land. Additionally, the species is caught in traps set for rodents by local people.

Asiatic Short-tailed Shrew *Blarinella quadraticauda* (Fig. 3b): This study and Bui (2022) recorded this species in Lao Cai (Hoang Lien NP, Van Ban), Son La (Ngoc Chien), and Ha Giang (Tay Con Linh NR) provinces at altitudes of 700–2900 m a.s.l. It is also believed to occur in the Vietnam-China border area (Wilson and Mittermeier, eds., 2018). Agricultural activities and tourism development have fragmented and reduced the species' habitat, leading to degradation. Van Sung's Shrew *Chodsigoa caovansunga*: Only recorded in Ha Giang (Tay Con Linh NR, Khau Ca PA) at the elevation from 1,300–2,000 m a.s.l. (Lunde et al., 2003; Abramov et al., 2013; Bui et al., 2019; Bui, 2022), the species has been observed in high mountainous areas (usually above 1,500 m a.s.l). It nests in rock crevices and tree hollows under thick leaf litter, in soft, moist soil with abundant insects (Bui, 2022). The species is facing habitat loss due to the impacts of understory agriculture, agroforestry and hiking.

Small-toothed Mole *Euroscaptor parvidens* (Fig. 3c): This fossorial species is

scatteredly distributed in the southern part of the Truong Son range (on the plateaus of Dak Lak, Mo Nong, Lam Vien, and Di Linh), extending to near the sea at Hon Ba, at the elevation from 378–1400 m a.s.l. The species is experiencing a significant population declining due to habitat loss caused by human encroachment activities.

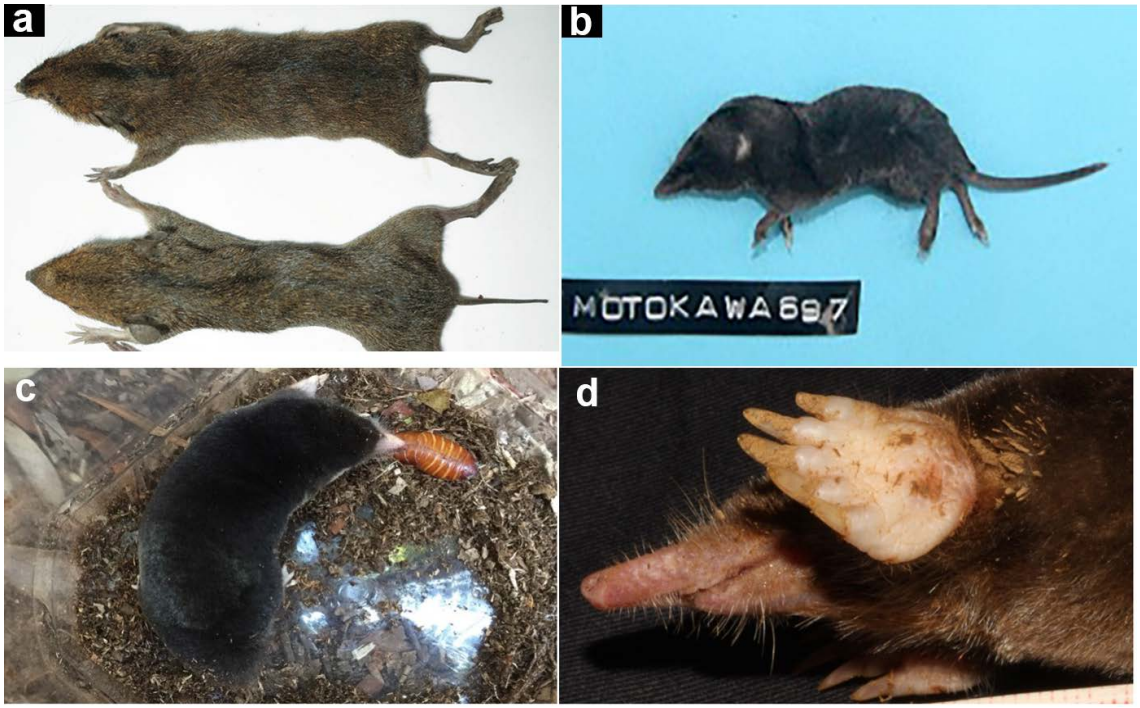


Figure 3. Photo of certain species of the Order Eulipotyphla. a. Vietnameses Gymnure *Neohylomys vietnamensis* (AA); b. Asiatic Short-tailed Shrew *Blarinella quadraticauda* (BTH); c. Small-toothed Mole *Euroscaptor parvidens* (NTS); d. Vietnamese Mole *Euroscaptor subanura* (NTS) [*Photographed by* Alexei Abramov: AA; Bui Tuan Hai: BTH; Nguyen Truong Son: NTS]

Vietnamese Mole *Euroscaptor subanura* (Fig. 3): Recorded in Tuyen Quang (Na Hang NR), Vinh Phuc (Tam Dao NP), Hanoi (Ba Vi NP), Phu Tho (Xuan Son NP), Ninh Binh (Cuc Phuong NP), Nghe An (Pu Huong NP), Quang Binh (Phong Nha-Ke Bang NP) and Son La (Xuan Nha NR) with the elevation from 250–570 m a.s.l. (Kawada et al., 2012; Bui et al., 2020; Bui, 2022; Abramov et al., 2024). The species is distributed at low altitudes, and human activities such as cultivation, mining and construction are causing its habitat to shrink.

CHIROPTERA

Lesser Dog-faced Fruit Bat *Cynopterus brachyotis* (Fig. 4): Recorded across a wide range from North to South in various habitat types, including areas at the border between primary forests, secondary forests, and orchards (Dang et al., 2008; Kruskop, 2013; Nguyen et al., 2022; Vu, 2021), at the elevations from 300–700 m a.s.l., this species, along with other bat species, it is being hunted for food in certain localities. Additionally, the use of nets to protect crops in orchards has significantly reduced its population.

Island Flying Fox *Pteropus hypomelanus*, Lyle's Flying Fox *Pteropus lylei* and Large Flying-Fox *Pteropus vampyrus* (Fig. 4): These three species share a common distribution range, often being found together in the same locations. They have been documented in mangrove forests, coastal shrub forests, and melaleuca forests in southern Vietnam,

including: Ho Chi Minh City (Can Gio), Soc Trang (Long Phu, Cu Lao Dung, Soc Trang Town), Ba Ria-Vung Tau (Con Dao NP), Kien Giang (U Minh Thuong NP and Phu Quoc Island), and Ca Mau (Hon Khoai Island, Cha La, U Minh Ha NP, Ngoc Hien) (Dang et al., 2008; Nguyen et al., 2009; Kruskop, 2013; Abramov et al., 2018b; Vu, 2021; Nguyen et al., 2022; Nguyen, 2024). Currently, all three species are still being illegally hunted for food and sold in many localities within their distribution range. It is very difficult to control the exploitation activities of local people, as all three species often inhabit fruit-growing areas, where locals typically set up mist nets to catch bats to protect their crops. Some of the captured bats are eaten, while others are sold to restaurants that serve wildlife meat. Additionally, the species' habitat is being lost due to the conversion of natural forest areas for agricultural, forestry, and fisheries purposes.

Allen's Horseshoe Bat *Rhinolophus episcopus* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Phu Tho (Xuan Son NP), Cao Bang (Phia Oac-Phia Den NP), Tuyen Quang (Na Hang NR), Thanh Hoa (Xuan Lien NR), Quang Binh (Phong Nha-Ke Bang NP) (Vuong et al., 2017; Nguyen et al., 2010; Vu, 2021; Vu et al., 2021). They are recorded at elevations ranging from 300 to 1,200 m a.s.l. The population numbers at these locations have not been determined because encounters with the species in the wild are very infrequent. This species is usually recorded individually or in small groups in caves in the mountainous regions of northern and central Vietnam, at elevations between 300 and 1200 meters. It is often hunted alongside other cave-dwelling bats for food by local people. Its habitat is shrinking and degrading due to quarrying activities, guano collection, tourism development, and the reduction of natural forest areas due to local encroachment.

Marshall's Horseshoe Bat *Rhinolophus marshalli* (Fig. 4): Recorded in Bac Kan (Ba Be NP), Lang Son (Huu Lien NR, Mau Son Mountain), Son La (Xuan Nha NR), Yen Bai (Luc Yen), Bac Giang (Tay Yen Tu NR), Ha Nam (Thuong Ninh), Hai Phong (Cat Ba NP), Ninh Binh (Cuc Phuong NP), Quang Ninh (Bai Tu Long NP, Dong Son-Ky Thuong NR), Thanh Hoa (Xuan Lien NR), Nghe An (Pu Mat NP, Pu Huong NR) (Dang et al., 2008; Kruskop, 2013; Nguyen et al., 2010; Nguyen et al., 2022; Nguyen et al., 2010; Vu, 2021; Vu et al., 2021), Kon Tum (Ngoc Linh NR) and Lam Dong (Bidoup-Nui Ba NP) (Nguyen et al., 2021). They are distributed from 300–1,200 m a.s.l. This species roosts in caves, especially in limestone mountain areas, and forages along trails beneath natural forest canopies, planted forests, and orchards (Wilson & Mittermeier, 2019). This bat is often hunted along with other bats in caves and its habitat is gradually shrinking due to human activities fluctuating the environment.

Thai Horseshoe Bat *Rhinolophus siamensis* (Fig. 4) **:** Recorded in Lao Cai (Hoang Lien NP), Phu Tho (Xuan Son NP), Ha Giang (Khau Ca PA), Cao Bang (Phia Oac-Phia Den NP), Tuyen Quang (Na Hang NR), Bac Kan (Ba Be NP), Hai Phong (Cat Ba NP), Ninh Binh (Cuc Phuong NP), Thanh Hoa (Xuan Lien NR), Quang Binh (Phong Nha-Ke Bang NP), Quang Tri (Bac Huong Hoa and Dakrong NRs) with distributed from 300–1200 m a.s.l. (Kruskop, 2013; Nguyen et al., 2022, Nguyen et al., 2010; Vu, 2021; Vuong et al., 2017). The species roosts individually or in small groups with other bats in caves in mountainous regions of northern and central Vietnam, and is favoured to hunting for food. Its habitat is increasingly fragmented and degraded.

King Horseshoe Bat *Rhinolophus rex* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Ha Giang (Khau Ca PA), Tuyen Quang (Cham Chu NR, Na Hang NR), Bac Kan (Kim Hy NR), Lang Son (Huu Lien NR, Mau Son), Phu Tho (Xuan Son NP), Thai Nguyen (Than Sa-Phuong Hoang NR), Ninh Binh (Cuc Phuong NP), Nghe An (Pu Mat NP, Pu Huong NR), Ha Tinh (Vu Quang NP), Quang Binh (Phong Nha-Ke Bang NP), Thua Thien-Hue (Bach Ma NP) with distributed from 3001200 m a.s.l. (Dang et al., 2008; Kruskop, 2013; Nguyen, 2020; , Nguyen et al., 2010; Vu,

2021). The species roots in caves in forested areas on karst and non-karst mountains, along with other species of *Hipposideros* (Leaf-nosed Bat), *Rhinolophus* (Horseshoe Bat), and Vespertilionidae (Vesper bats). It tends to live solitary in niches or rock crevices within caves. Its habitat is increasingly fragmented, degraded, and affected by tourism activities at its recorded distribution sites. This species, along with other bats in caves, is being hunted for food.

Tail-less Leaf-nosed Bat *Coelops frithii* (Fig. 4)**:** Recorded in Tuyen Quang (Na Hang NR), Lang Son (Huu Lien NR), Hai Phong (Cat Ba NP), Ninh Binh (Cuc Phuong NP), Nghe An (Pu Mat NP), Da Nang (Son Tra), Kon Tum (Chu Mom Ray NR) with distributed from 300–700 m a.s.l. (Kruskop, 2013; Nguyen & Vu, 2011; Nguyen et al., 2022; Nguyen et al., 2010; Vu, 2021). The species roosts solitarily in small crevices within large caves, cliffs, or under tree canopies in limestone and karst mountain areas at low elevations below 1,000 m a.s.l. Its living and foraging habitats are shrinking and degrading due to tourism development and infrastructure construction, as well as forest encroachment activities.

Phou Khao Khouay Leaf-nosed Bat *Hipposideros khaokhouayensis* (Fig. 4): Recorded in Ha Giang (Tay Con Linh NR), Hai Phong (Cat Ba NP), and Hai Duong (Nham Duong area), this species is distributed at elevations ranging from 300 to 700 m a.s.l. (Kruskop, 2013; Nguyen et al., 2022; Vu, 2021). The species is found in caves or rock crevices in limestone mountains and often congregates in small groups of about 5 to 10 individuals. It usually forages under the canopies of natural and plantation forests (Wilson & Mittermeier, 2019). At Cat Ba NP (Hai Phong), groups of a few individuals have been recorded living in limestone caves, which are increasingly affected by tourism activities.

Ha Long Leaf-nosed Bat *Hipposideros alongensis* (Fig. 4): Recorded in Tuyen Quang (Na Hang NR), Bac Kan (Ba Be NP), Quang Ninh (Bai Tu Long NP), Hai Phong (Cat Ba NP), Ninh Binh (Cuc Phuong NP) with distributed around 300–370 m a.s.l. (Vu, 2021; Nguyen et al., 2022). The species housings in small groups of 5–10 individuals, with larger groups of up to 20 individuals observed in caves within limestone mountain forests. It forages far from its roosting area, with feeding grounds recorded under natural forest canopies in limestone and karst mountains, plantation forests, orchards, and mangrove forests.

Griffin's Leaf-nosed Bat *Hipposideros griffini* (Fig. 4): Recorded in Hai Phong (Cat Ba NP), Kon Tum (Chu Mom Ray NP), Dong Nai (Cat Tien NP), Dak Nong (Krong No) (Vu, 2021; Vu et al., 2021). They distributed around 300–500 m a.s.l. The species roosts in caves, rock crevices, and large tree hollows in limestone and karst mountains, foraging under natural forest canopies (Wilson & Mittermeier, 2019). Its habitat is currently threatened by cave exploitation for tourism development and changes in natural forest landscapes.

Shield-faced Leaf-nosed Bat *Hipposideros lylei* (Fig. 4): Recorded in Tuyen Quang (Na Hang NR), Bac Kan (Ba Be NP), Lang Son (Huu Lien NR), and Ninh Binh (Cuc Phuong NP) distributed around 300–600 m a.s.l. (Kruskop, 2013; Nguyen et al., 2010; Vu, 2021). This species roosts in small groups of males and females in caves located in limestone forest areas. They are often found in the same caves with other bat species, including Leaf-nosed bats and Mosquito bats, in the limestone regions of Northern Vietnam. Due to their large size and distribution in regions inhabited by ethnic minorities with traditions of hunting bats for meat, populations of this species have dramatically declined in recorded locations. Additionally, habitat loss from guano extraction, timber harvesting, tourism development, and land conversion further threatens the species.

Shield-nosed Leaf-nosed Bat *Hipposideros scutinares* (Fig. 4)**:** This species has only been recorded in Quang Binh (Phong Nha-Ke Bang NP) and Quang Tri (Dakrong NR) (Kruskop, 2013; Nguyen et al., 2010; Vu, 2021). The species roosts in caves within its distribution area below 400 m a.s.l. Currently, its habitat is threatened by cave tourism activities, which

disturb its roosting behavior, as well as by habitat degradation due to tourism development and land-use changes.

Swinhoe's roundleaf bat *Hipposideros swinhoei* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Lam Dong (Bidoup-Nui Ba NP), and Dong Nai (Cat Tien NP) with distributed around 300–1,200 m a.s.l. (Kruskop, 2013; Kruskop & Vasenkov, 2016; Nguyen et al., 2021; Vu, 2021). This species lives in caves and forages beneath natural forest canopies (Wilson & Mittermeier, 2019). Many of the caves and foraging habitats are threatened by tourism and human activities.

Eastern Barbastelle *Barbastella darjelingensis* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP) with very few individuals observed distributed around 1000 m a.s.l. (Kruskop & Shchinov, 2010; Kruskop, 2013; Vu, 2021). Echolocation calls have also been recorded in the northeastern provinces of Lang Son and Quang Ninh (Vu, 2021). Recently, the species has been recorded in natural mountain forests in northwestern Vietnam (Kruskop & Shchinov, 2010; Wilson & Mittermeier, 2019). However, its habitat is shrinking due to infrastructure development for tourism.

Painted Woolly Bat *Kerivoula picta* (Fig. 4): Recorded in Thanh Hoa (Thuong Xuan), Ho Chi Minh City (Cu Chi), Kien Giang (U Minh Thuong NP) (Dang et al., 2008, Kruskop, 2013), Ninh Thuan (Loi Hai), and Binh Thuan (Phu Lac, Tuy Phong). The species is found in broad-leaved forests, mangrove forests, and agricultural ecosystems at low altitudes, below 300 m a.s.l. However, these ecosystems are deteriorating due to human activities, forest and agricultural land conversion purposes. The species is often trapped for commercial purposes due to its striking and aesthetically pleasing colouration to be used as display specimens and animal trading.

Great Evening Bat *Ia io* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Tuyen Quang (Na Hang NR), Bac Kan (Ba Be NP, Kim Hy NR), Lang Son (Huu Lien NR), Son La (Copia NR), Phu Tho (Xuan Son NP), Ninh Binh (Cuc Phuong NP), Quang Binh (Phong Nha-Ke Bang NP), and Thua Thien-Hue (Bach Ma NP) (Dang et al., 2008; Kruskop, 2013; Vu, 2021; Vu et al., 2021) with direct captures by the authors at the reported locations. The species roosts in caves and forages beneath primary and secondary forest canopies in limestone regions and adjacent areas distributed from 300–1,200 m a.s.l. Its habitat is increasingly fragmented, reduced, and degraded due to forest land conversion and tourism development in limestone caves. The species often roosts individually or in large groups with other bats, as a reason, local people often hunt it for food.

Rickett's Big-footed Myotis *Myotis pilosus* (Fig. 4): Recorded in Lang Son (Huu Lien NR), Hai Duong (Chi Linh District), Bac Kan (Ba Be NP), Hai Phong (Cat Ba NP), Nghe An (Pu Mat NP), and Quang Binh (Phong Nha-Ke Bang NP) (Kruskop, 2013; Wilson & Mittermeier, 2019; Vu, 2021), with direct captures by the authors at some of these locations. The species forages around water bodies (lakes, reservoirs, small streams, and large rivers) under secondary forest canopies, in limestone forests, and in open habitats at various elevations in Northern and Central Vietnam from 200–500 m a.s.l. During winter, it roosts or hibernates in caves near agricultural fields or beneath forest canopies near large lakes (Wilson & Mittermeier, 2019).

Lesser Hairy-winged Bat *Harpiocephalus harpia*(Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Cao Bang (Pia Oac-Phia Den NR), Bac Kan (Ba Be NP), Tuyen Quang (Na Hang NR), Lang Son (Huu Lien NR), Hai Phong (Cat Ba NP), Nghe An (Pu Huong NR), Quang Binh (Phong Nha-Ke Bang NP), Quang Tri (Lao Bao), Kon Tum (Ngoc Linh NR), and Lam Dong (Bidoup-Nui Ba NP) (Dang et al., 2008, Nguyen et al., 2015). The species lives in crevices and forages beneath limestone or mountain forest canopies with 300–1,000 m a.s.l. Currently, its habitat continues to be fragmented, reduced and degraded due to forest land conversion for tourism development and illegal land encroachment.

Figure 4. Photo of certain species of the order Chiroptera. a. Lesser Dog-faced Fruit Bat *Cynopterus brachyotis* (NTS); b. Island Flying Fox *Pteropus hypomelanus* (NTS); c. Large Flying-Fox *Pteropus vampyrus* (NTS); d. Lyle's Flying Fox *Pteropus lylei* (NTS); e. Allen's Horseshoe Bat *Rhinolophus episcopus* (NTS); f. Marshall's Horseshoe Bat *Rhinolophus marshalli* (NTS); g. Thai Horseshoe Bat *Rhinolophus siamensis* (NTS); h. King Horseshoe Bat *Rhinolophus rex* (NTS); i. Tail-less Leaf-nosed Bat *Coelops frithii* (NTS); j. Phou Khao Khouay Leaf-nosed Bat *Hipposideros khaokhouayensis* (NTS); k. Ha Long Leaf-nosed Bat *Hipposideros alongensis* (NTS); l. Griffin's Leaf-nosed Bat *Hipposideros griffini* (VDT); m. Shield-faced Leaf-nosed Bat *Hipposideros lylei* (NTS); n. Shield-nosed Leaf-nosed Bat *Hipposideros scutinares* (NTS); o. Swinhoe's roundleaf Bat *Hipposideros swinhoei* (NTS); p. Painted Woolly Bat *Kerivoula picta* (NTS); q. Eastern Barbastelle *Barbastella darjelingensis* (SK); r. Great Evening Bat *Ia io* (NTS); s. Rickett's Big-footed Myotis *Myotis pilosus* (NTS); t. Lesser Hairy-winged Bat *Harpiocephalus harpia* (NTS); u. Golden-tipped Tube-nosed Bat *Harpiola isodon* (NTS); v. Beelzebub Tube-nosed Bat *Murina beelzebub* (NTS); w. Dalat Tube-nosed Bat *Murina harpioloides* (NTS); x. Kon Tum Tube-nosed Bat *Murina kontumensis* (NTS); y. Lorelie Tube-nosed Bat *Murina lorelieae* (NTS); z. Peters's Trumpet-eared Bat *Phoniscus jagorii* (NTS); aa. Hodgson's Long-eared Bat *Plecotus homochrous* (NTS); ab. Harlequin Bat *Scotomanes ornatus* (NTS); [*Photographed by* Nguyen Truong Son: NTS; Vu Dinh Thong: VDT; Sergei Kruskop: SK]

Golden-tipped Tube-nosed Bat *Harpiola isodon* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Ha Giang (Tay Con Linh NR), and Kon Tum (Ngoc Linh NR) (Kruskop, 2013; Kruskop et al., 2006; Kruskop & Shchinov, 2010; Nguyen et al., 2015). The species lives and forages along streams in evergreen forests at elevations from 1,950–2,400 m a.s.l in the Northwest and Central Highlands regions. Its habitat is fragmented, reduced, and degraded due to agricultural activities and tourism development.

Beelzebub Tube-nosed Bat *Murina beelzebub* (Fig. 4): Recorded in Quang Tri (Bac Huong Hoa NR), Kon Tum (Ngoc Linh NR), Gia Lai (Kon Ka Kinh NP), and Quang Ngai (Ba To District) (Csorba et al., 2011; Nguyen et al., 2016, Nguyen et al., 2015, Wilson & Mittermeier, 2019) (Fig. 3). This species inhabits relatively undisturbed primary or secondary forests on limestone or mountain terrain in Central and Southern Vietnam around 400–1,750 m. Its habitat is shrinking, fragmented, and degraded due to forest land encroachment for agriculture and forest products gathering.

Dalat Tube-nosed Bat *Murina harpioloides* (Fig. 4): Only recorded in Lam Dong (Bidoup-Nui Ba NP) and considered endemic (Nguyen et al., 2015; Nguyen et al., 2021; Wilson & Mittermeier, 2019). The species lives in evergreen forests on the Central Highlands around 1,500–1,700 m a.s.l. However, its habitat is shrinking, fragmented, and degraded due to forest products gathering and infrastructure development for tourism.

Kon Tum Tube-nosed Bat *Murina kontumensis* (Fig. 4): First recorded and described based on specimens collected in Kon Tum (Ngoc Linh) (Nguyen et al., 2015; Wilson & Mittermeier, 2019) (Fig. 3). It lives in relatively undisturbed mixed evergreen forests at 1,750 m a.s.l. Its habitat is shrinking and degraded due to illegal forest products gathering.

Lorelie Tube-nosed Bat *Murina lorelieae* **(**Fig. 4): Recorded in Kon Tum (Ngoc Linh) (Vuong et al., 2014; Nguyen et al., 2015; Wilson & Mittermeier, 2019). The species lives in undisturbed evergreen forests in the Central Highlands from 1,500–1,750 m a.s.l. However, its habitat is shrinking and degraded due to forest products gathering activities.

Peters's Trumpet-eared Bat *Phoniscus jagorii* (Fig. 4): Recorded in Phu Tho (Xuan Son NP), Hai Phong (Cat Ba NP), Quang Ninh (Bai Tu Long NP), Lam Dong (Bidoup-Nui Ba NP), and Dong Nai (Dong Nai Culture and NR) (Kruskop, 2013; Nguyen et al., 2021; Nguyen et al., 2016; Vu, 2021; Vu et al., 2021). The species roosts in limestone caves or beneath forest canopies in the Northeast, Central Highlands, and Southeast regions at low altitudes, around 200–600 m a.s.l. It forages along trails. Currently, its habitat is shrinking due to agriculture, tourism development, and forest products gathering.

Hodgson's Long-eared Bat *Plecotus homochrous* (Fig. 4): First recorded in Vietnam in evergreen mountain forests in Hoang Lien NP (Lao Cai) (Fukui et al., 2020). This is the first record of the species in Southeast Asia (Fukui et al., 2020). The species lives in evergreen forests at elevations from 1,950 to 2,200 m a.s.l. in the Northwest.

Harlequin Bat *Scotomanes ornatus* (Fig. 4): Recorded in Lao Cai (Hoang Lien NP), Tuyen Quang (Na Hang NR), Bac Kan (Ba Be NP), Lang Sơn (Huu Liên NR), Vinh Phuc (Tam Dao NP), Ninh Binh (Cuc Phương NP), Ha Tinh (Vu Quang NP), Quang Binh (Phong Nha-Ke Bang NP), Thua Thien Hue (Bach Ma NP), Binh Dinh, Gia Lai (Kon Ka Kinh NP, Kon Chu Rang NR), Lam Dong (Bidoup-Nui Ba NP) (Dang et al., 2008; Kruskop, 2013; Nguyen et al., 2021; Nguyen et al., 2016; Vu, 2021). The species inhabits diverse habitats in both limestone and non-limestone mountainous areas, around 250–600 m. However, its habitat is being reduced and degraded due to agricultural activities encroaching on forest land, exploitation of forest products, infrastructure development, and expansion of roads and tourism activities.

Collared Sprite *Thainycteris aureocollaris*: Recorded in Tuyen Quang (Na Hang NR), Vinh Phuc (Tam Dao NP), Ha Tinh (Vu Quang NP), Thua Thien Hue (Bach Ma NP) (Dang et al., 2008, Kruskop, 2013). This species lives in evergreen forests in hilly or mountainous regions, often near water bodies with altitudes around 300–700 m a.s.l. Activities encroaching on forest land are leading to habitat loss and continue to cause a decline in the species' population.

Wrinkle-lipped Free-tailed Bat *Mops plicatus*: Recorded in Bac Kan (Ba Be NP), Phu Tho (Xuan Son NP), Vinh Phuc (Tam Dao NP), Lang Son, Ha Tinh (Huong Son), Quang Tri (Khe Sanh), Dong Nai (Dinh Hoa) (Dang et al., 2008; Kruskop, 2013; Vu, 2021). Caves and forest habitats within limestone and non-limestone mountain ecosystems have been acknowledged as shelter for this species with low elevation, around 200–500 m a.s.l. Forest land encroachment continues to reduce its habitat, leading to population declines.

RODENTIA

Black Giant Squirrel *Ratufa bicolor* (Fig. 5): Recorded in Ha Giang (Bac Quang, Tay Con Linh NR, Khau Ca PA), Cao Bang (Bao Lac, Tra Linh, Trung Khanh, Phia Den-Pia Oac NP), Lai Chau (Tuan Giao), Lao Cai (Hoang Lien NP, Van Ban), Tuyen Quang (Na Hang NR), Bac Kan (Cho Don, Ba Be NP), Lang Son (Binh Gia, Chi Lang, Huu Lien NR), Yen Bai (Phu Yen), Son La (Quynh Nhai, Copia NR, Xuan Nha NR, Ta Xua NR), Phu Tho (Xuan Son NP), Thai Nguyen (Than Sa-Phuong Hoang NR), Vinh Phuc (Tam Dao NP), Quang Ninh (Dong Sơn-Ky Thuong NR, Bai Tu Long NP), Hai Phong (Cat Ba NP), Thanh Hoa (Lang Chanh, Xuan Lien NR, Ben En NP), Nghe An (Pu Mat NP, Pu Huong NR), Ha Tinh (Huong Son, Ke Go), Quang Binh (Phong Nha-Ke Bang NP), Quang Tri (Bac Huong Hoa NR, Dakrong NR), Thua Thien Hue (Phong Dien NR, Bach Ma NP, Sao La Hue NR), Quang Nam (Ngọc Linh NR, Sao La Quang Nam NR), Kon Tum (Ngoc Linh NR), Gia Lai (Krong Pa, Kon Chu Rung, Kon Ka Kinh NP, Chu Prong, A Yun Pa), Dak Lak (Chu Yang Sin NP), Dak Nong (Ta Dung NR, Nam Nung), Lam Dong (Bidoup-Nui Ba NP, Di Linh), Binh Thuan (Nui Ong NR), Dong Nai (Cat Tien NP), Tay Ninh (Lo Go-Xa Mat NP), Kien Giang (Phu Quoc NP), Ba Ria-Vung Tau (Con Dao NP) (Abramov & Shchinov, 2018b; VRDB, 2007; Dang et al., 2008; Nguyen et al., 2022; Nguyen, 2024). The species is common in evergreen and semi-evergreen broadleaf forests, dry deciduous forests in tropical and subtropical mountains, moving in trees, high tree forests on lowland mountains with many fruit trees, limestone mountains, old forests, secondary forests, bamboo forests, or along riverbanks and streams from 250–2,000 m a.s.l. The species is currently hunted for food and trade, and young individuals are captured and sold as pets.

Hairy-footed Flying Squirrel *Belomys pearsonii* (Fig. cover)**:** Recorded in Lai Chau (Muong Muon), Lao Cai (Hoang Lien NP), Ha Giang (Tay Con Linh NR, Quan Ba, Bac Me NR), Tuyen Quang (Na Hang NR, Cham Chu NR), Bac Kan (Ba Be NP), Lang Son (Huu Lien NR), Son La (Quynh Nhai, Copia NR, Xuan Nha NR), Phu Tho (Xuan Son NP), Thai Nguyen (Than Sa-Phuong Hoang NR), Vinh Phuc (Tam Dao NP), Hoa Binh (Cho Bo), Thanh Hoa (Xuan Lien-Ba Thuoc NR) (Dang et al., 2008; Dang et al., 2008; Nguyen, 2020). The species is recorded in primary forests on high mountains at elevations ranging from 660–800 m a.s.l. However, the habitat at these recorded locations is currently being reduced and degraded due to logging and deforestation. Additionally, the species is hunted for food and trade in areas where it is found.

Particolored Flying Squirrel *Hylopetes alboniger* (Fig. 5): Recorded in Tuyen Quang (Na Hang NR), Lang Son (Huu Lien NR), Quang Ninh (Tay Yen Tu NR, Dong Son-Ky Thuong NR), Thua Thien Hue (Bach Ma NP, Sao La Hue NR), Quang Nam (Sao La Quang Nam NR, Song Thanh NP), Binh Dinh, Kon Tum (Chư Mom Ray NP, Ngoc Linh NR), Dak Lak (Chu Yang Sin NP), Tay Ninh (Lo Go-Xa Mat NP), Kien Giang (Phu Quoc NP) (Dang et al., 2008; Dang et al., 2008; Ly et al., 2019; Nguyen et al., 2022; Nguyen, 2024). The species is recorded in primary forests on high

mountains at elevations ranging from 350–1,700 m a.s.l This species is hunted for food and medicinal purposes. Its habitat is shrinking, fragmented, and degraded.

Indochinese Flying Squirrel *Hylopetes phayrei:* Recorded in Yen Bai (Nghia Lo), Son La (Bac Yen), Quang Nam (Ngoc Linh NR) (Dang et al., 2008 and this research). Information regarding the altitude distribution of the species is limited. However, based on the recorded distribution in the Northwest and Central Highlands regions, it appears that the species is found at altitudes ranging from 500 to under 1,500 m a.s.l. The species' habitat is shrinking and degrading due to logging and deforestation, and it is also hunted and traded for food and as pets.

Red-cheeked Flying Squirrel *Hylopetes spadiceus* (Fig. 5c): Recorded in Kon Tum (Ngoc Linh NR, Chu Mom Ray NP), Dak Lak (Yok Don NP), Lam Dong (Bidoup-Nui Ba NP), Ba Ria-Vung Tau (Con Dao NP), Kien Giang (Phu Quoc NP, U Minh Thuong NP, Kien Luong) at evergreen forest, secondary forest around 200–1,200 m A.S.L (Dang et al., 2008; Nguyen et al., 2022; Nguyen, 2024). This species is hunted for food and medicinal purposes. Its habitat is shrinking, fragmented, and degraded.

Spotted Giant Flying Squirrel *Petaurista elegans* (Fig. 5): Recorded in Lai Chau (Phin Ho), Lao Cai (Hoang Lien NP, Van Ban), Son La (Xuan Nha NR, Quynh Nhai, Copia NR, Muong La), Yen Bai (Mu Cang Chai PA), Ha Giang (Tay Con Linh NR), Cao Bang (Phia Oac-Phia Den NR) at the evergreen forest, secondary forest of Northeast and Northwest around 700**–**1,800 m a.s.l. (Dang et al., 2008). The species' habitat is shrinking, fragmented, and degraded. It is hunted for food, kept as pets, displayed, and traded.

Indian Giant Flying Squirrel *Petaurista philippensis* (Fig. 5): This species is widely distributed in primary forests with large trees from North to South (Dang et al., 2008; Ly et al., 2019) and is recorded at elevations over 700 m a.s.l. in protected areas. It is currently hunted for food, medicinal use, and decoration. Its habitat is shrinking, fragmented, and degraded.

Hon Khoai squirrel *Callosciurus honkhoaiensis* (Fig. 5f): This species is found in evergreen forests on low mountains, commonly seen on large and medium trees on Hon Khoai Island (Nguyen et al., 2018; Nguyen et al., 2022; Nguyen, 2024) and Tho Chu Island (this study) below 200 m a.s.l. The habitat is shrinking and degrading due to infrastructure development and tourism on these islands.

Sort-furred Tree Mouse *Typhlomys chapensis* (Fig. 5): They were only recorded in Lao Cai (Hoang Lien NP) at the primary forest around 1,200–1,400 m a.s.l. (Dang et al., 2008; Abramov et al., 2012; Abramov et al., 2014; Nguyen & Cao, 2002). The distribution of this species is fragmented, and its habitat is shrinking and degrading due to agricultural activities and tourism development.

Lesser Marmoset Rat *Hapalomys delacouri*: Recorded in Cao Bang (Phia Oac-Phia Den NR), Ha Tinh (Ke Go), Kon Tum (Dak To) with occurs in montane tropical wet evergreen and semi-evergreen (Dang et al., 2008; Abramov et al., 2012; Abramov et al., 2017; Wilson & Mittermeier, 2016, 2017). It is highly arboreal and probably is restricted to bamboo habitats between 600–1,500 m a.s.l. This species lives and nests in bushes within mixed bamboo forests, occasionally found in deciduous evergreen forests. However, its habitat is shrinking, fragmented, and degraded, and it is hunted for food and medicinal use.

Paulina's limestone rat *Saxatilomys paulinae*: Recorded in Quang Binh (Minh Hoa area near Phong Nha-Ke Bang NP) (Musser et al., 2005; Nguyen et al., 2015). Primarily found in karst landscapes with large and small limestone mountains covered by vines, with steep slopes and numerous small caves providing suitable shelter around 400–600 m a.s.l. This terrain type is also found in Northeastern Vietnam (Musser et al., 2006). This species is hunted for food and traditional medicine. Its habitat is shrinking, fragmented, and degraded.

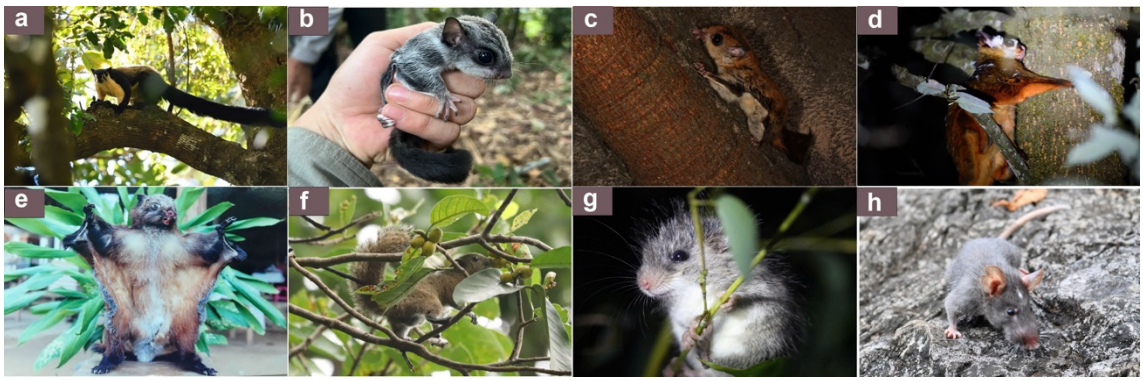


Figure 5. Photo of some rodent species. a. Black Giant Squirrel *Ratufa bicolor* (LMH); b. Particolored Flying Squirrel *Hylopetes alboniger* (LNT); c. Red-cheeked Flying Squirrel *Hylopetes spadiceus* (NTS); d. Spotted Giant Flying Squirrel *Petaurista elegans* (LMH); e. Indian Giant Flying Squirrel *Petaurista philippensis* (NTS); f. Hon Khoai squirrel *Callosciurus honkhoaiensis* (NTS); g. *Typhlomys* cf. *chapensis* (LNT); h. Daovantien's limestone rat *Tokinomys daovantieni* (LNT) [*Photographed by* Le Manh Hung: LMH; Ly Ngoc Tu: LNT; Nguyen Truong Son: NTS]

Daovantien's limestone rat *Tonkinomys daovantieni* (Fig 5): Recorded in Lang Son (Huu Lien NR, Bac Son) and recently in Bac Kan (Ba Be NP), Cao Bang (Nguyen Binh) around 370–700 m a.s.l (Balakirev et al., 2013; Dang et al., 2008; Musser et al., 2006; Wilson & Mittermeier, 2016, 2017; Balakirev et al., 2023). They live in forests on limestone mountains with many small caves (Musser et al. 2006; Balakirev et al., 2023) at 370–700 m a.s.l. This species is hunted for food. Its habitat is shrinking, fragmented, and degraded due to road construction, stone mining, logging, and agricultural activities.

Laotian rock rat *Laonastes aenigmamus*: Recorded in Quang Binh (Phong Nha-Ke Bang NP) at around 300–500 m a.s.l. (Nguyen et al., 2014; Wilson & Mittermeier, 2016, 2017). It is found in typical limestone mountain ecosystems of the Truong Son Mountain range. Our results show that the species lives in caves at the base of limestone mountains with slopes ranging from low to high. Its burrows are usually close to the ground, with an opening about 30 cm wide and a depth of around 56–60 cm (Nguyen et al., 2014). This species is currently hunted for food and trade.

CONCLUSION

Based on the research results from 2001 to the present, a total of 48 species included in the checklist of mammals in Vietnam need conservation attention. The order Eulipotyphla includes 5 species, the order Chiroptera includes 30 species, and the order Rodentia includes 13 species recommended for conservation. These species face significant threats, including habitat loss, hunting, and trapping, which are leading to population declines.

The distribution status of species has been assessed, encompassing various habitat types. Among these, evergreen forests on high mountains, limestone forests with numerous caves, coastal mangrove ecosystems, and forest ecosystems on certain islands are prioritized for protection against all impacts. The identified priority sites for habitat protection include two in the Northeast (Tay Con Linh NR, Cat Ba NP), three in the Northwest (Hoang Lien NP, Xuan Son NP, Xuan Nha NR), four in the North Central Coast (Pu Mat NP, Phong Nha-Ke Bang NP, Bac Huong Hoa NR, Dak Rong NR), three in the Central Highlands (Ngoc Linh NR, Chu Yang Sin NP, Bidoup-Nui Ba NP), and five in the Mekong Delta and isolated islands (U

Minh Thuong NP, U Minh Ha NP, Phu Quoc Island, Con Dao Island, and Hon Khoai Island). Data on distribution and threats will assist in assessing conservation status and facilitate the planning of management strategies for wildlife conservation and sustainable development.

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