

**Population assessment, habitat suitability and conservation
of the Northern White-cheeked Gibbon (*Nomascus leucogenys*)
in Vu Quang National Park, Vietnam**



Final project report to the Gibbon Conservation Alliance



**Prepared by: Tran Van Dung
Vietnam National University of Forestry
Contact: dungtv@vnuf.edu.vn**

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Summary

The Northern White-cheeked Gibbon (*Nomascus leucogenys*) is distributed in northwestern Vietnam, northern Laos, and, until recently, in southern China. The species is listed as Critically Endangered in the IUCN Red List due to its sharp population decrease and habitat loss. In the project, to provide baseline data for managers and conservationists implementing conservation actions, we conducted a field survey on the population status of *N. leucogenys* in Vu Quang National Park using the audio point count approach. We, then, integrated the Distance Sampling and Species Distribution Model to estimate the population size and potential habitat of this endangered gibbon. The field survey was conducted from April to July 2020 with 18 camps and 40 listening posts. A total of 19 northern gibbon groups were identified during the survey in Vu Quang National Park. Five of these groups were detected by direct observations. The daily gibbon calling probability was estimated at 0.263 (95% CI: 0.065–0.461). The gibbon groups are mainly recorded in the center of Vu Quang National Park. The area of suitable gibbon habitat was predicted at nearly 251.85 km² and accounted for 45.56% of the total area of Vu Quang National Park. We also estimated the gibbon density at about 0.74 group/km² (95% CI: 0.31–1.78) and the gibbon population size at about 185 (95% CI: 78–448) groups. Therefore, the gibbon population in Vu Quang should be one of the priorities for conservation of this species in Vietnam, besides the populations of Pu Mat NP and Xuan Lien NR. In addition, the project organized gibbon conservation activities for several villages in the buffer zone of Vu Quang National Park with more than 500 local participants. Finally, based on population status and the main threat to this Critically Endangered gibbon, we provide recommendations for implementing conservation actions for the species in Vu Quang National Park.

1. Introduction

Nowadays, biodiversity is increasingly declining, and especially primate species due to habitat loss, hunting, climate change, and other threats (Estrada et al. 2017). The size of the wildlife population most directly illustrates the degree of species endangerment and the effectiveness of conservation policies and practices (McComb et al. 2010). Therefore, knowledge on the population status of species can contribute to conservation efforts and help to address the biodiversity crisis (Hassel-Finnegan et al. 2008; Vu et al. 2018a). Understanding the population status of a species is of high importance for monitoring, and also is a top priority for conservation programs and action plans (Buckland et al. 2001). However, we are seriously lacking data on the population status of many species (Coudrat et al. 2013; Sodhi et al. 2009; Tordoff et al. 2012), especially rare species.

Of the 20 currently recognised gibbon species, all are considered endangered with extinction. Therefore, information on their population status is crucial and very necessary to monitor and implementing conservation plans. Accurate population estimates for a species enable managers and conservationists to determine the threat level and to prioritize populations for conservation intervention. However, methods used for estimating gibbon populations are still limited with a large number of bias resulting in inaccurate results.

The Northern White-cheeked Gibbon (*Nomascus leucogenys*), a crested gibbon, is distributed in northwestern Vietnam, northern Laos and, until recently, southern China. In Vietnam, the species occurs from the southwest of the Black River (Dien Bien province) to north of Rao Nay River (Ha Tinh Province) (Rawson et al. 2011). The population of this species has decreased by at least 80% over the past 45 years (Bleisch et al. 2008), and this gibbon is listed as Critically Endangered in IUCN red list (IUCN 2021). The main threats to the species are illegal hunting and habitat loss because of illegal logging and expanding cultivation areas (Nguyen et al. 2011; Rawson et al. 2011). Therefore, this gibbon is a species of special conservation concern in Vietnam as well as in Southeast Asia. The total population size of *N. leucogenys* in Vietnam remains unclear. Only a few rapid surveys focused on the status and distribution of the species have been conducted. According to the recent rapid surveys, 84 gibbon groups were detected in 10 isolated protected areas in northern Vietnam (Nguyen et al. 2011). A rapid survey in 13 days in 2011 confirmed 10 groups in northwest of Vu Quang National Park, while the majority of the protected area has not been surveyed. Therefore, Vu Quang National Park needs to have an additional survey to determine the population size, and conducting the conservation activities in the area (Rawson et al. 2011).

In the study, to provide baseline data for managers and conservationists implementing conservation actions for species, we used the audio point count method (Brockelman & Ali, 1987) to gather field data. We, then, use the approach in integrating Distance Sampling and Species Distribution Model (Tran & Vu, 2020) to estimate the population abundance of *N. leucogenys* in Vu Quang National Park. The result of population size for the gibbon in the protected area can be used for implementing long-term monitoring and conservation actions.

2. Goal and objectives

2.1. Goal

The goal of the project was provided and updated information on the population, distribution, and threats of the Northern White-cheeked Gibbon in Vu Quang National Park. The project will also implement activities to enhance the conservation capacity of forest rangers in Vu Quang National Park and the awareness on conservation of local communities.

2.2. Objectives

1. To assess the population status of Northern White-cheeked Gibbon in Vu Quang National Park.
2. To identify the threats to the gibbon population and its habitat.
3. To implement gibbon conservation activities in the study area.
4. To provide appropriate recommendations for species management and conservation in Vu Quang National Park.

3. Method

3.1. Study area

Vu Quang National Park (NP) was established in 2002 (Degree 102/2002/QD-TTg of Prime Minister), covering an area of 55,273.6 ha. Currently, Vu Quang NP is located in three districts in Ha Tinh province, including Vu Quang, Huong Khe, Huong Son district. The protected area lies on the Annamite mountain, which is the highest biodiversity area in Vietnam as well as Indochina. Vu Quang NP connects with Huong Son forest to the north and Nakai-Nam Theun National protected area (353,200ha) to the south-west Laos PDR, which is one of the largest primary forest areas for conservation in Indochina (BirdLife International, 2019). Until now, 94 mammals, 315 birds, 58 reptiles, and 31 amphibians have been confirmed in Vu Quang NP (Vu Quang NP, 2014). Two new mammals were discovered from the national park in the 1990s, including Sao La (*Pseudoryx nghetinhensis*), and Giant Muntjac (*Muntiacus vuquangensis*) (Vu Quang NP, 2014). The fauna of Vu Quang NP is not only diverse in the number of species but also contains high endemic level in Indochina, such as Northern White-cheeked Gibbon (*Nomascus leucogenys*), Edwards's Pheasant (*Lophura edwardsi*). Therefore, Vu Quang NP was assessed as an important site in conserving wild animals, especially large mammals (Eve, 2000). Furthermore, the protected area is also determined as an important bird area in Vietnam (BirdLife International, 2019; Tordoff 2002), and lies Annamese Lowlands Endemic Bird Area (BirdLife International, 2019). In addition, the protected area reported that 1,678 flora species with 191 families have been confirmed (Vu Quang NP, 2014). In which, 94 species were listed in the Vietnam Red List Book (2007). Vu Quang NP is considered as an important regional conservation priority in Vietnam. However, the ecosystem in Vu Quang NP is facing degradation due to anthropogenic impacts such as deforestation, illegal wildlife hunting, fragmented habitat (Birdlife International, 2019; Eve, 2000).



Figure 1. Location of Vu Quang NP in Vietnam

3.2. Survey method

An open questionnaire method was used before conducting the field surveys. Interviewees are local hunters, forest rangers, and nature reserve's staffs, who have historically interacted with the forests about the distribution of the species in the areas. We asked about the presence, locations, group structure, and main threats of the gibbon population by surveyors. Information acquired via the interviews was used to aid the field survey results and evaluating the threats the endangered species are facing.

In the project, we used the auditory point count method to assess gibbon population size and density during the survey (Brockelman & Ali, 1987). Group and individuals were recorded using combined information from angles, distances, and song characteristics. The sampling points were defined by topographic and habitat in the survey areas. The field survey was conducted from April to July 2020. In total, 40 listening posts in 18 camps have been surveyed. In particular, because of the extreme weather in Vu Quang, there were 28 and 12 listening posts surveyed in three and two successive days, respectively. Surveyors listened from 04:00 to 11:00. During the surveys, the surveyors recorded compass bearing, distance to the calling gibbon, start and end time of all song bouts, and type of songs. The distance from listening posts to the gibbon call location was estimated using a rangefinder and topographic map. GPS devices were used to record the location of the listening posts in the field. Information about wildlife trapping and habitat disturbances was also gathered by our surveyors. During the same sampling time period, we also set up recorders to record the songs of gibbon. The data from recorders will be used to aid the auditory point count method.

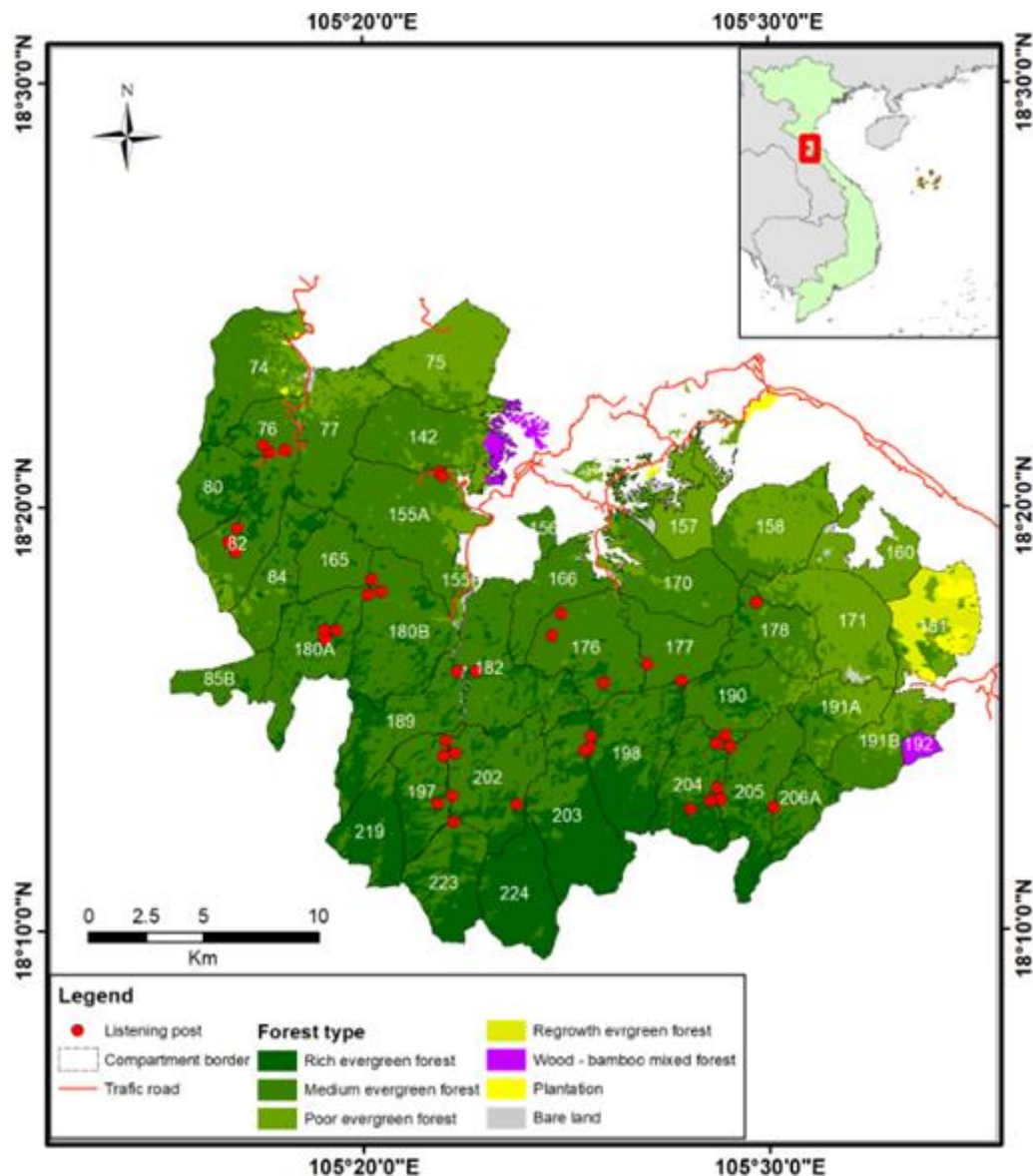


Figure 2. The location of listening posts for gibbon survey in Vu Quang NP.

3.3. Data analysis

Locations of gibbon groups were determined through the triangulation using the angle and distance from surveyors because there is overlap among listening posts in MapInfo 10.5 (Pitney Bowes Business Insight). Different groups were differentiated by their locations. If detected groups are >500m apart (Brockelman & Ali, 1987), we considered them as separate groups.

Moreover, we used vocalization software to analyze and determine the total number of gibbon individuals in each group base on the structure of the songs. RAVEN software (Cornell Lab of Ornithology) was used to generate spectrograms and count individuals. The sonograms could help to distinguish between the songs of male, female or juvenile gibbons. Crested gibbon songs consist of phrases from both sexes. The great call is produced by adult females, is the most easily identifiable phrase of the gibbon song. A duet is a song bout in which both sexes produce their loud vocalizations and exhibit vigorous movements in an interactive manner. Young gibbons normally give calls with their parents at the same time and thus can easily be counted in sonograms (Konrad & Geissmann, 2006).

3.3.1. *Calling probabilities*

Because gibbon groups do not call daily (Brockelman and Ali 1987; Geissmann et al. 2000; Pham 2002), the field survey period should be conducted over at least three consecutive days to obtain a high proportion of groups singing (Brockelman & Srikosamatara, 1993). We used the “closed population” assumption (Vu et al. 2018b) to increase the accuracy of daily calling probability. The gibbon groups detected at distances < 700 m from listening posts should be used to calculate the probability. With the mountainous area like Vu Quang NP, the maximum hearing distance is longer than that of the flat area (Vu and Dong, 2015). Therefore, we used group detected at distances < 1,000 m to calculate the probability of the gibbon song followed. In the study, we used 19 gibbon groups that were recorded in the listening posts over three consecutive days to calculate the calling probability of gibbon in Vu Quang in one day (p_1) based on the method of Jiang et al. (2006).

3.3.2. *Distance sampling*

We used the distance sampling method (Buckland et al., 2001) to estimate the population density in the study area by Distance program (Thomas et al., 2010). The distance sampling method allows for reduced detection probability of animals as distance increases. Statistic models include Uniform, Half-normal, and Hazard rate with cosine and hermite polynomials, simple polynomial expansion as suggested by Buckland et al. (2001) be used to model the relation between detection probability and distance. We selected the best model using Akaike Information Criteria (AIC) (Buckland et al., 2001). One main assumption of distance sampling is detection on the line or at the listening station will equal to one. If not, an estimated detection probability on the line or at the listening/observing station is needed to correct density estimates. This estimate is necessary for gibbon surveys because gibbons do not call every day (Brockelman & Ali, 1987).

3.3.3. *Species distribution modeling*

There were seven environmental variables using to generating suitable habitat for *N. leucogenys* in Vu Quang NP. The environmental variables were selected based on the characteristics in selecting the habitat of the gibbon, and the relationship among variables. There were three variables related to vegetation status of the study area, including Primary forest layer; Tree canopy cover; Tree canopy height. Three variables related to landcover were download from the GLAD team (GLAD-UMD and SERVIRMekong 2017); three variables describe the topography (elevation, slope, and aspect). The DEM layer was download from the Shuttle Radar Topography Mission (SRTM) 1 Arc Second at <https://earthexplorer.usgs.gov/>. In addition, to assess the impact of local residents on the suitable distribution of gibbon, we also used the variable of distance from residence (including residential areas, and agricultural lands, traffic roads). This data was extracted from the land cover map, both of the core zone and the buffer zone of Vu Quang NP (scale 1:25,000). All the data layers were converted to raster and resampled to a resolution of 30 m x 30 m.

We used the locations of gibbon group recorded from the audio point count method as the occurrence data for the MaxEnt model. To avoid model over-fitting bias due to spatial autocorrelation, we removed the duplicate occurrence points by selecting one locality per 500 m², leading to 19 occurrence locations. Because the number of occurrences of gibbon was small (<25), thus we applied the jackknife method for a small sample size (Pearson et al., 2007) to run the final model.

Species distribution modelling uses species occurrence data along with environmental predictor variables to project a model of suitable habitat for species from existing information (Phillips et al. 2006). We applied the MaxEnt (v. 3.3.3k; Phillips et al. 2006) with the user-defined parameters to model the suitable habitat of gibbon in Vu Quang NP. Forty-eight candidate models with combinations of the “feature class” and “regularization multiplier” to select the best model. In the study, we used six types and combinations of restriction (“feature class”), including linear (L), quadratic (Q), threshold (T), hinge (H), linear+ quadratic (L+Q), and linear + quadratic + hinge (L+Q+H) (Morales et al. 2017). Each feature class was combined with regularization multiplier values from 0.5 to 4 (interval = 0.5) to create candidate models. To select the best model, we used the ENMeval package in R of Muscarella et al., (2014) to find the minimum AICc value from 48 candidate models. MaxEnt software can generate a map layer with pixels representing suitable level with values ranging from 0 to 1. Outputs of the model was analyzed by using ArcMap software version 10.2 (ESRI, Redlands, USA). The area of suitable habitat was used to calculate the density of gibbon in the study area. The integrating Distance sampling and Species distribution modelling approach were described by Tran & Vu (2020).

The conservation activities were implemented with the collaboration of the Vietnam National University of Forestry and Vu Quang NP. Community meetings in order to talk about protecting wildlife were conducted in communes in the buffer zone of Vu Quang NP. The posters, and T-shirts were printed gibbon's photo as a tool to encourage people to protect gibbon and delivered to our team members, Vu Quang NP' staffs, volunteers, and local people.

The appropriate recommendations for gibbon conservation were proposed base on the population status, distribution, threats on the gibbon. Importantly, the level of awareness of local communities and staffs of NR will be considered in the recommendation for gibbon.

4. Results and discussion

4.1. Gibbon groups detected and calling probability

In the project, we detected 19 northern white-cheeked gibbon groups during the field survey in Vu Quang NP. In particular, only one group called on three days, five groups sang on two days, and the remaining groups called only on one day each. We directly observed five groups in the field. The detail of gibbon groups is shown in Table 1.

We determined all of the gibbon groups at a distance <1,300 m from listening posts. The daily gibbon calling probability was estimated at 0.263 (95% CI: 0.065- 0.461). The calling probability of gibbon in Vu Quang NP was almost equal to that Northern Yellow-cheeked Gibbons (*N. annamensis*) in Kon Ka Kinh NP (0.275; Ha et al., 2011) but lower than those of field surveys in Ta Dung NP (0.5; Hoang et al., 2010), and in Song Thanh NR (0.55; Tran & Vu, 2020).

During the field survey, our team often experienced bad weather (rain and mist), that might have caused a lower calling probability of gibbons in Vu Quang NP. It should be noted that the rainfall in the rainy season can suppress vocal activities (Coudrat et al. 2015; Phan and Gray 2009; Rawson 2004).

Table 1. Groups of Northern White-cheeked Gibbons (*Nomascus leucogenys*) detected during the survey in Vu Quang NP. Abbreviations: x = detected on the survey day; 0 = not detected on the survey day.

ID group	Day of survey			Forest compartment	Listening post
	Day 1	Day 2	Day 3		
1	x	x	0	176	7.2
2	x	0	0	177	7.2
3	x	0	0	177	7.1
4	0	0	x	198	8.3
5	x	0	0	198	8.1; 8.2
6	x	x	0	203	8.1; 8.2
7	x	0	0	202	8.1; 8.2
8	x	0	0	197	9.1
9	x	x	0	197	8.2; 8.3
10	0	0	x	197	8.3
11	x	x	x	180B	11.2; 11.3
12	0	0	x	180B	11.3
13	0	0	x	165	11.1; 11.2
14	x	0	0	180A	Observed
15	x	0	0	82	Observed at 14.1
16	0	x	0	82	14.1; 14.2
17	0	0	x	80	14.1
18	x	x	0	204	16.1; 16.2
19	0	x	0	204	16.1

4.2. Distribution of gibbons in Vu Quang NP

During the field survey, we detected 19 gibbon groups in Vu Quang NP. The gibbon groups mainly distributed in the center of Vu Quang NP. In particular, at least three groups were determined at 80 and 82 compartments, and four other groups distributed in the intersection of compartments number 165, 180A, and 180B. The remaining gibbon groups concentrated in the southern part of Vu Quang NP, including compartment numbers 176, 177, 198, 197, 202, 203, 204. Generally, the northern white-cheeked gibbon distributed in the center of the core zone of Vu Quang NP. It can be seen that the areas were far from the border of the protected area and might take many efforts to access the sites due to the rugged terrain from buffer zone. The area was cover primarily by rich and medium evergreen broad leaves forest and less the disturbance of human activities.

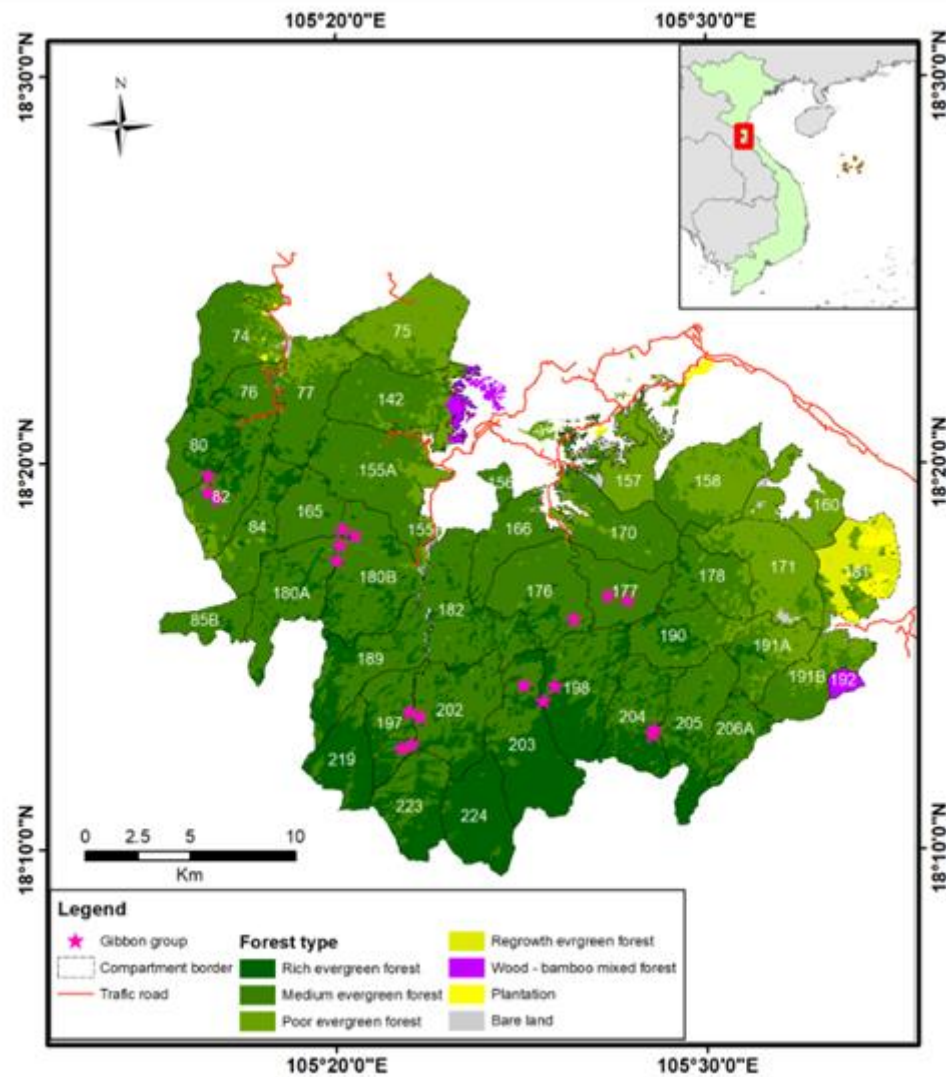


Figure 3. The location of detected gibbon groups in Vu Quang NP.

4.3. Habitat suitability for gibbons in Vu Quang NP

Based on the result of ENMeval, we selected the model with feature class = H and regularization multiplier = 3 as the best model to generate the suitable area of gibbon in Vu Quang NP ($AIC_c = 512.42$). Our model predicted the suitable habitat with high value of area under the curve (mean $AUC_{\text{training}} = 0.909 \pm 0.004$; mean $AUC_{\text{test}} = 0.854 \pm 0.105$). The suitable habitat of gibbon was predicted at nearly 251.85 km², and accounted for 45.56% total area of Vu Quang NP (Figure 4).

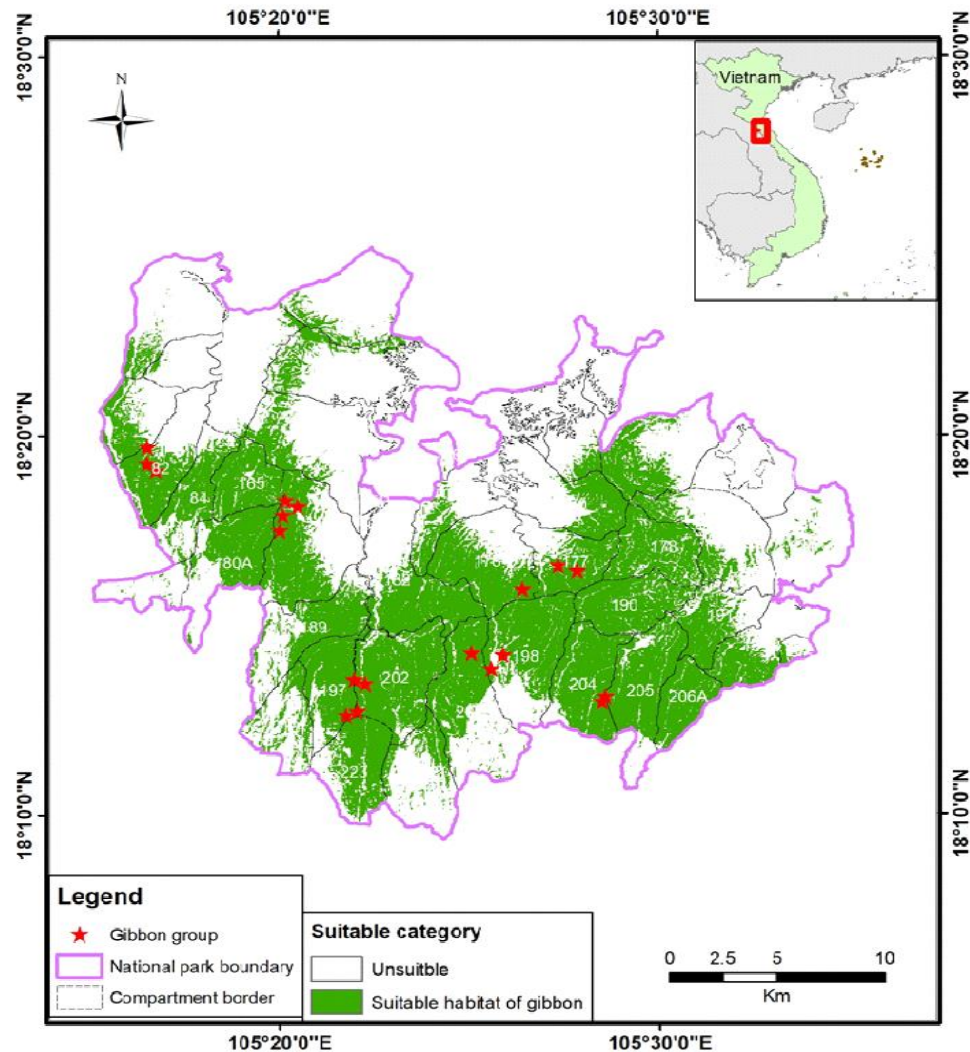
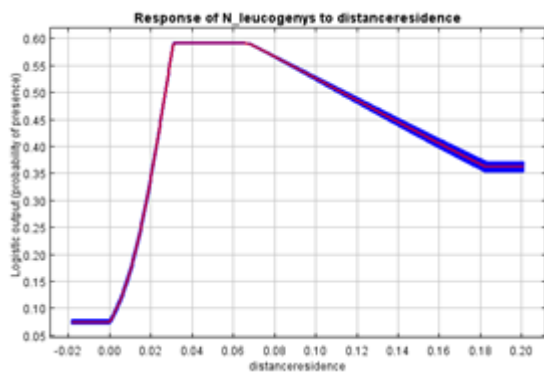
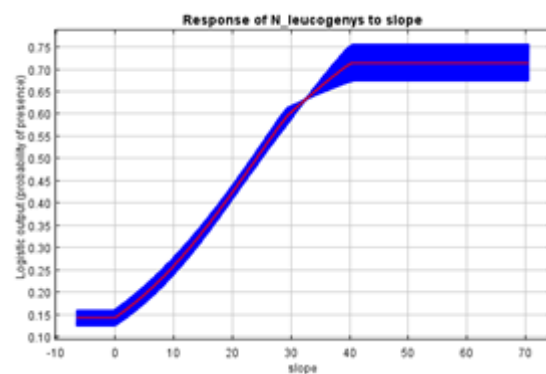


Figure 4. The habitat suitability for Northern White-cheeked Gibbons (*N. leucogenys*) projected using MaxEnt model in Vu Quang NP.

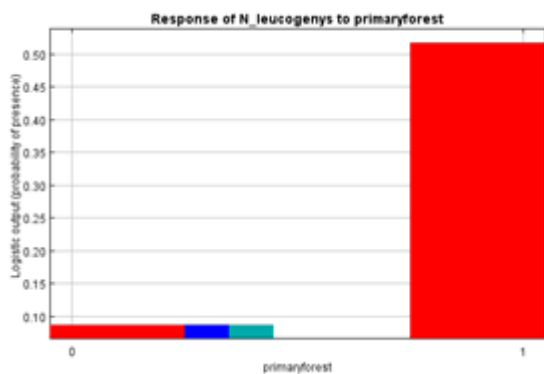
It can be seen that the suitable habitat of gibbon in Vu Quang NP generated by the MaxEnt model covers most of the gibbon groups detected during our field survey in 2020. The suitable area concentrates in the center of Vu Quang NP. Our model suggests that the “Distance to residence” (58%) is the most important variable followed by “Slope” and “Primary Forest” with 19.8% and 13.2%, respectively. With the increase of distance to the villages, the habitat is to be more suitable for gibbon. The habitat near the residential area might be disturbed due to activities of local people such as agriculture production, road construction, illegal logging, while gibbon is a species very sensitive to anthropogenic activities. In addition, the suitable area also focuses on the regions with high slopes. We assume that the rugged terrain areas may be less impacted by local communities. Thus, it should be the potential distribution of gibbon. Our model also seems to be underestimation when areas in the western and southern part next to the boundary of the NP are unsuitable to the gibbon because these areas are covered by primary forest and are far from villages. The result can also explain by the influence of high elevation on the distribution of gibbon. The suitable altitude of the gibbons is mainly under 2,000 m asl (Minh et al., 2005; Tran & Vu, 2020), while the areas in the western and southern of Vu Quang NP are dominated by high mountains with more than 2,000 m elevations. The response of gibbons to major environmental variables is shown in Figure 5.



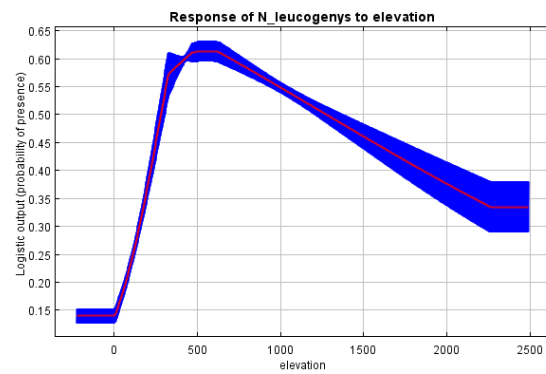
(a) Response of suitable area of *N. leucogenys* to Distance to residence.



(b) Response of suitable area of *N. leucogenys* to slope.



(c) Response of suitable area of *N. leucogenys* to Primary forest.



(d) Response of suitable area of *N. leucogenys* to Distance to elevation.

Figure 5. The response of gibbons to the most important environmental variables

4.4. Population size estimation of gibbons in Vu Quang NP

Based on the result of Distance sampling analysis, we select the Uniform function with cosine expansion as the best model to estimate the population size of gibbon in Vu Quang NP (AIC value = 120.32). The detection probability of calling within 1,300 m is estimated at 0.30 (95% CI: 0.26-0.36). The model also estimated the gibbon density of about 0.74 groups/km² (95% CI: 0.31-1.78) (Table 2).

Table 2. Results of distance analysis for four different models in a survey for Northern White-cheeked Gibbon (*N. leucogenys*) in Vu Quang NP.

Model	AIC	X ²	Detection probability (95% CI)	D (95% CI) (group/km ²)
Uniform + cosine	120.32	0.44	0.30 (0.26-0.36)	0.74 (0.31-1.78)
Half-normal + cosine	120.56	0.43	0.27 (0.18-0.39)	0.86 (0.34-2.16)
Half-normal + hermite polynomial	120.56	0.43	0.27 (0.18-0.39)	0.86 (0.34-2.16)
Uniform + simple polynomial	121.86	0.25	0.41 (0.35-0.50)	0.55 (0.23-1.33)
Hazard rate + cosine	124.08	0.19	0.29 (0.15-0.55)	0.80 (0.28-2.24)
Hazard rate + simple polynomial	123.40	0.16	0.19 (0.02-1.00)	1.14 (0.13-10.01)

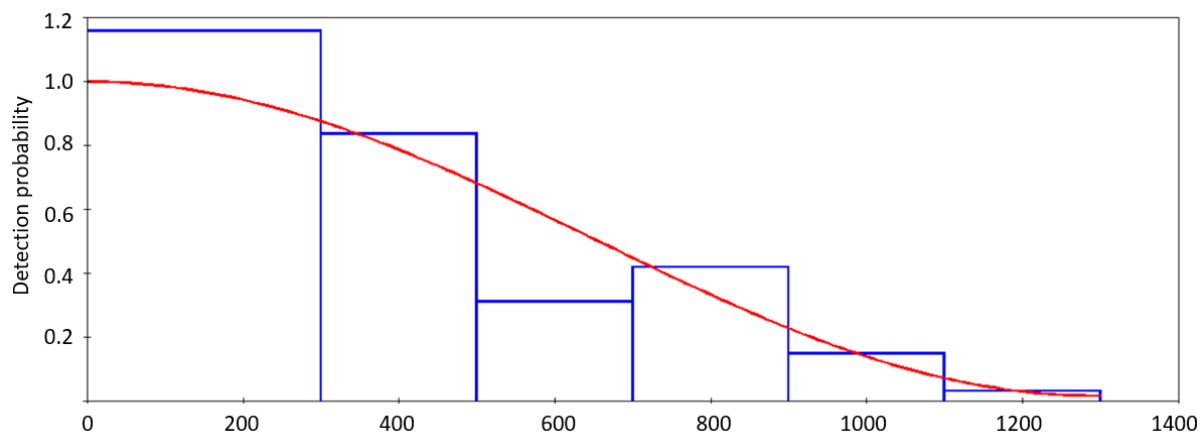


Figure 6. Detection of probability function of Uniform model with cosine expansion for calling gibbon groups in a survey for Northern White-cheeked Gibbon (*N. leucogenys*) in Vu Quang NP.

Integrating the result from Distance Sampling and MaxEnt model, we estimate gibbon population size in Vu Quang NP about 185 (95% CI: 78 - 448) groups. Our result is the first report of the status and distribution of crested gibbon for Vu Quang NP reserve since the rapid survey of Nguyen et al. (2011) in the northwest of the protected area. With 19 confirmed group and 185 estimated group, gibbon population in Vu Quang should be concerned as one of the priorities for conservation the species in Vietnam beside Pu Mat NP (22 confirmed groups and 130 estimated groups; Luu and Rawson, 2011), and Xuan Lien NR and adjacent Pu Hoat NR, with an estimate of at least 41 groups (Rawson et al., 2011). In addition, Vu Quang NP possesses a long boundary with Nakai-Nam Theun National Protected Area, one of the most important areas for gibbon conservation in Laos PDR (Chanthaphone, 2013). Thus, the transboundary conservation activities between Vu Quang NP and Nakai-Nam Thuen should be proposed for conservation the critically endangered gibbon.

4.5. The major threats to gibbons and other wildlife species in Vu Quang NP

Illegal hunting is possibly the biggest threat to the gibbon and other wildlife species in Vu Quang NP. We could not detect any case of illegal hunting gibbon during the field survey. However, we met several other wildlife species that were hunted mostly by traps, including primates (Red-Shanked Douc Langurs), Civets, and Annamite Striped Rabbit. Hunting activities often occur in remote areas in Vu Quang NP. Therefore, the protected area rangers are facing many challenges to control the hunting activities due to the far distance from the forest ranger stations and the complex topography of Vu Quang NP.



Figure 7. An adult Red Shanked Douc Langur (*Pygathrix nemaeus*) was captured by trap.



Figure 8. An Annamite Striped Rabbit (*Nesolagus timminsi*) was captured by trap.

4.6. Implementing gibbon conservation activities in Vu Quang NP

In cooperation with Vu Quang NP, we implemented conservation activities to improve the awareness of local communities in the buffer zone of Vu Quang NP, including Tan Phu village (Huong Khe district), Kim Tho, Kim Quang (Vu Quang district), and Lang Che village (Huong Son district). In the meeting, our team presented and discussed with local authorities and communities on gibbon conservation information such as the current status of the gibbon in Vu Quang NP; why is it necessary to conserve gibbons; the role of local communities in gibbon conservation; the current regulations of law in the protection of gibbons and other wild species. We also organized “Question and Answer Gameshow” to ask and provide knowledge on gibbon conservation to local people. Nearly 500 participants from local authorities, forest rangers, and communities involved in our meetings and expressed their positive commitments and support to gibbon conservation. Local people also suggested various recommendations to our team and Vu Quang NP staffs for protecting the endangered gibbon. Awareness material including posters, lecture files were distributed to Vu Quang NP, and local people. The project also provided 50 T-shirts to our volunteers, forest rangers of Vu Quang NP, and local villagers.



Figure 9. Conservation activities carried out during this project to raise awareness of local people in Vu Quang NP.

4.7. Recommendation for gibbon conservation in Vu Quang NP.

Based on the status, distribution of the gibbon population, and major threats to the species in Vu Quang NP, we suggest recommendations to the gibbon population, and improve the successful conservation efforts.

(a) Increasing the capacity for law enforcement management in conserving gibbon as well as other wildlife species

The forest rangers of the Vu Quang should be increased both in quantity and quality. Lack of the number of forest rangers was the main reason leading to a limited number of patrols. In addition, the staffs also need to improve their knowledge and skills in identifying and monitoring wildlife species, including Northern White-cheeked Gibbon. The training for forest rangers also should focus on the abilities in using technical equipment such as GPS, camera, or recorders, and mapping software. It allows the management board to reduce the budget for hiring the gibbon experts.

The illegal hunting situation should be strictly prevented in the core zone of the protected area. The illegal wildlife traps need to be removed and destroyed immediately. In addition, the management board of Vu Quang NP should conduct more conservation activities, especially for villages near the forest, encourage the local people to stop using traps for hunting wildlife species.

(b) Establishing a monitoring program for Northern White-Cheeked Gibbon in Vu Quang NP

The data on population dynamics plays a vital role in conserving endangered wildlife species. Therefore, a monitoring program for northern white-cheeked gibbon should be established annually. Some listening posts for monitoring gibbon are center of Vu Quang NP,

including compartment numbers 80, 82, 180A, 180B 176, 177, 198, 197, 202, 203, 204. Furthermore, the forest range of Vu Quang NP will participate in the program as key members, which allows to improve staff members' ability and reduce the expenses for hiring experts from other organizations.

(c) Rising the awareness and living standard for local community in conserving gibbon

The cooperating between protected area management broad and local people is crucial to encourage communities in conserving gibbon and their habitat. More conservation activities should be conducted for local communities around Vu Quang NP, in which Posters, T-shirts can be used as a useful tool to attract local people involving in the activities. The content of the document can focus on biodiversity laws and the value of natural resources. In addition, we also should organize education courses for students in communes, where are in the buffer zone of the Vu Quang NP. The picture, movies should be used to combine with presentations in class. The activities will help the students to raise natural love and encourage them to participate in conservation wildlife programs. In addition, enhancing the cooperation between Vu Quang NP and Nakai-Nam Theun NP is also very important to implementing transboundary conservation activities for gibbon as well as for other wildlife species.

5. Financial statement

The finance of the project was covered by Gibbon Conservation Alliance (USD 5,000), Idea Wild (USD 750). Fund has been disbursed following to proposed budget in the proposal. The detail of expenditure is shown in Table 3.

Table 3. The summary of actual expenditure for the project. (1 USD = 22,890.00 VND).

No	Description	Estimated budget			Actual amount		Difference (USD)
		Amount from GCA	From IDEA WILD	Total	USD	VND	
1	Vehicle Rental: 2 motorbikes x 50 days x USD 8 (travel during interview (5 days) and fieldwork (40 days) by motorbike (2 people/1 motorbikes), and conservation activities (5 days)	800	160	960	955.00	21,860,000.00	5
2	Vehicle Gas and Maintenance: Gas for motorbikes during interview, fieldwork, conservation activities (2 x 50 days x USD 3)	300	60	360	350.15	8,015,000.00	9.85
3	Travel: 4 team members x USD 50 (Travel from Hanoi to study sites and vice versa by coach (Hanoi - Vu Quang) for field survey.	200	–	200	157.27	3,600,000.00	42.73
4	Travel: 2 team members x USD 50 (Travel from Hanoi to study sites and vice versa by coach (Hanoi - Vu Quang) for implementing conservation activities	100	–	100	78.64	1,800,000.00	21.36

No	Description	Estimated budget			Actual amount		Difference (USD)
		Amount from GCA	From IDEA WILD	Total	USD	VND	
5	Lodging: 20 days (5 days interview and 10 days fieldwork) x USD 10x 2 rooms (2 people/room) (other days in fieldwork will stay in camp in the forest)	300	100	400	436.87	10,000,000.00	-36.87
6	Lodging for conservation activities (1 room x 5 days x USD 10)	50	–	50	54.61	1,250,000.00	-4.61
7	Food in interview process: 6 people (4 team members + 2 local guides) x 5 days interview x USD 5)	150	360	510	552.64	12,650,000.00	-42.64
8	Food for field survey: (7 people (4 team members + 1 forest ranger + 2 local guide) x 40 days fieldwork x USD 5))	1,400	–	1,400	1,382.70	31,650,000.00	17.3
9	Food for conservation activities: (3 people (2team members + 1 forest ranger) x 5 days x USD 5))	75	–	75	69.90	1,600,000.00	5.1
10	Wage for assistants (local guides) USD 7/ person/day (2 people x5 interview days) + (3 people x 40 fieldwork days)	910	70	980	1,010.05	23,120,000.00	-30.05
11	T-shirt (USD 8 x 50)	400	–	400	415.03	9,500,000.00	-15.03
12	Printing poster (USD 3 x 5 posters)	15	–	15	19.66	450,000.00	-4.66
13	Batteries for digital camera, GPS, recorders and other field equipment (20 package of 4 Energizer AAA x USD 2 + 80 package of 2 Energizer D x USD 2)	200	–	200	179.99	4,120,000.00	20.01
14	First aid kits: 3 kits x USD 10 + USD 20 medical supplies,	50	–	50	45.87	1,050,000.00	4.13
15	Communications (telephone/internet/postage)	50	–	50	55.92	1,280,000.00	-5.92
Total		5,000	750	5750	5,764.3	131,945,000.00	-14.3

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8. Appendices

Appendix 1. The project team during the field survey in Vu Quang NP



Gibbon habitat in Vu Quang NP.



A big tree in the core zone of Vu Quang NP.



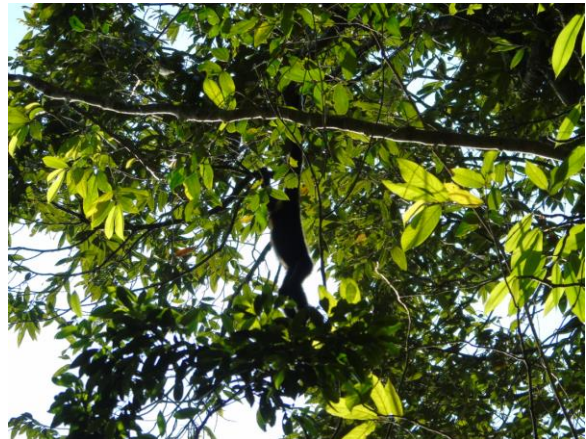
Project team member at a listening post.



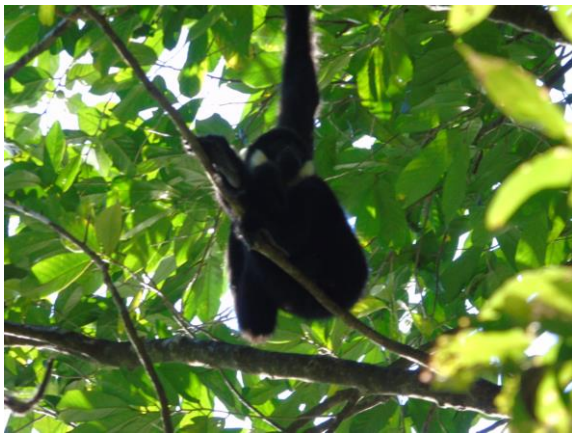
Project team members during the field survey.



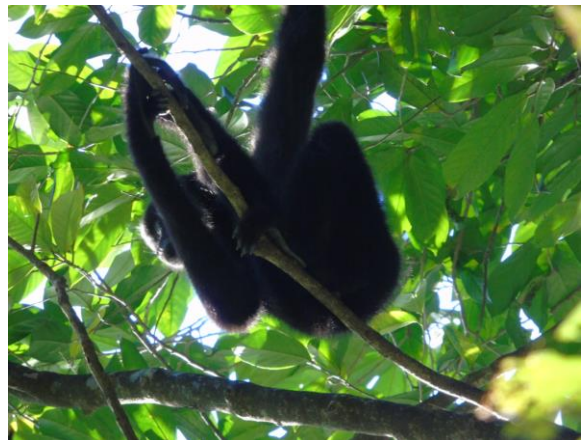
A forest ranger station in Vu Quang NP.



A gibbon observed during the field survey in Vu Quang NP.



An adult male gibbon observed during the field survey in Vu Quang NP.



An adult male gibbon observed during the field survey in Vu Quang NP.

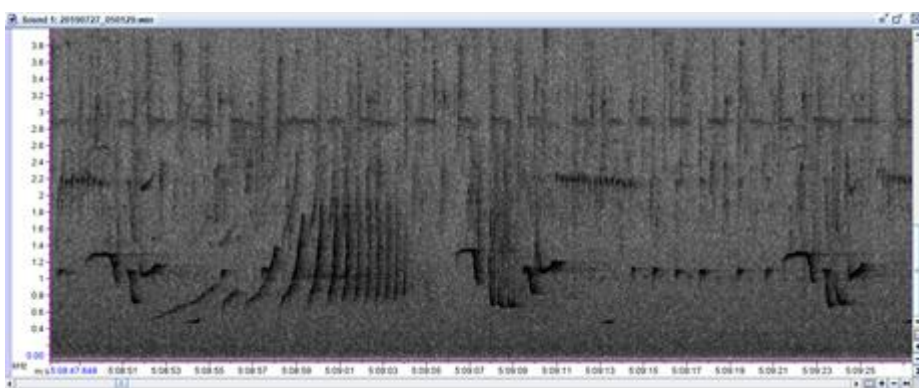
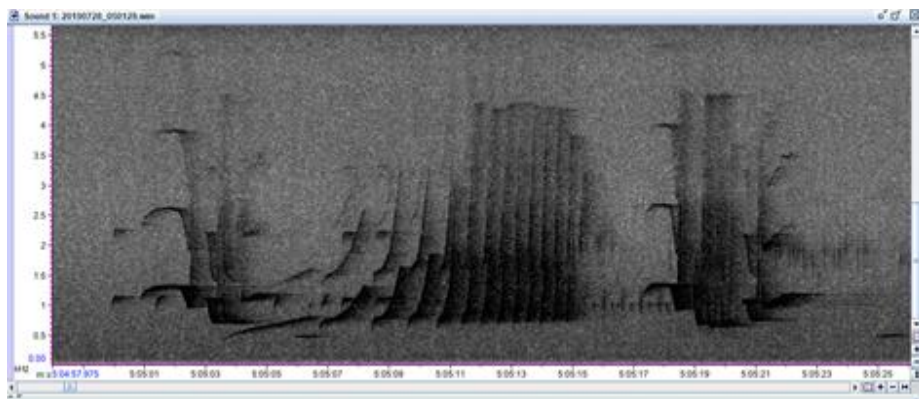
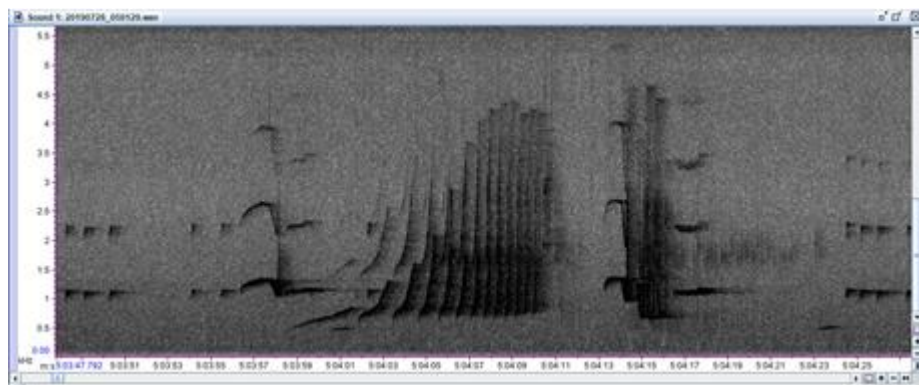
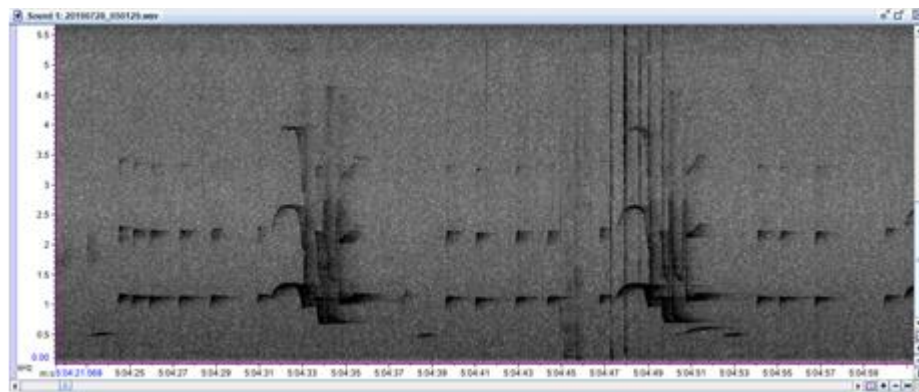


A civet was captured by trap.



The survey team moving to the field camp on Vu Quang lake.

Appendix 2. Sonograms of gibbon calls recorded in Vu Quang NP



Appendix 3. Gibbon conservation activities in Vu Quang NP.

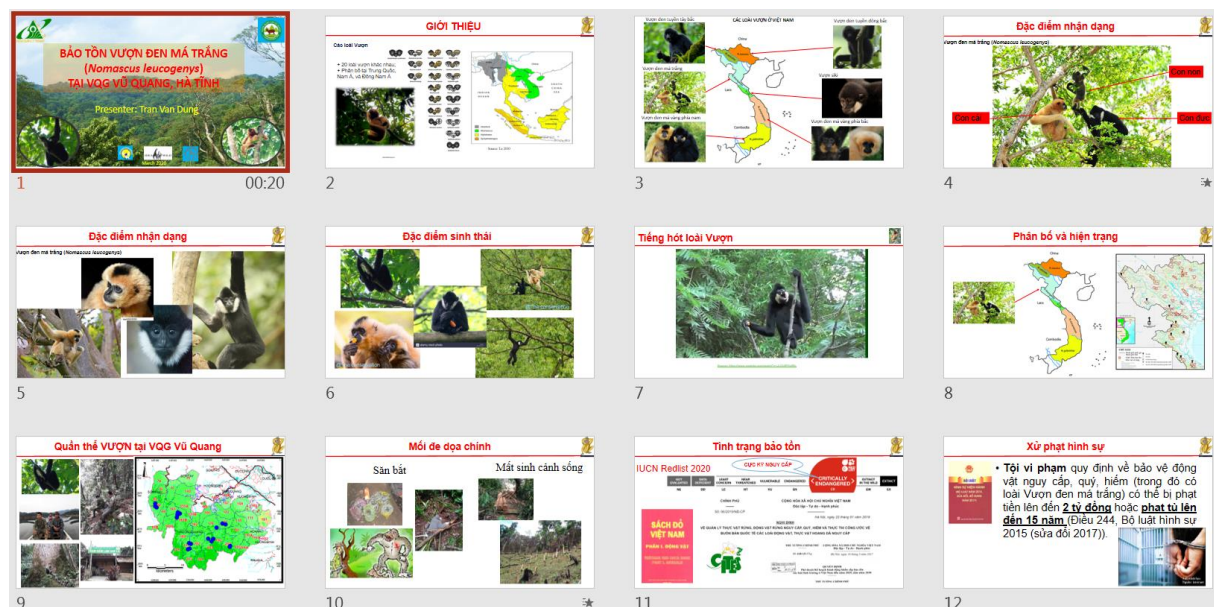








This T-shirt was designed for gibbon conservation activities.



A presentation on gibbon conservation was prepared for conservation activities.



Poster 1 for gibbon conservation activities.



Poster 2 for gibbon conservation activities.