

Rediscovery of a remnant population of the ‘Critically Endangered’ Delacour’s langur (*Trachypithecus delacouri*) in the Yen Mo limestone complex, Ninh Binh Province, Vietnam

Trinh Dinh Hoang¹, Tran Van Giang², Tilo Nadler², Nguyen Thi Thu Hien², Nguyen Tra My² and Govinda Lienart²

¹ King Mongkut's University of Technology Thonburi, Thailand

² Three Monkeys Wildlife Conservancy, Vietnam

Corresponding author: Trinh Dinh Hoang <trinhdinhhoang@gmail.com>

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Summary

A remnant population of Delacour's langurs (*Trachypithecus delacouri*) was rediscovered in the Yen Mo limestone complex. This significantly expanded our knowledge of the distribution and conservation status of the species. Through a combination of interview surveys, ground surveys, and drone surveys, 37 individuals across four groups were documented, primarily confined within the Yen Mo District forest. This discovery marks the third-largest population of the species. In addition, the survey also provided comprehensive insights into other wildlife, revealing diverse species, including rhesus macaques (*Macaca mulatta*) and Assamese macaques (*Macaca assamensis*), Indochinese serows (*Capricornis [milneedwardsii] maritimus*) and keeled box turtles (*Cuora mouhotii*). The Indochinese serow is listed as ‘Vulnerable’ and the keeled box turtle as ‘Endangered’.

However, persistent threats such as hunting activities, although no direct evidence on langurs, along with other anthropogenic activities such as agriculture and limestone quarrying, underscore the urgent need for conservation action. The current fragmented management of the area poses significant challenges, necessitating a unified management approach that transcends administrative boundaries. Establishing a management board, strengthening enforcement measures, and upgrading the protection status of the area are crucial steps toward safeguarding the Delacour's langur in the area. This species, in turn, has the full potential to serve as a flagship species for the entire limestone complex, drawing attention to its conservation needs and highlighting the importance of preserving its broader ecosystem.

Tái phát hiện quần thể sót lại của loài được xếp hạng ‘Cực kỳ nguy cấp’ - Voọc mông trắng (*Trachypithecus delacouri*) tại quần thể núi đá vôi Yên Mô, tỉnh Ninh Bình, Việt Nam

Tóm tắt

Nghiên cứu này báo cáo việc phát hiện lại một quần thể còn sót lại của loài voọc mông trắng (*Trachypithecus delacouri*) tại Khu phức hợp núi đá vôi Yên Mô, nâng cao đáng kể kiến thức về sự phân bố và hiện trạng bảo tồn của loài. Thông qua kết hợp khảo sát phỏng vấn, khảo sát mặt đất và khảo sát bằng máy bay không người lái, 37 cá thể thuộc bốn đàn đã được ghi nhận, chủ yếu được giới hạn trong Khu rừng phòng hộ Yên Mô. Khám phá này đánh dấu quần thể lớn thứ ba của loài. Ngoài ra, cuộc khảo sát cũng cung cấp những hiểu biết toàn diện về các loài động vật hoang dã khác, phát hiện về đa dạng các loài bao gồm khỉ vàng (*Macaca mulatta*) và khỉ mồm (*Macaca assamensis*), Sơn dương Đông Dương (*Capricornis [milneedwardsii] maritimus*) và rùa sa nhân (*Cuora mouhotii*). Sơn dương Đông Dương được liệt kê là ‘Dễ bị tổn thương’ và rùa sa nhân là ‘Nguy cấp’.

Tuy nhiên, các mối đe dọa vẫn còn diễn ra như hoạt động săn bắt, mặc dù không có bằng chứng

trực tiếp đe dọa tới vọc mỏng trắng nhưng cùng với các hoạt động tiêu cực khác do con người gây ra như canh tác nông nghiệp và khai thác đá vôi. Do vậy, cấp thiết có các hoạt động bảo vệ rừng và bảo tồn sinh cảnh nơi đây được nghiêm ngặt hơn. Việc quản lý và bảo vệ khu vực hiện nay đặt ra những thách thức đáng kể, đòi hỏi một cách tiếp cận quản lý thống nhất vượt qua ranh giới hành chính. Thành lập ban quản lý, tăng cường các biện pháp thực thi và nâng cấp tình trạng bảo vệ khu vực là những bước quan trọng để bảo vệ vọc mỏng trắng. Đối với loài linh trưởng này hoàn toàn có đầy đủ tiềm năng để đóng vai trò là một loài xếp hàng đầu cho toàn bộ quần thể núi đá vôi nơi đây, thu hút sự chú ý đến nhu cầu bảo tồn và làm nổi bật tầm quan trọng của việc bảo tồn hệ sinh thái rộng lớn hơn của loài.

Introduction

Vietnam hosts a rich diversity of 25 primate species (Prime Minister of Government 2017; Blair et al. 2023). However, an alarming 80% of these species are teetering on the brink of extinction, as highlighted by the IUCN Red List of Threatened Species (Nadler 2010). Among the most imperiled is the Delacour's langur (Nadler et al. 2020a). This folivorous primate, renowned for its striking dichromatic black and white fur, thrives in limestone habitats, where its adaptation is especially remarkable (Nadler et al. 2003; Zhijin Liu et al. 2019; Tengcheng Que et al. 2021). Endemic to Vietnam, the Delacour's langur is confined to a small area in the north-central region, intensifying its vulnerability to habitat loss and fragmentation (Nadler et al. 2003; 2004; 2015). Classified as 'Critically Endangered' by the IUCN Red List of Threatened Species, this species frequently appears on the list of 'The World's 25 Most Endangered Primates', underscoring the urgent need for conservation efforts (Schwitzer et al. 2017). Despite dedicated conservation efforts, the species continues to encounter persistent threats. Historically, these threats have been attributed to poaching, while recent challenges arise from rapid habitat destruction and consequent fragmentation, notably driven by expanding land use and large-scale limestone quarrying. These pressing issues underscore the urgent need to intensify surveying efforts to assess the status of remaining populations and take informed conservation actions.

Recent drone surveys have confirmed the largest population of the species within the limestone complex of Van Long Nature Reserve and the adjacent unprotected Dong Tam area. The survey identified 179 individuals in 28 groups across the surveyed plots, with modeling estimating a total of around 300 individuals in 44 groups for the entire area (Trinh Dinh Hoang et al. 2024). Similarly, using the same drone survey method, the second-largest subpopulation was confirmed within the unprotected Kim Bang limestone complex of Ha Nam Province, comprising 104 individuals in 16 groups across all survey plots, with a modeling estimation of 175 individuals in 25 groups (Trinh Dinh Hoang 2022). Additionally, an extra, smaller population exists in Trang An, consisting now of 7 individuals, as a result of a reintroduction project aimed at creating an additional safeguarded population (Nadler et al. 2020). Although the likelihood of most scattered subpopulations across the region being eradicated due to the lack of sightings over several years is high (Nadler 2004; 2010; Nadler & Brockman 2014).

One area where a small population of Delacour's langurs could possibly still be found was in the Yen Mo limestone complex (Fig. 1).

The first information on the occurrence of Delacour's langurs in this limestone mountain was obtained during a survey in 1996. A complete group of 6 individuals was hunted in 1994. The remaining population was estimated at only 5-6 individuals (Nadler 1996; Baker 1999). Further surveys in 2000 (Nadler & Luong Van Hao 2000) and 2002 (Le Thien Duc & Le Huu Oanh 2002) reported a population of 9-10 individuals in the area. In a 2009 survey, 2 groups with a total of 9-10 individuals were found (Luong Van Hao & Nadler 2009). Recent interviews with authorities and locals have reported sightings of Delacour's langur, suggesting that a remnant population may still exist.

The Yen Mo limestone complex, intersected by provincial borders between Ninh Binh and Thanh Hoa Provinces, spans from Northwest to Southeast, encompassing Yen Mo and Tam Diep

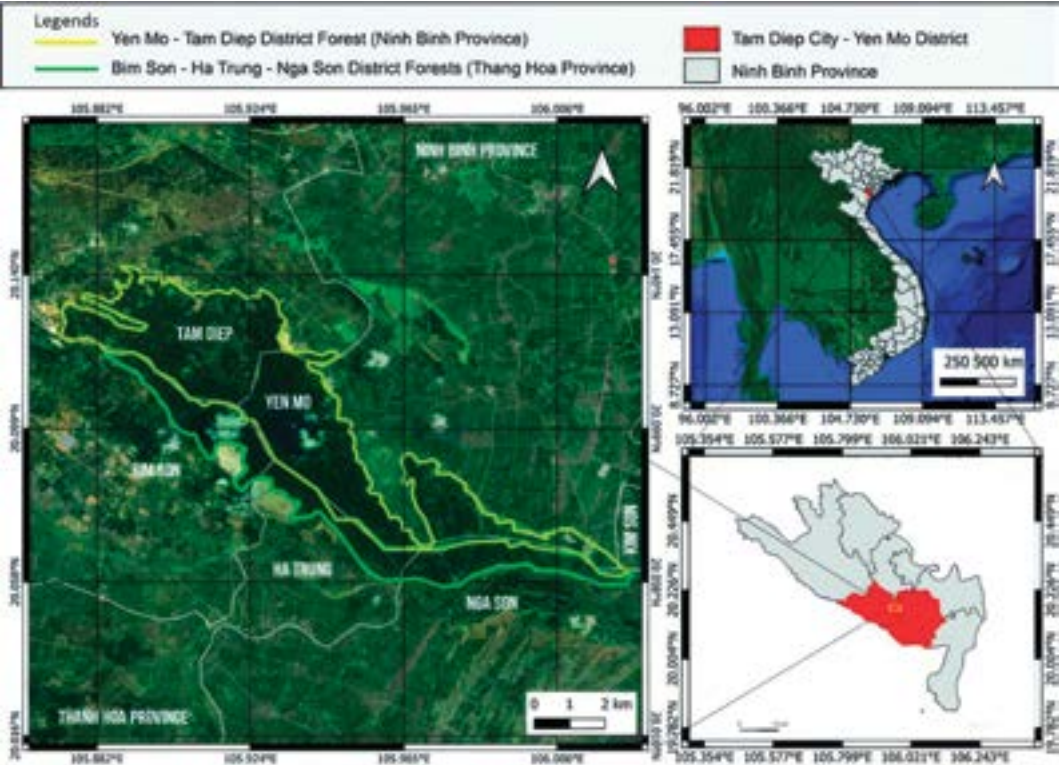


Fig.1. Location of the Yen Mo limestone complex in northern Vietnam, encompassing Ninh Binh and Thanh Hoa Provinces. The yellow outline represents the Yen Mo – Tam Diep District forests, while the green outline represents the Bim Son, Ha Trung, and Nga Son District forests in Thanh Hoa Province.

Districts in Ninh Binh Province and extending to Bim Son, Ha Trung and Nga Son Districts in Thanh Hoa Province. Each section falls under the jurisdiction of the People’s Committee of its respective province, while the daily management of natural resources is supervised by the district authorities. The forest’s protection status across the different districts is mostly designated as protection forests, currently under a relatively low level of protection. The landscape of the Yen Mo limestone complex is characterized by razor-sharp limestone karst formations and steep mountainous terrains with covered with evergree limestone forest alternating with significant portions of large bare rock surfaces (Fig. 2).



Fig.2. Typical landscape in the Yen Mo Limestone Complex. Photo: Tilo Nadler.

To navigate the challenging terrain of steep limestone cliffs, we employed a combination of interview, ground, and drone surveys between October 2023 and March 2024, each offering unique

strengths. However, due to logistical and administrative complexities, the study was limited to the Ninh Binh portion of the complex, still covering approximately 75% of the entire limestone complex. By integrating different survey methodologies, the study aimed to comprehensively assess the current status of the Delacour's langur population in the Yen Mo limestone complex and establish a baseline dataset for long-term population monitoring. Ultimately, this approach aims to facilitate targeted and informed conservation interventions for both the population of Delacour's langur in the Yen Mo limestone complex and the species as a whole.

Methods

Interview Survey

Interviews were opportunistically conducted with local authorities, residents who frequently access the forest, and experienced hunters. The primary objective of these interviews was to gather data on potential hotspots of Delacour's langur, as well as other wildlife, existing threats, terrain details, and accessibility. With the support of locals, waypoints were established on a map where the langurs have been previously observed in the limestone complex, facilitating the creation of a map depicting their potential distribution. To supplement this, historical records on Delacour's langur were collected (Nadler 1996; Baker 1999; Nadler & Luong Van Hao 2000; Le Thien Duc & Le Huu Oanh 2002; Luong Van Hao & Nadler 2009)

Ground Survey

Survey transect lines were established as the survey team explored various areas, aiming to cover as much of the limestone complex as possible, assisted by 1-2 local guides (Fig. 3). The ground survey lasted for 14 days, spanning two months between November and December 2024, and encompassed a total distance of 119 km. Tools such as a Nikon P900 camera, Vixen binoculars, and various tracking applications like GPS-map 62 (Garmin), Locus maps, Cybertracker, and Gaia GPS were used to document observations on paths, topography, wildlife, and threats. Data from this survey method also aided in identifying take-off areas for the subsequent drone survey.



Fig.3. Ground survey in the Tam Diep and Yen Mo District forests within the Ninh Binh Province section of the Yen Mo limestone complex. The track lines indicate the routes taken by survey teams to monitor and record data on the presence and distribution of wildlife, particularly Delacour's Langur.

Drone survey

Following the ground survey, the drone study spanned three months from January to March 2024 and involved surveying the area using the DJI Mavic 3T drone, equipped with a high-resolution optical camera (48 MP) and a thermal camera (640 x 512 PX). The survey design comprised 33 plots with its epicenter each spaced 1000 m apart in a grid-like structure, with radii ranging from 100-300 m depending on the valley structure (Fig. 4). Ultimately, 27 plots could be surveyed due to no-flight zone restrictions imposed by authorities. Each plot was surveyed a minimum of four times over 2-3 consecutive days, with two sessions in the morning and two in the afternoon. Flights lasted one full battery charge, approximately 45 min, during which langurs were actively searched. When flying around the edges of the plots, and a group was observed outside the plots, the geolocation was also allocated. Thermal imaging was utilized to detect heat signatures emitted by live animals within the forest canopy. Detected heat signatures were recorded, and the drone flew vertically above the object to obtain precise GPS coordinates. Subsequently, focusing on areas with detected heat signatures, the drone captured detailed images using the optical camera with zoom capabilities to visually confirm and identify the animals.

Results

Delacour's langur

The ground and drone surveys conducted along established transects provided comprehensive insight into the distribution and population of langurs within the limestone complex (Fig. 5 to 8, Table 1). Ground surveys confirmed the

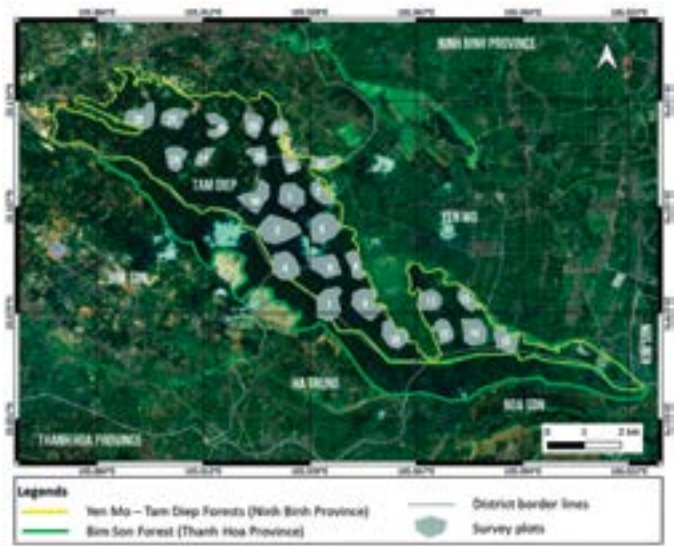


Fig.4. Drone survey plots established in the Tam Diep and Yen Mo District forests within the Ninh Binh Province section of the Yen Mo limestone complex.

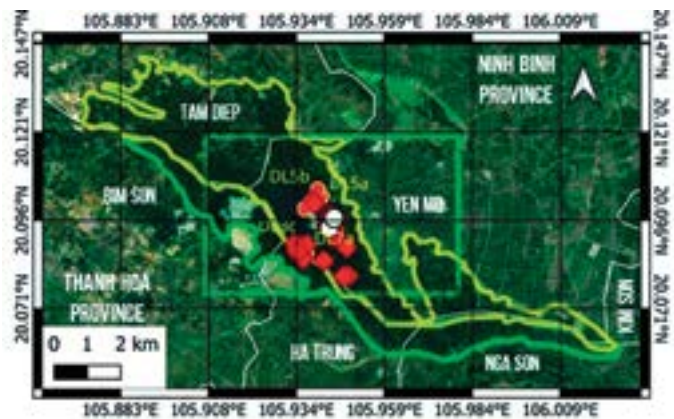


Fig.5. Overview combining all record points from all survey methods.

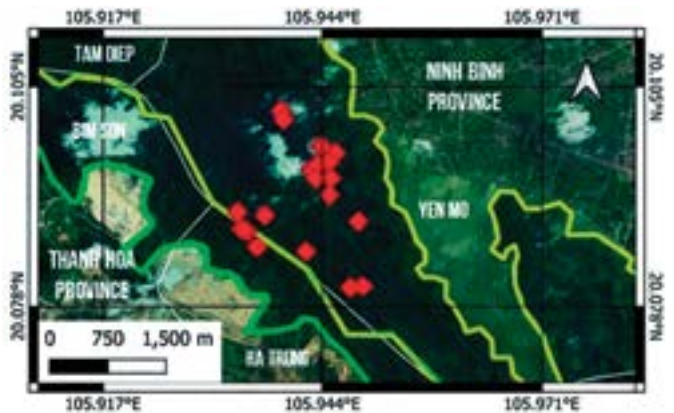


Fig.6. The occurrence of Delacour's langurs identified through interviews.

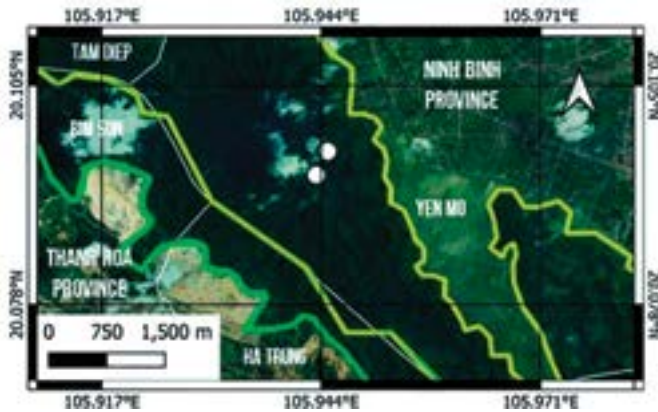


Fig.7. Locations of Delacour's langurs confirmed by ground surveys (2 groups, total 7 individual).

langurs' presence primarily in the central part of the Yen Mo District forest, aligning with hotspot locations identified through interview surveys. Conversely, langurs were notably absent from certain areas, such as the southeastern portion of Tam Diep District forest and the northwestern portion of Yen Mo District forest. The ground survey only counted two groups comprising a total of 7 individuals as factors like foggy weather and topographic obstructions hindered visibility, potentially impacting the count accuracy.

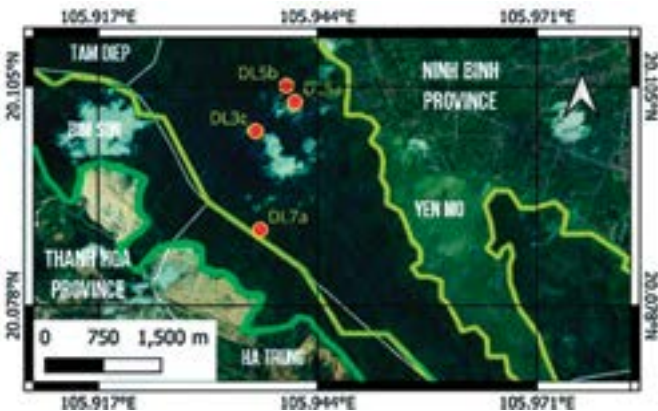


Fig.8. Specific sites of confirmed presence of Delacour's langurs from drone surveys (4 groups, total 37 individuals).

Table 1. Occurrence of Delacour's langur based on drone survey in Tam Diep and Yen Mo District forests within the Ninh Binh Province section of the Yen Mo limestone complex.

Date	Ref Survey plot	Ref Group	Group Size	Coordinates		Observation Survey plot	Maximum individuals
				Y	X		
01/02/2024	5	DL5a	11	20,102982	105,940822	inside	11
02/02/2024	5	DL5a	5	20,104975	105,939766	outside	
19/02/2024	1	DL5a	8	20,107483	105,938792	outside	
13/03/2024	5	DL5a	4	20,096059	105,940136	outside	
02/02/2024	5	DL5b	7	20,098675	105,942567	inside	7
02/02/2024	6	DL5b	4	20,097088	105,943084	outside	
13/03/2024	5	DL5b	1	20,096059	105,940136	outside	
12/03/2024	3	DL3c	2	20,099583	105,936543	outside	5
13/03/2024	3	DL3c	5	20,099375	105,935977	outside	
27/02/2024	7	DL7a	5	20,086935	105,93771	outside	14
27/02/2024	7	DL7a	14	20,087171	105,93652	outside	
Total groups		4				Total individuals	37

In contrast, drone surveys provided enhanced efficiency and resolution in locating langur groups. These aerial observations confirmed that the population is mainly confined to the central part of the limestone complex. Four groups totaling 37 individuals were identified. The dynamic nature of langur behavior, including subgroup formations during foraging, required careful follow-up to clearly delineate distinct groups. Additionally, langurs were mostly observed outside established survey plots, necessitating the inclusion of all sightings for a comprehensive assessment. Consequently, due to the species' rarity and the limitations of strict plot surveys, extrapolation models for the entire limestone complex were not applied to ensure an accurate representation of the langur population size.

For comparative purposes, the current distribution was compared with historical interview and ground survey records conducted before 2010 (Fig. 9). While the historical numbers could not be ascertained, the comparison revealed a similar distribution of langurs in the Yen Mo District forest, with a few observations in the adjacent southern strip of the limestone complex within Thanh Hoa Province. The present study was hampered in studying this area; however, given its relatively small size and the ongoing intensive limestone quarrying in that section, we do not expect to find a significant number of individuals.

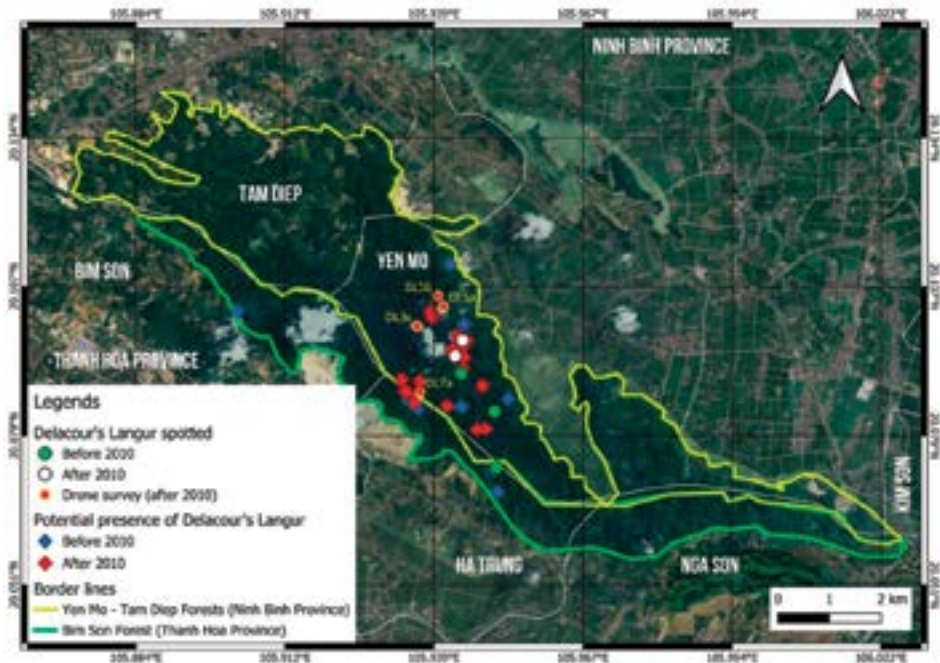


Fig.9. Distribution of Delacour's langur before and after 2010. Records of potential occurrences are based on interviews with locals in the field.

Other wildlife

While the primary aim of the present study was to assess the status of Delacour's langur in the Yen Mo limestone complex, the study also gathered information on other wildlife species in the area through ground transects and drone plots. Locals reported the presence of notable wildlife such as Indochinese serow (*Capricornis [milneedwardsii] maritimus*), Assamese macaques (*Macaca assamensis*), and Rhesus macaques (*Macaca mulatta*) (Figs. 10, 11; Table 2). The ground and drone surveys confirmed the occurrence of all these species, but also the keeled box turtle (*Cuora mouhotii*), Pallas's squirrel (*Callosciurus erythraeus*), and the oriental pied hornbill (*Anthracoceros albirostris*). Notably, given its relative rarity in the area, the presence of Indochinese serow, listed as 'Vulnerable' by the IUCN and included in Appendix I of CITES, was detailed. The drone survey counted only five

individuals during the entire drone survey, consisting of an adult-juvenile pair located in Tam Diep District forest and three other individuals scattered throughout the Yen Mo District forest.



Fig.10. Distribution of Assamese and rhesus macaques, as a result of the ground survey. For the Assamese macaque, a total of 210 individuals were distributed among 15 different groups, while for the rhesus macaque, there was one large group consisting of 47 individuals.

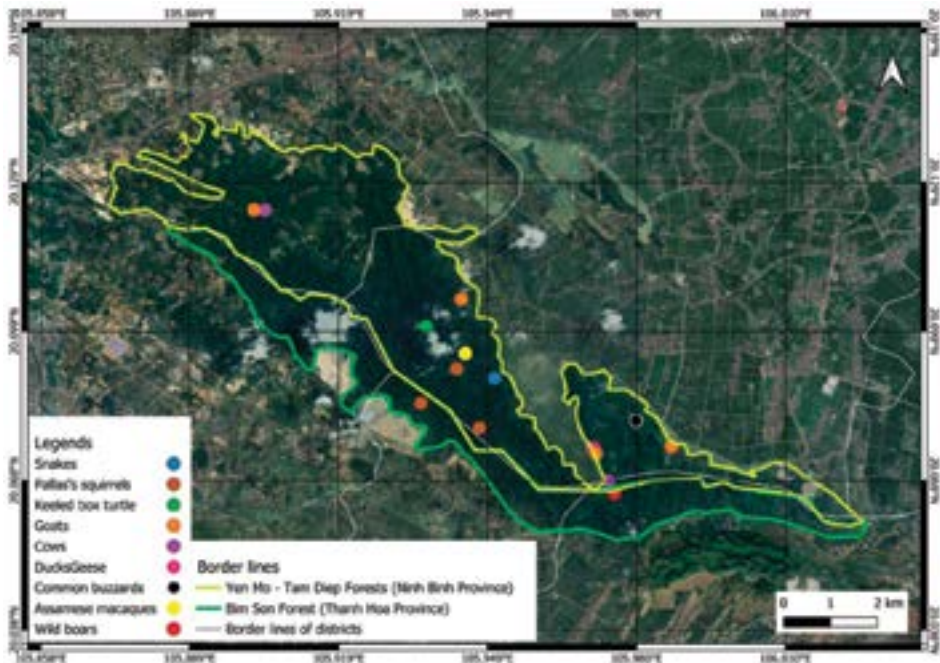


Fig.11. Records of animals during the ground survey.

Table 2. Animal records during ground and drone surveys.

No.	Common name	Scientific name	CITES	IUCN Red list	Ground survey			Drone Survey		
					Observed	Groups	Individuals	Observed	Groups	Individuals
1	Dela-cour's langur	<i>Trachypithecus delacouri</i>	Appendix II	CR	YES	2	7	YES	4	37
2	Assamese macaque	<i>Macaca assamensis</i>	-	NT	YES	1	15	YES	15	200
3	Rhesus macaque	<i>Macaca mulatta</i>	-	LC	NO	-	-	YES	1	47
4	Indo-chinese serow	<i>Capri-cornis [milneedwardsii] maritimus</i>	Appendix I	VU	NO	-	-	YES	-	5
5	Pallas's squirrel	<i>Callosciurus erythraeus</i>	-		YES	-	not assessed	YES	-	not assessed
6	Common buzzard	<i>Buteo buteo</i>	Appendix II	LC	YES	-	1	YES	-	not assessed
7	Oriental pied hornbill	<i>Anthracoceros albirostris</i>	Appendix II	LC	NO	-	-	YES	-	not assessed
8	Keeled box turtle	<i>Cuora mouhotii</i>	-	EN	YES	-	2	NO	-	not observed
9	Duck/Goose	domestic	-	-	YES	-	± 40	YES	not assessed	not assessed
10	Goat	domestic	-	-	YES	-	± 40	YES	-	± 50
11	Cow	domestic	-	-	YES	-	± 23	YES	-	unknown
12	Pig	domestic	-	-	YES	not assessed	not assessed	YES	-	± 60

Noteworthy to further detail is the primate fauna in the area, particularly the macaques. The drone survey revealed several macaque groups with relatively large numbers of individuals scattered across the limestone complex. Among these, the Assamese macaque predominates, estimated to comprise approximately 200 individuals distributed among 15 different groups, while the Rhesus macaque was identified with only one group, of 47 individuals. Although the Assamese macaque was among the species identified with the largest population and the highest number of groups, the majority of them were concentrated in the Yen Mo District forest. Meanwhile, rhesus macaques were sighted in one localized area in Yen Mo District forest in relative proximity to upland agricultural areas.

Threats

Local resident's report that over a decade ago, wildlife sightings, especially mammal species, were more frequent, but have since become rare, indicating a decline in populations. Interviews and ground surveys revealed persistent hunting activities, with evidence of various traps (footholds, snares, live traps, and mist nets) indicating widespread hunting practices targeting wildlife, including small mammals and birds (Fig. 12). Furthermore, residual agricultural products and litter accumulation were observed across the area, suggesting continuous agricultural activities. Agricultural cultivation, primarily for commercial trade and livestock husbandry, was observed in arable valleys, involving crops like Cassava, Achira, and Maize, leading to forest degradation. The presence of domestic animals, including ducks, geese, cows, pigs, and goats, was detected, particularly at forest edges and valleys, indicating land use for livestock (Fig. 11). Notably, the drone survey showed over 50 roaming goats, which are known to directly compete with Delacour's langur for food resources and space. Of particular concern is also the ongoing limestone quarrying, which, if left uncontrolled, poses one of the most significant threats in the long run whereby an estimated 400 ha of the 4,473 ha of the Yen Mo limestone complex has already been completely excavated, with no signs of halting.

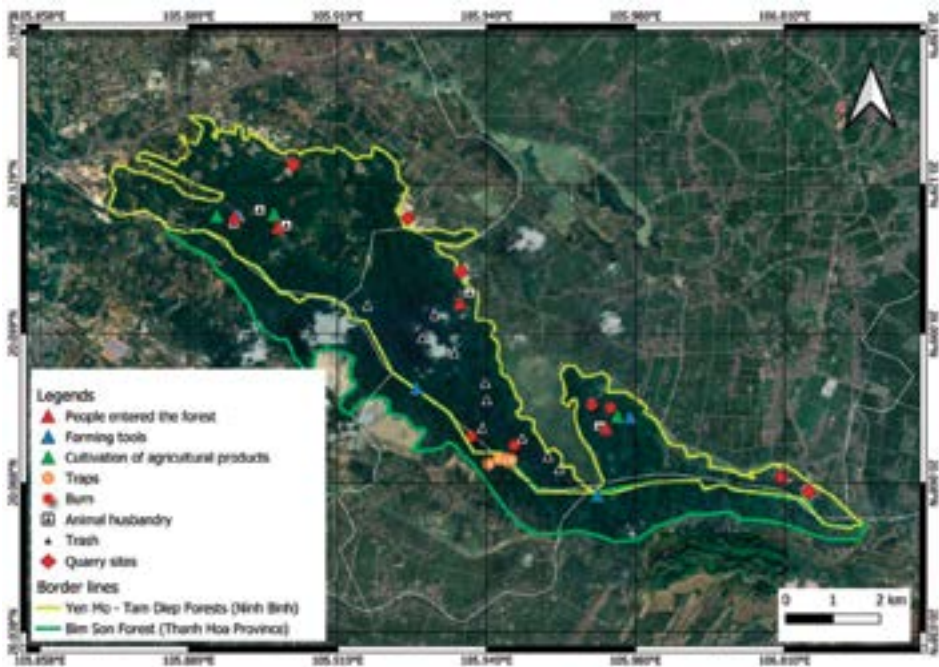


Fig.12. Identified threats during the ground survey.

Discussion

Delacour's langur, confined to a restricted area in northern Vietnam, has witnessed a significant shrinking in its distribution over the past few decades, with most subpopulations likely extinct (Nadler 2004; 2015). Given the species' critically endangered status, the search for remaining subpopulations is imperative. Our surveys led to the rediscovery of 37 individuals across four groups, marking it as the third-largest known population after the ones in and Van Long Nature Reserve and Kim Bang Forest (Fauna & Flora International 2024; Trinh Dinh Hoang et al. 2024), highlighting the importance of the population for conservation of the critically endangered Delacour's langur

The data gathered through combined interview, ground and drone surveys enabled us to map the distribution of the langur, revealing its primary occurrence within Yen Mo District forest in the central portion of the Yen Mo limestone complex. Based on the drone survey, the species' core distribution

was about 100 ha, but considering its potential home range, it would occupy approximately 400 ha of the 4,473 ha limestone complex. Comparison of this information with historical records indicates a similar distribution pattern consistent with present records, with langurs concentrated in the central part of the Yen Mo limestone complex and absent from its southeastern and northwestern sections. Historical surveys also noted langur presence in a narrow strip south of Yen Mo District forest, in Thanh Hoa Province, specifically in Bim Son and Ha Trung Districts. Due to administrative and logistical limitations during the present study, this area could not be re-surveyed. Future surveys should aim to assess the presence of remaining langurs in that section. However, given the relatively small size of this area and the intensive quarrying in that section, no significant increase in the known number of total langurs for the entire limestone complex is anticipated.

The concentration of the Delacour's langur in a constrained area rather than being scattered across the entire limestone complex raises questions about the factors influencing their distribution. Langurs are sensitive to environmental factors such as topography, climate and vegetation (Blair et al. 2021). For instance, no langurs were observed in the extended rocky surface with low vegetation coverage near Yen Thai communes in the southeastern part of the limestone complex. Furthermore, distribution might be influenced by the co-occurrence of other animal species. The survey revealed significant populations of 200 Assamese macaques and 47 Rhesus macaques distributed across the limestone complex, indicating potential competition between macaques and langurs (Nadler et al. 2019; Nguyen Dac Manh et al. 2020). A negative correlation between Delacour's langurs and Assamese macaques was found (Trinh Dinh Hoang pers. comm.). While natural factors may influence distribution and require further research, it is more likely that prolonged anthropogenic impacts, such as habitat destruction and hunting, have significantly influenced their distribution and population size over the recent decades.

While no direct evidence was found of current hunting activities targeting Delacour's langur, ground surveys revealed hunting activities, including the discovery of several traps. Hunting pressure is expected to significantly impact the local fauna, as reflected in the scarcity of species like the Indochinese serow, with only five individuals detected across the study area. Additionally, activities such as waste disposal, agriculture, and burning were observed, along with the presence of a significant number of goats, known for damaging vegetation and competing for resources with langurs (Wojciechowski & Nguyen Hong Chung 2013). Of particular concern are quarrying activities, which already affected nearly 8% of the Yen Mo limestone complex, especially in its southern border in Thanh Hoa Province. The quarrying activities has led to the complete flattening of limestone formations in these areas, vanishing the flora and fauna that depend on them. If left unchecked, the swift and seemingly relentless expansion observed in the neighboring Kim Bang limestone complex, where we estimate based on satellite images that 31% (± 2102 ha) of the 4713 ha block has already been excavated, is likely to result in comparable adverse effects in the Yen Mo limestone complex.

Mitigating the anthropogenic threats is crucial to prevent the extirpation of the Delacour's langurs in the Yen Mo limestone complex. Without immediate conservation efforts, the species faces a high risk of localized extinction, as evidenced by the dramatic reduction of the species historical range over the past 15 years. Surveys before 2010 identified 16 subpopulations (Nadler 2004; Nadler et al. 2015), but the lack of recent sightings in 12 subpopulations (75%) suggests that these groups have likely become extinct in less than two decades. The discovery in the present study of a still viable, though precarious, population presents the last opportunity for timely conservation. These remaining groups have potential for recovery, making these efforts critical for preserving both the local population and the species as a whole. The feasibility of such actions is demonstrated by the population in Van Long Nature Reserve, which quadrupled due to similar efforts since the 1990s (Nguyen Van Linh et al. 2019). Preserving genetic diversity and safeguarding remaining subpopulations will improve adaptability, disease resistance, and overall survival, reducing the risk of the species' extinction (Ebenau et al. 2011; Nadler 2015).

The rediscovery of the Delacour's langur population in Yen Mo District forest presents a critical opportunity for targeted conservation efforts. Their restricted distribution within the central part of

the limestone complex exacerbates their vulnerability to localized threats, yet also provides an opportunity to implement intensified patrolling units in this specific portion of the limestone complex. However, given that the langurs do not adhere to artificial borders, a comprehensive conservation strategy encompassing the entire limestone complex is essential. This necessitates the establishment of a management board for this limestone complex comprising governmental representatives from the relevant districts and provinces, alongside stakeholders such as NGOs, citizen representatives, and industries such as quarry managers. In the longer term, upgrading the forest status to a higher protection level using the Delacour's langur as a flagship species is crucial for safeguarding the area's biodiversity. This effort also involves on-the-ground law enforcement, offering ecotourism as an alternative income source for the community, and fostering environmental awareness about the area's significance and the urgent need to preserve it.

References

- Baker L** (1999): Survey of the Delacour's langur (*Trachypithecus delacouri*). Frankfurt Zoological Society and Endangered Primate Rescue Center. (Unpubl. report).
- Blair ME, Cao Thi Hong Giang, Lopez-Nandam EH, Veronese-Paniagua DA, Birchette MG, Kenyon M, Md-Zain BM, Munds RA, Nekaris KAI, Nijman V, Roos C, Thach Manh Hoang, Sterling EJ & Le Duc Minh** (2023): Molecular phylogenetic relationships and unveiling novel genetic diversity among slow and pygmy lorises, including resurrection of *Xanthonycticebus intermedius*. *Genes* 14(3), 643; <https://doi.org/10.3390/genes14030643>.
- Blair ME, Nguyen Tuan Anh, Le Minh Duc, Liu Z, Meng T, Horning N, Sterling EJ, Thach Hoang Minh, Xu M & Galante PJ** (2021): Karst as an abiotic driver of Francois' langur distribution, with predictions for biological communities on karst under climate change. *Frontiers of Biogeography*. 13.4, e51838
- Blair ME, Sterling EJ & Hurley M** (2011): Taxonomy and conservation of Vietnam's primates: A review. *Am. J. Primatol.*, 73(11), 1093-1106.
- Ebenau A, Nadler T, Zinner D & Roos C** (2011): Genetic population structure of the critically endangered Delacour's langur (*Trachypithecus delacouri*) in Van Long Nature Reserve, Vietnam. *Vietnamese J. Primatol.* 1(5), 1-15.
- IUCN Red List of Threatened Species** (2024): Delacour's langur *Trachypithecus delacouri*.
- Le Tien Duc & Le Huu Oanh** (2002): Survey on primates, especially the Delacour's langur (*Trachypithecus delacouri*) in Tam Diep mountain, Ha Trung District, Thanh Hoa Province. Cuc Phuong National Park, Frankfurt Zoological Society and Endangered Primate Rescue Center. (Unpubl. report).
- Luong Van Hao & Nadler T** (2009): Distribution of Delacour's langur (*Trachypithecus delacouri*) in Ha Vinh Commune, Ha Trung District, Thanh Hoa Province and Yen Dong Commune, Yen Mo District, Ninh Binh Province. Frankfurt Zoological Society. (Unpubl. report).
- Nadler T** (1996): Survey for the Delacour's langur in Yen Mo, Tam Diep and Bim Son. Frankfurt Zoological Society. (Unpubl. report).
- Nadler T** (2004): Distribution and Status of the Delacour's langur (*Trachypithecus delacouri*) and recommendations for its long-term conservation. In: Nadler T, Streicher U & Ha Thang Long (eds.): Conservation of Primates in Vietnam; pp. 63-71. Frankfurt Zoological Society, Hanoi.
- Nadler T** (2010): Status of Vietnamese primates – complements and revisions. In: Nadler T, Rawson BM & Van Ngoc Thinh (eds.): Conservation of Primates in Indochina; pp. 3-16. Frankfurt Zoological Society and Conservation International, Hanoi.
- Nadler T** (2015): The critical status of the Delacour's langur (*Trachypithecus delacouri*) and the call for a National Action Plan. *Vietnamese J. Primatol.* 2(4), 1-12
- Nadler T & Brockman D** (2014): Primates of Vietnam. Endangered Primate Rescue Center, Vietnam.
- Nadler T, Bui Van Tuan & Hoang Quoc Huy** (2019): Unexpected incidents during reintroduction of Hatinh langurs (*Trachypithecus hatinhensis*). *Vietnamese J. Primatol.* 3(1), 41-54.
- Nadler T & Luong Van Hao** (2000): Delacour's langur survey in the Yen Mo, Tam Diep, Bom Son limestone mountain. Frankfurt Zoological Society. (Unpubl. report).
- Nadler T, Momberg F, Nguyen Xuan Dang & Lormee N** (2003): Vietnam Primate Conservation Status Review 2002, Part 2: Leaf Monkeys. Fauna & Flora International-Vietnam Program and Frankfurt Zoological Society, Hanoi.
- Nadler T, Quyet LK, Rawson BM & Coudrat CNZ** (2020a): *Trachypithecus delacouri*. The IUCN Red List of Threatened Species.
- Nadler T, Rabett R, O'Donnell S & Nguyen Thi Mai Huong** (2020b): Delacour's langur (*Trachypithecus delacouri*) reintroduction program: A preliminary report on the trial release into the Trang An UNESCO World Heritage Site, Ninh Binh Province, Vietnam. *Vietnamese J. Primatol.* 3(2), 39-48.
- Nguyen Dac Manh, Tran Van Dung & Vu Tien Thinh** (2020): The competition between macaques and Cao Vit gibbon in Trung Khanh Species & Habitat Conservation Area, Cao Bang Province. *J. Forestry Science and Technology* 9, 103–112.
- Nguyen Van Linh, Mai Van Quyen & Nadler T** (2019): Rapid population increase of the 'Critically Endangered' Delacour's langur (*Trachypithecus delacouri*) in Van Long Nature Reserve due to strict protection. *Vietnamese J. Primatol.* 3(1), 3-18.
- Prime Minister of Government** (2017): Urgent Conservation Action Plan for Primates in Vietnam to 2025, Vision to 2030. Hanoi.
- Schwitzer C, Mittermeier RA, Rylands AB, Chiozza F, Williamson EA, Macfie EJ, Wallis J & Cotton A** (2017): Primates in Peril: The World's 25 Most Endangered Primates 2016–2018. IUCN SSC Primate Specialist Group, International Primatological Society, Conservation International, and Bristol Zoological Society.

- Tengcheng Que et al.** (2021): The reference genome and transcriptome of the limestone langur, *Trachypithecus leucocephalus*, reveal expansion of genes related to alkali tolerance. *BMC Biology* 19:67. <https://doi.org/10.1186/s12915-021-00998-2>.
- Fauna & Flora International** (2024): Report on the conservation of Delacour's langur in Ha Nam Provinve. (Unpubl. report).
- Trinh Dinh Hoang, Tran Van Giang, Nguyen Tra My, Nguyen Van Linh, Ta Quang Trung, Dinh Van Quynh, Do Van Thuy, Pham Van Cuong, Pham Ngoc Nam & Lienart G** (2024): Report for a UAV survey of Delacour's langur in Van Long Nature Reserve and Dong Tam forest, northern Vietnam. Van Long Nature Reserve, Three Monkeys Wildlife Conservancy, King Mongkut's University of Technology Thonburi & Rufford Foundation. (Unpubl. report).
- Wojciechowski F & Nguyen Hong Chung** (2013): The status of Delacour's langur (*Trachypithecus delacouri*) in the planned extension area of Van Long Nature Reserve. *Vietnamese J. Primatol.* 2(2), 37-47.
- Zhijin Liu et al.** (2019): Genomic Mechanisms of Physiological and Morphological Adaptations of Limestone Langurs to Karst Habitats. *Mol. Biol. Evol.* 37(4), 952–968.