TAM HOP AREA – PU MAT NATIONAL PARK CAMERA TRAP REPORT

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SUMMARY

- The Tam Hop area hosts a surprisingly diverse mammal community with rare species, even those not detected in any other areas of the National Park. The good diversity in this area warrants stricter protection from the Park where it should be operated as one of the core areas like Khe Choang, given the heavy hunting pressure the area currently receives. This systematic survey sets a baseline on which future studies and projects can reference.
- 98 camera traps have been set using a fine grid system, collecting 3700 nights of viable effort.
- A baseline inventory of small mammals has been collected and analyzed, giving better understanding of the site's biodiversity.

KEY RESULTS

- 42 species were identified, 21 of which are mammals, which includes taxon like the Owston's Civet (*Chrotogale owstoni*), the bear (*Ursidae*), and the Binturong (*Arctictis binturong*).
- Despite a good variety of threatened species detected, no pangolins nor otters were detected.
- No human disturbances were detected, although 4 cameras were not found upon retrieval.

METHODS

Study Area

Pu Mat National Park (NP), one of the largest protected areas in Vietnam, is situated in the North end of the Annamites mountains, along the Vietnam-Laos border. The innate diversity of the rain forest habitat combined with the remoteness and inaccessibility of the region allows the Park to harbor rich faunal and floral communities in which many rare and endangered taxa are endemic.

Geographically, Pu Mat NP is located at around 18.92 °N, 104.68 °E **(Figure 1)**. It lies in the Northern Annamites rain forest ecoregion (Dinerstein et al., 2017). The annual average temperature is 22 ºC, ranging from 12 ºC to 32 ºC. Mean annual precipitation is 1400 mm, with most rainfall occurring between May and September (data from Worldclim, Fick & Hijmans, 2017).

Figure 1: Map of Tam Hop Area and Pu Mat National Park inset within a map of Vietnam.

Pu Mat is home to several mammal species threatened to extinction, including the Asian Elephant (*Elephas maximus*), Owston's Civet (*Chrotogale owstoni*), the Sunda Pangolin (*Manis javanica*), and possibly Saola (*Pseudoryx nghetinhensis*) and Tiger (*Panthera tigris*). The site is also considered an Important Bird Area with certain threatened avian species such as Annamite Crested Argus (*Rheinardia ocellata*). However, due to the increase of human activities such as illegal hunting, forest exploitation extending to the region, populations of many fauna species in Pu Mat National Park are dwindling.

The Tam Hop area is one of the divisions in Pu Mat NP, lying at the Northeast in the Park. Being right on the boundary between the protected area and outside residential areas, it naturally receives a heightened hunting pressure. This survey is the first time a systematic study has been conducted in Tam Hop by Save Vietnam's Wildlife, whose result will provide a better understanding of the faunal inventory, as well as help assess the impact of illegal wildlife poaching on the area.

Data Collection

This survey utilized a fine grid design, where 98 camera traps were set across 49 stations (2 traps per station). Each station lies on a square cluster of 4 stations, spaced 1 km apart. Clusters are then spaced 3 km from each other on a square grid **(Figure 2)**.

To increase detection rates, traps were set near features that attract animal activities such as small trails, flood spots, open areas, and are allowed to be anywhere within 100m of the pre-determined locations. To further maximize detection rates at any station, traps were also set so that they face away from each other while being roughly 20m apart. Traps were set around 30cm from the ground, suitable for detecting medium to small ground-based mammals and birds. Foliage around the traps area was partially cleared to increase visibility and limit false triggers.

Data Analysis

After traps are retrieved, images were classified using the TimeLapse2 software. TimeLapse2 is a program specialized for image analysis for camera traps with a very simple and intuitive interface yet still is very useful, which helps streamline classification workflow significantly (Greenberg et al., 2019). After images are classified, a data table with the images' metadata as well as user-input data (e.g. species, counts, etc.) can be extracted for further analysis.

Due to being the focus of the project, mammal species are identified to the species level, where possible. Birds and reptiles are reported where necessary but are left out of the analysis process.

Data and statistical analysis were done using R program (R Core Team, 2022).

To ensure temporal independence, the notionally independence threshold between records of the same species is set at 60 minutes, i.e., multiple records of the same species taken by the same camera within 60 minutes of each other will be treated as 1 single record.

Table 1: Camera trap effort.

List of all camera traps set in the project, their setup and retrieval dates, how many days they were in the field, viable effort in trap nights, and number of unique species they have detected. Viable effort is determined by the difference in days between the first and last detection.

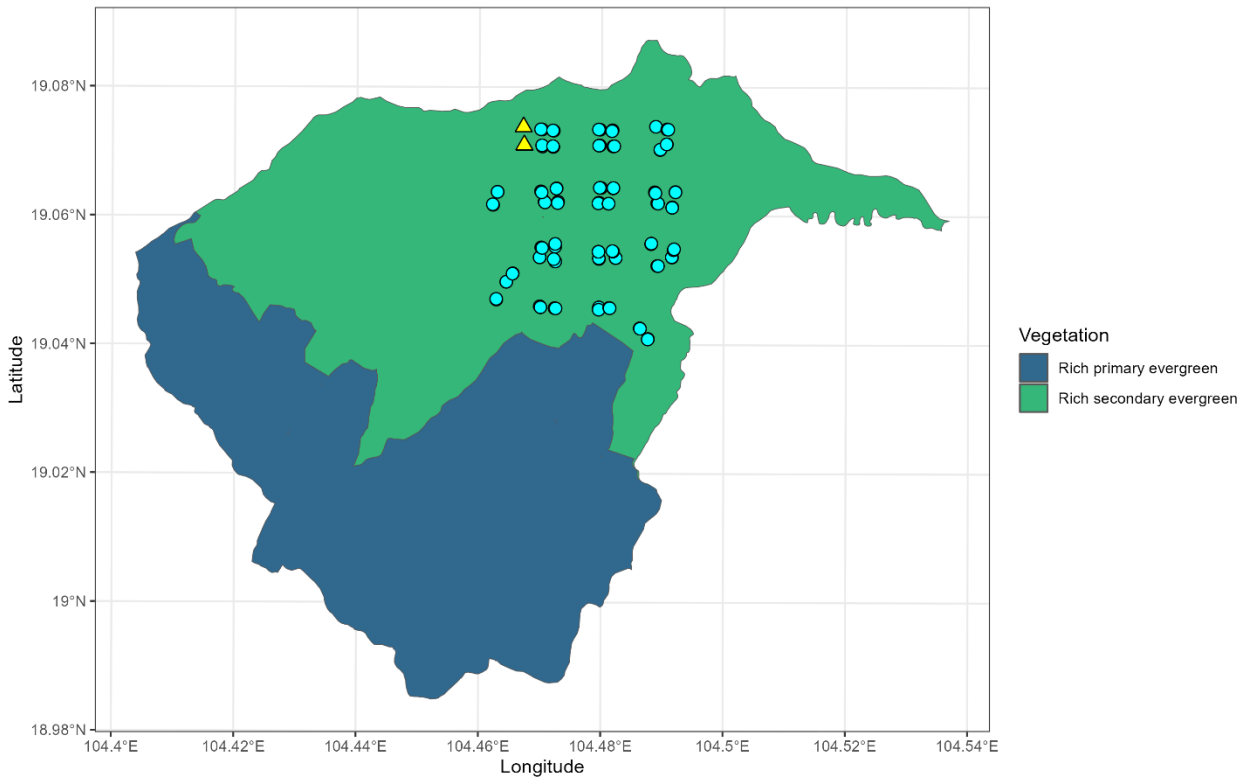
	Station	Camera ID	Setup Date	Retrieve Date	Days in field	Viable Effort (nights)	Unique Species	Notes
1	TH 1	CA703573	09/03/2023	11/05/2023	63	58	13	
2	TH 1	CA700570	09/03/2023	11/05/2023	63	0	2	
3	TH 2	CA700580	11/03/2023	13/05/2023	63	53	8	
4	TH 2	CA703596	11/03/2023	13/05/2023	63	53	4	
5	TH 3	CA703576	11/03/2023	13/05/2023	63	60	7	
6	TH 3	CA700611	11/03/2023	13/05/2023	63	45	8	
7	TH 4	CA703645	08/03/2023	10/05/2023	63	52	5	
8	TH 4	CA700613	08/03/2023	10/05/2023	63	40	3	
9	TH 5	CA700592	06/03/2023	08/05/2023	63	0	0	
10	TH 5	CA703577	06/03/2023	08/05/2023	63	61	12	
11	TH 6	CA700612	13/03/2023	15/05/2023	63	51	7	
12	TH 6	CA700597	13/03/2023	15/05/2023	63	3	3	
13	TH 7	CA703622	07/03/2023	09/05/2023	63	59	13	
14	TH 7	CA703605	07/03/2023	09/05/2023	63	51	6	
15	TH 8	CA703632	06/03/2023	08/05/2023	63	7	2	
16	TH 8	CA700594	06/03/2023	08/05/2023	63	35	2	
17	TH 9	Tamhop005	13/03/2023	15/05/2023	63	47	9	
18	TH 9	Tamhop008	13/03/2023	15/05/2023	63	0	0	
19	TH 10	CA700566	10/03/2023	12/05/2023	63	59	5	
20	TH 10	CA703591	10/03/2023	12/05/2023	63	52	9	
21	TH 11	CA703642	12/03/2023	14/05/2023	63	47	8	
22	TH 11	CA703652	12/03/2023	14/05/2023	63	55	13	
23	TH 12	CA703654	12/03/2023	14/05/2023	63	56	5	
24	TH 12	CA700586	12/03/2023	14/05/2023	63	0	0	
25	TH 13	CA703566	09/03/2023	11/05/2023	63	40	4	
26	TH 13	CA703629	09/03/2023	11/05/2023	63	57	12	
27	TH 14	CA703580	11/03/2023	13/05/2023	63	56	6	
28	TH 14	CA703660	11/03/2023	13/05/2023	63	50	2	
29	TH 15	CA703628	11/03/2023	13/05/2023	63	41	3	
30	TH 15	CA700609	11/03/2023	13/05/2023	63	28	6	
31	TH 16	CA703607	08/03/2023	10/05/2023	63	54	4	
32	TH 16	CA703669	08/03/2023	10/05/2023	63	5	3	
33	TH 17	CA703662	06/03/2023	08/05/2023	63	49	12	
34	TH 17	CA700587	06/03/2023	08/05/2023	63	12	3	
35	TH 18	CA700517	13/03/2023	15/05/2023	63	47	8	
36	TH 18	CA700513	13/03/2023	15/05/2023	63	58	8	
37	TH 19	CA703572	07/03/2023	09/05/2023	63	36	4	

38	TH 19	CA703601	07/03/2023	09/05/2023	63	55	16	
39	TH 20	CA703561	06/03/2023	08/05/2023	63	34	5	
40	TH 20	CA703647	06/03/2023	08/05/2023	63	50	5	
41	TH 21	Tamhop001	13/03/2023	15/05/2023	63	59	11	
42	TH 21	Tamhop002	13/03/2023	15/05/2023	63	56	10	
43	TH 22	CA703671	09/03/2023	11/05/2023	63	45	7	
44	TH 22	CA703667	09/03/2023	11/05/2023	63	43	9	
45	TH 23	CA703659	09/03/2023	11/05/2023	63	48	12	
46	TH 23	CA703650	09/03/2023	11/05/2023	63	13	6	
47	TH 24	CA703579	11/03/2023	13/05/2023	63	51	5	
48	TH 24	CA703586	11/03/2023	13/05/2023	63	0	0	
49	TH 25	CA703619	11/03/2023	13/05/2023	63	54	7	
50	TH 25	CA703626	11/03/2023	13/05/2023	63	54	8	
51	TH 26	CA703625	08/03/2023	10/05/2023	63	49	7	
52	TH 26	CA703638	08/03/2023	10/05/2023	63	43	4	
53	TH 27	CA703584	08/03/2023	10/05/2023	63	55	8	
54	TH 27	CA700602	08/03/2023	10/05/2023	63	60	12	
55	TH 28	CA700562	06/03/2023	08/05/2023	63	46	7	
56	TH 28	CA703599	06/03/2023	08/05/2023	63	15	4	
57	TH 29	CA703624	13/03/2023	15/05/2023	63	55	10	
58	TH 29	CA703587	13/03/2023	15/05/2023	63	41	7	
59	TH 30	CA703637	07/03/2023					lost
60	TH 30	CA703606	07/03/2023					lost
61	TH 31	CA703620	07/03/2023	09/05/2023	63	5	6	
62	TH 31	CA700569	07/03/2023	09/05/2023	63	23	3	
63	TH 32	CA703636	06/03/2023	08/05/2023	63	0	1	
64	TH 32	CA703615	06/03/2023	08/05/2023	63	45	8	
65	TH 33	Tamhop004	13/03/2023	15/05/2023	63	59	10	
66	TH 33	Tamhop006	13/03/2023	15/05/2023	63	59	12	
67	TH 34	CA703664	10/03/2023	12/05/2023	63	32	4	
68	TH 34	CA703563	10/03/2023	12/05/2023	63	42	3	
69	TH 35	CA703581	10/03/2023	12/05/2023	63	58	17	
70	TH 35	CA703646	10/03/2023	12/05/2023	63	63	13	
71	TH 36	CA703614	12/03/2023	14/05/2023	63	56	7	
72	TH 36	CA703567	12/03/2023	14/05/2023	63	59	9	
73	TH 37	CA703602	12/03/2023	14/05/2023	63	37	9	
74	TH 37	CA703592	12/03/2023	14/05/2023	63	38	8	
75	TH 38	CA703677	09/03/2023	11/05/2023	63	47	7	
76	TH 38	CA703600	09/03/2023	11/05/2023	63	5	2	
77	TH 39	CA703678	09/03/2023	11/05/2023	63	0	0	
78	TH 39	CA703569	09/03/2023	11/05/2023	63	55	2	
79	TH 40	CA700616	11/03/2023	13/05/2023	63	0	1	
80	TH 40	CA700604	11/03/2023	13/05/2023	63	55	5	
81	TH 41	CA700515	11/03/2023	13/05/2023	63	28	6	

82	TH 41	CA703608	11/03/2023	13/05/2023	63	56	6	
83	TH 42	CA703612	08/03/2023	10/05/2023	63	0	0	
84	TH 42	CA703575	08/03/2023	10/05/2023	63	45	3	
85	TH 43	CA703565	08/03/2023	10/05/2023	63	57	12	
86	TH 43	CA703582	08/03/2023	10/05/2023	63	38	7	
87	TH 44	CA703617	06/03/2023	08/05/2023	63	20	4	
88	TH 44	CA703558	06/03/2023	08/05/2023	63	6	2	
89	TH 45	CA703675	13/03/2023	15/05/2023	63	29	4	
90	TH 45	CA700598	13/03/2023	15/05/2023	63	22	3	
91	TH 46	CA700564	07/03/2023					lost
92	TH 46	CA700605	07/03/2023					lost
93	TH 47	CA700512	07/03/2023	09/05/2023	63	14	3	
94	TH 47	CA703658	07/03/2023	09/05/2023	63	48	7	
95	TH 48	CA703635	06/03/2023	08/05/2023	63	59	7	
96	TH 48	CA703594	06/03/2023	08/05/2023	63	34	8	
97	TH 49	Tamhop007	13/03/2023	15/05/2023	63	59	11	
98	TH 49	Tamhop003	13/03/2023	15/05/2023	63	44	3	
	Total				**5922**	**3700**		

Figure 2: Camera traps locations

Locations of camera traps used in this project. Lost traps are marked with yellow triangles.

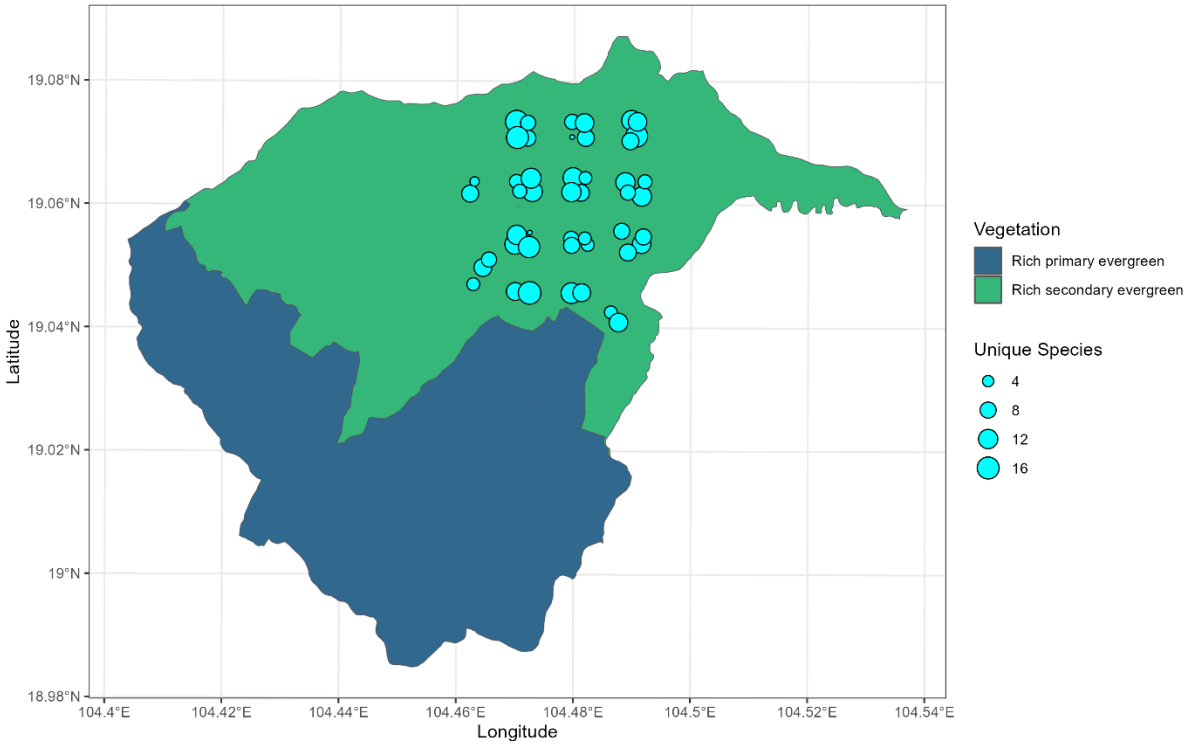


RESULTS

Camera trap locations and effort:

Across all 94 camera traps, a total effort of 5922 trap nights were collected, of which, 3700 nights were viable i.e. detected animals. 4 camera traps were lost during retrieval, presumably due to thefts **(Table 1)**.

Figure 3: Location of camera traps with detections and number of unique species



Species encountered:

42 different species were identified to the species level, 21 of which were mammals, 19 were birds, and 2 were reptiles **(Table 2).** Mice (*Muridae*) and Ferret badgers (*Melogale* sp.) records were not identified to the species level due to challenges in identification through photos. 1 bear (*Ursidae*) record was unfortunately not identified to the species level due to bad camera angle.

Some notable records include the 1 bear individual, the Endangered Owston's Civet (*Chrotogale owstoni*), the Vulnerable Binturong (*Arctictis binturong*), and the Vulnerable Greater Spotted Eagle (*Clanga clanga*).

Unfortunately, no pangolins were detected in the survey, despite the good variety of notable species detected in the area.

Out of all species, 1 is classified as Endangered in the IUCN Red List (Owston's Civet), 5 as Vulnerable, 3 as Near Threatened, with the rest belonging to Least Concern category **(Table 2)**.

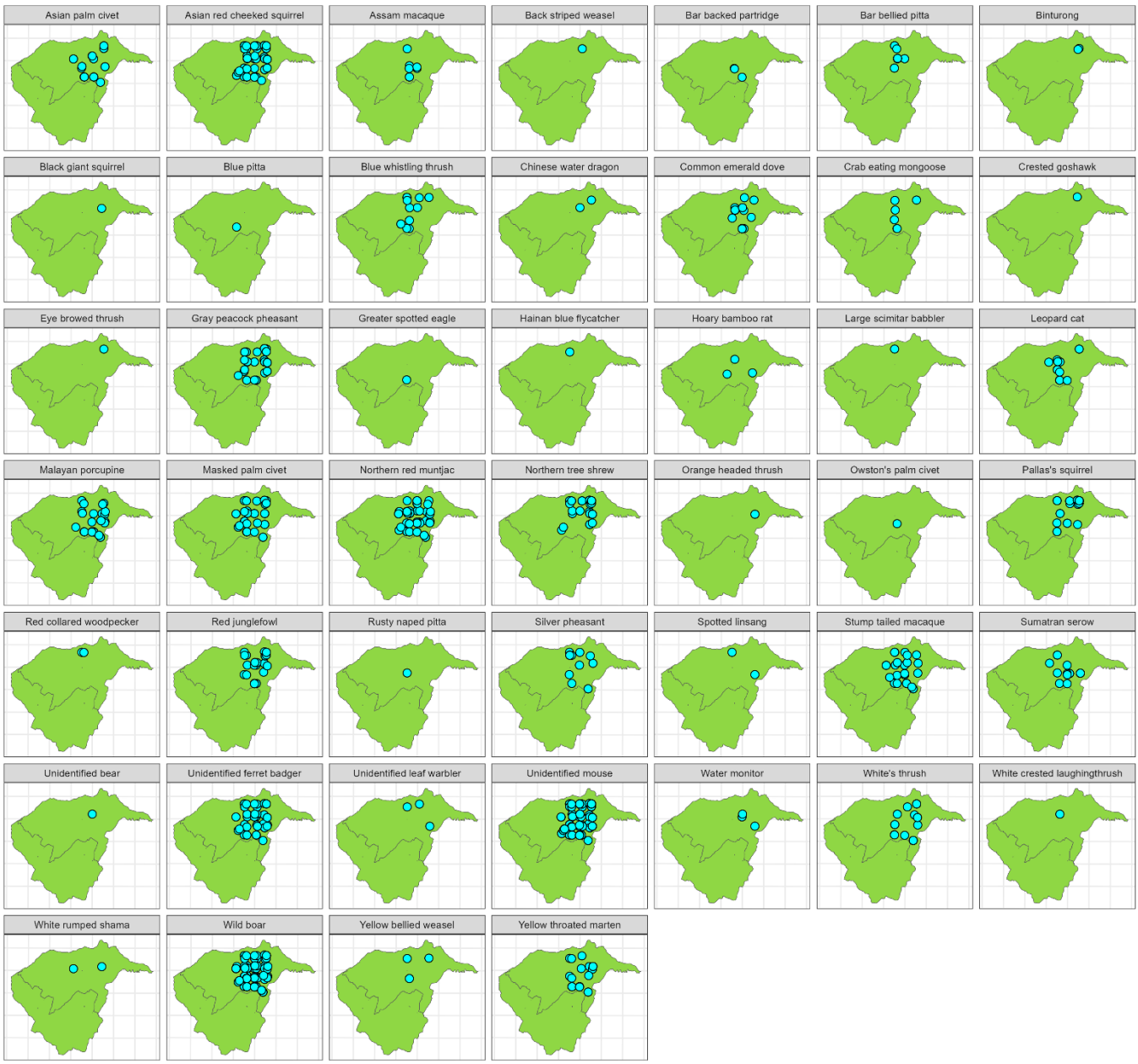
Table 2: A summary of species encountered in the survey and their status on the IUCN Red List

	Common Name	Scientific Name	No. of Detections *	IUCN Red List Status
1	Owston's civet	*Chrotogale owstoni*	1	EN
2	Stump tailed macaque	*Macaca arctoides*	91	VU
3	Sumatran serow	*Capricornis sumatraensis*	20	VU
4	Binturong	*Arctictis binturong*	2	VU
5	Chinese water dragon	*Physignathus cocincinus*	2	VU
6	Greater spotted eagle	*Clanga clanga*	1	VU
7	Assam macaque	*Macaca assamensis*	22	NT
8	Red collared woodpecker	*Picus rabieri*	2	NT
9	Black giant squirrel	*Ratufa bicolor*	2	NT
10	Wild boar	*Sus scrofa*	554	LC
11	Unidentified mouse	*Muridae*	523	LC
12	Asian red cheeked squirrel	*Dremomys rufigenis*	179	LC
13	Northern red muntjac	*Muntiacus vaginalis*	102	LC
14	Northern tree shrew	*Tupaia belangeri*	92	LC
15	Unidentified ferret badger	*Melogale* sp.	90	LC
16	Gray peacock pheasant	*Polyplectron bicalcaratum*	86	LC
17	Pallas's squirrel	*Callosciurus erythraeus*	72	LC
18	Red junglefowl	*Gallus gallus*	62	LC
19	Malayan porcupine	*Hystrix brachyura*	61	LC
20	Masked palm civet	*Paguma larvata*	51	LC
21	Common emerald dove	*Chalcophaps indica*	47	LC
22	Common palm civet	*Paradoxurus hermaphroditus*	31	LC
23	Bar bellied pitta	*Hydrornis elliotii*	31	LC

24	Yellow throated marten	*Martes flavigula*	26	LC
25	White's thrush	*Zoothera aurea*	25	LC
26	Blue whistling thrush	*Myophonus caeruleus*	22	LC
27	Silver pheasant	*Lophura nycthemera*	19	LC
28	Leopard cat	*Prionailurus bengalensis*	16	LC
29	Crab eating mongoose	*Herpestes urva*	8	LC
30	Bar backed partridge	*Arborophila brunneopectus*	5	LC
31	Water monitor	*Varanus salvator*	5	LC
32	Yellow bellied weasel	*Mustela kathiah*	4	LC
33	Hoary bamboo rat	*Rhizomys pruinosus*	3	LC
34	Orange headed thrush	*Geokichla citrina*	2	LC
35	Spotted linsang	*Prionodon pardicolor*	2	LC
36	White crested laughingthrush	*Garrulax leucolophus*	2	LC
37	White rumped shama	*Copsychus malabaricus*	2	LC
38	Back striped weasel	*Mustela strigidorsa*	1	LC
39	Blue pitta	*Hydrornis cyaneus*	1	LC
40	Crested goshawk	*Accipiter trivirgatus*	1	LC
41	Eye browed thrush	*Turdus obscurus*	1	LC
42	Hainan blue flycatcher	*Cyornis hainanus*	1	LC
43	Large scimitar babbler	*Erythrogenys hypoleucos*	1	LC
44	Rusty naped pitta	*Hydrornis oatesi*	1	LC
45	Unidentified leaf warbler	*Phylloscopus* sp.	3	NA
46	Unidentified bear	*Ursidae*	1	NA

*notionally independent detections, separated by a minimum of 60 minutes

Figure 4: Encounter locations for each species (cyan circles) in U Minh Thuong National Park.



Notable species:

Owston's Civet (*Chrotogale owstoni*): Owston's Civet is an Endangered small carnivore, and one of SVW's focus species. Occurring natively in the country, the species is currently facing a rapid decline in population where it was uplisted by the IUCN from Vulnerable as recently as 2016 (Timmins et al., 2016).

The area of Tam Hop in Pu Mat NP is one of the few sites where Owston's Civet are consistently detected, while camera trap surveys by SVW in other sites within its range fail to capture the species, even in other, well-protected areas of the Park. The occurrence of this threatened species in this area, together with the variety of rarely detected species in this survey warrants better protection efforts for the area, especially given the heavy hunting pressure this area is under.

In this survey, we report 1 Owston's Civet detection.

Bear (*Ursidae*): The two bear species native in Vietnam, the Sun Bear (*Helarctos malayanus*) and Asiatic Black Bear (*Ursus thibetanus*) are both under heavy pressure of being hunted and farmed for bear bile and other products. Both species are listed as Vulnerable in the IUCN Red List (Garshelis & Steinmetz, 2016; Scotson et al., 2016)

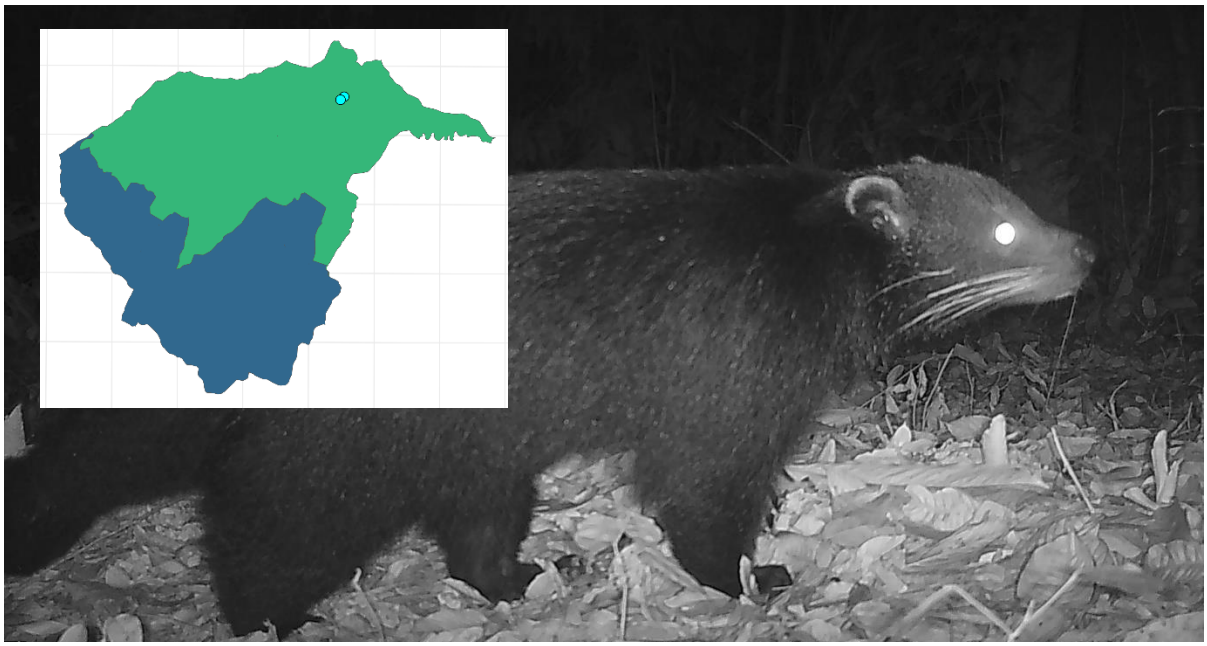
Although bear bile farming has been banned in the country since 2005, evidence shows that there is still an active illegal industry running behind the scenes (Green et al., 2022). Theses illegal farms, and many legal ones in other countries such as China, provides a demand for wild bears from poachers and hunters to fulfill, exacerbating the conservation situation for the taxon.

In this survey, we report 1 bear detection of unidentified species.

Binturong (*Arctictis binturong*): The Binturong is an evasive species which is currently assessed as Vulnerable in the IUCN Red List (Willcox et al., 2016). Threatened by habitat loss and hunting for food and traditional medicines, the population of this species is rapidly dwindling and approaching national extirpation. Binturongs are also popular as pets due to their slow and docile appearance.

This survey importantly marks the first time a Binturong has been detected via camera trap in Vietnam, where previous studies in the country with both terrestrial and arboreal camera traps have failed to capture species. Direct observations are also few in numbers. The species is reportedly unafraid of human, and are conspicuous to both surveyors and hunters, which means that the low number of direct observations likely reflects low population (Willcox et al., 2016). Nonetheless, concrete detections such as these are a relieving sign that the species still persists in this area, further requiring better protection in the area of Tam Hop, given the strong hunting pressure from the surrounding area.

Here we report 2 detections of the species in this survey.



Undetected species

In this survey, we failed to detect many species of interest, including the Sunda Pangolin (*Manis javanica*), the Chinese Pangolin (*Manis pentadactyla*) and the otter species.

Human interference

No human interactions were detected in this survey, which is a good sign considering the heavy hunting pressure this area receives. However, 4 of the 98 cameras were not found upon retrieval, presumably due to thefts, meaning that locals might yet still enter the forest and remove the cameras upon encountering to avoid identification and punishment.

DISCUSSION AND RECOMMENDATION

Tam Hop is reportedly under heavy hunting pressure from the surrounding residential areas, yet, as reported in this survey, it hosts an impressive faunal community of rare and endangered species. This result is relatively impressive, compared to other, perhaps better protected areas such as Khe Choang.

Bear species have not been detected by any of SVW's camera trap survey throughout the country since 2019, which continues to give hopes to the conservation of such a highly sought-after taxon. Hunting pressure on wild bear populations in the form of stock suppliers for bear farms is still present, despite a nation-wide ban on bear bile farming. The international illegal wildlife trade is also a source of demand, specifically to countries where bear bile farming is still legal and/or poorly regulated, together with demands for other products such as bear paws or meat. Many bear sanctuaries have since been operating in the country, rescuing hunted and farmed bears, and those intercepted in the illegal wildlife trade market. Early conversations to release suitable rescued bears from the wild have been held by SVW and many authorities. However, this task proves to be a difficult endeavor, considering the various confounding factors that it involves. In the meantime, site protection and demand reduction, especially around areas where the species are still detected such as here in Tam Hop, must continue.

Binturongs have not been reported in any published camera trap studies in Vietnam. This gap likely arises in part from the fact that it is predominantly an arboreal species, while most camera traps surveys in the country are set low on the ground to detect terrestrial species (although it has been reported that the species descend to the ground more frequently than previously thought). However, low abundance nationally plays a large part. Binturongs are threatened by hunting, snaring, and the illegal wildlife trade, where they are sold as pets, food, and medicines (Willcox et al., 2016). The infrequent number of records, even in areas intensively surveyed nationally and regionally (for example, Thailand, Laos, Cambodia) suggests that the paucity of records is a genuine indication of declining populations (Chutipong et al., 2014; Coudrat et al., 2014; Gray et al., 2014). The fact that Pu Mat NP and particularly Tam Hop area is still harboring at least some Binturong individuals is a relieving sign for the species in Vietnam and calls for an immediate increase in site-protection effort, at least in the area. Tam Hop might be the last bastion of the species nationally.

Given the successful result of this survey, Tam Hop area should be considered a main operating site of Pu Mat NP as well as other stakeholders operating in the area. The success of Khe Choang area in implementing a SMART-based patrol system is a prime example for other areas, including Tam Hop, to follow suit.

We also recommend that camera trapping activities be repeated every 2-3 years using the same method to better document changes to the wildlife communities in the Park, in turn to inform the authorities about the effectiveness at which authority is enforced at the site and eventually help with the final decision-making process.

Other than on-site protection, off-site aspects of conservation also need to be considered, such as the cultural and socio-economic situations of the residents surrounding the core area of the Park and how they affect hunting pressure. Subsequently, effective demand reduction

and education campaigns can be deployed using the results of such studies, in combination with the on-site law enforcement that is currently in place.

ACKNOWLEDGEMENT

We would like to thank Pu Mat National Park for providing us with administrative and manpower support during this survey.

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APPENDIX: CAMERA TRAP RECORDS OF ORDER CARNIVORA IN TAM HOP AREA OF PU MAT NATIONAL PARK

Owston's Civet (*Chrotogale owstoni*)

Common Palm Civet (*Paradoxurus hermaphroditus*)

Masked Palm Civet (*Paguma larvata*)

Crab-eating Mongoose (*Herpestes urva*)

Spotted linsang (*Prionodon pardicolor*)

Unidentified bear (*Ursidae*)

Yellow-throated Marten (*Martes flavigula*)

Yellow-bellied Weasel (*Mustela kathiah*)

Back-striped Weasel (*Mustela strigidorsa*)

Unidentified Ferret-badger (*Melogale* sp.)

Leopard Cat (*Prionailurus bengalensis*)