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ANNAMITE STRIPED RABBIT *NESOLAGUS TIMMINSI*
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ASSESSMENT OF THE BIODIVERSITY

Hue Saola Nature Reserve, Thua Thien Hue, Vietnam

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

asl	Above Sea Level
BCC	Biodiversity Conservation Corridors
CAL	Central Annamites Landscape
CarBi	Avoidance of deforestation and forest degradation in the border area of southern Laos and central Vietnam for the long-term preservation of carbon sinks and biodiversity project
DARD	Department of Agriculture and Rural Development
DoNRE	Department of Natural Resources and Environment
EBA	Endemic Bird Area
FPD	Forest Protection Department
GIS	Geographic Information Systems
ha	Hectares
IBA	Important Bird Area
IZW	Leibniz Institute for Zoo and Wildlife Research
MARD	Ministry of Agriculture and Rural Development
MB	Management Board
MoNRE	Ministry of Natural Resources and Environment
NP	National Park
NR	Nature Reserve
PA	Protected Area
PNR	Proposed Nature Reserve
SMART	Spatial Monitoring and Reporting Tool
SNR	Saola Nature Reserve
SOP	Standard Operating Procedure
TNA	Training Needs Assessment
UTM	Universal Transverse Mercator
WWF	World Wide Fund for Nature

EXECUTIVE SUMMARY

The Central Annamites houses one of the largest continuous natural forest areas in continental Asia. It is home to many endemic species including the saola (*Pseudoryx nghetinhensis*), large antlered muntjac (*Muntiacus vuquangensis*), Truong Son muntjac (*Muntiacus truongsonensis*), Owston's civet (*Chrotogale owstoni*), crested argus (*Rheinardia ocellata*), and Annamite striped rabbit (*Nesolagus timminsi*); as well as other species of high conservation value including gibbons (*Nomascus annamenis*), red and grey shanked douc langurs (*Pygathrix* spp) and several pheasants (*Lophura* spp).

The Central Annamites is included as part of the Annamite Range Moist Forests, one of the Global 200 Ecoregions which have been identified as the most crucial areas for conservation of global biodiversity (Olson & Dinerstein 1998). Within the Indochina region it is recognized as being an important biodiversity corridor containing multiple Key Biodiversity Areas within the target area of Quang Nam and Thua Thien Hue Provinces, including; A Luoi-Nam Dong; Bach Ma; Ngoc Linh; Phong Dien and Song Thanh (Tordoff et al 2012). But while the Central Annamites are characterized by high biodiversity, it is also under high anthropogenic pressures, which have reduced the population sizes of the region's most important threatened and endemic taxa. The two biggest threats to wildlife are poaching and logging; poaching (commonly through snaring) has targeted ground dwelling mammals and birds, and logging has disturbed arboreal species.

Most information available to management boards stems from rapid wildlife and habitat assessments conducted prior to the preparation of an investment plan for establishment of these nature reserves which produce lists of species, but often includes no quantitative data on species abundance or distribution making it difficult to set management priorities. The Biodiversity Inventories component under the Green Annamites project aims to establish a baseline for biodiversity monitoring systems in identified PAs (Song Thanh Nature Reserve, Quang Nam Saola Nature Reserve, Phong Dien Nature Reserve, Thua Thien Hue Sao La Nature Reserve, Bac Hai Van Protection Forest Area). This will include creation of species lists, abundance estimates of key species and threat analysis data in the landscape that will provide input into management planning and zoning of target protected areas. This data will serve as a basis for upgrading, expanding and establishing new PAs in the landscape and facilitating sustainable management.

The current report details biodiversity surveys conducted in Hue Saola Nature Reserve as part of the USAID funded Green Annamites project, with this component implemented by WWF-Vietnam. Taxonomic surveys included field-based surveys for small mammals (Class: Mammalia), birds (Class: Aves), Reptiles (Class: Reptilia), amphibians (Class: Amphibia) and plants (Kingdom: Plantae). In addition, extensive camera trapping was conducted in order to detect largely terrestrial mammals and birds, which would not be detected through other methods.

Prior to surveys, scoping work was conducted to provide an initial assessment of the current state of knowledge of targeted taxa for biodiversity surveys in the protected areas of Thua Thien Hue and Quang Nam provinces. The Scoping Report outlined the initial approaches to surveys in terms of methods and effort to be applied. Subsequently, Standard Operating Procedures (SOPs) were developed to detail the methodological approaches for collecting and analyzing data. The creation of Standard Operating Procedures ensured a standardized approach across protected areas in terms of data collection and analysis during field-based biodiversity assessments. Six SOPs were developed:

- SOP for Small Mammal Surveys
- SOP for Bird Surveys
- SOP for Amphibian and Reptile Surveys
- SOP for Plants
- SOP for Camera Trapping
- SOP for Field-based Threat Assessments

To facilitate skills transfer to protected area staff for biodiversity assessments, a Training Needs Assessment (TNA) was conducted with ranger and technical staff. The TNA focused on staff current capacities in relation to species identification and monitoring with all competency assessments following the IUCN Global Register of Competences for Protected Area Practitioners (Appleton, 2016). This provided a basis for development of training curricular to support PA staff in developing capacity in biodiversity monitoring, which was delivered through classroom and field-based training. Protected area staff then engaged in the field-based biodiversity assessments presented in this report to allow for application of the training.

Subsequently, biodiversity surveys were conducted in Hue Saola Nature Reserve in early 2018 by the expert technical teams supported by protected area staff. Results show that for Hue ASola Nature Reserve there are a recorded; 42 small mammal species from 13 Families including one Endangered and three Vulnerable species on the Red Data Book (MoST, 2007) while camera trapping revealed an additional two Vulnerable large mammal species; 161 bird species from 114 Genera and 35 Families including one species listed on the Red Data Book of Vietnam (MoST, 2007); 73 Amphibian and Reptile species from 59 Genera and 22 Families including six Vulnerable, six Endangered and two Critically Endangered species on the Red Data Book of Vietnam (MoST, 2007) and two Vulnerable and four Endangered species on the IUCN Red List (IUCN, 2018); and 1,035 plant species from 159 Families including two Critically Endangered, 19 Endangered and 21 Vulnerable species on the Red Data Book of Vietnam (MoST, 2007) and one Data Deficient species on the IUCN Red List (IUCN, 2018).

In addition, a systematic camera trap approach, developed by WWF-Vietnam and Leibniz Institute for Zoo and Wildlife Research (IZW) and has been rolled out in all protected areas targeted under the Green Annamites project, providing a scientifically rigorous baseline for monitoring trends in wildlife over time. This camera trapping approach will be fundamental for understanding effectiveness of management interventions over coming years and should be prioritised for replication in other protected areas in the region and for follow-up repeat surveys in coming years. Finally, historical deforestation and forest degradation have been assessed for Hue Saola Nature Reserve in order to provide an overview of PA performance in maintaining forest cover and forest connectivity.

These data have fed into a process for assessing the suitability of Hue Saola Nature Reserve to be extended which are described in a report on zonation for biodiversity inventories in selected protected areas in Quang Nam and Thua Thien Hue provinces, which was also produced by WWF-Vietnam under the USAID supported Green Annamites project. Hue Saola Nature Reserve continues to play an important role in the protected area network of the Central Annamites Landscape, supporting biodiversity in-situ and connectivity in the broader landscape. Continued investment in protecting these resources is required to ensure persistence in the face of threats.

PART 1. SITE DESCRIPTION

Hue Saola Nature Reserve is located between 16°3'7" to 16°9'50" N and from 107°25'41" to 107°33'39" E, in southwest Thua Thien Hue province. The site includes the districts of A Luoi and Nam Dong and the communes of Huong Nguyen, Thuong Quang and Thuong Long. Hue Saola Nature Reserve was designated on the 9th of October 2013, through decision 2020/2013/QĐ-UBND, with the explicit goal of preserving habitat for the Critically Endangered saola *Pseudoryx nghetinhensis*. The sites total area is 15,324.35 hectares, composed of 8,092 ha of strictly protected zone, 7,108 ha of ecological restoration zone and 124 ha of service-administration zone.

The total forest cover of Hue Saola Nature Reserve is 92.99% of the total area. A total breakdown of forest types can be seen in The site currently has a Management Plan for the years 2015 - 2020. Total staff in Hue Saola Nature Reserve is 25 individuals.

TABLE 1 – FOREST COVER TYPES OF HUE SNR IN 2018

No	Forest cover types	Area in ha	%
1	Forest plantation	6.50	0.04
2	Mixed timber and bamboo forest	598.06	3.90
3	Evergreen broadleaf - rich forest	2,641.13	17.23
4	Evergreen broadleaf - medium forest	3,105.09	20.26
5	Evergreen broadleaf - poor forest	3,174.96	20.72
6	Evergreen broadleaf - regrowth forest	4,323.78	28.22
7	Bamboo forest	489.13	3.19
8	Bare land (grass land, shrub)	985.70	6.43
	Total Area	15,324.35	100.00

Figure 1 *– Map showing the location and forest cover of Hue Saola Nature Reserve.*

Hue Saola NR is contiguous with Quang Nam Saola NR (See **Figure 1**), collectively covering an area of approximately 32,000 ha across both Thua Thien Hue and Quang Nam provinces. The NR (together with the Quang Nam Saola NR) is situated on the northern flank of a ridge of mountains, which extends eastwards from the main chain of the Annamite mountains to the East Sea at the Hai Van pass. From this ridge, a number of smaller ridges extend northwards, dividing the proposed nature reserve into a number of separate catchments. The area contains rugged terrain, experiences high annual rainfall, and includes both broadleaf and montane wet evergreen habitats. Habitats in Hue Saola Nature Reserve are largely composed of lowland and montane evergreen broadleaf forests. Forests at lower elevations are generally more degraded and historically cultivation has occurred in valley bottoms (Tordoff et al. 2004). Despite degradation processes over the years, the site still contains significant amounts of intact lowland evergreen forest which is relatively rare in the Vietnamese context.

Previous survey work in the 1990s and early 2000s documented several flagship large mammals, including leopard *Panthera pardus*, tiger *Panthera tigris*, gaur *Bos gaurus*, sun bear *Helarctos malayanus*, saola, and large-antlered muntjac *Muntiacus vuquangensis* (Long, 2005; Tordoff et al., 2003; Van et al., 2006). However, reports of most of these species are decades old and it is likely that today they are either extirpated or occur at extremely low densities. The only recent evidence of saola came from a 2013 camera trap photo in the Quang Nam Saola Nature Reserve, and most biologists agree that there are no viable saola populations in this landscape (Tilker et al 2017). The situation is similar for another Critically Endangered endemic ungulate, the large-antlered muntjac, which has not been definitively recorded in the protected area despite considerable search effort (Rob Timmins pers. comm., 2017). Historically there has been limited information related to the avifauna of Hue Saola Nature Reserve, although the site lies within the southern portion of the Annamese Lowlands Endemic Bird Area (EBA) (BirdLife International, 2018). Likewise, small mammal surveys have not been conducted at the site historically and these therefore represent new records for the PA. The Green Corridor Project (2006) recorded significant plant biodiversity, inclusing 869 species including over 100 orchid species. The current survey expands on this work that has been conducted previously.

PART 2: SURVEY DESCRIPTION

OVERVIEW

A diversity of methods was used in the collection, compilation and analysis of data for this report in line with the taxonomic diversity of species surveyed. Taxonomic surveys included field-based surveys for small mammals (Class: Mammalia), birds (Class: Aves), Reptiles (Class: Reptilia), amphibians (Class: Amphibia) and plants (Kingdom: Plantae). In addition, extensive camera trapping was conducted in order to detect largely terrestrial mammals and birds, which would not be detected through other methods. While it is recognized that camera trapping contributes to both mammal and bird survey work, because of the fundamentally different nature of the approach and its use in biodiversity monitoring through occupancy approaches results are presented independently for this method from small mammal and bird survey general approaches. Additionally, a forest cover and fragmentation assessment was performed for each of the five targeted protected areas to determined changes in forest cover and key areas threatened by forest degradation and deforestation.

A key outcome for conducting biodiversity assessments within Hue Saola Nature Reserve was to provide a basis for biodiversity monitoring. Biodiversity monitoring can be done in a number of ways, including direct full counts of all individuals of a species at a site, determination of densities based on sampling regimes which provide estimates of populations of the surveyed taxon and relative density estimates, which provide an estimate of relative abundance per unit survey effort,

but not an actual or estimated number of animals. All methods can be used as approaches to monitor wildlife populations and descend in order of power to do so, however ascend in increasing complexity, time and cost to complete.

Complete counts of a population are rarely feasible in tropical forests because of the complicated terrain high mobility of animals and low densities and are not used in this survey protocol, and there are few examples in the Vietnamese context and only for the smallest most threatened populations (e.g. Cat Ba langurs *Trachypithecus poliocephalus* and Yangtze Giant Softshell Turtle *Rafetus swinhoei*). Estimates of abundance use a variety of methods including distance sampling (e.g. Buckland et al., 2001), Spatially Explicit Capture Recapture (e.g. Kidney et al., 2016) and others. However, these approaches have seldom been used in the Vietnamese context due to low densities of wildlife and steep topography which can lead to invalidations to assumptions in methods (e.g. insufficient captures to model density) and which require very high survey effort, with high cost on a small number of taxa that are susceptible to that methodological approach. As such, they are generally inappropriate for large scale biodiversity surveys that attempt to capture multiple taxa. Relative density estimates, which is simply number of observations divided by survey effort, provides an index which allows for monitoring of trends over time, but is generally not an overly powerful approach to monitoring as surveys are generally not randomised or stratified and error is high, making trend detection less powerful.

To address these issues, surveys in Hue Saola Nature Reserve were conducted using the most powerful methods possible within the limited budget and timelines available. Relative density surveys were conducted for amphibians and reptiles and small mammals and birds using varying approaches described in each section below. These provide a basis for future surveyors to compare against if the same survey protocols are used in follow-up surveys. The most powerful approach to biodiversity monitoring within the context of the Central Annamites Landscape, where population densities are low and topography is difficult, however, is occupancy approaches for camera trapping.

Occupancy models are a well-established analytical tool within the fields of ecological research and biodiversity monitoring (MacKenzie and Royle, 2005; O'Brien and Kinnaird, 2008). One of the fundamental problems with most biological survey techniques is that non-detection, or failure to record a species, does not mean that the species is not present (Kéry and Royle, 2016; MacKenzie et al., 2002). Most species will never be perfectly detected. As a result, the proportion of areas in which the species was recorded, referred to as naïve occupancy, will always be lower than the actual proportion of areas where the species occurs, referred to as true occupancy. To account for imperfect detection rates, MacKenzie et al. (2002) suggested conducting repeated surveys in an area to calculate a detection probability, and then incorporating this information into a statistical framework that estimates true occupancy (MacKenzie et al., 2002). The resulting occupancy estimate, denoted by psi (Ψ), is therefore closer to the actual number of sites occupied by the species of interest.

Occupancy is useful within a monitoring context for two reasons: (1) it provides a more accurate representation of species occurrence, and therefore a more accurate conservation baseline, and (2) repeated surveys can assess changes in species occupancy, and therefore offer insight into temporal population trends. In a broad sense, occupancy can be used as surrogate for abundance (Kéry and Royle, 2016; MacKenzie et al., 2006), but it should to be noted that under certain circumstances occupancy and abundance might be not correlated at a small scale (Sollmann et al., 2013). There are several advantages of occupancy models. In contrast to abundance data—which requires researchers to count individual animals, and in the context of camera-trapping is only possible for species with individually-recognizable markings—occupancy analyses uses simple detection / non-detection data, which can be collected for all species that can be camera-trapped (MacKenzie et al., 2006; O'Connell et al., 2011). (2) Occupancy models can incorporate covariates—including habitat quality metrics and proxies for hunting pressure—therefore providing insight into the factors influencing species occurrence in a landscape (Bailey et al., 2014; O'Connell et al., 2011). (3) Based on these covariate

associations, occupancy models can be used to predict species distribution (or species richness, if modeling multiple species) across a landscape, therefore providing insight into potential occurrence to areas that were not surveyed (Kéry and Royle, 2016).

Therefore, the recommendation for future surveyors interested in determining trajectories of wildlife populations in Hue Saola Nature Reserve, is to focus on the replication of the model presented here for camera trapping. The methodology returns a large number of detections and provides a statistically sound approach to modelling changes in distribution of wildlife. Camera traps capture a relatively large suite of species, namely terrestrial mammals and birds, which are those taxa which are most threatened by processes in the Central Annamites Landscape; namely blanket ground-based snaring (Gray et al., 2017). Recovery in distribution of camera trappable taxa (i.e. increases in occupancy), is therefore likely to represent a reduction in threat. Moreover, the nature of camera trapping is such that PA staff can be trained in relatively short periods of time to operate and set cameras in the forest which is not the case for other techniques which often require extensive training as identification and recording is done in the field.

To facilitate field based biodiversity surveys, Standard Operating Procedures (SOPs) were developed. SOPs were developed for surveys using camera trapping and on small mammals, birds, reptiles and amphibians and plants and field-based threat assessments. Subsequently, these formed the basis of a training program for rangers and technical staff from each of the five target Protected Areas (PAs) and included 61 trainees including 43 forest protection staff and 18 technical staff. The creation of SOPs supported a standardized approach across protected areas in terms of data collection and analysis for field-based biodiversity assessments. Each SOP varied considerably as approaches for detecting different taxonomic groups differ. For example, bird surveys include approaches for mist netting birds while mammal surveys include SOPs on trap deployment including baiting and trap placement. Please refer to specific SOPs for more details on the methodological approaches used under these studies, however an overview is provided below.

In addition to theory training, PA staff received field-based training during the biodiversity surveys. During this training, information was collected from participants to help determine key areas for surveys and to determine logistics such as entry and exit points and access. This was further detailed and corroborated by conducting interviews with local community members, involving discussions with experienced hunters from local villagers and sketch mapping hotspots of diversity. Before the field surveys, all information was cross checked and discussed with leaders of the protected areas. Survey teams were comprised of experienced local community members, as both local guides and as holders of Local Ecological Knowledge, and local rangers to develop capacity of PA staff in biological surveys.

AIMS

The objective of this survey were to collate and extend our understanding of the biodiversity values of Hue Saola Nature Reserve and provide a basis for management of key biodiversity values. Fundamental to the objective of the work was to identify and fill gaps from previous biodiversity surveys, to which end an assessment or previous surveys effort was conducted (See USAID Green Annamites Report: *Scoping Report: Biodiversity Inventories in Selected Protected Areas in Quang Nam and Thua Thien Hue Provinces*). Based on this assessment, additional survey work was designed to both expand species lists available for each PA, provide a basis for monitoring biodiversity impact of the USAID Green Annamites project and to provide a basis for assessment for expansion or uplisting of parts of the protected area network in Quang Nam and Thua Thien Hue Provinces.

This report outlines the finding from biodiversity surveys and forest cover and forest fragmentation assessments from Hue Saola Nature Reserve.

SURVEY METHODS

CAMERA TRAPPING

Camera-trapping is a widely-used non-invasive survey method to gather data on terrestrial mammal and bird communities. The method has been used for a variety of wildlife studies, and is especially well-suited to study elusive, cryptic, or rare species (Ancrenaz et al., 2012; Burton et al., 2015; O'Connell et al., 2011; Sunarto et al., 2013). Camera trapping has the ability to accumulate data over large areas and in remote regions (Ancrenaz et al., 2012), and can provide information on distribution, behavior, and species-specific responses to environmental and anthropogenic factors (O'Connell et al., 2011; Sollmann et al., 2012, Gray et al, 2014).

In this study, camera trapping was systematic and carried out throughout most parts of the surveyed nature reserves. This allows data to be analyzed within an occupancy framework. Such an analysis allows researcher to assess occurrence probabilities in the target areas, therefore providing information necessary to the establishment of a conservation baseline. Camera trap stations were spaced approximately 2.5 km apart with a buffer of 500 m. Cameras were positioned so that the minimum distance between stations was at least 2 km. To increase detection probabilities, cameras were set along animal trails, water sources, ridgelines, or other natural features. To further increase detection probabilities, cameras were set facing different directions, stationed within a 20 x 20 m square. Cameras were set 20-40 cm above the ground to ensure that all mammal and bird species, including smaller species such as Annamite striped rabbit or pangolin, were consistently detected. Vegetation was cleared so that the camera had a clear window of the immediate surrounding area. Cameras were programed to take 3-5 photographs per trigger without delay between triggers. Units were operational 24 hours per day.

The R package *camtrapR* (Niedballa et al., 2016) was used for all data processing. Photos were identified to species level by two independent experts (Andrew R. Tilker and An Nguyen for Saola Nature Reserves, and An Nguyen and Thanh Nguyen for Bac Hai Van, Song Thanh NR and Phong Dien NR). To minimize false positives, all photographs that could not be confidently identified to species-level (or appropriate taxonomic unit in the case of species-complexes) were excluded from the analysis. A threshold of 60 minutes was set for temporal independence (i.e. photographic sequences for a given species within this time frame were treated as a single detection). Detection histories were created using a 15-day occasion length, resulting in a minimum of four occasions per station. We chose a 15-day detection history length to avoid zero-inflation in the detection matrixes.

To estimate species occupancy, data was analyzed within an occupancy framework (Kéry and Royle, 2016; MacKenzie et al., 2006; Mackenzie and Royle, 2005) using the *unmarked* R package (Fiske and Chandler, 2011). We used a maximum likelihood rather than Bayesian approach due to potential complications with model selection in the latter framework (Kéry, 2010; Kéry and Royle, 2016). Although environmental covariates can be incorporated in the occupancy analyses we did not include covariates in this analysis for simplicity. A thorough occupancy analysis, using ecological and environmental covariates, would require months of intensive work and was not within the scope of this project.

SMALL MAMMALS

Given the diversity of small mammal fauna, a variety of methods were used to catch and identify a representative sample of the sites diversity. A diverse trapline will collect a greater diversity of species; so, a variety of traps should be used to sample as many microhabitats as possible. During the survey, we conducted day and night time direct observations utilized box and cage traps, pitfall traps, mole traps, mist nets and harp traps to sample as diverse an assemblage of small mammals as possible.

Box and cage traps were used for capturing rodents and shrews; they are lured into the traps and captured alive when they depress a baited pan releasing a spring- loaded door. We used Sherman traps largely for rodents (Genera:*Maxomys, Niviventer*, *Rattus* and *Mus*) and shrews (Genera:

Crocidura, Brarinella, Chodsigoa, Episoriculus), water shrew and Gymnure. Tomahawk cage traps were used for for larger-sized rodents (e.g. Genera: *Leopoldamys*, *Bandicota* and *Berylmys*), and local cage traps for tree squirrels (e.g. Genus: *Callosciurus*, *Dremomys*, *Tamiops* and *Menetes*). In general box and cage traps were set on the ground in dense vegetation, on top of and along logs, and small streams to maximize captures. We also used mole traps made of polyvinyl chloride pipe that were set on the trails along small trails where mole tunnels were observed.

Pitfall traps were used for small rodents and shrews (e.g Genera: *Mus, Crocidura, Brarinella, Chodsigoa, Episoriculus*, and Gymnure) that scurry close to the ground. Pitfall trap-lines were placed in a line and consisted of regularly spaced 10-15 liter buckets sunk flush with the level of the ground. Rodents and shrew were guided into pitfall traps by a 0.5-meter-high plastic drift-fence stapled to support stakes hammered into the ground every 3-4 m. Pitfall trap-lines typically included ten to twenty pitfalls spaced evenly over 50-100 meters, with traps spaced more closely in complex habitats for more effective sampling.

Mist nets and harp traps were used for the live capture of bats (Order: Chiroptera) while flying, after which they can be identified and released. The nets and traps were set to cross trails in the forest, over small ponds and streams in the forest or near forest edges, at openings at the forest edges and the entrances of caves. The harp traps were set at similar locations and in dry streambeds that could function as travel corridors for bats. Mist nets and harp traps were generally set up from 17:30 to 18:00 and checked every 20 min before dusk from 18:30 to 22:00/ 23:00. Regular checking ensured that bats did not remain in traps for long periods of time which can cause mortality.

Figure 2 *- A harp trap set in the forest.*

Identification of small mammals was conducted in field with no samples taken during the surveys. Identification was done based on external characters using a large number of references (Abramov et al., 2013; Borisenko et al., 2008; Corbet and Hill, 1992; Dang et al, 2007; Dang et al., 2008; Daosavanh et al., 2013; Francis, 2001, 2008; Hendrichsen et al., 2001; Hoang 2018, Kawada et al., 2008, 2009, 2012; Kruskop, 2013,; Kruskop & Eger 2008; Kruskop et al., 2006, Le and Cao, 1998; Lunde and Nguyen, 2001; Lunde et al., 2017; Muser et al., 2006; Nguyen et al., 2013, 2016a, b, 2015a,b; Thorington et al. 2012; Vu & Tran 2005; Vu et al., 2017a,b; Wilson and Reeder, 2005;

Zemlemerova et al., 2016; Zenkins et al., 2007, 2009, 2010 a,b, 2013.) All trapping was conducted in accordance with the guidelines approved by the American Society of Mammalogists (Sikes *et al.* 2011)

Given the rapid nature of surveys, calculation of absolute abundances of small mammals was prohibitive in terms of cost and time. In addition, we calculated an estimation of dominance index D and species constancy C following Tischler (1949). Dominance indicies provide insight into the relative abundance of different taxa within the small mammal community, which may change depending on habitat (degradation) and offtake and therefore can act as an indicator of change over time. According to the dominance index D the following classes were distinguished: eudominants >10%; dominants: 5.1-10%; subdominants: 2.1-5%; and recedents: 1,1-2,0%. The values of the constancy index C fell into the following categories: absolutely constant species: 75.1-100%; constant species: 50.1-75.0%; accessorial species: 25.1-50.0%; and accidental species: <25%.

BIRDS

Bird surveys were conducted during the day and at night to capture records of diurnal and nocturnal species. All species of bird that were observed directly or heard during the field survey were recorded. The observation period was from 05:30 until 18:00 each day. In order to survey nocturnal species (e.g. Owls and Nightjars), observations were also conducted from 20:00 until 22:00 on some days.

During the survey, and at each of the survey sites, data were collected on the bird community, using a modification of the method outlined in Bibby et al. (2003). This involves making a list of the first 10 species recorded (commonly called a MacKinnon list), and then repeating the process until 10 such lists have been made. A species may be recorded on any list only once. Lists were made between 06:00 and 10:00. The start-time and end-time for each list is noted and the observer walks at a slow walking-pace with pauses to identify birds. The same transect is never walked twice, to avoid recording the same individual birds. Plotting the accumulated total number of species recorded against the number of lists made gives a species discovery curve, whose steepness reflects species richness and indicates how many more species are likely to still be found at the locality. Species that occur on a high proportion of lists are the most abundant or conspicuous species of the local avifauna (Bibby et al. 2003).

At other times, observers walked slowly and deliberately along trails in the forest, with frequent stops to observe mixed feeding flocks or birds feeding at fruiting trees. Observers used binoculars (Swarovski EL 8x32) and field guides (Robson 2009) for species identification. Photos were taken of birds as a matter of course and opportunistically for other species (Nikon D5, lens 300 mm and 600 mm) as well as to record the status of habitats, and the occurrence of threats. Sound recording and playback were used to confirm records as well as checking the status of some rare species. Interviews were conducted whenever meeting local hunters or people living within or around the surveyed sites.

REPTILES AND AMPHIBIANS

For reptiles and amphibians, absolute measures of density are very difficult to obtain, and as such most methods rely on comparative counts which are useful for quantitative comparison between areas and identification of key spots for wildlife. This methodology can encompass sightings and indirect evidence of species' presence (which are difficult to correlate with population densities) and is suited to a rapid assessment of reptiles and amphibians.

Strip transects were used to systematically record species presence, and calculate a density index (individuals per km walked). Establishing a density index within a study area provides a baseline measure with which to monitor population trends over time. Reptiles and Amphibian data can also

be collected opportunistically while on forest patrol, or surveying for other species. Field observations were collect while walking standard line transects (cross-sectional sample method: Burnham & Anderson 1993). The locations of transects were mapped using hand-held GPS units (Garmin 64s) and survey distances were measured from the resulting maps to aloe for calculations of relative density. Survey times were also recorded.

During surveys, attempts were made to sample a variety of habitats (e.g. valleys, slopes and ridge-tops) but also to visit sites likely to be of particular significance for amphibians and reptiles (e.g. waterholes on ridges, undisturbed streams likely to be used by big-headed turtles, rocky areas used by monitor lizards). For each encounter (direct observation) with a key species, the following information was recorded:

- Date and time/GPS location/altitude;
- Habitat type: active and fallow swidden fields, bamboo forest, secondary evergreen forest, primary evergreen forest, primary forest on limestone, sub-montane forest, riverine forest, open water (streams and rivers);
- Species encounter/direct observation

This reptiles and amphibian assessments focused on 'key species'. These species were selected primarily on the basis of their conservation importance, but also on the basis of their comparative ease of detection. A list of key species for the biodiversity assessment is given in **Table II.**

TABLE 2– PRIORITY REPTILE AND AMPHIBIAN SPECIES TARGETED UNDER THIS SURVEY.

Species	Scientific Name	Status
REPTILES		
Water dragon	*Physignathus concincinus*	VU
Snake (all species)		V-E
Lizards		V-E
Big-headed Turtle	*Platysternum megacephalum (Gray, 1831)*	EN/R
Indochinese box turtle	*Cuora galbinifrons (Bourret, 1939)*	CR/V
Chinese three-striped box turtle	*Cuora trifasciata (Bell, 1825)*	CR/V
Chinese stripe-necked turtle	*Ocadia sinensis (Gray, 1834)*	EN
Black-breasted leaf turtle	*Geoemyda spengleri (Glemlin, 1789)*	EN
Four-eyed Turtle	*Sacalia quadriocellata (Siebenrock, 1903)*	EN/V
Elongated tortoise	*Indotestudo elongata (Blyth, 1853)*	VU
Impressed tortoise	*Manouria impressa (Gunther, 1822)*	EN
Wattle-necked soft shell turtle	*Palea steindachneri (Wiegman, 1835)*	EN
Chinese soft shell turtle	*Pelodiscus sinensis (Siebenrock, 1906)*	VU
Monitor lizards	*Varanus* spp.	V
Tokay gecko	*Gekkogecko*	NT
AMPHIBIAN		
Forest toad	*Ingerophrynus galeatus*	VU

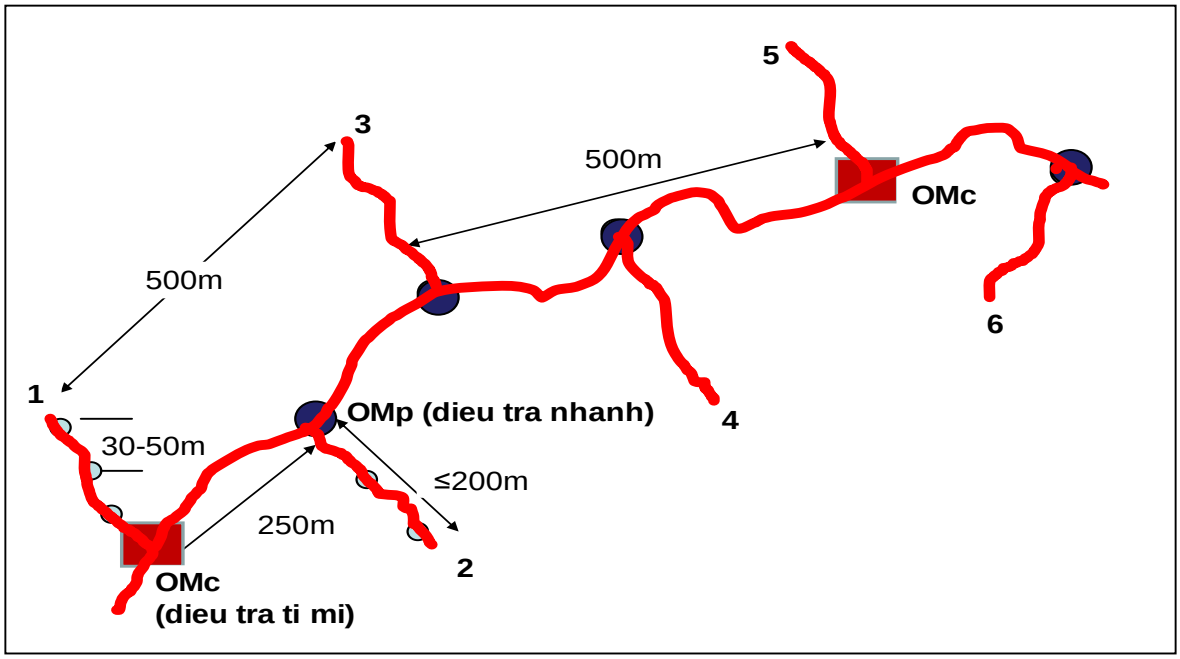
TABLE 2– PRIORITY REPTILE AND AMPHIBIAN SPECIES TARGETED UNDER THIS SURVEY.		
Bana toad	*Leptobrachium banae*	VU
Xeno frog	*Xenophrys palpebralespinosa*	CR
Spin frog	*Quasipaa spinosa*	EN
Kio frog	*Rhacophorus kio*	VU

Conservation status in the Vietnam Red Data Book (E = Endangered; V = Vulnerable; R = Rare; T = threatened) Conservation Status in the IUCN Red List of Threatened Species (2018) (CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient).

PLANTS

The methods for conducting vegetation surveys comprised three main components which are illustrated in **Figure 3** below. Figure 1 illustrates a main survey route (in red), with supplementary survey routes (also in red, marked 1-6) branching off from the main route. Along the main route are the main sample pilots (OMc) and the supplementary sample pilots (OMp), while on the supplementary routes are smaller observational points (marked as blue circles). Details of each of these approaches is described below.

Figure 3 *- Methodological approach for sampling plants used during this survey.*

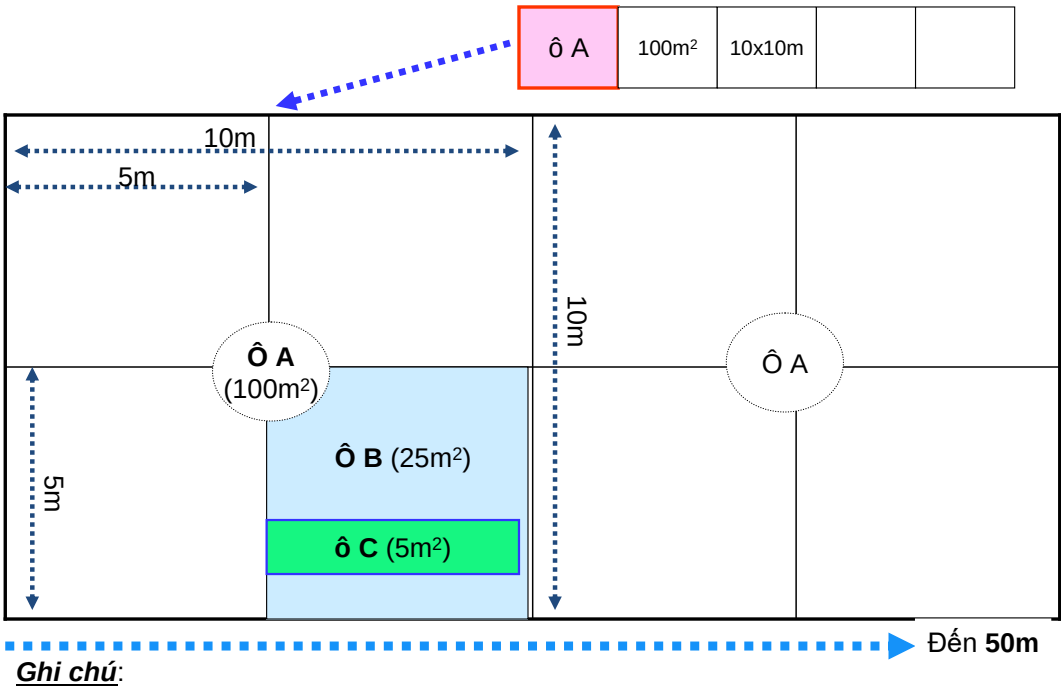


Main Survey Routes are set to capture diversity in plant communities, and as such were set up to run across a diversity of landscape features and through different forest types. In general, a main survey route should go from the lowest to highest point in the survey area to ensure capture of a diversity of forest types and habitats. Survey routes aimed to be 2km long and were walked slowly to allow plant identification and mapped. Surveys captured fully grown trees within 20m of the central transect line and shrubs and bushes within 5-10m of the transect line. Data on species collected included location coordinates, photos and specimens.

In addition, Main Sample Plots (OMc) were conducted every 1000m along the length of the Main Survey Route. OMcs are designed to survey in detail the forest structure. Location can be directly on the Main Survey Route or just off it depending on sites topography, access, vegetation etc. See

Figure 4 for details on how plots should be subdivided. Within each OMc detils on the plant community were recorded (e.g. structure density, rate of canopy, $D_{1.3}$, H_{vn}, H_{dc}, D_t) for all trees which have $D_{1.3}$ ≥6cm. The OMc is further subdivided into 5 small plots (A plots) with dimensions of 10x10m (100m²) each. These are further subdivided into 4 smaller plots (B Plot) with a square of 5x5m (25m²) each, and one B Plot randomly chosen for surveying regenerating plants which have a height ≥1.5m and a $D_{1.3}$ < 6cm. Within each B Plot, a further subdivision was made into C Plots with dimensions of 1x5m (5m²), to survey for regenerating plants which have a height <1.5m and other non-timber plants (e.g. shrubs and bushes).

***Figure 4** - How to organize components in the main sample plot.*



Ghi chú:

- Kích thước ô mẫu đầy đủ là 10x50m (gồm 5 ô A)
- Kích thước ô A là 10x10m
- Kích thước ô B là 5x5m
- Kích thước ô C là 1x5m

Additional Supplementary Sample Plots (OMps) were used to survey species composition using quick sampling methods. OMps of 100m² (10m x 10m) were placed every 250m along the Main Survey Route, but not in areas that already contained a Main Sample Plot (OMc). In the first OMp on the Main Survey Route, we recorded all species that occur in the OMp and in subsequent OMps, and record only new species that have not occurred in previous OMps but also record any high conservation value species that occur. Additional supplementary routes were also surveyed perpendicular to the Main Survey Route every 250m (alternating sides) following the same approach as the Main Survey Route. Every 30-50m along the Supplementary Route we set up an Observation Point with a diameter of10m where we rapidly assessed and noted the presence of new species. When three Observational Points on a Supplementary Route were similar in characteristics (i.e. few additional new species being recorded) then the route was stopped and we moved on to the next.

Plant samples were collected throughout the survey where new species were suspected or there was an inability for field identification. Identification of samples was then conducted through comparison with herbarium specimens. Plant samples included branches and leaves and where possible included reproductive parts of fruits and flowers as these facilitate identification. Samples were photographed and distinguishing features noted (e.g. colour of flowers and fruit) and bagged and labelled and 70-90% alcohol added to preserve samples until they can be properly mounted.

Identification of plants was conducted in the field or later using samples at Hue University of Agriculture and Forestry. Materials for classification included; Brummitt (1999), Pham Hoang Ho (1999); List of plant species in Vietnam, 2001, 2005 (Volume I-IIII) and the Vietnam Red Book (MoST, 2007) while plant usage followed the literature on traditional uses such as Do Tat Loi (2004) and Vo Van Chi, (2012).

FOREST COVER AND FOREST FRAGMENTATION

The Hansen et al. (2013) forest data is a dataset by the University of Maryland in collaboration with other institutions to show the global change in forest cover. Originally created in 2013, this dataset has been updated multiple times since its creation and now includes data from the year 2000 until 2016. The forest information is analyzed from Landsat satellite images and the first versions of the dataset up to 2012 made use of Landsat 7 data. The use of the newer satellite Landsat 8 was integrated into this dataset after 2013.

The dataset comes not as a final forest cover product for every single year, but instead consists of multiple layers that together form the information of the forest change. The three following layers of information where used to create the annual forest cover data:

- The forest cover for the year 2000. This is shown as a percentage of tree cover for every pixel.
- Annual loss of forest cover from the years 2001 to 2016
- Gain of forest cover from 2001 to 2012. This data is not annual, but consolidates all twelve years into one. This data on its own cannot be used to show regeneration of forest/reforestation and often corresponds with plantations.

The first step is to determine forest cover. The forest cover for the year 2000 is shown as a density: 0 to 100%, where 100% means a full canopy cover for that area and 0% is no forest at all. If the density of forest cover is very low, it will not be forest but only patches of trees. However, the meaning of this differs from landscape to landscape as natural forest assemblages (e.g. dry deciduous dipterocarp) may have naturally low forest cover. After analyzing the different densities with Landsat/Sentinel imagery and previous forest cover data, all forest cover densities above 20% where determined as forest. Therefore, all areas that show a forest cover density below 20% are non-forest areas and are not used in the analysis.

Forest Fragmentation analysis is done by defining forest in different classes based on spatial connection. The basis is in defining core forest, which is forest that is a certain distance from non-forest areas. This often corresponds to undisturbed or primary forest that is mostly intact and, from this, other forest classes can be derived. There is inner and outer edge forest, which is all forest that is connected to a core area, but within the buffer distance between core forest and non-forest areas. Inner edge forests are perforations within core areas, where outer edge forest is on the outside of core forest areas. For the sake of this analysis, both classes are grouped together under Edge Forest. All other classes are grouped under Fragmented Forest and include loops, bridges, branches and islets. These are defined by how they connect different core forest areas, but the specific classes are not necessarily better forest classes from others in the created Fragmented Forest class. Therefore, they are grouped together.

Most of the forest change happens through degradation, which is the change to a lower forest class. This means that there is small scale forest loss happening within an area, which results in this area changing in class. Deforestation in the middle of a core forest area does not only lead to the direct loss of core forest through deforestation, but also the conversion of core forest around this deforested area. Degradation of core forest is the change from core to either edge or fragmented forest. Degradation of Secondary forest is the change from edge forest to fragmented forest.

PART 3. RESULTS: CAMERA TRAPPING

COMPLETENESS OF COVERAGE

Camera trapping in Hue SNR was conducted between July and December 2015 as part of camera trapping work conducted under the USAID/MSI funded project, *Biodiversity Monitoring*. The approach in Hue SNR utilised the same approach as has been used for the other four PAs for which biodiversity inventory and monitoring baselines have been set up under the USAID Green Annamites project as detailed in the Survey Methods section. Surveys in Hue SNR were coupled with those in Quang Nam SNR as the areas are contiguous. In the Hue portion of this transboundary PA, a total of 21 camera trap stations (with two cameras per station) were set up following the systematic design as documented in the Survey methods section. Because of the standardised approach to sampling, coverage of the Hue SNR is relatively complete, as shown in **Figure 5.** Total survey effort included 2,610 Camera Trap Nights, which is measured as the sum of 24 hour periods each camera is active during the survey period. This represents the smallest camera trap effort for any of the five target PAs (with the exception of Phong Dien NR for which incomplete results are available at time of writing) under the USAID Green Annamites project, which is a factor of the relatively small size of the PA and the standardised approach which dictates a spacing of 2.5km between camera stations (see **TABLE 2**).

SURVEY RESULTS

The survey in the Hue Saola NR was conducted at the same time with the surveys in Quang Nam Saola NR. In total 16 ground-dwelling mammal species and 9 ground birds (**TABLE 2**) (17 mammal and 13 bird species in total Annex 2) were recorded. Overall the list of recorded species was similar to the other sites, and there was no mammal species which was not also recorded in other areas. As with the other sites, the most frequently recorded species were species believed to be highly resilient to snaring pressure, such as ferret badgers, common palm civet, and Eurasian wild pig. The naïve occupancy of two larger ungulates, the Annamite dark muntjac species complex and serow, were relatively low compared to the other areas, likely reflective of a severely depressed population. Despite the lower detections of these species the overall detection success (number of detections per 100 camera trap nights) was relatively high compared to the other areas. Additionally, the number of species per 100 trap nights was also high compared to the other study sites. As with the Quang Nam Saola Nature Reserve, it is unknown if the intensive snare-removal efforts over the last several years have contributed to these higher indices, and if so, to what extent. Further repeated surveys are needed to evaluate the impact of intensive snare-removal activities on the terrestrial mammal and bird communities in this protected area.

TABLE 2 - SPECIES LIST, NUMBER OF DETECTIONS AND NAIVE OCCUPANCY ESTIMATES OF ALL GROUND DWELLING MAMMAL AND BIRD SPECIES IN HUE SAOLA NATURE RESERVE.

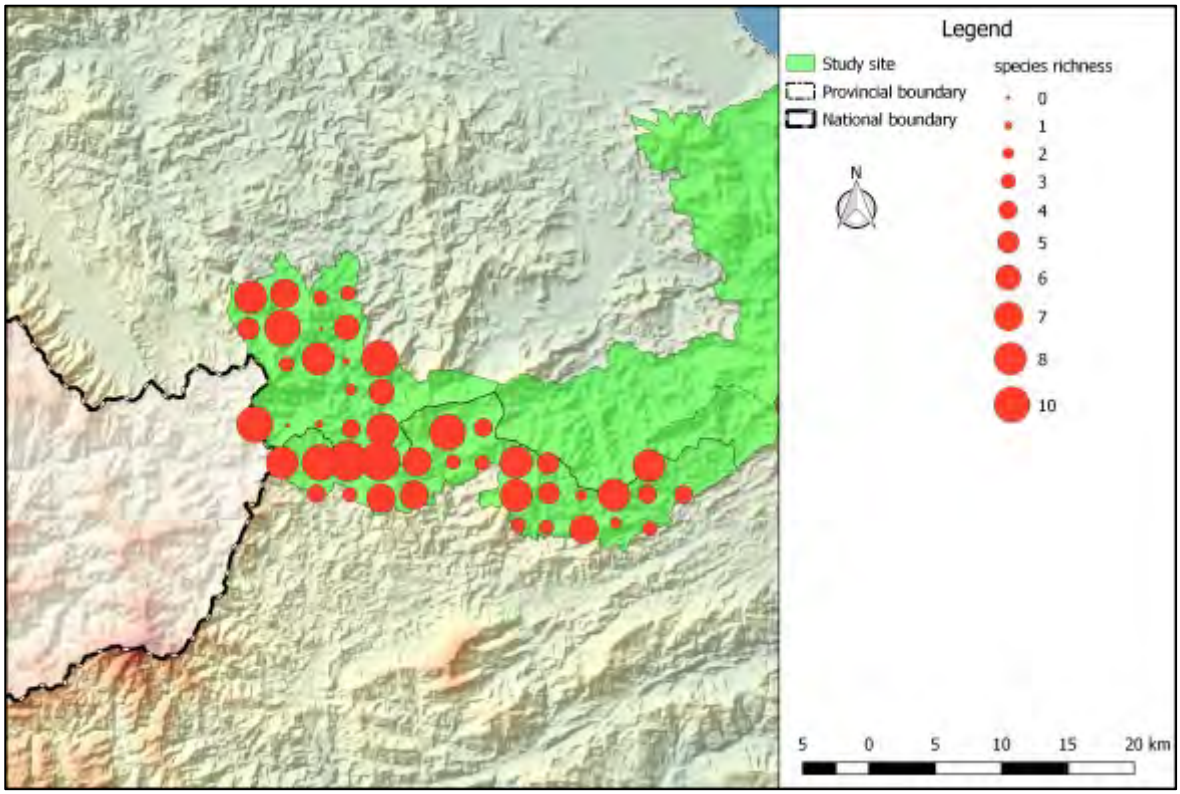
Species	No. detect.	No. station	Naïve	P	SE.P	PSI	SE.PSI
Mammal							
Stump-tailed macaque	17	12	0.571	0.136	0.037	1.000	0.008
Northern pig-tailed macaque	15	9	0.429	0.189	0.090	0.728	0.3
Yellow-throated marten	4	3	0.143	-	-	-	-
Ferret badger species	83	13	0.619	0.483	0.075	0.667	0.118

TABLE 2 - SPECIES LIST, NUMBER OF DETECTIONS AND NAIVE OCCUPANCY ESTIMATES OF ALL GROUND DWELLING MAMMAL AND BIRD SPECIES IN HUE SAOLA NATURE RESERVE.

Species	No. detect.	No. station	Naïve	P	SE.P	PSI	SE.PSI
Masked palm civet	6	4	0.190	0.135	0.119	0.419	0.344
Common palm civet	17	7	0.333	0.253	0.100	0.480	0.188
Spotted linsang	4	4	0.190	-	-	-	-
Crab-eating mongoose	27	9	0.429	0.329	0.104	0.466	0.146
Leopard cat	4	3	0.143	-	-	-	-
Eurasian wild pig	72	12	0.571	0.322	0.082	0.710	0.160
Dark muntjac	2	2	0.095	-	-	-	-
Red muntjac	29	8	0.381	0.482	0.098	0.407	0.115
Serow	1	1	0.048	-	-	-	-
Malayan porcupine	11	6	0.286	0.199	0.114	0.467	0.241
Asiatic brush-tailed porcupine	20	6	0.286	0.390	0.111	0.330	0.120
Annamite striped rabbit	17	4	0.190	0.424	0.139	0.212	0.098
Bird							
Annam partridge	4	2	0.095	0.247	0.207	0.129	0.102
Bar-backed partridge	1	1	0.048	-	-	-	-
Red junglefowl	1	1	0.048	-	-	-	-
Crested argus	6	3	0.143	0.198	0.161	0.236	0.182
Emerald dove	11	7	0.333	0.269	0.104	0.459	0.175
Bar-bellied pitta	6	2	0.095	0.274	0.207	0.129	0.102
Blue whistling thrush	1	1	0.048	-	-	-	-
Orange-headed thrush	14	4	0.190	0.144	0.127	0.302	0.262
Scaly thrush	15	2	0.095	-	-	-	-

Naïve occupancy: the proportion of sites at which the target species was detected;
P: Detection probability;
SE.p: Standard error of detection probability P;
Psi: Occupancy probability;
SE.Psi: Standard error of occupancy probability Psi.

Figure 5 *– Distribution of cameras and number of species detected at each camera trap station in Hue SNR (top) and Quang Nam SNR (bottom).*



KEY SPECIES ACCOUNTS

Annamite striped rabbit

The Annamite striped rabbit is a recently-described Annamite endemic known only from the Northern and Central Annamites landscape (Abramov et al., 2008). Most of the species habitat occurs in Vietnam (Abramov et al, 2008). Biologists have little information about its ecology and conservation status. The species is currently listed as Data Deficient on *The IUCN Red List of Threatened Species* (Abramov et al., 2008). Camera trapping recorded Annamite striped rabbit in four of the five study sites: Hue and Quang Nam Saola NR, Song Thanh NR, and Phong Dien NR (**Figure 6**). There were no records from the Bac Hai Van. The Hue and Quang Nam Saola NRs appear to hold the strongest populations of Annamite striped rabbit among the study sites that were surveyed. Although habitat related factors could be also be responsible for the higher occupancy estimates in the Saola Nature Reserves, it is nonetheless possible that the significant efforts by the WWF Forest Guard teams to remove snares from these two areas has had a positive impact on the Annamite striped rabbit population. Due to the presumably short generation time of the Annamite striped rabbit compared to other ground-dwelling mammals, it is possible that this species "rebounded" faster than larger and longer-lived mammals such as muntjac and sambar. However, it should be noted that without baseline data this remains speculative; additional repeated systematic surveys would be needed to confirm this hypothesis.

Figure 6 *- Annamite striped rabbit* Nesolagus timminsi*, an Annamite endemic.*

Annamite dark muntjac

The taxonomy of the dark muntjacs *(Muntuacus rooseveltorum / truongsonensis)* is unclear. At present, there appears to be at least two, and probably three or more, species within this complex. However, without a thorough and detailed review of the taxonomy of this group, taxonomic assignments to the species level are not possible. Both *Muntiacus rooseveltorum* and *truongsonensis* are listed as Data Deficient (Timmins and Duckworth, 2016a, 2016b). Dark muntjac was recorded in all sites except Bac Hai Van, indicating that the complex may be relatively resilient to high levels of hunting pressure (**Figure 7**). However, there could be one or more highly threatened species within the complex.

Figure 7 *- Annamite dark muntjac* Muntiacus rooseveltorum / truongsonensis.

Crested argus

This Near Threatened large galliform *Rheinardia ocellata* has a wide distribution in the Annamites (Birdlife International, 2016a). Although considered to be common in Vietnam in the past (Le et al. 2004), it now appears to be rare in most areas. Its precipitous decline from historic levels is almost certainly a result of intensive snaring pressure. The species was recorded in the Saola Nature Reserves, Phong Dien NR and in Song Thanh NR (**Figure 8**). It is either rare or extinct in Bac Hai Van.

Figure 8 - *Male crested argus* Rheinardia ocellata.

THREATS

Despite the significant camera-trapping effort in Hue Saola NR, there are a number of species known to historically occur that were not recorded in these surveys which may indicate extirpations or near extirpation. Missing species include: (1) all large and medium-sized carnivores (tiger *Panthera tigris*, leopard *Panthera pardus*, clouded leopard *Neofelis nebuloa*, dhole *Cuon alpinus*, Asiatic golden cat *Catopuma temminckii*, marbled cat *Pardofelis marmorata* and sun bear *Helarctos malayanus,* (2) all large ungulates (gaur *Bos gaurus* and elephant *Elephas maximus*), and (3) small mammals targeted for the illegal wildlife trade (pangolin *Manis* spp.). Although it is possible that individuals of some of these species might still occur in the landscape, it is unlikely that there are viable populations present, and the data strongly indicates that these species are either extinct or functionally extinct from the landscape. The ecological consequences of their loss through cascading effects remain unknown, but from other tropical ecosystems it is known that the loss of larger carnivores or ungulates can have severe ecological consequences (Peres et al., 2015; Terborgh et al., 2001).

The highest-priority conservation species that was not recorded during this survey is the Critically Endangered Annamite endemic, the saola, *Pseudoryx nghetinhensis*. It is likely that this species is on the verge of *in situ* extinction (Timmins et al, 2016c, Tilker et al 2017). However, the failure of intensive camera trapping surveys across five protected areas to record even a single photograph of the species (the last record being in Quang Nam SNR in 2013) highlights again the direness of the situation. Should saola persist in the Hue-Quang Nam SNR complex, it is certain that the species exists as a few isolated individuals, and that nothing resembling a viable population persists. This underlies the IUCN Species Survival, Commission Saola Working Group's assessment that capture of any remaining saola in the landscape for *ex-situ* captive breeding remains the best hope for the species.

The snaring crisis across the landscape and the region in general is now well documented (e.g. Gray et al., 2017, 2018). During the six-year period of the WWF CarBi project from 2011-2017, more than 100,000 snares were removed from the Hue and Quang Nam SNRs alone (WWF unpublished data). Snare occupancy decreased in apparent response to increased enforcement action during that period (Wilkinson, 2016), however high levels of snaring are still present in the forest and are still being removed by WWF-Vietnam supported local community snare-removal teams to reduce the potential impact to the resident terrestrial snare-susceptible species. Reintroduction for reinforcement of existing populations or rewildling remains an option in to the longer term, when snaring is brought under control, which will likely require concerted enforcement, arrests and convictions and demand reduction approaches.

PART 4. RESULTS: SMALL MAMMALS

COMPLETENESS OF COVERAGE

Small mammal surveys in Hue Nam Saola Nature Reserve were conducted between the 16th and 27th of March The survey area was focused around A Roong vault, from transportation station in A Roong commune to the border station in Huong Nguyen commune, from NR management office to A Tep forest ranger station in Huong Nguyen commune, A Luoi District, Thua Thien Hue. The area from A Roong vault to the border station in Huong Nguyen commune consist of monsoon tropical broad-leaf evergreen forests with large trees (diameter =1m), and many smaller trees (diameter 50-70m), palms, ferns, lianas and bamboo. The area from A Pat to A Tep stations consists of primary monsoon tropical broad-leaf evergreen forests. In elevation of less than 500m, there were good forests with a large number of big trees (diameter ca. 1m, height more than 25m), closed canopy. Under forest canopy, there were shrubs, ferns, lianas and bamboo. This area was also impacted due to logging and hunting. There were also many streams, small waterfalls with a lot of rocks.

Survey effort included 50 observation hours during the day and 32 hours at night. For sampling, we used 1,035 m^2h of mist net, 638.64 m^2h of harp trap sampling, 32 trap nights of mole traps, 255 trap nights of pitfall traplines, 530 trap nights of box and local cage traps. Survey effort is presented in **Table 3**.

TABLE 3 - SURVEY EFFORT FOR SMALL MAMMAL SURVEYS.

Date	Site	Day observation Start/finish: hrs	Mist net (m^2nh)	Harptrap (m^2th)	Mole trap (trap nights)	Pitfall trapline (trap nights)	Box and Cage traps (trap nights)	Night observation Start/finish: hrs
16/3/2018	Trapline #15	-	72	61.44	-	-	40	18:30-21:00: 2.5
16/3/2018	Trapline #16	5:30-11:00: 5.5	-	-	8	30	50	19:00-21:00: 3.0
16/3/2018	Trapline #17	-	108	61.44	-	30	30	19:30-21:30: 2.0
19/3/2018		-	126	61.44	-	-	-	20:00-22:00: 2.0
17/3/2018	Trapline #18	7:30-12:30: 5.0	-	-	8	30	30	-
18/3/2018		7:30-12:30: 5.0	-	-	8	30	30	-
19/3/2018		7:30-12:30: 5.0	-	-	8	30	30	-
17/3/2018	Trapline #19	-	81	61.44	-	-	-	18:30-21:30: 3.0
18/3/2018		-	81	61.44	-	-	-	-

TABLE 3 - SURVEY EFFORT FOR SMALL MAMMAL SURVEYS.

Date	Site	Day observation Start/finish: hrs	Mist net (m^2nh)	Harptrap (m^2th)	Mole trap (trap nights)	Pitfall trapline (trap nights)	Box and Cage traps (trap nights)	Night observation Start/finish: hrs
21/3/2018	Trapline #20	-	-	-	-	-	40	-
22/3/2018		7:30-9:30: 2.5	-	-	-	-	40	-
23/3/2018		7:30-10:30: 3.0	-	-	-	-	40	-
24/3/2018		7:30-10:00: 2.5	-	-	-	-	40	-
21/3/2018	Trapline #21	-	-	54	-	15	-	18:45-21:45: 3.0
22/3/2018		5:45-7:45: 2.0	135	54	-	15	-	18:45-21:45: 3.0
23/3/2018		5:00-8:00: 3.0	-	54	-	15	-	18:00-21:00: 3.0
25/3/2018	Trapline #22	-	162	54	-	-	20	18:00-21:00: 3.0
26/3/2018	Trapline #23	8:00-11:30: 3.5	162	54	-	30	40	18:00-22:00: 4.0
27/3/2018		6:00-11:30: 5.5	-	-	-	30	40	18:30-22:00: 3.5
23/3/2018	Trapline #24	8:00-10:30: 2.5	-	-	-	-	30	-
24/3/2018		6:00-11:00: 5.0	-	61.44	-	-	30	18:00-21:00: 3.0
Effort		**50**	**1035**	**638.64**	**32**	**255**	**530**	**32**

KEY SPECIES ACCOUNTS

In Hue SNR we recorded 42 species, including Chiroptera (20), Rodentia (16), Soricomorpha (5), Scandentia, Erinaceomorpha and Dermoptera (1 species each), see Annex I for more detail. In total 5 Orders and 13 Families were represented. Diversity was intermediate for the sites surveyed (see **Table 4**).

TABLE 4 – TOTAL SMALL MAMMAL SPECIES RECORDED AT EACH SITE AND DIVERSITY INDICES.

Areas	Species Recorded	# Indiv.	Shannon Index	Simpson Index
Bac Hai Van PNR	30	124	2.7	0.90
Song Thanh NR	51	141	3.6	0.98
Quang Nam SNR	37	152	3.1	0.95
Hue SNR	42	154	3.3	0.95
Phong Dien NR	34	69	3.2	0.96

The dominant level of species is presented using D dominance index. This index is classified into three levels: absolute dominant (D>10%), dominant (D=5.1-10%) and less dominant (D=2.1-5%). Dominance indices are presented in .

TABLE 5 – DOMINANCE INDICES – SMALL MAMMALS

Common Name	Scientific Name	Dominance Index
Andersen's Leaf-nosed Bat	*Hipposideros pomona*	16.88%
Pallas's Squirrel	*Callosciurus erythraeus*	9.74%
Cambodian Striped Squirrel	*Tamiops rodolphii*	5.84%
Asian Red-cheeked Squirrel	*Dremomys rufigenis*	5.84%
Northern Treeshrew	*Tupaia belangeri*	5.19%

TABLE 5 – DOMINANCE INDICES – SMALL MAMMALS		
Indo-Chinese Lesser Brown Horseshoe Bat	*Rhinolophus microglobosus*	4.55%
Large Brown Flying Squirrel	*Petaurista philippensis*	4.55%
Greater Flat-headed Bat	*Tylonycteris malayana*	3.90%
Millard's Rat	*Dacnomys cf. millardi*	3.25%
Polynesian Rat	*Rattus exulans*	3.25%

We recorded 31 species distributed under 500 m in elevation, 23 species were recorded from 500 to 800 m in elevation. Most species are distributed between 400 – 700 m elevation. There are five species distributed at above 700 m elevation, including: Taiwanese Gray Shrew *Crocidura* cf. *tanake*, Zaisevi Shrew *Crocidura zaitsevi*, Small-Toothed Mole *Euroscaptor parvidens*, Millard's Rat *Dacnomys millardi*, Long-tailed Giant Rat *Leopoldamys sabanus*, Indomalayan Maxomys *Maxomys surifer*.

Water Shrew *Chimarrogale* cf. *varennei* (Least Concern)
In Vietnam, two water shrew species are reported, namely Himalayan Water Shrew *Chimarrogale himalayca* (distributed in northern Vietnam) and *Chimarrogale varennei* (previously known as *Chimarrogale platycephalus*, a Japanese endemic species) (Abramov et al., 2016). During our surveys, samples of water shrew genus *Chimarrogale* were collected in areas along streams in Hue Saola NR (Traplines #15 and 24). In addition, we observed its movements at night in areas along streams in Quang Nam SNR (Trapline #10). If individuals belong to *Chimarrogale varennei*, these would represent new records for all five survey areas. This species has been previously known in the Central Highlands of Vietnam. The current status of this species has not been evaluated. However, its living habitats are being threatened due to human activities. For example, electric fishing gears are the most dangerous tools to destroy all aquatic resources and also have strong impacts on the species.

Small-toothed Mole *Euroscaptor parvidens* (Data Deficient)
Currently, only four mole species have been reported from Vietnam (Kawada et al., 2009, 2012; Zemelerova et al., 2016). However, the status of these species is not clearly understood. Although small-toothed mole (*Euroscaptor parvidens*) is only known in Vietnam (IUCN, 2018), its status was already assessed by Kawada et al (2009, 2012), and recently evaluated by Zamlemrova et al. (2016). This species is distributed only in the Central Highlands of Vietnam (Chu Yan Sin NP, Bi Doup – Nui Ba NP, Bao Lac District).

During our surveys, traces of the species were observed, and individuals were collected in several survey trails, including Song Thanh NR (Trapline #7, 15°39'29N; 107°37'14E), Quang Nam SNR (A Vương: 15°57'54N, 107°36'06E; Ta Lu: 15°57'47N, 107°40'54E), Heu SNR (Trapline 18, 16°02'20N; 107°27'21E), Phong Dien NR (Trapline #26, 16^{0}23'38N; 107^{0}10'19E). In comparison to previous studies (Kawada et al. 2009, 2012), results show that the species is being impacted by cultivation activities, plantations, logging, etc. The frequency of detection of the species was much lower than that in previous studies in 2006-2009 (Kawada et al., 2009)

Figure 9 *- Small-toothed Mole Euroscaptor parvidens*

Large Brown Flying Squirrel *Petaurista philippensis* (Least Concern)
This is the largest species in the family Sciuridae; its weight can be up to 3kg. This species can also be a bio-indicator for forest quality because it can only live in primary or well regenerated forests with numerous big trees. However, this species is a target animal for hunting and trapping when local people want to have food, especially before the new year holiday. During our surveys, 2 individuals were observed in Trapline #2 (16^{0}11'42N-108^{0}07'52E) in Bac Van Van NR at 20:01, 01/03/2018 and 19:45, 04/03/2018, respectively. Other two individuals were observed in Trapline #4 (15°36'17N-107°38'48E) at 20:17 and 20:35 in Song Thanh NR. In addition, we also recognized many skulls kept in local houses in A Tep village, Bhalee commune (Quang Nam). Especially, we observed and photographed one individual at 7:45, 21/03/2018 near Cha Lenh station (16^{0}04'40N-107^{0}29'12E) (A Luoi District). The animal stopped in the top of a high tree and did not move because of humid and foggy weather. The photograph showed the difference between this individual and other known species. The individual has ears with white hair while other known species has ears with dark-brown hair (Daosavanh *et al.* 2013). We suggested to continue to observe and study deeply about this animals in central Vietnam. More studies will help to clarify the distributional range of the genus *Petaurista* in Vietnam and Indochina. The species is listed as Vulnerable on the Vietnam Red Data Book (MoST 2007).

Figure 10 *– The large brown flying squirrel Petaurista philippensis*

THREATS

Hunting customs and wildlife trading are both main threats to small mammals in the survey areas. These activities happen more seriously in new year holiday when people want to have special food to treat their visitors or to sell for money. During this time, it is more difficult to control or monitor local people's activities because they irregularly set up more traps. Our survey reported that local people usually go to forests for trapping from December to February. They often catch small mammals, especially rats for food in new year holiday. We did not hear any gun shots during our survey, but we confirmed that hunting small mammals using guns still happens, especially Quang Nam SNR (A Tép 1, Bhallee common). Although we did not take any photos for this report, we directly observed several guns which were used to hunt animals. In addition, people using local traps in large numbers increases the risks for small mammals.

Our surveys also reported that rats are the favourite food, and easy to be captured; thus, local people usually used different kinds of traps to capture rats. Before setting up traps, local people usually spread cassava products on trails, which they wanted to trap, to attract rats. This method was called "rat feeding" which made rats familiar with baits. Different kinds of traps used are semicircular-shaped clamp-traps with different sizes depending on target animals. Local people usually set up traps around their paddy fields, along forests trails. The target small mammals can be large size rats, e.g. Bower's White-toothed Rat *Berylmys*, Long-tailed Giant Rat *Leopoldamys*, Millard's Rat *Dacnomys* cf. *millardi* or medium size rats, e.g. Indomalayan Maxomys *Maxomys surifer*, Chestnut White-bellied Rat *Niviventer fulvescen,* or flying squirrel Large Brown Flying Squirrel *Petaurista philippensis*, Pallas's Squirrel *Callosciurus errythraeus*, and Asian Red-cheeked Squirrel *Dremomys rufigensis*. Sometimes, they also trapped several weasels of the families Mustenidae and Herpestidae.

Besides hunting for food, local people also trapped animals for trading. They often sold animals to other wildlife traders or to their neighbours. Our survey reported that the prices can range 70,000-80,000 VND/ind. for rats with weight of up to 400g; 100,000 VND/ind. for squirrels, and 250,000-300,000VND/kg for bamboo rats. Normally, they can directly process captured animals in forests or bring them to home. Rats can be processed by removing hairs, or by being dried on fires. Rat innards can be cooked with some forest leaves as traditional food. Beside rodents, some large

mammals were also captured and traded in some places near protected areas. The price may be 180,000 VND/kg for wild pig; 110,000 VND/kg for chamois; 100,000 VND/kg for muntjac; 400,000-500,000 VND/individual for large flying squirrels; 250,000VND/kg for Common Palm Civet, and Annamite Striped Rabbit about 300,000VND/individual.

PART 5. RESULTS: BIRDS

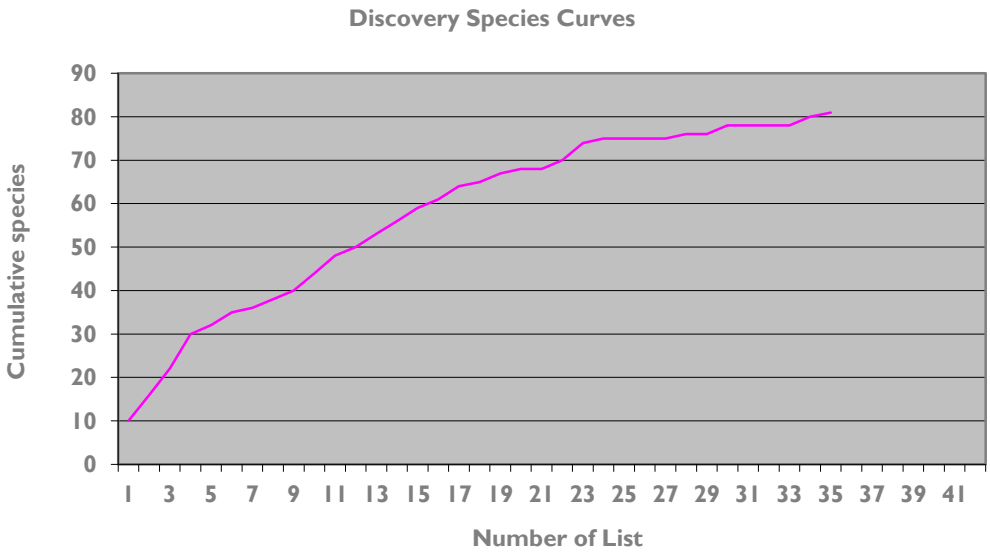
COMPLETENESS OF COVERAGE

There was limited information available related to the avifauna of Hue Saola Nature Reserve prior to this survey. In 2004, WWF implemented the Thua Thien Hue Green Corridor project and bird species throughout the region were surveyed, mainly along the Ho Chi Minh highway in the A Tep1, A Tep 2 and A Roang forest areas (Nguyen Cu & Nguyen Tran Vy, 2006). Some records of some important bird species were identified for conservation, including Crested Argus *Rheinartia ocellata* and Great Hornbill *Buceros bicornis* (Nguyen Cu & Nguyen Tran Vy, 2006). The current survey was conducted between 21st and 27th March, 2018 and was designed to maximize the number of species records available for the nature reserve.

The survey was conducted at three selected sites including the forest areas around A Tep (UTM 0768235-1776119); Tra Lenh (UTM 0765540-1779034) and Tay Sao La (UTM 0763728-1781920) forest guard stations, Hue Saola Nature Reserve, Hung Nguyen commune, A Luoi district, Thua Thien Hue province. The main habitats for all three selected sites were lowland evergreen forest. Most of the area was disturbed and degraded as the result of Ho Chi Minh highway construction during 1998-2005. The forest cover is good in some area around A Tep, Tra Lenh and Tay Sao La forest guard station while some other parts along Ho Chi Minh highway are the bare hills or scrub. The anthropogenic habitats surrounding A Roang village were also surveyed on an *ad hoc* basis during 13th March 2018.

The species accumulation curve (see **Figure 11**) shows that new species discoveries did not reach asymptote during the current survey, although clearly tails off, suggesting additional records would be made with additional survey effort.

Figure 11 *- Species accumulation curve for bird surveys in Hue Saola NR using the MacKinnon list approach.*



KEY SPECIES ACCOUNTS

A total of 139 bird species were recorded during the field survey. All of these were directly recorded by observation, photography and identification of calls (Annex I). This brings the total number of species so far recorded for the protected areas to 161 (Annex I). Of these, four species are listed in the IUCN Red list (IUCN, 2018), which included Indochinese Wren Babbler *Jabouilleia danjoui* (Near-Threatened), Annam Partridge *Arborophila merlini* (Near-Threatened), Austen's Brown Hornbill *Anorrhinus austeni* (Near-threatened), Great Hornbill *Buceros bicornis* (Near-threatened). Five species are also listed in the Vietnam Red Data Book (MoST, 2007): Indochinese Wren Babbler (Threatened), Austen's Brown Hornbill (Threatened), Great Hornbill (Threatened), Long-tailed Broadbill *Psarisomus dalhousiae* (Threatened) and Ratchet-tailed Treepie *Temnurus temnurus* (Threatened). Of importance, the two species of Hornbills are listed on Decree 160/2013 of the Vietnamese Government – (Nguyen The Cuong et al., 2015).

The bird community recorded at the forest areas of Sao La Hue Nature Reserve is characteristic of lowland evergreen forest which is characterized by the presence of a large number of species in the *Corvidae*, *Sylviidae*, *Pycnonotidae* and *Megalaimidae*. The species most frequently recorded in this habitat during the survey included White-winged Magpie *Urocissa whiteheadi,* Black-winged Cuckoo-shrike *Coracina melaschistos*, Scarlet Minivet *Pericrocotus flammeus,* Black Drongo *Dicrurus macrocercus,* Ashy Drongo *D. leucophaeus,* Greater Racket-tailed Drongo *D. paradiseus,* Pin Striped Tit Babbler *Macronus gularis,* Large Scimitar Babbler *Pomatorhinus hypoleucos*, Buff-breasted Babbler *Trichastoma tickelli,* Grey-throated Babbler *Stachyris nigriceps*, White-crested Laughingthrush *Garrulax leucolophus,* Black-throated Laughingthrush *Dryonastes chinensis,* White-bellied Erpornis *Erpornis zantholeuca*, Mountain Fulvetta *Alcippe peracensis*, Yellow-browed Warbler *Phylloscopus inornatus,* Dark-necked Tailorbird *Orthotomus atrogularis,* Black-crested Bulbul *Pycnonotus melanicterus*, Puff-throated Bulbul *Alophoixus pallidus*, Black Bulbul *Hypsipetes leucocephalius*, Grey-eyed Bulbul *Iole propinqua,* Red-vented Barbet *Megalaima lagrandieri*, Green-eared Barbet *M. faiostricta*.

As the survey was carried out in the middle of the spring migration season, the fairy large number of wintering and migratory species has been recorded including Oriental Honey Buzzard *Pernis ptilorhynchus,* Grey-faced Buzzard *Butastur indicus*, Black Baza *Aviceda leuphotes*, Japanese Sparrowhawk *Accipiter gularis*, Peregrine Falcon *Falco peregrinus,* Long-tailed Shrike *Lanius schach*, Brown Shrike *L. cristatus,* Asia Brown Flycatcher *Muscicapa dauurica*, Grey-headed Canary Flycatcher *Culicicapa ceylonensis*, Blue and White Flycatcher *Cyanoptila cyanomelana,* Blue Rock Thush *Monticola solitarius*, Barn Swallow *Hirundo rustica,* Red-jumped Swallow *H. daurica*, Yellow-browed Warbler, Spangle Drongo *Dicrurus hottentottus,* Fujian Niltava *Niltava davidi,* Siberian Blue Robin *Luscinia cyane,* White-tailed Robin *Cinclidium leucurum,* Orange-headed Thrush *Zoothera citrina,* Olive-backed Pipit *Anthus hodgsoni*.

Due to the limitation of observers and survey time, only 35 MacKinnon lists were made during the survey, a total of 81 species were recorded on one or more list (**Figure 11**). The eleven most commonly recorded bird species were Puff-throated Bulbul which was recorded on 20 lists (57.1%), Asian Fairly Bluebird *Irena puella* on 17 lists (48.6%), Green-eared Barbet and Dark-necked Tailorbird *Orthotomus atrogularis* on 15 lists (42.8%), Black Drongo *Dicrurus macrocercus* on 14 lists (40%), Pin Striped Tit Babbler on 13 lists (37.1%), Black-winged Cuckoo-shrike *Coracina melaschistos* and Golden-throated Barbet on 12 lists (34.3%), Mountain Fulvetta 11 lists (31.4%), Red-vented Barbet and Scarlet Minivet *Pericrocotus flammeus* on 10 lists (28.6%). The next 19 commonly recorded species were White-winged Magpie *Urocissa whiteheadi* and Ashy Drongo *Dicrurus leucophaeus* on 9 lists (25.7%), Red-headed Trogon *Harpactes erythrocephalus* on 8 lists (22.8%), Drongo Cuckoo *Surniculus lugubris* and Blue-winged Leafbird on 7 lists (20%), Large Scimitar Babbler *Pomatorhinus hypoleucos* and Orange-bellied Leafbird *Chloropsis hardwickii* on 6 lists (17,14%), Black Bulbul, Sultant Tit *Melanochlora sultanea*, Streaked Spiderhunter *Arachnothera magna*, Red-jumped Swallow *Cecropis daurica*, Green-billed Malkoha *Phaenicophaeus tristis*, Greater Jacket-tailed Drongo *Dicrurus paradiseus*, Scaly-breasted Partridge *Arborophila chloropus* on 5 lists (14.3%) and Crimson

Sunbird *Aethopiga siparaja,* Mountain Imperial Pigeon *Ducula badia*, Grey-eyed Bulbul *Iole propinqua*, Thick-billed Green Pigeon *Treron curvirostra,* Bay Woodpecker *Blythipicus pyrrhotis* on 04 lists (11.4%).

Indochinese Wren Babbler *Jabouilleia danjoui* (Near-threatened)
Indochinese Wren Babbler is fairly rare at Sao La Hue Nature Reserve, only one call of this species was recorded on 22 March 2018 at the forest area south of A Tep forest guard station (UTM 0767732-1775119). The bird was recorded in the fairly good lowland evergreen forest. Indochinese Wren Babbler is one of the restricted range species and is currently listed in IUCN Red List (2018) under the category as Near-Threatened. This species is also listed in Vietnam Red Data Book (2007) as Threatened [IUCN, 2018, Vietnam Red Data Book, 2007].

Annam Partridge *Arborophila merlini* (Near-threatened)
Annam Partridge is an uncommon species in Hue Saola Nature Reserve with only two calls of this species were recorded during the survey. One was on 21 March 2018 in the forest area about two km south of Tra Lenh forest guard station (UTM 0766240-1779324) at an elevation of 660 m asl. The other call was recorded in the forest area close to A Tep forest guard station on 22 March 2018 at an elevation of 520 m asl (UTM 0767425-1775626). Both areas are covered by fairly intact lowland evergreen forest habitat. Annam Partridge is an endemic species and is currently under threat through habitat loss and trapping. This species is also listed in IUCN Red List (IUCN, 2018) under the category as Near-Threatened.

Great Hornbill *Buceros bicornis* (Near-threatened)
One bird was observed and photographed on 21 March 2018 just in front of A Tep forest guard station (UTM 0767010-1776281) at an elevation of 510 m asl. The bird was perched on the branch of fairy large and tall tree situated just along the Ho Chi Minh highway (**Figure 12**). According to Mr. Ho Van Hom, a forest ranger at Tay Sao La forest guard station, there is a group of three to five individuals living in sub-zone 350 of Sao La Hue Nature Reserve (Ho Van Hom *pers.com*). Currently, Great Hornbill is highly threatened in Vietnam as a result of habitat loss and hunting. This species is listed as Near-Threatened in IUCN Red List (IUCN, 2018) and Threatened in Vietnam Red Data Book (MoST, 2007). Great Hornbill is also recorded in the Decree 160/2013 of the Vietnamese Government (Nguyen The Cuong *et al.* 2015).

***Figure 12** - Great Hornbill, a Near Threatened species still occurring in Hue SNR.*

Austen's Brown Hornbill *Anorrhinus austeni* (Near-threatened)
A group of three birds was observed and photographed in the forest area of south-east of A Tep forest guard station (UTM 0768235-1776119) on 23 March 2018 at an elevation of 550 m asl. This area is not far from the site where the large flock of this species recorded at Quang Nam SNR on 14 March 2018 during surveys there. Currently, Austen's Brown Hornbill is threatened in Vietnam as a results of habitat loss, logging of large trees and hunting pressure. This species is listed as Near-Threatened on the IUCN Red List (IUCN, 2018) and Threatened in the Vietnam Red Data Book (MoST, 2007). This species is also recorded in Decree 160/2013 of the Vietnamese Government (Nguyen The Cuong et al. 2015).

THREATS

No direct threats were recorded during the survey, which is a direct result of high patrol effort and strict control of Hue SNR forest guard stations and WWF-supported forest protection groups. However, one group of three local people wasn observed and photographed on 26 March 2018 when they tried to hide their motorbikes behind the Tra Lenh forest guard station. On the spot interview showed that they were going to the forest to catch frogs and ready for an overnight trip. Their activity may disturb wildlife (particularly with nocturnal species) and cause several other threats such as forest fire during their stay. They may also catch other animals if there is no control from forest rangers. The other threat to the biodiversity at Hue SNR is the trapping pressure. Several snares were observed in the forest area close to A Tep forest guard station. These snares were old, but trapping is still occuring in some remote areas within the nature reserve.

PART 6. RESULTS: REPTILES AND AMPHIBIANS

COMPLETENESS OF COVERAGE

Surveys in Hue Saola Nature Reserve started from the headquarters of the nature reserve in A Luoi district, Thua Thien Hue province. Surveys were conducted along two transects over four days, from 05/04/2018 to 08/04/2018. A total of 3 hours and 2 minutes along 1.6 km of transects was completed as described in **Table 6**.

TABLE 6 - SURVEY EFFORT FOR AMPHIBIANS AND REPTILES

	Transect Location	Habitat descriptions	Coordinates	Alt. (m)	Transect length (km)	Date	Survey duration		
							Start	End	Hrs
T4.1	A pat stream 1	Primary and secondary forests	766078/1779122 765554/1779021	700-730	0.7	07/04/18	19:38	20:46	1:07
T4.2	Apat stream 2	Primary and secondary forests	766155/1779024 765777/1778473	630-750	0.9	08/04/18	15:24	21:03	1:55

KEY SPECIES ACCOUNTS

Key species accounts are provided below and provide a basis for monitoring relative abundance of some relatively abundant species as well as providing comparison across protected areas surveyed. Many of these species (as indicated below) act as indictors of habitat types and forest health.

Indochinese Water Dragon *Physignathus cocincinus*

Indochinese Water Dragon were found along 15 forest transects in protected areas surveyed in Quang Nam and Thua Thien Hue provinces. Habitats they were recorded from include active and idle swidden fields, secondary forests, primary forests and around streams and rivers. The density of Indochinese water dragon is very high in transects 1.8 (4.28 encounters / km), 2.4 (2.75 encounters / km) and 5.3 (5.71 encounters / km) (Table 7).

TABLE 7 - ENCOUNTER RATES FOR INDOCHINESE WATER DRAGON

Transect	No. encounters	Km surveyed	Encounters / km
Hue Saola NR			
T4.2	1	0.9	1.11

Figure 13 *- Indochinese water dragon.*

Granular spiny frog *Quasipaa verrucospinosa* (Near Threatened)
Granular spiny frogs were found in 15 forest transects in the protected area network of Hue and Quang Nam provinces. Habitats included secondary forests, primary forests and around streams and rivers. The density of Indochinese is very high in transects 1.4 (2.21 encounters / km), 4.1 (2.94 encounters / km) and 5.2 (4.28 encounters / km). This species inhabits higher altitudes in the landscape. It occurs mostly in undisturbed primary forest habitats, with an altitude of more than 500 m. No evidence of the species was found on lower mountainsides and disturbed forest.

This species is valuable for the local residents, who collect them when they enter the forest for other activities. Local people are very aware of the distribution of granular spiny frog species as it is a target species for food and commercial sale.

TABLE 8 - ENCOUNTER RATES FOR GRANULAR SPINY FROGS

Transects	No. encounters	Km surveyed	Encounters / km
Hue Saola NR			
T4.1	2	0.7	2.94
T4.2	2	0.9	2.23

Figure 14 *- Granular spiny frog.*

Smooth soft poilan frog *Limnonectes poilani* (Least Concern)
Smooth soft poilan frogs were found in the almost all 18 forest transects in the five surveyed protected areas in Quang Nam and Hue provinces. They were found in secondary forests, primary forests and around streams and rivers. The density of the species was very high in transects 1.2 (8.26 encounters / km), 2.5 (4.73 encounters / km) and 4.1 (4.41 encounters / km). This species is also a valuable species for local communities as it is targeted for hunting for both local consumption and trade. Local hunters often hunt this species in slow moving streams and ponds.

TABLE 9 - ENCOUNTER RATES FOR SMOOTH SOFT POILAN FROGS

Transects	No. encounters	Km surveyed	Encounters / km
Saola Hue Natural Reserve			
T4.1	3	0.7	4.41
T4.2	2	0.9	2.23

Figure 15 *- Smooth soft poilan frog.*

Black striped frog *Sylvirana nigrovittata* (Least Concern)
Black striped frog was found in all protected area along 8 transects. The density of Black striped frog is very high in transects 5.2 (8.57 encounters / km), 2.5 (3.15 encounters / km), 4.1 (4.41 encounters / km).

TABLE 10 - ENCOUNTER RATES BLACK STRIPED FROG

Transects	No. encounters	Km surveyed	Encounters / km
Saola Hue Natural Reserve			
T4.1	3	0.7	4.41

Figure 16 *- Black striped frog*

Hasse spadefood toad *Leptobrachium hasseltii* (Least Concern)
Hasse spadefood toads were found in all 12 transects of Bac hai van protected area, Phong Dien, Saola Quang Nam and Song Thanh NRs. The density of Hasse spadefood toad is very high in transects 1.7 (19.80 encounters / km), 2.5 (3.15 encounters / km) and 3.3 (2.83 encounters / km), 5.3 (2.59 encounters / km). This species is indicator species for undisturbed rock stream habitats. The appearance of this species can measure the lower impact to habitats in the protected area.

TABLE 11 - ENCOUNTER RATES HASSE SPADEFOOD TOADS

Transects	No. encounters	Km surveyed	Encounters / km
Saola Hue Natural Reserve			
T4.2	1	0.9	1.11

Figure 17 *- Hasse spadefood toad*

Staine pitviper *Trimeresurus stejnegeri*
Staine pitviper were found on 4 transects of Phong Dien, Saola Hue, Saola Quang Nam and Song Thanh NRs. The density of Staine pitviper is very high in transects 4.1 (1.4 encounters / km) and 3.3 (0.47 encounters / km). This species is quite common in the landscape, and not a significant target of hunting by local communities. Community mapping also recognized it as a very common snake in the region.

TABLE 12 - ENCOUNTER RATES OF STAINE PITVIPER

Transects	No. encounters	Km surveyed	Encounters / km
Saola Hue Natural Reserve			
T4.1	1	0.7	1.47

Figure 18 *- Staine pitviper*

THREATS

The overall distribution of the reptile and amphibian fauna primarily reflects the patterns of human disturbance, which mask differences in distribution according to habitat and altitude, etc. Reptiles and amphibians are forced away from lower river valleys and peripheral areas of reserves towards the remoter mountainous areas. Indochinese Box Turtle, for example, is preferentially a species of lowland river valleys but is now almost always encountered in high and remote mountain areas, where it tries to find refuge from hunters. The highest densities of reptiles and amphibian are found in the remotest areas which are least accessible to hunters, although the highest diversities of some reptiles and amphibians are found in mosaic areas where a mixture of primary and secondary habitats occurs.

Snaring for terrestrial wildlife remains a large threat, although does not overly effect reptiles and amphibians; snares were commonly encountered during surveys. Timber exploitation is still widespread within the landscape and forms an important part of village livelihoods, and evidence of logging activities Is commonly encountered. Logging continues to disturb evergreen forest habitat and retard regeneration of previously disturbed areas. So too does burning and conversion of forest to swidden fields: This has a direct impact on the natural habitats of turtles and still occurs in several areas (e.g. Aun and Arec villages in Saola Quang Nam Natural Reserve). Gold mining is largely restricted to Song Thanh Natural Reserve, based on our observations in the field; an issue which continues to disturb aquatic habitats and probably has a major impact on populations of aquatic animals, such as otters and water birds.

PART 7. RESULTS: PLANTS

COMPLETENESS OF COVERAGE

Plant surveys in Thua Thien Hue Saola NR were conducted between 08th March, 2018 and 13th March, 2018. Surveys were conducted along four main survey routes as described in **Table 13**.

Surveys returned a full species list of 1,035 species of 162 families of vascular plant species for the NR (see Annex I). The surveys added additional species to those found previously. In comparison with the data of MARD (2013), the survey results have increased known diversity by 217 species and 32 families. Meanwhile, compared with the data of the Department of Science and Technology (2012) the survey added 248 species and 9 families. All of the families and most of the species in 2012 inventory which was encountered during the survey but due to the limited time to describe the status of each species, we only prioritized information collection for the valuable species of high conservation priority. It should be noted that several species previously recorded have not been rediscovered including for example *Sindora simensis* and *Paphiopedilum appletonianum*. This may due to two possibilities: either confusion in species identification or the low species density while the access time is insufficient. Therefore, it is necessary to invest more time and resources in order to complete the plant list for NR in the near future.

TABLE 13- SURVEY EFFORT FOR PLANT SURVEYS IN HUE SAOLA NR

No	Route code	*SL-T1*	*SL-T2*	*SL-T3*	*SL-T4*
1	Time	03/09/2018	03/10/2018	03/11/2018	03/12/2018
2	Weather	Rainy, cold	Rainy, cold	Slightly rainy, cold	Rainy, cold
3	Starting point co-ordinate	48Q59867-83433	48Q60849-82315	48Q63489-81871	48Q61235-82132
4	Ending point co-ordinate	48Q60273-84305	48Q60996-82253	48Q63743-81036	48Q61474-82277

TABLE 13- SURVEY EFFORT FOR PLANT SURVEYS IN HUE SAOLA NR					
5	Route length	2057m	2250m	1620m	2530m
7	Terrain type	Low mountain	Low mountain	Low mountain	Low mountain
8	Forest status on the route	Average forest	Poor and newly regenerated forest,	Average forest	Average forest
9	Threatening findings	Illegal logging and non-timber product exploitation	Non-timber product exploitation	Animal trapping	No findings
10	Impact level to the forest resources	Strong	Average	Average	Weak
11	Endangered species found on the route	*Dacrycarpus imbricatus, Codonopsis javanica*	*Aquilaria crassna Pierre ex Lecomte, Anoectochilus*	*Cinnamomum parthenoxylon, Anoectochilus*	*Cinnamomum parthenoxylon, Dacrycarpus imbricatus*

KEY SPECIES ACCOUNTS

Results show that there are at least 44 rare and endangered species in Hue Saola NR, including 37 species listed on the Vietnamese Red Data Book (MoST, 2007; CR - 2 species, EN - 15 species, VU - 20 species); 13 species belonging to Decree 32/2006 (group IA - 3 species, group IIA - 10 species) and one species on the IUCN Red List of Threatened Species (IUCN, 2018). In comparison to previous publications, the number of plant species listed in the rare and endangered group has significantly increased (34 species) based on this work. A full list of important species of conservation concern in Hue Saola NR is given in **Table 14**.

TABLE 14 - PLANT SPECIES OF CONSERVATION CONCERN IN HUE SAOLA NR					
No.	**Latin name**	**Local name**	**Red Book**	**Decree 32**	**IUCN 2018**
1.	*Aglaia spectabilis* (Miq.) Jain & Bennet.	Gội nếp; Gội tía	VU		
2.	*Anoectochilus annamensis* Aver.	Giải thùy Trung bộ		IA	
3.	*Anoectochilus setaceus* Blume	Giải thùy tơ	EN	IA	EN
4.	*Aquilaria crassna Pierre* ex Lecomte	Dó bầu	EN		
5.	*Ardisia silvestris* Piard	Lá khôi	VU		
6.	*Bulbophyllum astelidum* Aver.	Cầu diệp sao	EN		
7.	*Canthium dicoccum* (Gaertn.) Teysm. & Binn.	Xương cá	VU		
8.	*Chukrasia tabularis* A. Juss.	Lát hoa	VU		
9.	*Cinnamomum parthenoxylon* (Jack) Meisn.	Re hương	CR	IIB	
10.	*Codonopsis javanica* (Blume) Hook. f.	Đảng sâm	VU	IIA	
11.	*Coscinium fenestratum* (Gaertn.) Colebr.	Vàng đắng		IIA	
12.	*Dendrobium amabile* (Lour.) O' Brien	Thủy tiên hường	EN		
13.	*Dendrobium nobile* Lindl.	Hoàng phi hạc	EN	IIB	

TABLE 14 - PLANT SPECIES OF CONSERVATION CONCERN IN HUE SAOLA NR

No.	Latin name	Local name	Red Book	Decree 32	IUCN 2018
14.	*Embelia parviflora* Wall. ex A. DC. 1834.	Thiên lý hương	VU		
15.	*Enicosanthellum plagioneurum* (Diels) Ban	Nhọc trái khớp lá thuôn	VU		
16.	*Eria obscura* Aver.	Nỉ lan tối	EN		
17.	*Erythrophleum fordii* Oliv.	Lim xanh		IIA	
18.	*Euonymus chinensis* Lindl.	Đỗ trọng nam	EN		
19.	*Fibraurea tinctoria* Lour.	Hoàng đằng		IIA	
20.	*Goniothalamus macrocalyx* Ban	Giác đế đài to	EN		
21.	*Goniothalamus vietnamense* Ban	Bổ béo đen	VU		
22.	*Illicium petelotii* A.C. Sm, 1947	Hồi núi	EN		
23.	*Indosinias involucrata* (Gagnep.) Vidal	Cúc mai	CR		
24.	*Ixodonerium annamense* Piard	Néo; Mô	VU		
25.	*Lithocarpus amygdalifolius* (Skan) Hayata	Dẻ hạnh nhân	VU		
26.	*Lophopetalum wightianum* Arn.	Ba khía	VU		
27.	*Madhuca pasquieri* (Dubard) H. J. Lam.	Sến mật	EN		
28.	*Markhamia stipulata* (Wall.) Seem. ex Schum.	Kè đuôi nhông;		IIA	
29.	*Melanorrhoea laccifera* Pierre	Sơn huyết	VU		
30.	*Melientha suavis* Pierre	Rau sắng,	VU		
31.	*Michelia balansae* (DC) Dany	Giổi lông	VU		
32.	*Pachylarnax praecalva* Dany	Mỡ vạng	VU		
33.	*Paphiopedilum appletonianum* (Gower) Rolfe	Hài đài cuốn	VU	IA	
34.	*Parashorea stellata* Kurz	Chò đen	VU		
35.	*Paris polyphylla* Smith	Trọng lâu nhiều lá	EN		
36.	*Pauldopia ghorta* (G. Don) Steen.	Đinh cánh	EN		
37.	*Peliosanthes teta* Andr.	Sâm mây	VU		
38.	*Raphistemma hooperianum* (Blume) Decne	Trâm hùng	EN		
39.	*Rauvolfia cambodiana* Pierre ex Pitard	Ba gạc lá to	VU		
40.	*Rhopalocnemis phalloides* Jungh.	Chùy đầu dương hình	VU		
41.	*Sindora siamensis* Teysm. ex Miq.	Gụ mật	EN	IIA	
42.	*Sindora tonkinensis* A. Chev. ex K. &S. Larsen	Gụ lau;	EN	IIA	
43.	*Stephania rotunda* (Lour)	Bình vôi		IIB	

TABLE 14 - PLANT SPECIES OF CONSERVATION CONCERN IN HUE SAOLA NR

No.	Latin name	Local name	Red Book	Decree 32	IUCN 2018
44.	*Styrax litseoides* J. E. Vidal	Bồ đề lá bời lời;	EN		

Red Data Book (MoSt, 2007): EN = Endangered; VU = Vulnerable; NT = Near-threatened.
Decree 32/2006/NĐ- CP; Group IA – Plants banned from exploitation and use for commercial purposes; Group IIA – Plants restricted from exploitation and use for commercial purposes.
IUCN (2018): CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least Concern.

In terms of plants of value: there are 204 species of timber tree; 574 species for medicinal purposes (55.45% of total recorded species); 242 species for ornaments; and other species group for NTFPs such as food, plastic, essential oils, tannins, fibers, handicrafts.

THREATS

Several threats to resident plant species, and conservation in general, were identified during the surveys. Logging was historically an issue from before the Nature Reserve's establishment and during infrastructure construction. Currently, timber harvesting in the NR has significantly declined due to the management of foresters and forest patrols. The areas where small scale logging now occurs are located adjacent to protection forests, waterways and close to residential areas (e.g. 351, 352 sub-areas). Currently timber species targeted for harvesting include *Hopea pierrei, Madhuca pasquieri, Michelia spp., Sindora tonkinensis, Erythrophleum fordii, Pometia pinnata, Heritiera cochinchinensis*.

NTFPs exploitation is the most significant factor affecting the plant resources of the Hue Saola Nature Reserve. The population decrease is alarming for high value species including *Paris Polyphylla* Sm and other rare orchids: *Anoectochilus setaceus, Dendrobium amabile, Dendrobium nobile, Paphiopedilum appletonianum.* The over-exploited species recently belong to the medicinal plant with high consumption demand such as *Homalomena occulta* (Thiên niên kiện), *Callerya reticulata* (Kê huyết đằng), *Acorus gramineus* (Thạch xương bồ), *Stephania rotunda* (Bình vôi), *Morinda* spp (Ba kích). and rare orchids with beautiful flowers. Other NTFPs species which are regularly harvested for community use but which have low impact on the resources of the nature reserve, include rattan, palm leaf, Chuon bark – *Garcinia merguensis*, vegetable species and honey.

The cattle grazing in the Nature Reserve is also one of the obstacle to conservation activities and damaging to biodiversity. Moreover, they do not only often eat grass but also many valuable herbaceous species and regenerating trees which negatively affects forest recovery and development. Areas most affected by cattle are surrounding the border of Huong Nguyen and adjacent areas (A Roang No.1 tunnel and A Tep).

The opening of mission roads and electricity line construction have been causing direct damage to the vegetation and creating access opportunities to other rare species, especially orchids and medicinal plants. In addition, these works also contribute to the spread of invasive species, harmful species and increase the risk of erosion and landslides.

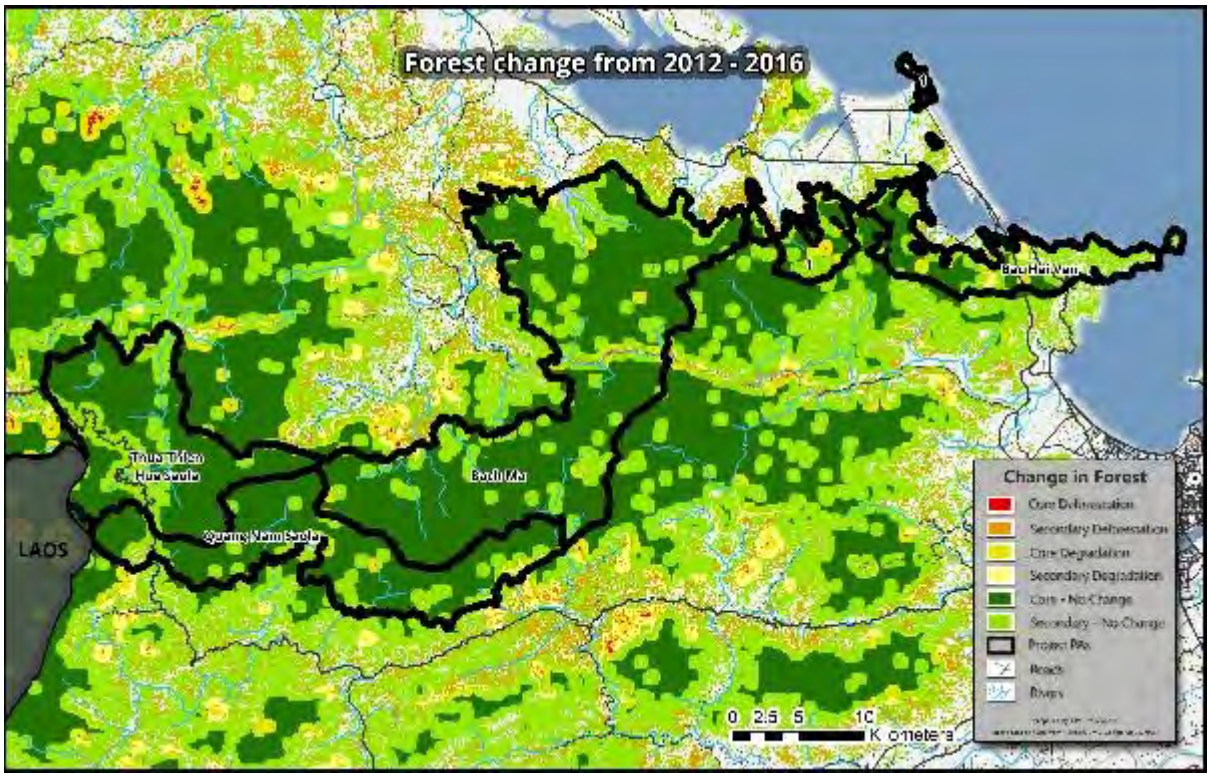
PART 8. RESULTS: FOREST COVER AND FRAGMENTATION

Hue Saola Nature Reserve is performing considerably better than other target PAs, showing low relative amounts of forest change over the course of four years. Very little forest loss occurred; only 3 ha (0.02%) between 2012 and 2016 with none of this in core forest, only secondary forests. There is a road coming into Hue SNR from Quang Nam Saola in the south and this exits the protected area in the west. This road is the main cause for the low forest continuity in the area, however forest functionality in terms of connectivity of core forests declined only marginally in the period assessed. The minimal degradation of core forest was all caused by deforestation just outside of the protected area. In general, forest cover and status was stable in Hue SNR between 2012 and 2016 (**Error! Reference source not found.** and **Figure 19**).

TABLE 15 – FOREST COVER CHANGE

PA Name	Year	Frag. Forest	Edge Forest	Core Forest	Core Defor.	2ndry Defor.	Core Deg.	2ndry Deg.
Hue Saola NR	2012	676	3,591	11.045	-	3	96	4
	2016	679	3,681	10,949				

Figure 19 *- Map showing the Deforestation/Degradation of Thua Thien Hue Saola NR (far left), Quang Nam Saola NR, and Bac Hai Van PNR between 2012 and 2016.*



PART 9: CONCLUSIONS AND RECOMMENDATIONS

1. The current species totals for Hue Soala Nature Reserve after the completion of this survey and assessment of historical records stands at: 42 small mammal species from 13 Families including one Endangered and three Vulnerable species on the Red Data Book (MoST, 2007) while camera trapping revealed an additional two Vulnerable species; 161 bird species from 114 Genera and 35 Families including one species listed on the Red Data Book of Vietnam (MoST, 2007); 73 Amphibian and Reptile species from 59 Genera and 22 Families including six Vulnerable, six Endangered and two Critically Endangered species on the Red Data Book of Vietnam (MoST, 2007) and two Vulnerable and four Endangered species on the IUCN Red List (IUCN, 2018); and 1,035 plant species from 159 Families including two Critically Endangered, 19 Endangered and 21 Vulnerable species on the Red Data Book of Vietnam (MoST, 2007) and one Data Deficient species on the IUCN Red List (IUCN, 2018).

2. Inventories for Hue Saola Nature Reserve are unlikely to be complete, despite the survey effort utilised across multiple taxa as described in this report. Additional bird surveys both spatially and temporally should be conducted to supplement the existing incomplete list. Small mammal fauna is likewise likely under represented and would benefit from additional work. The large increases in the number of plant taxa recognised for the PA found by this survey suggest additional plant surveys would also return many additional records. Likewise, turtle fauna is very likely under represented and additional field records are required to confirm interviews conducted under this survey given many of these taxas highly threatened status.

3. The lack of additional saola records over recent years, despite considerable effort through extensive camera trapping, is a cause for considerable concern given the site was designated for the species conservation. It seems unlikely that a viable population of the species persists within the protected area complex. Additional detection work should however be conducted with the end aim of capture and translocation to the under-development saola breeding centre in Bach Ma National Park. It seems likely, that an ex-situ breeding option for this highest of priority endemic taxon is the only way forward for conservation.

4. Work under this survey has provided a strong basis for monitoring of biodiversity over time. The camera trapping baseline represents the most robust approach to monitoring of trends for a large number of wildlife taxa ever conducted in Vietnam. Additional repeats of the camera trapping work should be conducted at 2-3 year intervals to determine changes in occupancy. While positive changes (i.e. population rebound, distribution expansion) are unlikely to be seen within a 2-year time period, a frequent sampling approach may safeguard against unnoticed catastrophic decline should direct threats increase or trophic cascades occur with the removal of large carnivores from the site or other complex effects.

5. Habitat is very stable within the Hue Saola Nature Reserve, with only 0.02% forest loss in the period 2012-2016. This is likely due to very positive management response to logging and encroachment by the Management Board and the engagement of local community members through community-based patrol and snare removal work, supported by WWF-Vietnam. Enforcement effort should be maintained under the current model given its proven effectiveness at reducing deforestation processes. Forest clearing and burning for paddy fields must be strictly controlled or prohibited. The areas allowed for burning must be controlled because those areas are very close to natural forests; when they are burned, there is high possibility that natural forests fire will occur.

6. Hunting with snares continues to be a major threat, probably the most significant threat, to biodiversity in Hue Saola Nature Reserve. Snare removal through the community-ranger model has been successful in the past under the CarBi project, and should be continued. However, it is

clear that snare removal, in and of itself, is insufficient to control illegal hunting. A combination of additional enforcement effort with a focus on arrest and prosecution for those involved in wildlife hunting and especially trade should be made. However, this needs to be conducted in coordination with other initiatives which include community engagement in reducing forest crime and demand reduction approaches both around the protected area and in the landscape in general to overcome the cultural demand for wildlife products.

7. It is beyond the scope of this report, which addresses issues around inventory and monitoring of wildlife populations, to address enforcement models that protected area management boards should pursue, however, it is clear that enforcement which involves arrest and prosecution as a deterrent, should be strengthened for effective nature protection. This applies to forest encroachment and hunting of species within the boundaries of the protected area. Mixed patrols and enforcement action with Hung Nguyen border army station, local police and in cooperation with Quang Nam Saola Nature Reserve should help to control the trapping and collecting of wildlife species by strictly patrolling the main trails which are frequently used by local people who mainly come from Quang Nam province. Currently, the number of forest rangers as well as forest guard stations in Sao La Hue Nature Reserve is limited with only three forest guard stations with a total of approximately 20 forest rangers.

8. Communication and education activities on forest protection should continue to be updated and disseminated to local people, restaurant owners and wildlife traders in several areas, for example: Thanh My, Prao, Azich (Nam Giang and Tay Giang District), A Dot (A Luoi District). Enforcement effort should particularly focus in several areas, e.g. A Roong, Huong Nguyen. Awareness raising awareness of local community about the importance of biodiversity at the Sao La Hue Nature Reserve may also be beneficial as a partial solution to reducing hunting pressure as discussed above.

9. Livelihood improvement activities for local communities may also provide an economic offset for current hunting activities, however the causal relationship between improved economic activity and reduced hunting activity is not clear and should be underpinned by sound theory and understanding of the local context given the generally high costs of such activities. Support for NTFP development, can represent a win-win scenario for sustainable forest management but must be carefully considered to ensure prevention of violations and degradation of such resources.

10. Additional capacity for protected area staff is required if staff are to be self-sufficient in terms of conducting field-based surveys and conducting data analysis. The Training Needs Assessment showed that staff capacity is self-assessed as generally low for conducting this work, there is a lack of confidence at least and it is assumed this reflects an actual gap in capacity. In general, the skills associated with conducting species surveys and monitoring to return statistically meaningful results is currently beyond most PA staff in Vietnam. Recent research (Le Thanh An et al. 2018) has shown that only 5.43% of National Park staff in Vietnam have a background in biology, ecology or environmental protection, with most (74.09%) having academic training in forestry, agriculture or fisheries. As such, the Management Board should aim to recruit additional capacity amongst their staff in relevant positions to support biodiversity related work. While some skill transfer can be made during short term investments in training as conducted under this project, university level training at undergraduate level is required to understand the statistical approaches to data analysis. Additional capacity and participation in wildlife assessments and monitoring will help to develop understanding of the relative importance of forest crime relating to wildlife and needs from a management perspective. Additional capacity for law enforcement activities may also be required but is beyond the scope of this report.

11. Additional focus on biodiversity monitoring in the planning and budgeting for protected areas is generally required through the protected areas system in Vietnam. No direct assessment was

conducted under this work to determine budget allocations for these fundamental tasks for PA management in relation to biodiversity conservation, however, it is recommended that explicit budgeting for these activities is made to support development of monitoring work within the PA and that provincial budgets ensure these key tasks are accounted for.

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ANNEX I: SPECIES LIST

SPECIES RECORDED BY CAMERA TRAP

TABLE 16 - MAMMAL SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN Red List
	SCARDENTA							
	Tupaiidae							
1	*Tupaia belangeri*	Northern treeshrew	x	x	x	x	x	LC
	PRIMATES							
	Cercopithecidae							
2	*Macaca arctoides*	Stump-tailed macaque	x	x	x	x	x	VU
3	*Macaca mulatta*	Rhesus macaque			x		x	LC
4	*Macaca leonina*	Northern pig-tailed macaque	x	x	x		x	VU
5	*Pygathrix nemaeus*	Red-shanked douc langur						EN
	CARNIVORA							
	Mustelidae							
6	*Mustela kathiah*	Yellow-bellied weasel		x	x			LC
7	*Martes flavigula*	Yellow-throated marten	x	x	x	x	x	LC
8	*Melogale* spp.	Ferret badger species	x	x	x	x	x	LC
	Viverridae							
9	*Chrotogale owstoni*	Owston's civet			x		x	EN
10	*Paguma larvata*	Masked palm civet	x	x	x		x	LC
11	*Paradoxurus hermaphroditus*	Common palm civet	x	x	x	x	x	LC
12	*Prionodon pardicolor*	Spotted linsang	x	x	x	x		LC
	Herpestidae							
13	*Herpestes javanicus*	Small Asian mongoose				x		LC
14	*Herpestes urva*	Crab-eating mongoose	x	x	x		x	LC
	Felidae							
15	*Prionailurus bengalensis*	Leopard cat	x	x	x	x	x	LC
	Ursidea							
16	*Ursus thibetanus*	Asiatic black bear			x			VU
	ARTIODACTYLA							
	Suidae							
17	*Sus scrofa*	Eurasian wild pig	x	x	x	x	x	
	Cervidae							
18	*Tragulus kanchil*	Lesser oriental chevrotain			x	x	x	LC
19	*Muntiacus truongsonensis/rooselvetorum**	Annamite dark muntjac	x	x	x		x	DD
20	*Muntiacus vaginalis*	Red muntjac	x	x	x		x	LC
21	*Muntiacus vuquangensis*	Large-antlered muntjac			x	x		CR
22	*Rusa unicolor*	Sambar					x	VU
	Bovidae							
23	*Capricornis milneedwardsii*	Serow	x	x	x	x	x	NT
	RODENTIA							
	Hystricidae							
24	*Hystrix brachyura*	Malayan porcupine	x	x	x	x	x	LC
25	*Atherurus macrourus*	Asiatic brush-tailed porcupine	x	x	x	x	x	LC
	LAGOMORPHA							

TABLE 16 - MAMMAL SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN Red List
	Leporidae							
26	*Nesolagus timminsi*	Annamite striped rabbit	x	x	x		x	DD
	Total number of recorded species		**17**	**18**	**23**	**14**	**20**	

** The Annamite dark muntjac represents a species complex composed of two or three species*

TABLE 17 - BIRD SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN red list
	GALLIFORMES							
	Phasianidae							
1	*Arborophila merlini**	Annam partridge	x	x	x	x	x	LC
2	*Arborophila rufogularis*	Rufous-throated partridge		x		x	x	LC
3	*Arborophila brunneopectus*	Bar-backed partridge	x	x	x	x	x	LC
4	*Gallus gallus*	Red junglefowl	x		x	x	x	LC
5	*Lophura diardi*	Siamese fireback			x	x		LC
6	*Lophura nycthemera*	Silver pheasant		x	x			LC
7	*Polyplectron bicalcaratum*	Grey peacock-pheasant					x	LC
8	*Rheinardia ocellata*	Crested argus	x	x	x		x	NT
	PICIFORMES							
	Picidae							
9	*Picus rabieri*	Red-collared woodpecker						NT
	COLUMBIFORMES							
	Columbidae							
10	*Chalcophaps indica*	Emerald dove	x	x	x	x	x	LC
	GRUIFORMES							
	Rallidae							
11	*Rallina eurizonoides*	Slaty-legged crake			x	x	x	LC
	ACCIPITRIFORMES							
	Accipitridae							
12	*Spilornis cheela*	Crested serpent eagle						LC
13	*Nisaetus nipalensis*	Mountain hawk eagle			x			LC
	PELECANIFORMES							
	Ardeidae							
14	*Gorsachius melanolophus*	Malayan night heron				x	x	LC
	PASSERIFORMES							
	Pittidae							
15	*Pitta soror*	Blue-rumped pitta			x	x	x	LC
16	*Pitta elliotii*	Bar-bellied pitta	x		x			LC
	Corvidae							
17	*Urocissa xanthomelan*	White-winged magpie	x	x	x			NT
	Turdidae							
18	*Myophonus caeruleus*	Blue whistling thrush	x			x	x	LC
19	*Zoothera citrina*	Orange-headed thrush	x	x	x	x	x	LC
20	*Zoothera dauma*	Scaly thrush	x	x				LC
	Muscicapidae							
21	*Kittacincla malabarica*	White-rumped shama	x					LC

TABLE 17 - BIRD SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN red list
	Timaliidae							
22	*Garrulax milleti*	Black hooded laughingthrush	x		x			NT
23	*Garrulax monileger*	Lesser necklaced Laughing thrush						LC
24	*Garrulax leucolophus*	White-crested Laughing thrush			x	x		LC
25	*Pomatorhinus hypoleucos*	Large scimitar babbler	x	x				LC
26	*Stachyris strialata*	Spot-necked babbler						LC
27	*Alcippe rufogularis*	Rufous-throated fulvetta						LC
	Total number of recorded species		**13**	**10**	**15**	**12**	**12**	

* *Taxonomy of this partridge is unclear and by some sources it is considered a sub-species of* Arborophila chloropus.

SMALL MAMMAL SPECIES RECORDED

TABLE 18 – SMALL MAMMAL SPECIES RECORDED IN HUE SAOLA NATURE RESERVE

TT	Scientific name	English Name	Record	Location	# Indiv.	Coordinates	Elevation (m)
	I. SCANDENTIA Wagner, 1855						
	1. Tupaiidae Gray, 1825						
1	*Tupaia belangeri* (Wagner, 1841)	Northern Treeshrew	I,C,O B,O	Trapline #15 Trapline #20	1,3 1,3	16°02'48N; 107°27'43E 16⁰02'13N 107⁰29'58E	450 752
	II. DERMOPTERA Illiger, 1811						
	2. Cynocephalidae Simpson, 1945						
2	*Galeopterus variegatus* (Audebert, 1799)	Sunda Flying lemur	In				
	III. SORICOMORPHA Gregory, 1910						
	3. Soricidae G. Fischer, 1814						
3	*Crocidura* cf. *tanakae* Kuroda, 1938	Taiwanese Gray Shrew	P	Trapline #17	2	16°02'30N; 107°27'30E	797
4	*Crocidura zaitsevi Jenkins, Abramov, Rozhnov, Makarova, 2007*	Zaisevi Shrew	P P	Trapline #17 Trapline #18	1 1	16°02'30N; 107°27'30E 16°02'20N; 107°27'21E	797 965
5	*Chimarrogale* cf. *varennei* Thomas, 1927	Water Shrew	B B	Trapline #15 Trapline #24	1 2	16°02'48N; 107°27'43E 16⁰04'40N; 107⁰29'12E	450 620
	4. Talpidae G. Fischer, 1814						
6	*Euroscaptor parvidens* (Miller, 1940)	Small-toothed Mole	Mo	Trapline #18	1	16°02'20N; 107°27'21E	956
	IV. CHIROPTERA Blumbach, 1779						
	5. Pteropodidae Gray, 1821						
7	*Cynopterus sphinx* (Vahl, 1797)	Greater Shortnosed Fruit Bat	M M	Trapline #15 Trapline #16	1 1	16°02'48N; 107°27'43E 16°02'30N; 107°27'30E	450 797
7	*Macroglossus sobrinus* Andersen, 1911	Hill Long-tongued Fruit Bat	M	Trapline #24	1	16⁰04'40N; 107⁰29'12E	620
	6. Rhinolophidae Gray, 1825						
9	*Rhinolophus affinis* Horsfield, 1823	Intermediate Horseshoe Bat	M H H	Trapline #22 Trapline #23: Trapline #24	1 1 1	16⁰05'10N; 107⁰29'12E 16◦06'25N; 107⁰27'39E 16⁰04'40N; 107⁰29'12E	552 884 620
10	*Rhinolophus luctus* Temminck, 1834	Great Woolly Horsehoe Bat	H H	Trapline #15 Trapline #22	3 1	16°02'48N; 107°27'43E 16⁰05'10N; 107⁰29'12E	450 552

TABLE 18 – SMALL MAMMAL SPECIES RECORDED IN HUE SAOLA NATURE RESERVE

TT	Scientific name	English Name	Record	Location	# Indiv.	Coordinates	Elevation (m)
	Rhinolophus microglobosus Csorba, Jenkins, 1998	Indo-Chinese Lesser Brown Horseshoe Bat	H H	Trapline #21 Trapline #24	3 4	16⁰03'04N; 107⁰30'06E 16⁰04'40N; 107⁰29'12E	541 620
11	*Rhinolophus pearsonii* Horsfield, 1851	Pearson's Horseshoe Bat	M	Trapline #15	1	16°02'48N; 107°27'43E	450
12	*Rhinolophus pusillus* Temminck, 1834	Least Horseshoe Bat	M H	Trapline #15 Trapline #21	2 2	16°02'48N; 107°27'43E 16⁰03'04N; 107⁰30'06E	550 541
	7. Hipposideridae Lydekker, 1891						
13	*Hipposideros armiger (Hodgson, 1835)*	Great Himalayan Leaf-nosed Bat	M	Trapline #22	1	16⁰05'10N; 107⁰29'12E	552
14	*Hipposideros grandis* Allen, 1936	Grand Leaf-nosed Bat	M	Trapline #23	1	16◦06'25N; 107⁰27'39E	844
15	*Hipposideros pomona* K. Andersen, 1918	Andersen's Leaf-nosed Bat	H H	Trapline #21 Trapline #24	8 18	16⁰03'04N; 107⁰30'06E 16⁰04'40N; 107⁰29'12E	541 620
	8. Megadermatidae H. Allen, 1864						
16	*Megaderma lyra E. Geoffroy, 1810*	Greater False Vampire	M	Trapline #15	1	16°02'48N; 107°27'43E	450
	9. Vespertilionidae Gray, 1821						
17	*Pipistrellus coromandra* (Gray, 1838)	Coromandel Pipistrelle	H	Trapline #15	1	16°02'48N; 107°27'43E	450
18	*Tylonycteris malayana* Chasen, 1940	Greater Flat-headed Bat	H	Trapline #15	6	16°02'48N; 107°27'43E	450
19	*Myotis ater (Peters, 1866)*	Peters's Myotis	H	Trapline #15	1	16°02'48N; 107°27'43E	450
20	*Myotis muricola* (Gray, 1846)	Nepalese Whiskered Myotis	H	Trapline #19	1	16⁰02'55N; 107⁰27'52E	421
21	*Murina cyclotis* Dobson, 1872	Round-eared Tube-nosed Bat	H	Trapline #21	1	16⁰03'04N; 107⁰30'06E	541
22	*Murina feae* (Thomas, 1891)	Ashy-gray Tube-nosed Bat	H	Trapline #21	1	16⁰03'04N; 107⁰30'06E	541
23	*Harpiocephalus harpia (Temminck, 1840)*	Lesser Hairy-winged Bat	H	Trapline #21	1	16⁰03'04N; 107⁰30'06E	541
24	*Kerivoula kachinensis* Bates, Struebig, Rossiter, Kingston, Oo, Mya, 2004	Kachin Woolly Bat	H	Trapline #15	2	16°02'48N; 107°27'43E	450
25	*Kerivoula hardwickii* (Horsfield, 1824)	Hardwicke's Woolly Bat	H	Trapline #15 Trapline #21	2 2	16°02'48N; 107°27'43E 16⁰03'04N; 107⁰30'06E	450 541
26	*Kerivoula titania* Bates, Struebig, Hayes, Furey, Mya, Thong, Son, Harrison, Csorba, Francis, 2007	Titania's Woolly Bat	H	Trapline #15	2	16°02'48N; 107°27'43E	450
	V. RODENTIA Bowdich, 1821						
	10. Sciuridae Fischer de Waldheim, 1817						
27	*Ratufa bicolor* (Sparrman, 1778)	Black Giant Squirrel	I,O O O	Trapline #16 Trapline #18 Trapline #21	1 1 2	16°02'30N; 107°27'30E	797 956 541

TABLE 18 – SMALL MAMMAL SPECIES RECORDED IN HUE SAOLA NATURE RESERVE							
TT	Scientific name	English Name	Record	Location	# Indiv.	Coordinates	Elevation (m)
						16°02'20N; 107°27'21E	
						16⁰03'04N; 107⁰30'06E	
28	*Hylopetes alboniger* (Hodgson, 1836)	Particolored Flying Squirrel	I,Os	Trapline #24	2 (Tail)	16⁰04'40N; 107⁰29'12E	620
29	*Hylopetes spadiceus* (Blyth, 1847)	Red-cheeked Flying Squirrel	In				
30	*Petaurista* cf. *philippensis* (Elliot, 1839)	Large Brown Flying Squirrel	O O O Os	Trapline #18 Trapline #21 Trapline #24 Adot common	1 1 1 4 (dead body)	16°02'20N; 107°27'21E 16⁰03'04N; 107⁰30'06E 16⁰04'40N; 107⁰29'12E	956 541 620
31	*Callosciurus erythraeus* (Pallas, 1779)	Pallas's Squirrel	B,O C O C,O C,(O O	Trapline #15 Trapline #20 Trapline #21 Trapline #22 Trapline #23 Trapline #24	(1),(3) 2 2 (1),(4) (1),(1) 2	16°02'48N; 107°27'43E 16⁰02'13N 107⁰29'58E 16⁰03'04N; 107⁰30'06E 16⁰05'10N; 107⁰29'12E 16◦06'25N; 107⁰27'39E 16⁰04'40N; 107⁰29'12E	450 752 541 552 884 620
32	*Dremomys rufigenis* (Blanford, 1878)	Asian Red-cheeked Squirrel	I,C C,O O C O	Trapline #15 Trapline #16 Trapline #19 Trapline #20 Trapline #23	1 (1),(2) 3 1 1	16°02'48N; 107°27'43E 16°02'30N; 107°27'30E 16⁰02'55N; 107⁰27'52E 16⁰02'13N 107⁰29'58E 16◦06'25N; 107⁰27'39E	450 797 421 752 620
33	*Menetes berdmorei* (Blyth, 1849)	Indochinese Ground Squirrel	I,C	Trapline #21	1	16⁰03'04N; 107⁰30'06E	541
34	*Tamiops rodolphii* (Milne-Edwards, 1867)	Cambodian Striped Squirrel	I,B C,O C,O	Trapline #16 Trapline #20 Trapline #21	1 (1),(4) (1),(2)	16°02'30N; 107°27'30E 16⁰02'13N 107⁰29'58E 16⁰03'04N; 107⁰30'06E	797 752 541
	11. Spalacidae Gray, 1821						
35	*Rhizomys pruinosus* Blyth, 1851	Hoary Bamboo Rat	Os	A Dot common	2		
	12. Muridae Illiger, 1811						
36	*Berylmys bowersi* (Anderson, 1879)	Bower's White-toothed Rat	C	Trapline #22	1	16⁰05'10N; 107⁰29'12E	552
37	*Dacnomys cf. millardi* Thomas, 1916	Millard's Rat	C	Trapline #16 Trapline #20	2 3	16°02'30N; 107°27'30E 16⁰02'13N; 107⁰29'58E	797 752
38	*Leopoldamys sabanus* (Thomas, 1887)	Long-tailed Giant Rat	C	Trapline #22	3	16⁰02'13N; 107⁰29'58E	752
39	*Maxomys surifer* (Miller, 1900)	Indomalayan Maxomys	C C	Trapline #16 Trapline #20	1 1	16°02'30N; 107°27'30E	797 752

TABLE 18 – SMALL MAMMAL SPECIES RECORDED IN HUE SAOLA NATURE RESERVE

TT	Scientific name	English Name	Record	Location	# Indiv.	Coordinates	Elevation (m)
						16⁰02'13N; 107⁰29'58E	
40	*Rattus exulans* (Peale, 1848)	Polynesian Rat	B B	Trapline #22 Trapline #24	2 3	16⁰02'13N; 107⁰29'58E 16⁰04'40N; 107⁰29'12E	752 620
	13. Hystricidae G. Fischer, 1817						
41	*Atherurus macrourus* (Linnaeus, 1758)	Asiatic Brush-tailed Porcupine	I,In, Os		I (Hair)		
42	*Hystrix brachyura* Linnaeus, 1758	Malayan Porcupine	I,In,Os		I (Hair)		

O – Observation; I – Interview; C – Local cage trap; B – Box trap; P – Pitfall trap; M – Mist net; H – Harp trap; Mo – Mole trap;

BIRD SPECIES RECORDED

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
		Galliformes					
	Pheasants	***Phasianidae***					
1	Scaly-breasted Partridge	*Arborophila choloropus*	H		X		
2	Annam Partridge	*A. merlini*	H	1,2,3	X		NT
3	Bar-backed Partridge	*A. brunneopectus*		2,3			
4	Red Junglefowl	*Gallus gallus*	O	3	X		
5	Crested Argus	*Rheinardia ocellata*		1,2,3			NT,V
		Piciformes					
	Woodpeckers	***Picidae***					
6	White-browed Piculet	*Sasia ochracea*		2			
7	Grey-capped Pymy Woodpecker	*Dendrocopos canicapillus*	P	2	X		
8	Greater Yellownape	*Picus flavinucha*	P	2	X		
9	Lesser Yellownape	*P. chlorolophus*	P		X		
10	Bay Woodpecker	*Blythipicus pyrrhotis*	H	2	X		
11	Greater Flameback	*Chrysocolaptes lucidus*	O		X		
	Barbets	***Megalaimidae***					
12	Red-vented Barbet	*Megalaima lagrandieri*	P	1,2	X		
	Green-eared Barbet	*M. faiostricta*	P	2	X		
	Golden-throated Barbet	*M. franklinii*	P	2		X	
		Bucerotiformes					
	Hornbills	***Bucerotidae***					
14	Austen's Brown Hornbill	*Anorrhinus austeni*	P	1			NT,T N160
15	Great Hornbill	*Buceros bicornis*	P	1			NT, T, N160
		Trogoniformes					
	Trogons	***Trogonidae***					
16	Red-headed Trogon	*Harpactes erythrocephalus*	O	2	X		
		Coraciiformes					
	Rollers	***Coraciidae***					
17	Dollarbird	*Eurystomus orientalis*	P	2	X		
	Bee-eaters	***Meropidae***					
18	Blue-bearded Bee-eater	*Nyctyornis athertoni*	O	2	X		
	Kingfishers	***Alcedinidae***					
19	Blyth's Kingfisher	*Alcedo hercules*		1			NT
20	Common Kingfisher	*A. atthis*	O		X		

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE							
No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
21	White-throated Kingfisher	*Halcyon smyrnensis*	O		X		
		Cuculiformes					
	Cuckoos	***Cuculidae***					
22	Large Hawk Cuckoo	*Hierococcyx sparverioides*	H		X		
23	Indian Cuckoo	*Cuculus micropterus*	P	2	X	X	
24	Eurasian Cuckoo	*C. canorus*	H	2			
25	Plaintive Cuckoo	*Cacomantis merulinus*	O		X		
26	Asian Emerald Cuckoo	*Chrysococcyx maculates*	P	2	X		
27	Drongo Cuckoo	*Surniculus lugubris*	H	2	X		
28	Asian Koel	*Eudynamys scolopacea*	H		X		
29	Green-billed Malkoha	*Phaenicophaeus tristis*	P	2	X		
30	Greater Coucal	*Centropus sinensis*	O	2	X		
		Apodiformes					
	Swifts and Needletails	***Apodiadae***					
31	Silver-backed Needletail	*Hirundapus cochinchinensis*	P	2	X	X	
32	Asian Palm Swift	*Cypsiurus balasiensis*	O		X		
33	Fork-tailed Swift	*Apus pacificus*	O	2	X		
		Psittaciformes					
		Psittacidae					
34	Red-breasted Parakeet	*Psittacula alexandri*		2			
		Stringiformes					
	Owls	***Stringidae***					
35	Mountain Scops-owl	*Otus spilocephalus*	P	2	X	X	
36	Collared Scops-owl	*O. bakkamoena*	H	2	X		
37	Collared Owlet	*Glaucidium brodiei*	H	2	X	X	
38	Asian Barred Owlet	*G. cuculoides*	H	2	X	X	
39	Brown Boobook	*Ninox scutulata*	H		X		
	Nightjars	***Caprimulgidae***					
40	Large-tailed Nightjar	*Caprimulgus macrurus*	H	2	X	X	
		Columbiformes					
	Doves, Pigeons	***Columbidae***					
41	Oriental Turtle Dove	*Streptopelia orientalis*	O		X		
42	Spotted Dove	*S. chinensis*	O		X		
43	Emerald Dove	*Chalcophaps indica*	O	3	X		
44	Thick-billed Green Pigeon	*Treron curvirostra*	O	2	X	X	
45	Pin-tailed Green Pigeon	*T. apicauda*	P	2	X		
46	Mountain Imperial Pigeon	*Ducula badia*	O	2	X	X	

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
		Ciconiformes					
	Eagles, Kites, Buzzards	***Accipitridae***					
47	Black Baza	*Aviceda leuphotes*	P		X	X	
48	Crested Serpent Eagle	*Spilornis cheela*	P	2	X	X	
49	Crested Goshawk	*Accipiter trivirgatus*	O	2	X	X	
50	Japanese Sparrowhawk	*A. gularis*	O		X		
51	Black Eagle	*Ictinaetus malayensis*	O		X	X	
52	Oriental Honey-buzzard	*Pernis ptilorhynchus*	P		X	X	
53	Grey-faced Buzzard	*Butastur indicus*	P		X	X	
54	Mountain Hawk-Eagle	*Nisaetus nipalensis*	P		X	X	
	Falcons	***Falconidae***					
55	Pied Falconet	*Microhierax melanoleucos*	P		X		
56	Peregrine Falcon	*Falco peregrinus*	O		X		
		Passeriformes					
	Pittas	***Pittidae***					
57	Blue-rumped Pitta	*Pitta soror*		2			
58	Bar-bellied Pitta	*P. elliotii*		1,2,3			T
	Broadbills	***Eurylaimidae***					
59	Silver-breasted Broadbill	*Serilophus lunatus*	O		X		
60	Long-tailed Broadbill	*Psarisomus dalhousiae*	O	2	X	X	T
	Leafbirds	***Irenidae***					
61	Blue-winged Leafbird	*Chloropsis cochinchinensis*	P	2	X		
62	Golden-fronted Leafbird	*C. aurifrons*	O		X		
63	Orange-bellied Leafbird	*C. hardwickii*	P	2	X		
64	Asian Fairy Bluebird	*Irena puella*	P		X	X	
	Ioras	***Aegithinidae***					
65	Common Iora	*Aegithina tiphia*	O		X	X	
66	Great Iora	*A. lafresnayei*	O		X		
	Shrikes	***Laniidae***					
67	Brown Shrike	*Lanius cristatus*	O	2	X		
68	Long-tailed Shrike	*L. schach*	P	2	X		
	Crows, Magpies	***Corvidae***					
69	White-winged Magpie	*Urocissa whiteheadi*	P	2,3	X	X	
70	Common Green Magpie	*Cissa chinensis*	O		X	X	
71	Indochinese Green Magpie	*C. hypoleuca*		2			
72	Racket-tailed Treepie	*Crypsirina temia*	O		X		
73	Ratchet-tailed Treepie	*Temnurus temnurus*	O	2	X	X	T
74	Southern Jungle Crow	*Corvus macrorhynchos*	P	2	X		

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
75	Maroon Oriole	*Oriolus traillii*	O		X		
76	Large Cuckoo-Shrike	*Coracina macei*	P	2	X		
77	Black-winged Cuckooshrike	*C. melaschistos*	P	2	X		
78	Long-tailed Minivet	*Pericrocotus ethologus*		2			
79	Scarlet Minivet	*P. flammeus*	P	2	X	X	
80	Bar-winged Flycatcher Shrike	*Hemipus picatus*	P		X		
81	Black Drongo	*Dicrurus macrocercus*	P		X	X	
82	Bronzed Drongo	*D. aeneus*	P	2	X		
83	Ashy Drongo	*D. leucophaeus*	P	2	X		
84	Crow-billed Drongo	*D. annectans*		2			
85	Spangled Drongo	*D. hottentottus*	O		X		
86	Lesser Racket-tailed Drongo	*D. remifer*	O		X		
87	Greater Racket-tailed Drongo	*D. paradiseus*	P	2	X	X	
88	Black-naped Monarch	*Hypothymis azurea*	O	2	X		
89	Asian Paradise Flycatcher	*Terpsiphone paradisi*	O	2	X		
90	Large Woodshrike	*Tephrodornis gularis*	O	2	X		
91	Ashy Woodswallow	*Artamus fuscus*	O		X		
	Old world Flycatchers	***Muscicapidae***					
92	Blue Whistling Thrush	*Myophonus caeruleus*	P	2,3	X	X	
93	Blue Rock-thrush	*Monticola solitarius*	P	2	X	X	
94	Asian Brown Flycatcher	*Muscicapa dauurica*	O		X		
95	Grey-headed Canary-flycatcher	*Culicicapa ceylonensis*	P		X		
96	White-tailed Flycatcher	*Cyornis concretus*	O		X		
97	Hainan Blue Flycatcher	*C. hainanus*	O		X		
98	Blue-throated Flycatcher	*C. rubeculoides*	O	2	X	X	
99	Tickell's Blue Flycatcher	*C. tickelliae*		2			
100	Blue and White Flycatcher	*Cyanoptila cyanomelana*	O		X		
101	Fujian Niltava	*Niltava davidi*	O		X		
102	Siberian Blue Robin	*Luscinia cyane*	O		X		
103	White-throated Fantail	*Rhipidura albicollis*	O		X		
104	Oriental Magpie Robin	*Copsychus saularis*	O		X		
105	White-rumped Shama	*C. malabaricus*	O	2,3	X		
106	White-tailed Robin	*Cinclidium leucurum*	O			X	
107	Slaty-backed Forktail	*Enicurus schistaceus*	O	2	X		
108	White-crowned Forktail	*E. leschenaulti*	O		X	X	
	Starlings, Mynas	***Sturnidae***					
109	Common Myna	*Acridotheres tristis*	O		X		

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
110	Hill Myna	*Gracula religiosa*	P	2	X		
	Tits	***Paridae***					
111	Sultan Tit	*Melanochlora sultanea*	P	2	X		
	Nuthatches	***Sittidae***					
112	Velvet-fronted Nuthatch	*Sitta frontalis*	P	2	X		
	Swallows	***Hirundinidae***					
113	Barn Swallow	*Hirundo rustica*	P		X		
114	Red-rumped Swallow	*H. daurica*	P		X	X	
	Bulbuls	***Pycnonotidae***					
115	Black-crested Bulbul	*Pycnonotus melanicterus*	O	2	X	X	
116	Red-whiskered Bulbul	*P. jocosus*	O	2	X		
117	Sooty-headed Bulbul	*P. aurigaster*	O		X		
118	Stripe-throated Bulbul	*P. finlaysoni*	O		X		
119	Puff-throated Bulbul	*Alophoixus pallidus*	P	2	X	X	
120	Flavescent Bulbul	*Pycnonotus flavescens*	O		X		
121	Asian Black Bulbul	*Hypsipetes leucocephalus*	O		X		
122	Grey-eyed Bulbul	*Iole propinqua*	P	2	X		
	White-eyes	***Zosteropidae***					
123	Japanese White-eye	*Zosterops japonica*	O		X		
	Thrushes	***Turdidae***					
124	Orange-headed Thrush	*Zoothera citrina*	O	3	X		
125	White's Thrush	*Z. dauma*		3			
	Babblers, Warblers..	***Sylviidae***					
126	Plain Prinia	*Prinia inornata*		2			
127	Common Tailorbird	*Orthotomus sutorius*	O	2	X		
128	Dark-necked Tailorbird	*O. atrogularis*	P	2	X		
129	Asian Stubtail	*Urosphena squameiceps*		2			
130	Yellow-browed Warbler	*Phylloscopus inornatus*	O		X		
131	Yellow-bellied Warbler	*Abroscopus superciliaris*		2			
132	Buff-breasted Babbler	*Trichastoma tickelli*	O	2	X	X	
133	Puff-throated Babbler	*Pellorneum ruficeps*		2			
134	Large Scimitar-babbler	*Pomatorhinus hypoleucos*	H	2,3	X	X	
135	White-browed Scimitar-babbler	*P. schisticeps*	O	2	X	X	
136	Streaked Wren Babbler	*Napothera brevicaudata*	H	2	X	X	
137	Indochinese Wren Babbler	*Jabouilleia danjoui*	H		X	X	NT, RRS
138	Grey-throated Babbler	*Stachyris nigriceps*	O	2	X	X	
139	Spot-necked Babbler	*S. striolata*	H	2	X	X	
140	Pin-striped Tit-babbler	*Macronous gularis*	P	2	X	X	

TABLE 19 - BIRD SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No.	English name	Scientific name	Records		Habitats		Notes
			TS	HS	D	L	
141	Grey-faced Tit Babbler	*M. kelleyi*		1,2			RRS
142	White-crested Laughingthrush	*Garrulax leucolophus*	H		X		
143	Lesser Necklaced Laughingthrush	*G. monileger*	P	2	X		
144	Black-throated Laughingthrush	*G. chinensis*	H	2	X		
145	Black-hooded Laughingthrush	*G. milleti*		3			NT
146	Mountain Fulvetta	*Alcippe peracensis*	P	1,2	X	X	
147	Rufous-throated Fulvetta	*A. rufogularis*		2			
148	White-bellied Erpornis	*Erpornis zantholeuca*	O	2	X	X	
	Flowerpeckers, Sunbirds	***Nectariniidae***					
149	Thick-billed Flowerpecker	*Dicaeum agile*		2			
150	Plain Flowerpecker	*D. concolor*	O		X		
151	Olive-backed Sunbird	*Cinnyris jugularis*	O		X		
152	Purple-naped Sunbird	*Hypogramma hypogrammicum*	O		X	X	
153	Crimson Sunbird	*Aethopyga siparaja*	P	2	X	X	
154	Little Spiderhunter	*Arachnothera longirostra*		2			
155	Streaked Spiderhunter	*A. magna*	P	2	X		
156	Purple-throated Sunbird	*Nectarinia sperata*		2			
	Sparrows	***Passeridae***					
157	Eurasian Tree Sparrow	*Parus montanus*	O		X		
	Munias	***Estrildidae***					
158	White-rumped Munia	*Lonchura striata*	O	2	X		
159	Black-headed Munia	*L. malacca*		2			
	Wagtails	***Motacillidae***					
160	Grey Wagtail	*Motacilla cinerea*	O		X		
161	Olive-backed Pipit	*Anthus hodgsoni*	O		X		

Notes: Taxonomy follows Inskipp et al. (1996). Vietnamese name follows Nguyen Cu *et al*., 2000 and Le Manh Hung (2012).
Status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened as per IUCN Red List (IUCN 2018). E = Endangered; V = Vulnerable; R = Rare; T = Threatened as per r Vietnam Red Data Book (MoST, 2007).
RRS = Range Restricted Species; N160 = Species listed in Decree 160/2013.
Record Type: O = Observed; P = Photographed; H = Heard, I = Interview and local reports
Habitats: L = Lowland evergreen forest; S = Scrub and plantation; D = Degraded lowland evergreen forest; A = Anthropogenic.
HS = Historical surveys: 1 = WWF Scoping Report 2017; 2 = Nguyen Cu & Nguyen Tran Vy, 2006; 3 = Nguyen The Truong An, 2018 (this survey using camera traps)
TS = This survey

TABLE 20 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 1: A Tep forest guard station, Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
21 March 2018 – survey along the Ho Chi Minh trail (from A Tep forest guard station to the North)			
List 1		List 2	
	Date: 21 March; 6h00 6h19		Date: 21 March; 6h20-6h39
1	Stripe Tit Babbler (H)	1	Puff-throated Bulbul (H)
2	Blue Whistling Thrush (01)	2	Annam Partridge (H)
3	Scarlet Minivet (02)	3	Dark-necked Tailorbird (02)
4	Mountain Fulvetta (H)	4	Black-winged Cuckoo-shrike (H)
5	Black-crested Bulbul (H)	5	Black Drongo (01)
6	White-winged Magpie (02)	6	Red-headed Trogon (H)
7	Puff-throated Bulbul (02)	7	Greater Flameback (02)
8	Black-winged Cuckooshrike (01)	8	Ashy Drongo (01)
9	Streaked Spiderhunter (01)	9	Stripe Tit Babbler (H)
10	Dark-necked Tailorbird (H)	10	Greater Coucal (H)
List 3		List 4	
	Date: 21 March; 6h40-7h01		Date: 21 March; 7h02-7h27
1	Drongo Cuckoo (H)	1	Golden-throated Barbet (H)
2	Black-crested Bulbul (02)	2	Black-throated Laughingthrush (H)
3	Large Scimitar Babbler (H)	3	Scarly-breasted Partridge (H)
4	Green-eared Barbet (H)	4	Puff-throated Bulbul (02)
5	Ashy Drongo (H)	5	Greater Jacket-tailed Drongo (H)
6	Puff-throated Bulbul (01)	6	Asian Fairy Bluebird (02)
7	Grey-eyed Bulbul (01)	7	Blue-winged Leafbird (02)
8	Stripe Tit Babbler (H)	8	Lesser Yellownape (01)
9	Dark-necked Tailorbird (01)	9	Stripe Tit Babbler (01)
10	Red-vented Barbet (H)	10	Orange-bellied Leafbird (01)
List 5		List 6	
	Date: 21 March; 7h28-8h00		Date: 21 March; 8h01-8h49
1	Red-vented Barbet (H)	1	Stripe Tit Babbler (H)
2	Silver-backed Needletail (04)	2	Golden-throated Barbet (H)
3	White-winged Magpie (H)	3	Asian Fairy Bluebird (01)
4	Puff-throated Bulbul (02)	4	Black-winged Cuckoo-shrike (H)
5	Asian Fairy Bluebird (01)	5	Mountain Fulvetta (01)
6	Green-eared Barbet (H)	6	Large Cuckooshrike (H)
7	Bay Woodpecker (H)	7	Dark-necked Tailorbird (H)
8	Drongo Cuckoo (01)	8	Green-billed Malkoha (01)
9	Orange-bellied Leafbird (02)	9	Blue-winged Leafbird (H)
10	Mountain Fulvetta (03)	10	Hill Myna (02)
List 7			
	Date: 21 March; 8h50-9h46		
1	Barn Swallow (07)		
2	Black-crested Bulbul (02)		
3	Puff-throated Bulbul (H)		
4	White-winged Magpie (H)		
5	Stripe Tit Babbler (H)		
6	Dark-necked Tailorbird (02)		
7	Scarlet Minivet (02)		
8	Green-eared Barbet (H)		
9	Black Drongo (01)		
10	Mountain Fulvetta (02)		
22 March 2018 – surveyed along the Ho Chi Minh trail (from A Tep forest guard station to the South – 500-650m als)			
List 8		List 9	
	Date: 22 March; 5h50-6h10		Date: 22 March; 6h11-6h36
1	Stripe Tit Babbler (H)	1	Stripe Tit Babbler (H)
2	Mountain Fulvetta (H)	2	Asian Fairy Bluebird (H)
3	Asian Fairy Bluebird (H)	3	Drongo Cuckoo (H)
4	Black Drongo (H)	4	Buff-breasted Babbler (01)
5	Drongo Cuckoo (H)	5	Ashy Drongo (01)
6	Black-throated Laughingthrush (H)	6	Mountain Fulvetta (01)
7	Green-eared Barbet (H)	7	White-tailed Flycatcher (H)

TABLE 20 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 1: A Tep forest guard station, Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
21 March 2018 – survey along the Ho Chi Minh trail (from A Tep forest guard station to the North)			
8	Dark-necked Tailorbird (H)	8	Large Scimitar Babbler (H)
9	Streaked Wren Babbler (H)	9	Blue-winged Leafbird (02)
10	Grey-throated Babbler (H)	10	Puff-throated Bulbul (H)
List 10		List 11	
	Date: 22 March; 6h37-7h12		Date: 22 March; 7h13-7h52
1	Thick-billed Green Pigeon (04)	1	Red-whiskered Bulbul (02)
2	Stripe Tit Babbler (H)	2	Greater Yellownape (H)
3	Blue-winged Leafbird (01)	3	White-browed Scimitar Babbler (H)
4	Dark-necked Tailorbird (H)	4	Black-throated Laughingthrush (H)
5	Spot-necked Babbler (H)	5	Black Drongo (01)
6	Black Drongo (01)	6	Dark-necked Tailorbird (02)
7	Orange-bellied Leafbird (01)	7	Puff-throated Bulbul (H)
8	Red Junglefowl (02)	8	Greater Coucal (01)
9	Asian Paradise Flycatcher (H)	9	Bay Woodpecker (H)
10	Puff-throated Bulbul (02)	10	Ashy Drongo (01)
List 12		List 13	
	Date: 22 March; 7h53-8h41		Date: 22 March; 8h42-9h18
1	Asian Fairy Bluebird (03)	1	Green-eared Barbet (H)
2	Red-vented Barbet (H)	2	Puff-throated Bulbul (H)
3	Black-winged Cuckoo-shrike (H)	3	Greater Jacket-tailed Drongo (01)
4	Thick-billed Green Pigeon (18)	4	Annam Partridge (H)
5	Scarly-breasted Partridge (H)	5	Blue Rock Thrush (01)
6	Red-jumped Swallow (02)	6	Greater Coucal (01)
7	White-jumped Shama (01)	7	Ratchet-tailed Treepie (H)
8	Green-eared Barbet (H)	8	Bar-winged Flycatcher Shrike (01)
9	White-winged Magpie (H)	9	Thick-billed Green Pigeon (40)
10	Red-vented Barbet (H)	10	Asian Fairy Bluebird (02)
	List 14		
	Date: 22 March; 9h19-9h54		
1	Crimson Sunbird (01)		
2	Orange-bellied Leafbird (02)		
3	Indochinese Wren Babbler (H)		
4	Spot-necked Babbler (H)		
5	Dark-necked Tailorbird (H)		
6	Asian Fairy Bluebird (03)		
7	Collared Owlet (H)		
8	Streaked Spiderhunter (01)		
9	Golden-throated Barbet (01)		
10	Scarlet Minivet (03)		
- 23 March 2018 – surveyed from A Tep forest guard station to the East			
List 15		List 16	
	Date: 23 March; 7h30-8h11		Date: 23 March; 8h12-8h37
1	Puff-throated Bulbul (H)	1	Red-vented Barbet (H)
2	Asian Fairy Bluebird (01)	2	Scarlet Minivet (02)
3	Grey-headed Canary Flycatcher (1)	3	Thick-billed Green Pigeon (H)
4	Black Drongo (1)	4	Striped Tit Babbler (H)
5	Bronzed Drongo (01)	5	Red-headed Trogon (H)
6	Drongo Cuckoo (H)	6	White-winged Magpie (H)
7	Black-winged Cuckoo-shrike (H)	7	Blue-winged Leafbird (02)
8	Green-eared Barbet (H)	8	Asian Fairy Bluebird (01)
9	Buff-breasted Babbler (01)	9	Mountain Imperial Pigeon (H)
10	Black Bulbul (H)	10	White-bellied Erpornis (01)
List 17		List 18	
	Date: 23 March; 8h38-9h22		Date: 23 March; 9h23-10h02
1	Golden-throated barbet (H)	1	Asian Fairy Bluebird (01)
2	Greater Jacket-tailed Drongo (01)	2	Crimson Sunbird (02)
3	Black Drongo (H)	3	Golden-throated Barbet (H)
4	Greater Necklaced Laughingthrush (04)	4	Red-vented Barbet (H)

TABLE 20 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 1: A Tep forest guard station, Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
21 March 2018 – survey along the Ho Chi Minh trail (from A Tep forest guard station to the North)			
5	White-jumped Shama (01)	5	Puff-throated Bulbul (02)
6	Yellow-browed Warbler (01)	6	Grey-eyed Bulbul (01)
7	Mountain Fulvetta (04)	7	Orange-bellied Leafbird (02)
8	Puff-throated Bulbul (02)	8	Large Scimitar Babbler (H)
9	Bay Woodpecker (H)	9	Crested Serpent Eagle (H)
10	Sultant Tit (01)	10	Ashy Drongo (02)

TABLE 21 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 2: Tra Lenh forest guard station, Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
- 24 March 2018 – surveyed along the Ho Chi Minh trail (from Tra Lenh forest guard station to the North)			
	List 19		List 20
	Date: 24 March; 6h00-6h17		Date: 24 March; 6h18-6h40
1	Mountain Fulvetta (H)	1	Golden-throated Barbet (H)
2	Grey-capped Pygmy Woodpecker (02)	2	Large Scimitar Babbler (H)
3	Black Drongo (01)	3	Red-vented Barbet (H)
4	Red-headed Trogon (H)	4	Collared Owlet (H)
5	Black-winged Cuckooshrike (H)	5	Scaly-breasted Partridge (H)
6	Green-eared Barbet (01)	6	Drongo Cuckoo (H)
7	Dark-necked Tailorbird (H)	7	Black Drongo (01)
8	White-jumped Shama (H)	8	Bronzed Drongo (01)
9	White-winged Magpie (H)	9	Asian Fairy Bluebird (02)
10	Asian Emeral Cuckoo (01)	10	Blue-winged Leafbird (02)
List 21		List 22	
	Date: 24 March; 6h41-7h09		Date: 24 March; 7h10-7h50
1	Puff-throated Bulbul (H)	1	Asian Fairy Bluebird (02)
2	Striped Tit Babbler (H)	2	Mountain Fulvetta (H)
3	Streaked Spiderhunter (01)	3	Black-winged Cuckoo-shrike (H)
4	Red-jumped Swallow (02)	4	Black Drongo (01)
5	Grey-capped Pymy Woodpecker (01)	5	Oriental Cuckoo (01)
6	Grey-eyed Bulbul (01)	6	Hill Myna (H)
7	Green-eared Barbet (H)	7	Dollarbird (02)
8	Pin-tailed Green Pigeon (01)	8	Puff-throated Bulbul (H)
9	Large Scimitar Babbler (H)	9	Greater Jacket-tailed Drongo (01)
10	Southern Jungle Crow (02)	10	Drongo Cuckoo (01)
List 23			
Date: 24 March; 7h50-9h01			
1	Scarly-breasted Partridge (H)		
2	Mountain Imperial Pigeon (H)		
3	Golden-throated Barbet (H)		
4	Pied Falconet (01)		
5	Scarlet Minivet (03)		
6	Velvet-fronted Nuthatch (02)		
7	Green-billed Malkoha (01)		
8	White-winged Magpie (03)		
9	Oriental Honey Buzzard (01)		
10	Crested Goshawk (02)		
- 25 March 2018 – surveyed along the small trail from Tra Lenh forest guard station to the west (A Pat stream)			
List 24		List 25	
Date: 25 March; 6h00-6h22		Date: 25 March; 6h23-7h14	
1	Green-eared Barbet (H)	1	Red-vented Barbet (H)
2	Asian Fairy Bluebird (02)	2	Pin-tailed Green Pigeon (01)
3	Black-winged Cuckoo-shirke (H)	3	Red-headed Trogon (01)
4	Dark-necked Tailorbird (H)	4	Silver-backed Needletail (03)
5	Black Drongo (01)	5	Streaked Spiderhunter (01)
6	Ashy Drongo (02)	6	Asian Emeral Cuckoo (01)
7	White-winged Magpie (H)	7	Long-tailed Broadbill (01)

TABLE 21 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 2: Tra Lenh forest guard station, Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
- 24 March 2018 – surveyed along the Ho Chi Minh trail (from Tra Lenh forest guard station to the North)			
8	Velvet-fronted Nuthatch (01)	8	Buff-breasted Babbler (H)
9	Scarlet Minivet (2)	9	Stripe Tit Babbler (H)
10	Puff-throated Bulbul (H)	10	Black Drongo (01)
List 26		List 27	
Date: 25 March; 7h15-8h16		Date: 25 March; 8h17-9h33	
1	Asian Fairy Bluebird (01)	1	Dark-necked Tailorbird (H)
2	Black-crested Bulbul (02)	2	Green-billed Malkoha (02)
3	Sultant Tit (03)	3	Black-winged Cuckoo-shirke (H)
4	Ashy Drongo (02)	4	Streaked Wren Babbler (H)
5	Streaked Spiderhunter (01)	5	Mountain Fulvetta (H)
6	Streaked Wren Babbler (H)	6	Ashy Drongo (01)
7	Golden-throated Barbet (H)	7	Blue-winged Leafbird (02)
8	Puff-throated Bulbul (03)	8	Black Bulbul (01)
9	Red-headed Trogon (H)	9	Greater Jacket-tailed Drongo (01)
10	Green-eared Barbet (H)	10	Yellow-browed Warbler (02)

TABLE 22 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 3: Km No.22 - Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
- 26 March 2018 – surveyed along the Ho Chi Minh trail (south of Km No.22)			
List 28		List 29	
Date: 26 March; 6h30-6h54		Date: 26 March; 6h55-7h44	
1	Olive-backed Pipit (03)	1	Red-vented Barbet (H)
2	Black-winged Cuckoo-shrike (H)	2	Golden-throated Barbet (H)
3	Greater Coucal (H)	3	Crimson Sunbird (02)
4	Mountain Fulvetta (H)	4	Puff-throated Bulbul (H)
5	Black Drongo (H)	5	Mountain Imperial Pigeon (H)
6	Red-jumped Swallow (02)	6	Blue-winged Leafbird (02)
7	Green-eared Barbet (H)	7	Dark-necked Tailorbird (H)
8	Lesser Yellownape (01)	8	Striped Tit Babbler (H)
9	Blue-winged Leafbird (05)	9	Orange-bellied Leafbird (01)
10	Scarlet Minivet (02)	10	Sultan Tit (02)
	List 30		List 31
	Date: 26 March; 7h45-8h14		Date: 26 March; 8h16-8h49
1	Large Cuckooshrike (01)	1	Asian Fairy Bluebird (02)
2	Ratchet-tailed Treepie (01)	2	Black-winged Cuckoo-shrike (H)
3	Red-headed Trogon (H)	3	Golden-throated Barbet (H)
4	Grey Wagtail (01)	4	Silver-backed Needletail (04)
5	Collared Owlet (H)	5	Spot-necked Babbler (H)
6	Scarlet Minivet (02)	6	Red-jumped Swallow (02)
7	Oriental Cuckoo (H)	7	Black Drongo (03)
8	Indian Cuckoo (H)	8	Black-crested Bulbul (02)
9	Green-eared Barbet (H)	9	Black Bulbul (02)
10	Golden-throated Barbet (H)	10	Green-billed Malkoha (02)
List 32			
	Date: 26 March; 8h50-9h43		
1	Scarlet Minivet (03)		
2	Ashy Drongo (01)		
3	Puff-throated Bulbul (02)		
4	Mountain Imperial Pigeon (02)		
5	Sultan Tit (01)		
6	Dark-necked Tailorbird (01)		
7	Blue-winged Leafbird (02)		
8	Dollarbird (02)		
9	Blue Rock Thrush (01)		
10	Red-headed Trogon (H)		
- 27 March 2018 – surveyed along the Ho Chi Minh trail (north of Km No.22)			

TABLE 22 - MACKINNON LIST RESULTS FOR HUE SAOLA NATURE RESERVE			
Site 3: Km No.22 - Sao La Hue Nature Reserve, Hung Nguyen Commune, A Luoi district			
- 26 March 2018 – surveyed along the Ho Chi Minh trail (south of Km No.22)			
List 33		List 34	
	Date: 27 March; 6h00-8h29		Date: 27 March; 8h30-09h16
1	Bay Woodpecker (H)	1	Grey-faced Buzzard (01)
2	Black Bulbul (02)	2	Black-winged Cuckooshrike (01)
3	Green-eared Barbet (H)	3	Red-headed Trogon (H)
4	Grey-eyed Bulbul (02)	4	Puff-throated Bulbul (H)
5	Black-winged Cuckooshrike (H)	5	Crimson's Sunbird (02)
6	Barn Swallow (02)	6	Green-eared Barbet (H)
7	Red-jumped Swallow (04)	7	Red-vented Barbet (H)
8	Scaly-breasted Partridge (H)	8	Plaintive Cuckoo (01)
9	Black Bulbul (02)	9	Golden-throated Barbet (01)
10	Blue Rock Thrush (01)	10	Green-billed Malkoha (01)
List 35			
	Date: 27 March; 9h17-10h04		
1	Grey-capped Pygmy Woodpecker (01)		
2	Blue-winged Leafbird (02)		
3	Asian Fairy Bluebird (03)		
4	Large Scimitar Babbler (H)		
5	Dark-necked Tailorbird (H)		
6	Scarlet Minivet (02)		
7	Sultan Tit (02)		
8	White-jumped Shama (01)		
9	White-winged Magpie (03)		
10	Blue and White Flycatcher (01)		

AMPHIBIAN AND REPTILES SPECIES RECORDED

TABLE 23 – AMPHIBIAN AND REPTILE SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No	English name	Scientific name	TS	HS	STATUS	
					IUCN	National
Amphibians						
1. Bufonidae						
1	Aisan common toad	*Duttaphrynus melanostictus*	*		LC	
2. Dicroglossidae						
2	Paddy frog	*Fejervarya limnocharis*	*		LC	
3	Common lowland Frog	*Hoplobatrachus rugulosus*	*		LC	
4	Bana frog	*Limnonectes bannaensis*	*		-	
5	Green puddle frog	*Occidozyga lima*	*		LC	
6	Granular spiny frog	*Quasipaa verrucospinosa*	*		NT	
7	Annan frog	*Quasipaa delacouri*		I	LC	EN
8	Khammon wart frog	*Limnonectes khammonensis*		I	DD	
9	Kuhl's creek frog	*Limnonectes kuhlii*		I	LC	
3. Ichthyophiidae						
10	Bana blind frog	*Ichthyophis bannanicus*		I	LC	VU
4. Microhylidae						
11	Quangdong rice frog	*Microhyla pulchra*		I	LC	
12	Banded bullfrog	*Kaloula pulchra*		I	LC	
5. Ranidae						
13	Chinese sucker frog	*Amolops ricketti*	*		LC	
14	Black striped frog	*Sylvirana nigrovittata*	*		LC	
15	Anderson's frog	*Odorrana andersonii*	*		LC	VU
16	Tonkin Huia frog	*Odorrana nasica*		I	LC	
17	Three triped grass frog	*Hylarana macrodactyla*	*		LC	
6. Rhacophoridae						
18	Peter' tree frog	*Philautus petersi*		I	LC	
19	Spotted leg tree frog	*Polypedates megacephalus*	*		LC	
20	Java whipping frog	*Polypedates mutus*	*		LC	
21	Kuri tree frog	*Kurixalus banaensis*	*		DD	
22	Nigro tree frog	*Rhacophorus nigropalmatus*		I	LC	VU
Reptiles						
7. Agamidae						
23	Scalled belly tree lizard	*Acanthosaura lepidogaster*	*		LC	
24	Garden fence lizard	*Calotes vercicolor*	*		-	
25	Indochinense water dragon	*Physignathus cocincinus*	*		-	VU
26	Indochinese forest lizard	*Calotes mystaceus*		I	-	
27	Spotted flying lizard	*Draco maculatus*	*		LC	
28	Capra tree lizard	*Acanthosaura capra*		I	-	
29	Gunther Bloodsucker	*Bronchocela smaragdina*		I	VU	
30	Vietnam long tail agama	*Bronchocela vietnamensis*		I	-	

TABLE 23 – AMPHIBIAN AND REPTILE SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No	English name	Scientific name	TS	HS	STATUS	
					IUCN	National
31	Kon tum tree lizard	*Pseudocalotes kontumensis*		I	-	
8. Gekkonidae						
32	Tokay	*Gekko gekko*		I	-	VU
33	House gecko	*Hemidactylus frenatus*	*		LC	
34	Conson slander toed gecko	*Cyrtodactylus condorensis*		I	-	
35	Irregula bow finger gecko	*Cyrtodactylus irregularis*		I	-	
36	Presented four tripped gecko	*Cyrtodactylus pseudoquadrigatus*		I	-	
37	Siamen leaf-toed gecko	*Dixonius siamensis*		I	-	
38	Stump tailed gecko	*Gehyra mutilata*		I	-	
39	Oriental leaf –toed gecko	*Hemidactilus bowringii*		I	-	
9. Scincidae						
40	Bowring skink	*Lygosoma bowringii*	*		-	
41	Short limbed skink	*Lygosoma quadrupes*		I	-	
42	Magrove skink	*Emoia atrocostata*		I	-	
43	Poilan skink	*Leptoseps poilani*		I	-	
44	Buonluoi forest skink	*Sphenomorphus buenloicus*		I	-	
45	Indian forest skink	*Sphenomorphus indicus*		I	-	
46	Chinese water skink	*Tropidophorus sinicus*		I	-	
47	Bavi water skink	*Tropidophorus baviensis*		I	-	
10. Varanidae						
48	Water monitor	*Varanus salvator*		I	LC	EN
11. Cylindrophiidae						
49	Red tailed pipe snake	*Cylindrophis ruffus*		I	LC	
12. Pythonidae						
50	Asiatic rock python	*Python molurus*		I	-	CR
51	Reticulated python	*Python reticulatus*	*		-	CR
13. Acrochordidae						
52	Indian water snake	*Acrochordus granulatus*		I	LC	
14. Colubridae						
53	Indochinese rat snake	*Ptyas korros*		I	-	EN
54	Ashy kukri snake	*Oligodon cinereus*		I	LC	
55	Common black-head snake	*Sibynophis collaris*		I	LC	
56	Formos snake	*Dendrelaphis formosus*		I	LC	
57	Canirated rat snake	*Ptyas carinata*		I	LC	
15. Elapidae						
58	Banded krait	*Bungarus fasciatus*	*		LC	EN
59	Blue krait	*Bungarus cadidus*	*		LC	
60	Chinese cobra	*Naja naja*		I	-	EN
16. Viperidae						
61	Horned - pitviper	*Protobothrops cornutus*		I	NT	

TABLE 23 – AMPHIBIAN AND REPTILE SPECIES LIST FOR HUE SAOLA NATURE RESERVE

No	English name	Scientific name	TS	HS	STATUS	
					IUCN	National
62	Staine pitviper	*Viridovipera stejnegeri*	*		LC	
63	Chinese habu	*Protobothrops mucrosquamatus*		I	LC	
17. Homalopsidae						
64	Blumbeos water snake	*Enhydris plumbea*		I	LC	
18. Lamprophiidae						
65	Mock viper	*Psammodynastes pulverulentus*		I	EN	
19. Natricidae						
66	Speckle belly keelback	*Rhabdophis chrysargos*		I	LC	
67	Grooved necked keelback	*Rhabdophis nuchalis*		I	LC	
68	Red – necked keelback	*Rhabdophis subminiatus*		I	LC	
20. Geoemydidae						
69	Black breasted leaf turtle	*Geoemyda spengleri*		I	EN	
70	Chinese tripped neck turtle	*Mauremys sinensis*		I	EN	
71	Indochinese box turtle	*Cuora galbinifrons*	*		CE	EN
21. Trionychidae						
72	Wattle neck softshell turtle	*Palea steindachneri*	*		EN	VU
22. Emididae						
73	Seben Snake	*Siebenrockiella crassicollis*		I	VU	

HS = Historical surveys: I = Hồ Thu Cúc (2002).
TS = This survey
Status IUCN: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern as per IUCN Red List (IUCN 2018). Status national: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; R = Rare; T = Threatened as per Vietnam Red Data Book (MoST, 2007).

THREATENED PLANT SPECIES RECORDED

TABLE 24 – THREATENED PLANT SPECIES LIST FOR HUE SAOLA NATURE RESERVE

ID	Family	Species (Latin name)	Record	Vietnam Red list	Decree 32	IUCN
1	Araliaceae	*Acanthopanax trifoliatus* (L). Voss	*	EN		
2	Meliaceae	*Aglaia spectabilis* (Miq.) Jain & Bennet.	*	VU		
3	Orchidaceae	*Anoectochilus setaceus* Blume	I	EN	IA	
4	Myrsinaceae	*Ardisia silvestris* Piard	I	VU		
5	Orchidaceae	*Bulbophyllum astelidum* Aver.	I	EN		
6	Rubiaceae	*Canthium dicoccum* (Gaertn.) Teysm. & Binn.	I	VU		
7	Meliaceae	*Chukrasia tabularis* A. Juss.	*	VU	LR	
8	Lauraceae	*Cinnamomum parthenoxylon* (Jack) Meisn.	*	CR	IIB	
9	Campanulaceae	*Codonopsis javanica* (Blume) Hook. f.	*	VU	IIA	
10	Orchidaceae	*Dendrobium amabile* (Lour.) O' Brien	I	EN		
11	Orchidaceae	*Dendrobium nobile* Lindl.	I	EN	IIB	
12	Dipterocarpaceae	*Dipterocarpus grandiflorus*	I	EN		
13	Dipterocarpaceae	*Dipterocarpus hasseltii* Blume	I	EN		
14	Myrsinaceae	*Embelia parviflora* Wall. ex A. DC. 1834.	*	VU		
15	Annonaceae	*Enicosanthellum plagioneurum* (Diels) Ban	I	VU		
16	Orchidaceae	*Eria obscura* Aver.	I	EN		
17	Celastraceae	*Euonymus chinensis* Lindl.	I	EN		
18	Annonaceae	*Goniothalamus macrocalyx* Ban	I	EN		
19	Annonaceae	*Goniothalamus vietnamense* Ban	*	VU		
20	Cucurbitaceae	*Gynostemma pentaphyllum* (Thumb.) Makino	*	EN		
21	Dipterocarpaceae	*Hopea pierrei*	*	VU		
22	Illiciaceae	*Illicium petelotii* A.C. Sm, 1947	*	EN		
23	Ochnaceae	*Indosinias involucrata*	*	CR		
24	Apocynaceae	*Ixodonerium annamense* Piard	I	VU		
25	Fagaceae	*Lithocarpus amygdalifolius* (Skan) Hayata	I	VU		
26	Celastraceae	*Lophopetalum wightianum* Arn.	I	VU		
27	Sapotaceae	*Madhuca pasquieri* (Dubard) H. J. Lam.	I	EN	VU	
28	Bombacaceae	*Markhamia stipulata* (Wall.) Seem. ex Schum.	I		IIA	
29	Anacardiaceae	*Melanorrhoea laccifera* Pierre	*	VU		
30	Opiliaceae	*Melientha suavis* Pierre	I	VU		
31	Magnoliaceae	*Michelia balansae* (DC) Dany	*	VU		
32	Magnoliaceae	*Pachylarnax praecalva* Dany	*	VU		
33	Orchidaceae	*Paphiopedilum appletonianum* (Gower) Rolfe	I	VU	IA	
34	Dipterocarpaceae	*Parashorea stellata* Kurz	I	VU		
35	Trilliaceae	*Paris polyphylla* Smith	I	EN		
36	Bombacaceae	*Pauldopia ghorta* (G. Don) Steen.	I	EN		
37	Convallariaceae	*Peliosanthes teta* Andr.	I	VU		
38	Asclepiadaceae	*Raphistemma hooperianum* (Blume) Decne	*	EN		
39	Apocynaceae	*Rauvolfia cambodiana* Pierre ex Pitard	I	VU		
40	Balanophoraceae	*Rhopalocnemis phalloides Jungh.*	*	VU		

TABLE 24 – THREATENED PLANT SPECIES LIST FOR HUE SAOLA NATURE RESERVE

ID	Family	Species (Latin name)	Record	Vietnam Red list	Decree 32	IUCN
41	Caesalpiniaceae	*Sindora siamensis* Teysm. ex Miq.	*	EN	IIA	
42	Caesalpiniaceae	*Sindora tonkinensis* A. Chev. ex K. &S. Larsen	*	EN	IIA	DD
43	Menispermaceae	*Stephania rotunda* (Lour)	*		IIB	
44	Styracaceae	*Styrax litseoides* J. E. Vidal	I	EN		

ANNEX 2: GLOSSARY

Core Forest:	in the forest cover assessment, core forest consists of intact interior forest pixels 1.25km from the forest edge.
Edge Forest	in the forest cover assessment, Inner Edge forest is a forest pixel on the edge of small interior non-forest, and Outer Edge forest is a pixel that is on the edge of forest and large non-forest areas.
EBA	an EBA is an Endemic Bird Area, which is is an area of land identified by BirdLife International as being important for habitat-based bird conservation because it contains the habitats of restricted-range bird species, which are thereby endemic to them.
IBA	an IBA is an Important Bird Area, which is an area identified using an internationally agreed set of criteria developed by BirdLife International as being globally important for the conservation of bird populations.
Medium Forest	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 101-200 m^3.
Naïve Occupancy	the proportion of locations from which a species was detected, not taking into account imperfect detection (see also occupancy and true occupancy).
Occupancy	a statistical model which estimates the proportion of areas that a species occurs in based on detections from repeat surveys (see also naïve occupancy and true occupancy).
Poor Forest	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 10-100 m^3.
Rich Forest	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 201-300 m^3.
Shannon Diversity Index	the Shannon diversity index (H) is an index that is commonly used to characterize species diversity in a community and accounts for both abundance and evenness of the species present.
Simpson's Diversity Index	the Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species.
SOP	a standard operating procedure is a set of step-by-step instructions designed to help workers carry out complex routine operation.
SMART	the Spatial Monitoring and Reporting Tool, which is a software application that enables you to collect, store, communicate, and evaluate ranger-based data related to patrol effort, patrol results, and threat levels.

TNA	a TNA is a Training Needs Assessment, which is a skill set gap analysis for employees used in order to determine what training needs are required for development of core competencies for a job.
True Occupancy	the actual proportion of locations that a species occurs in, taking into account imperfect detection (see also naïve occupancy and occupancy).