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# THE IMPACT OF PROTECTION STATUS, LOCAL PEOPLE'S AWARENESS AND HUNTING PRESSURE ON CONSERVATION OF DELACOUR'S LANGUR (*Trachypithecus delacouri*) IN NORTHERN VIETNAM

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## ABSTRACT

During 2019 and 2020, 14 areas in Northern Vietnam were surveyed for Delacour's langur *Trachypithecus delacouri* (Osgood, 1932) to confirm the status of distribution, estimated populations and intensity of hunting pressure. People from elected local authorities, as well as other individuals, were interviewed to determine their awareness of the langur's conservation. These data were combined for statistical analysis. The results showed that protection status was negatively correlated with hunting pressure ($R_s$ = -0.601; p = 0.006). Hunting pressure also had a negative relationship with the growth of the number of langur populations ($R_s$ = -0.616; p = 0.005) and the number of langur individuals ($R_s$ = - 0.578; p = 0.01). However, placing an area under State protection had no correlation with the growth of the population of Delacour's langur living there (p > 0.05). People's awareness in Van Long Nature Reserve was very high (over 99% strongly supported the conservation of Delacour's langur) which corresponded to the growth of Delacour's langur population in that area. To protect both the langurs and people's livelihoods, we, therefore, recommend turning the areas where Delacour's langurs are distributed into protected areas and also promoting people's awareness through legal dissemination and activities. The reintroduction of the species into suitable protected habitats should be carried out scientifically.

**Keywords:** Delacour's langur, *Trachypithecus delacouri*, hunting pressure, awareness, primate conservation, protection status.

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## INTRODUCTION

Vietnam's endemic primate, Delacour's langur *Trachypithecus delacouri* (Osgood, 1932), is listed as Critically Endangered in the IUCN Red List (Nadler et al., 2020) and Vietnam Red Data Book (Dang Ngoc Thanh et al., 2007). Delacour's langur was recorded decades ago in some provinces of Vietnam (Nadler et al., 2003). In 2015 about 19 subpopulations were recorded (Nadler, 2015). However, due to hunting pressure and habitat loss, currently, only a small number of populations are believed to still exist in four provinces (Roos et al., 2014). The only population reported to have an increasing population size is in Van Long Nature Reserve (Nguyen Van Linh et al., 2019). The remaining subpopulations have either missing information (Fauna & Flora International, 2016) or are declining, long unrecorded or likely extinct (Nadler & Brockman, 2014).

Except for the langur population in Ha Nam province, which has only been discovered and surveyed in the last 5 years (Trinh Dinh Hoang & Nguyen Tuan Anh, 2018), the trend of population fluctuations is unknown. Apart from Van Long Nature Reserve other subpopulations have mostly declined. One of the reasons for the growth of the langur population in Van Long Nature Reserve is possible is because the langurs are well protected by the local community. Only in Van Long Nature Reserve, does hunting pressure seem to have been eliminated. However, forest fire, land conversion to agricultural land, dust, toxic fumes, and blasting from limestone quarrying outside the nature reserve are current threats to the population (Nguyen Van Linh et al., 2019). The question is whether the elimination of the risk from hunting is the key reason for the growth of the Delacour's langur population in Van Long? If so, how does people's awareness affect hunting in Van Long Nature Reserve?

There have been a few previous studies where interviews were conducted to assess the current status of the conservation management of Delacour's langur. Dao Nguyen (2008) interviewed local people and other stakeholders about biodiversity conservation to assess the status of many animal species and their habitats - including Delacour's langur - and their impact on livelihoods. This report is particularly interested in the area of community-based conservation. However, statistical methods were not used by Dao Nguyen (2008). Elser & Nguyen Hong Chung (2013) also interviewed people about their knowledge of the local endemic langurs, their attitudes towards conservation and the reintroduction of the langurs into the area. The authors used a simple set of questionnaires and statistical analysis - so the data were not fully explored. They were mainly needed to gather information before carrying out the reintroduction of the langurs. In most studies of the distribution and conservation status of langurs, the interview method is used as an adjunct to other methods used to survey the presence of langur troops. It may also be a reluctant choice, such as applied in recent studies by Wojciechowski & Nguyen Hong Chung (2013) and Nadler (2015) when the langur population in that area has disappeared. Therefore, these studies did not provide in-depth statistical analysis and did not focus on assessing the effect of hunting pressure, one of the factors that directly affect the growth of a langur population. Other threats - such as habitat loss, competition for food by livestock, etc. - are less serious factors, which we combined into the factor protection status, i.e. whether the area is protected by the State or not. If an area is protected, most activities that cause habitat loss, change in fauna, flora, and many other human impacts will be closely monitored and may be prevented. In contrast, for unprotected areas, all such activities take place relatively easily. To answer the question about the relationship between hunting pressure and langur population growth, we conducted field surveys from January 2019 to October 2020. We interviewed people in the areas of the species distribution in northern Vietnam and documented the conservation status of Delacour's langur in several other

subpopulations. We also aimed to determine and update the intensity of hunting pressure for each area. Hunting pressure was compared with the protection status, the number of langur groups encountered, and the most up-to-date number of individuals at the distribution areas to find correlations. We also interviewed people at Van Long Nature Reserve to determine whether hunting really continues, and to find differences between the awareness of the interviewee groups, as well as the relationship between their awareness and the conservation of the langur.

## METHODS

The list of 19 areas where subpopulations of Delacour's langur had recently been seen was compiled by Nadler et al. (2003) and was reassessed by Nadler (2015). We used this list to conduct field surveys and collect hunting pressure information for sites that Nadler (2015) reported that the langurs were still present. From January 2019 to October 2020 there were a total of 115 days of fieldwork. We surveyed 14 of the 19 areas mentioned by Nadler (2015): Cuc Phuong National Park, Yen Mo mountain range, Hoa Lu - Tam Coc, Van Long area (eastern part), Van Long area (central part), Van Long area (western part); Lac Thuy district (Hoa Binh province), Kim Bang district (Ha Nam province), Huong Son mountain, Mai Chau area, Pu Luong Nature Reserve (NE-part), Pu Luong Nature Reserve (SW-part), Northern Ba Thuoc area, Ngoc Son mountainous area, and Nui Boi Yao area. An area that was not listed by Nadler (2015), Trang An UNESCO World Heritage Site also were surveyed. In the remaining areas (Bim Son mountain, Roc mountain, Phu Vinh mountainous area, Thiet Ong mountain, and Thach Thanh District), we interviewed experts and local people and received information indicating that the langurs were no longer present. A subpopulation is considered to be locally extirpated if no record has been made during the past 15 years. Information on hunting pressure was mainly collected from field trips and interviews with local people in the form of open-ended conversations, to determine if hunting existed in these areas and if yes, the hunters have targeted Delacour's langur or not. Hunting pressure information in the last five years is classified into three levels: None (no hunting), Low (with hunting but not targeting at the langurs), and High (with langur hunting). The interviews at Van Long Nature Reserve was carried out in the form of an interview with a questionnaire. We used 15 main questions and some sub-questions to clarify the honesty of the interviewees. Analysis of the questionnaire revolved around three central questions with the aim of assessing the respondents' understanding of Delacour's langur and its conservation status, as well as their actual views on the issue of protecting this species. The questions are designed to minimize the presence of terms to avoid confusion, focus on a few issues instead of too many. On the other hand, we added questions with the role of "cognitive probes" and "confirmatory probes" to increase reliability (Presser et al., 2004). The data were coded and analyzed using SPSS 19.0 (Myers et al., 2013).

## RESULTS

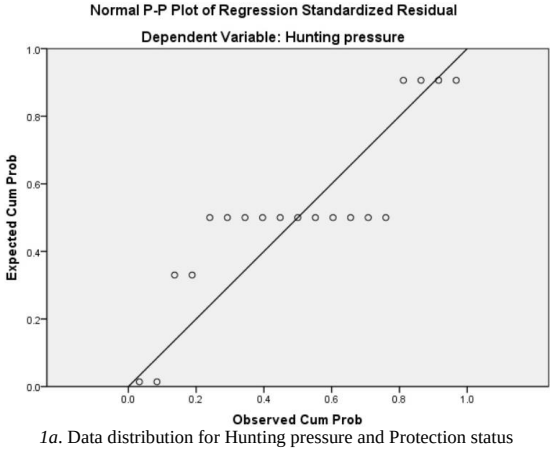
During the field surveys, the protection status of the areas, hunting pressure intensity, number of langur groups and individuals were recorded, and our results are summarized in Table 1.

Kolgomorov-Smirnov Z Test for Protection status ($Z = 1.638$; $p = 0.009$), Hunting pressure ($Z = 2.051$; $p = 0.0001$), Groups ($Z = 1.677$; $p = 0.007$), and Individuals ($Z = 1.831$; $p = 0.002$) indicated that the data did not follow a normal distribution. There is a negative correlation between Protection status and Hunting pressure ($R_s = -0.601$; $p = 0.006$). The negative relationship between these variances exist (ANOVA, $df = 1$; $F = 8.053$; $p = 0.011$) and can be displayed ($p = 0.002$) by the equation: $y = -0.75x + 2$ (Figs. 1a, 1b). However, there was no correlation between Protection status and neither Groups nor the number of Individuals of langurs ($p > 0.05$).

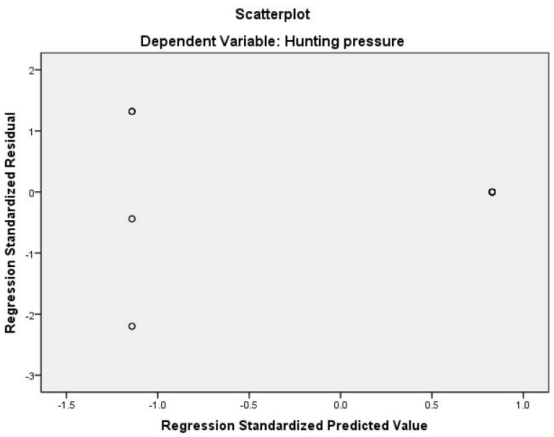
*Table 1*. Status of Delacour's langur subpopulations

| No. | Location | Protection status | Hunting pressure | Groups | Individuals | Sources |
|---|---|---|---|---|---|---|
| 1 | Cuc Phuong National Park, Ninh Binh province | Protected | Low | 2 | 4 | This study, 2020 |
| 2 | Yen Mo Mountain Range, Ninh Bình province | Not protected | High | 2 | 8 | Nguyen Vinh Thanh et al., 2013; This study 2020 |
| 3 | Bim Son mountain, Thanh Hoa province | Not protected | High | 0 | 0 | This study, 2020 |
| 4 | Hoa Lu - Tam Coc - Trang An, Ninh Bình province | Protected | Low | 1 | 3 | Nadler, 2020; This study, 2020 |
| 5 | Van Long Nature Reserve (eastern and central parts) , Ninh Bình province | Protected | None | 23 | 187 | Nguyen Van Linh et al., 2019; This study, 2020 |
| 6 | Van Long (western boundary) , Ninh Binh province | Protected | None | 4 | 38 | Nguyen Van Linh et al., 2019; This study, 2020 |
| 7 | Dong Tam, Lac Thuy, Hoa Binh province | Not protected | High | 2 | 9 | Trinh Dinh Hoang & Nguyen Tuan Anh, 2018; This study, 2019 |
| 8 | Kim Bang, Ha Nam province | Not protected | High | 14 | 85 | Trinh Dinh Hoang & Nguyen Tuan Anh, 2018; Nguyen Tuan Anh, 2019 |
| 9 | Huong Son mountain, My Duc, Ha Noi | Protected | High | 2 | 8 | This study, 2018; Nguyen Tuan Anh, 2019 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | Roc mountain, Kim Boi, Hoa Binh province | Not protected | High | 0 | 0 | Nadler, 2015 |
| 11 | Phu Vinh mountainous area, Tan Lac, Hoa Binh province | Not protected | High | 0 | 0 | Nadler, 2015 |
| 12 | Mai Chau mountainous area, Hoa Binh province | Not protected | High | 0 | 0 | This study, 2020 |
| 13 | Pu Luong Nature Reserve (NE-part) , Thanh Hoa province | Protected | High | 0 | 0 | This study, 2020 |
| 14 | Pu Luong Nature Reserve (SW-part) , Thanh Hoa province | Protected | High | 0 | 0 | This study, 2020 |
| 15 | Northern Ba Thuoc mountainous area, Thanh Hoa province | Not protected | High | 0 | 0 | This study, 2020 |
| 16 | Ngoc Son mountainous area, Hoa Binh province | Protected | High | 0 | 0 | Cano & Pham Quang Thien, 2010; This study, 2020 |
| 17 | Thiet Ong mountain, Thanh Hoa province | Not protected | High | 0 | 0 | Nadler, 2015 |
| 18 | Nui Boi Yao mountainous area, between Hoa Binh and Thanh Hoa | Not protected | High | 0 | 0 | Nadler, 2015; This study, 2020 |
| 19 | Thach Thanh district, Thanh Hoa province | Not protected | High | 0 | 0 | Nadler, 2015 |

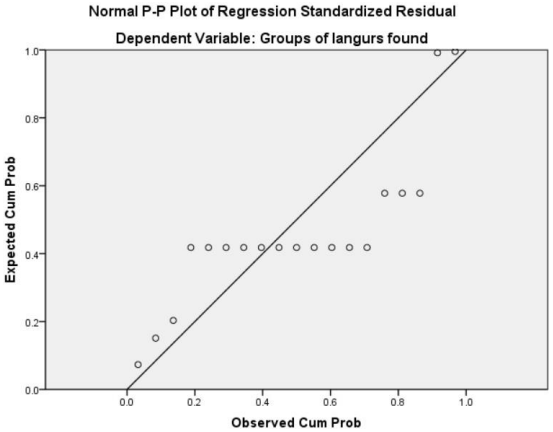



*1a*. Data distribution for Hunting pressure and Protection status

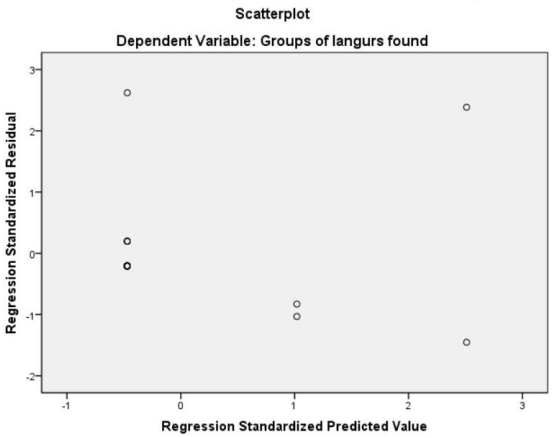



*1b*. Scatterplot of the standardized residuals with the standardized predicted values for Hunting pressure and Protection status

*Figure 1*. Regression model between protection status and hunting pressure




*2a*. Data distribution of Groups of langurs found and Hunting pressure




*2b*. Scatterplot of the standardized residuals with the standardized predicted values for Groups of langurs found and Hunting pressure

*Figure 2*. Regression model between hunting pressure and groups of langurs

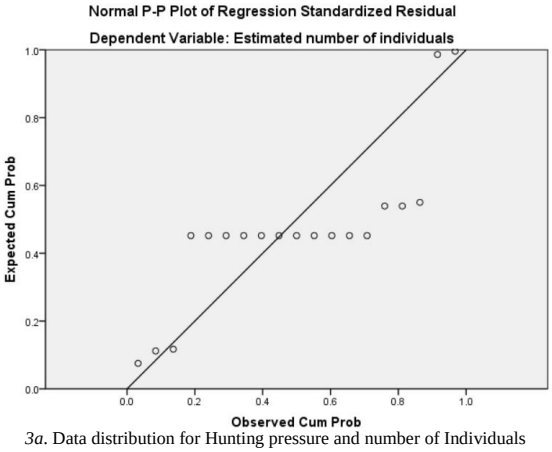
Meanwhile, a correlation between Hunting pressure and Groups of langurs was documented ($R_s$ = -0.616; p = 0.005). A linear relationship was found between the two variables as well (ANOVA, df = 1; F = 8.544; p = 0.009) and the equation that describes this negative relationship (p = 0.002) was y = – 5.084x + 11.195 (Figs. 2a, 2b).

Also, Hunting pressure and the number of Individuals of langurs found had a significant negative correlation ($R_s$ = -0.578; p = 0.01). Similarly, the negative relationship between Hunting pressure and the number of Individuals of langurs was linear (ANOVA; df = 1; F = 11.260; p = 0.004) and the equation that displays this negative relationship was y = -43.058x + 90.519 (Figs. 3a, 3b).

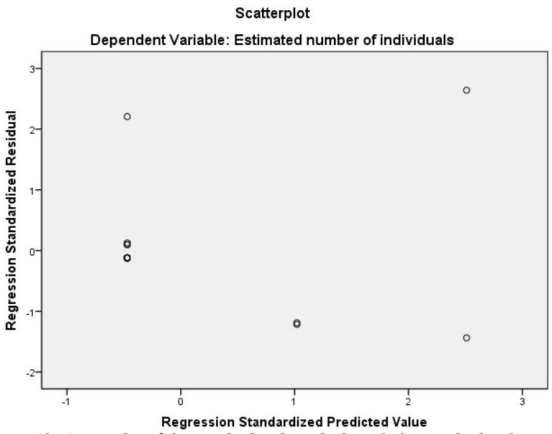
The above results show that if an area is upgraded from an unprotected area to a protected area, hunting might decrease more or less, but the number of langur populations and individuals might not increase, or they might even decrease. Therefore, in the case of Van Long Nature Reserve where the numbers of troops and individuals both increased dramatically, further explanation from the data on local people's awareness is required.

There were a total of 132 people interviewed with an equal number from Gia Van and Gia Hoa communes (Gia Vien district, Ninh Binh province). Three answers of three questions out of 27 answers for 27 questions have been selected for further analysis as dependent factors. Multinominal logistic

regression has been used to determine the influence of gender, occupation, and age on the answers. For the total data, there were two relationships that were statistically significant.




*3a*. Data distribution for Hunting pressure and number of Individuals




3b. Scatterplot of the standardized residuals with the standardized predicted values for the number of Individuals and Hunting pressure

*Figure 3.* Regression model between hunting pressure and number of individuals

Firstly, occupation influences the understanding of the places where langur troops are encountered, as shown by farmers (Occupation = 1) and tourism service employees (Occupation = 2), where people who work in tourism services know more about the habitat of the langur groups than do the farmers (Table 2).

Secondly, gender influences understanding the average individuals of a langur troop, where men have more knowledge than women, and as age increases, that knowledge tends to decrease. As noted above an equal number (66) of people were interviewed in each of the two communes, Gia Van and Gia Hoa, Gia Vien district, Ninh Binh province. Multinominal logistic regression has been used to analyze the difference between age, gender, and occupation of the interviewees within each commune. However, there was no significant difference found ($p > 0.05$). It can be said that, within each commune, no evidence supports that the factors of age, sex, and occupation affect the perception of people about Delacour's langur.

In both communes, the percentage of interviewees with awareness of Delacour's langur conservation is very high, more than 99.2% of them said that they feel the need for more widespread propaganda or attention to raising awareness of Delacour's langur protection in their community. Thus, most people have a very good awareness of the conservation of langurs, only a very small percentage (of farmers) have not yet paid attention to the conservation of this species. One factor that should be considered is the capacity of the protected area staff, but within data of the two communes, only 3 rangers (at age of 31, 32, and 34) were interviewed, insufficient for good statistical analysis. Assuming the rangers' awareness is good enough to carry out their task, the excellent awareness of local people may explain why this langur is well protected at Van Long Nature Reserve.

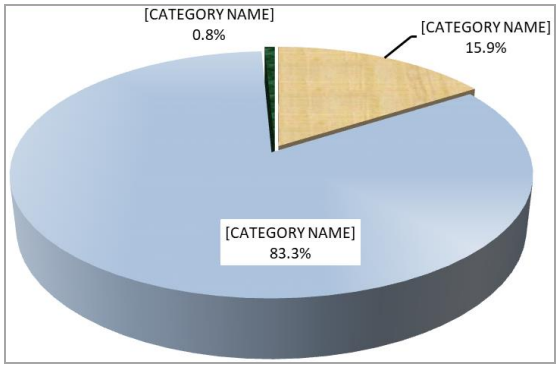



*Figure 4.* Local people's awareness of Delacour's langur protection

*Table 2*. Knowledge of local people about a langur group's habitat

| Goodness-of-Fit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Chi-Square | | df | | | Sig. | | | |
| Pearson | 50.558 | | 54 | | | .608 | | | |
| Deviance | 62.869 | | 54 | | | .191 | | | |
| Parameter Estimates | | | | | | | | | |
| Answer 5.2[a] | | B | Std. Error | Wald | df | Sig. | Exp (B) | 95% Confidence Interval for Exp(B) | |
| | | | | | | | | Lower Bound | Upper Bound |
| Others | Intercept | -20.481 | 1.481 | 191.345 | 1 | .000 | | | |
| | Age | .018 | .025 | .516 | 1 | .473 | 1.018 | .970 | 1.069 |
| | [Occupation=1] | 19.310 | .576 | 1124.626 | 1 | .000 | 2.433E8 | 78709469.530 | 7.521E8 |
| | [Occupation=2] | 21.713 | 1.347 | 259.735 | 1 | .000 | 2.690E9 | 1.919E8 | 3.772E10 |
| | [Occupation=3] | 39.929 | 7707.747 | .000 | 1 | .996 | 2.193E17 | .000 | .[b] |
| | [Occupation=4] | 19.091 | .000 | . | 1 | . | 1.956E8 | 1.956E8 | 1.956E8 |
| | [Occupation=5] | -.319 | 8618.394 | .000 | 1 | 1.000 | .727 | .000 | .[b] |
| | [Occupation=6] | 0[c] | . | . | 0 | . | . | . | . |

*Note:* a. The reference category is: At steep karst areas; b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing; c. This parameter is set to zero because it is redundant.

*Table 3.* Knowledge of local people about a langur group's number of individuals

| Goodness-of-Fit | | | |
|---|---|---|---|
| | Chi-Square | df | Sig. |
| Pearson | 152.669 | 248 | 1.000 |
| Deviance | 116.331 | 248 | 1.000 |

| Parameter Estimates | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Answer 8[a] | | B | Std. Error | Wald | df | Sig. | Exp(B) | 95% Confidence Interval for Exp(B) | |
| | | | | | | | | Lower Bound | Upper Bound |
| 1 individual | Intercept | -5.074 | 4.584 | 1.225 | 1 | .268 | | | |
| | Age | .065 | .076 | .723 | 1 | .395 | 1.067 | .919 | 1.240 |
| | [Gender=1] | -1.397 | 1.231 | 1.289 | 1 | .256 | .247 | .022 | 2.760 |
| | [Gender=2] | 0[b] | . | . | 0 | . | . | . | . |
| 2-4 individuals | Intercept | 3.786 | 1.617 | 5.482 | 1 | .019 | | | |
| | Age | -.079 | .031 | 6.461 | 1 | .011 | .924 | .870 | .982 |
| | [Gender=1] | -2.801 | 1.159 | 5.842 | 1 | .016 | .061 | .006 | .589 |
| | [Gender=2] | 0[b] | . | . | 0 | . | . | . | . |
| More than 8 individuals | Intercept | 2.115 | 1.157 | 3.343 | 1 | .068 | | | |
| | Age | -.012 | .020 | .340 | 1 | .560 | .989 | .951 | 1.028 |
| | [Gender=1] | -.475 | .453 | 1.098 | 1 | .295 | .622 | .256 | 1.512 |
| | [Gender=2] | 0[b] | . | . | 0 | . | . | . | . |
| Others | Intercept | -376.682 | .000 | . | 1 | . | | | |
| | Age | 5.163 | 189.3 | .001 | 1 | .978 | 174.701 | 1.288E-159 | 2.369E163 |
| | [Gender=1] | -4.594 | .000 | . | 1 | . | .010 | .010 | .010 |
| | [Gender=2] | 0[b] | . | . | 0 | . | . | . | . |

*Note:* a. The reference category is 5-8 individuals; b. This parameter is set to zero because it is redundant.

## DISCUSSION

It can be seen from Table 1 that although illegal hunting is common in forest areas across the small area of Vietnam reviewed in this study, according to Nguyen Van Linh et al. (2019), in the area of Van Long Nature Reserve (eastern and central parts) and even Van Long Nature Reserve (western part) are said to have no hunting activities. In the western part of Van Long, there are 4 areas mentioned in Nguyen Van Linh et al. (2019) are generally called "Giap Ranh" (including 4 areas: Dong Moi, Suoi Tep, Doi Bo, and Den Cat Dun), and are outside the boundary of the nature reserve. These areas are being planned to be incorporated into the nature reserve to expand the conservation area and habitat of the langur. For Van Long Nature Reserve (eastern and central parts), such information has been confirmed by a number of previous reports (Nadler, 2010). However, with Van Long Nature Reserve (western part), a place with 4 areas that have not been officially protected by the State, it still needs to be verified. Because of the absence of documents that provide evidence of hunting, there is currently no hunting status in Van Long Nature Reserve (western part). Evidence based on observation of animal responses in these places indirectly confirms the possibility that there is no hunting of langurs there, because of the existence and population growth of langur colonies and that they appear to be not afraid of people. The absence of hunting in Van Long Nature Reserve (eastern and central parts) is quite certain because langur groups often allow people to get very close to them, and some other animals such as waterfowl are not afraid of human presence, although they maintain a bit of distance from humans.

In this study there is no statistical relationship between an area being under state protection and another without such protection with hunting pressures, showing that State protection is only one factor that has an influence on hunters. Thus hunting prevention may depend on other factors in this case. The fact is that there are areas that are not protected by the State, but currently some sub-population of *T. delacouri* still exists there (Wojciechowski & Nguyen Hong Chung, 2013). From that, the protection of the forest should not be left to the rangers alone with their limited manpower, but in coordination with the whole local community. An important factor may be the perception of the local people, associated with the livelihoods on which they depend. In Van Long Nature Reserve, where for the past 15 years, an important part of people's income has been from tourism and service activities, which are closely related to the landscape inhabited by the Delacour's langur populations (Nguyen, 2008). Therefore, most people have a sense of protecting the langurs. The very few people who lack this awareness may do so because of a little economic conflict, perhaps because they are not allowed to graze goats into the strictly protected areas of the nature reserve. From our data, only a 55 year-old man whose family work with livestock (raising cows, fish), did not answer our questions clearly and seems to want the protected area to allow his family's cows to graze in the reserve. The next direction in the recovery of Delacour's langur population could be to protect the existing populations as well as re-introduce individuals raised at the Cuc Phuong Primate Rescue Center to new locations where the habitat is suitable for them, with a scientific plan and careful preparation. There have been some initial successes recorded at Van Long Nature Reserve (Beaumont, 2012; Agmen, 2014) and Trang An UNESCO World Heritage Site (Nadler et al., 2020) showing this is a viable possibility, as Delacour's langur has a diet with a large number of plants (Nguyen Vinh Thanh, 2008), including an invasive plant *Lantana camara* (Workman, 2009) and survive well in karst habitats.

## CONCLUSION

The results show that protection status is negatively correlated with the intensity of hunting pressure. Moving a habitat from unprotected to protected by the State reduces hunting activities. Hunting pressure has a

negative relationship with the growth of the langur population. However, based on our data, no correlation was found between the protection status of an area and the growth of the population of Delacour's langur living there. In addition, there is statistical evidence that people's awareness at Van Long Nature Reserve is very high, consistent with the growth of the langur population in that area. However, we do not have enough data to compare this relationship with other regions. It can be drawn that it is necessary to combine the protection for the langur and their habitats both from the State and from the local community, though.

From the above results, we recommend that all the areas where Delacour's langur occur should be upgraded to protected areas, and at the same time, people's awareness should be improved through law dissemination and providing livelihoods, following the model of Van Long Nature Reserve. It is also important to consider reintroducing some successfully rescued Delacour's langur individuals into suitable habitats protected by the State, after careful planning using appropriate scientific information.

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