



PARTICOLORED FLYING SQUIRREL *HYLOPETES ALBONIGER*  
PHOTO CREDIT: NGUYEN TRUONG SON

# ASSESSMENT OF THE BIODIVERSITY OF

## Quang Nam Saola Nature Reserve, Quang Nam, Vietnam

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## 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 truongsongensis*), 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 annamensis*), 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 Quang Nam 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 Quang Nam Saola Nature Reserve in early 2018 by the expert technical teams supported by protected area staff. Results show that Quang Nam Saola Nature Reserve there are a recorded; 37 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 mammal species; 140 bird species from 105 Genera and 30 Families including four species listed on the Red Data Book of Vietnam as Vulnerable (MoST, 2007); 194 Amphibian and Reptile species from 29 Families and three Orders including six Vulnerable, 15 Endangered species on the Red Data Book of Vietnam (MoST, 2007) and five Vulnerable and five Endangered and one Critically Endangered species on the IUCN Red List (IUCN, 2018); and 575 plant species from 157 Families including three Critically Endangered, 20 Endangered and 19 Vulnerable species on the Red Data Book of Vietnam (MoST, 2007) and one Critically Endangered, one Endangered and two Vulnerable 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 Quang Nam 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 Quang Nam Saola Nature Reserve to be extended which is 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. Quang Nam 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 I. SITE DESCRIPTION

Quang Nam Saola Nature Reserve is located between 17°56'57" to 18°05'25" N and from 105°51'07" to 106°04' 36" E, in Northwest Quang Nam province. The site includes the districts of Dong Giang and Tay Giang and the communes of Bhallee, A Vuong, Ta Lu and Song Kon. Quang Nam Saola Nature Reserve was designated on the 13<sup>th</sup> of July 2012, through decision 2265/QĐ-UBND, with a total area of 15,486.46 hectares. The site is composed of 13,805.13 ha of strictly protected zone and 1,681.33 ha of ecological restoration zone

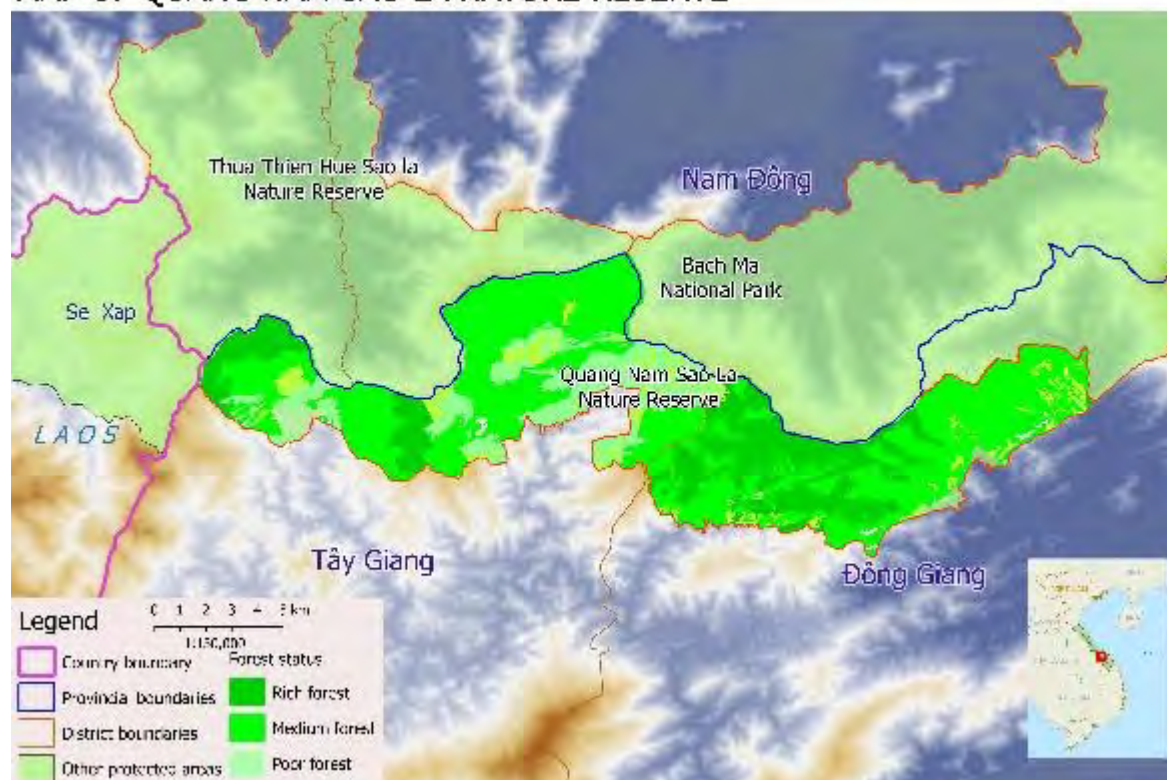
The total forest cover of Quang Nam Saola Nature Reserve is 15,411 ha, equal to 99.41% of the total area. The site currently has a Management Plan, for the period 2013 – 2015, vision to 2020. Total staff for Quang Nam Saola Nature Reserve is 26 individuals.

**TABLE 1 – FOREST COVER TYPES OF QUANG NAM SNR IN 2018**

No	Forest cover types	Current area	
		ha	%
1	Evergreen broadleaf - rich forest	3,360.11	21.70
2	Evergreen broadleaf - medium forest	8,853.06	57.17
3	Evergreen broadleaf - poor forest	2,127.36	13.74
4	Evergreen broadleaf - regrowth forest	900.58	5.82
5	Bare land (grass land, shrub)	245.35	1.58
Total natural area		15,486.46	100.00

*Figure 1 – Map showing the location and forest cover of Quang Nam Saola Nature Reserve*

### MAP OF QUANG NAM SAOLA NATURE RESERVE





Quang Nam Saola NR is contiguous with Hue 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 Hue 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.

## **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 determine changes in forest cover and key areas threatened by forest degradation and deforestation.

A key outcome for conducting biodiversity assessments within Quang Nam Saola Nature 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 swinhoiei*). 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 Quang Nam 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  $\psi$  ( $\psi$ ), 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 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 Quang Nam 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 was to collate and extend our understanding of the biodiversity values of Quang Nam 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 Quang Nam 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 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 indices 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 Error! Reference source not found..

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

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

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

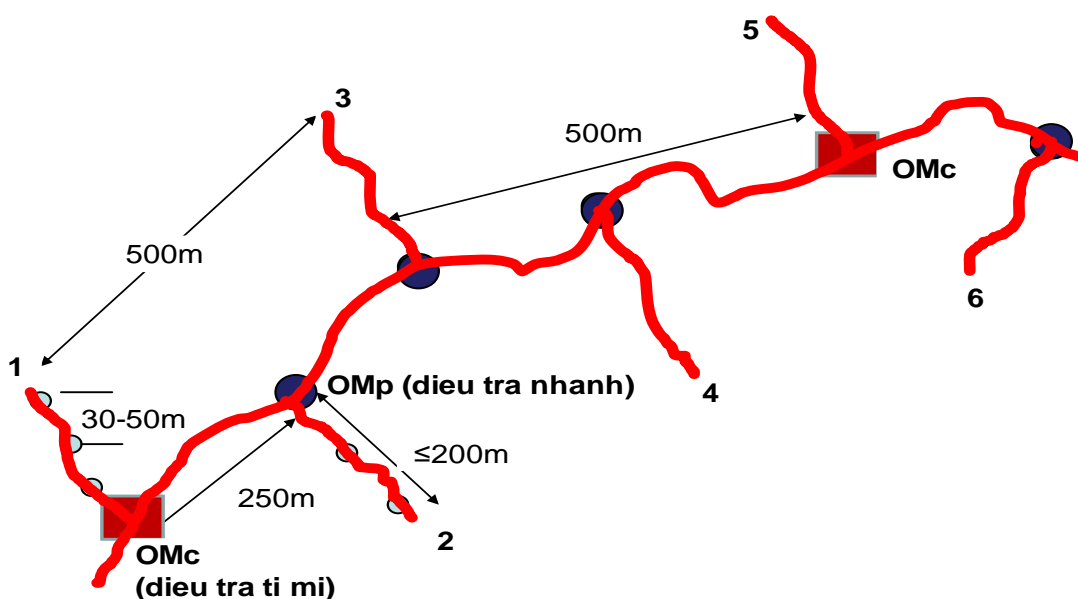
Bana toad	<i>Leptobrachium banae</i>	VU
Xeno frog	<i>Xenophrys palpebralespinosa</i>	CR
Spin frog	<i>Quasipaa spinosa</i>	EN
Kio frog	<i>Rhacophorus kio</i>	VU

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 3 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**

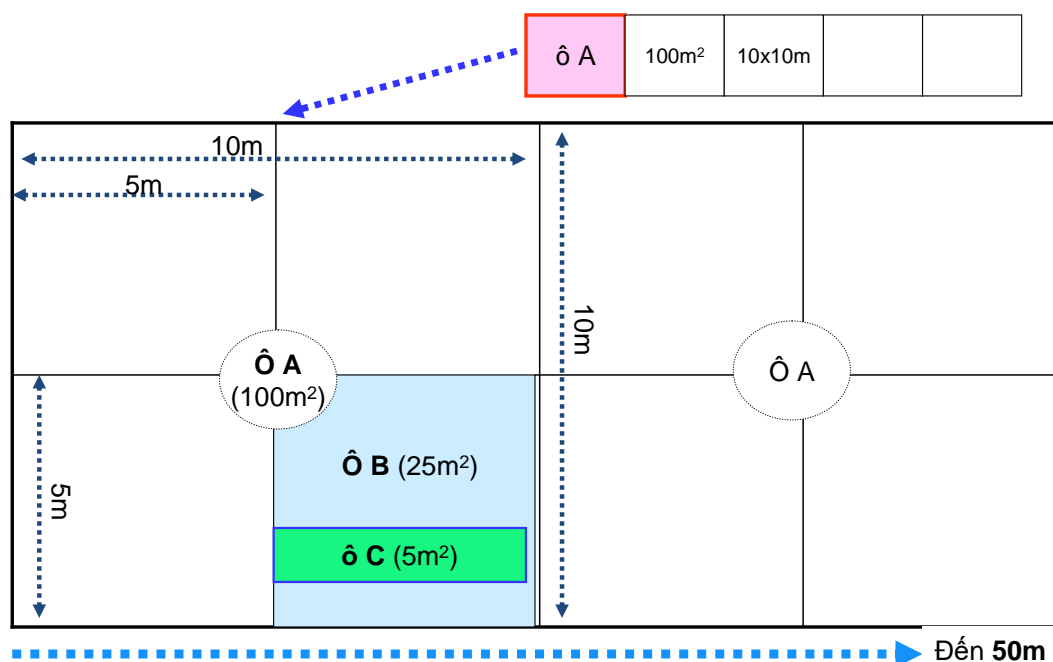


Main Survey Routes are set to capture diversity in plant communities, and as such were set up to run across a diversity of landscape features and through different forest types. In general, a main survey route should go from the lowest to highest point in the survey area to ensure capture of a diversity 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 details 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  $D_{1.3} \geq 6\text{cm}$ . The OMc is further subdivided into 5 small plots (A plots) with dimensions of  $10 \times 10\text{m}$  ( $100\text{m}^2$ ) each. These are further subdivided into 4 smaller plots (B Plot) with a square of  $5 \times 5\text{m}$  ( $25\text{m}^2$ ) each, and one B Plot randomly chosen for surveying regenerating plants which have a height  $\geq 1.5\text{m}$  and a  $D_{1.3} < 6\text{cm}$ . Within each B Plot, a further subdivision was made into C Plots with dimensions of  $1 \times 5\text{m}$  ( $5\text{m}^2$ ), to survey for regenerating plants which have a height  $< 1.5\text{m}$  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  $10 \times 50\text{m}$  (gồm 5 ô A)
- Kích thước ô A là  $10 \times 10\text{m}$
- Kích thước ô B là  $5 \times 5\text{m}$
- Kích thước ô C là  $1 \times 5\text{m}$

Additional Supplementary Sample Plots (OMps) were used to survey species composition using quick sampling methods. OMps of  $100\text{m}^2$  ( $10\text{m} \times 10\text{m}$ ) were placed every  $250\text{m}$  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  $250\text{m}$  (alternating sides) following the same approach as the Main Survey Route. Every  $30\text{-}50\text{m}$  along the Supplementary Route we set up an Observation Point with a diameter of  $10\text{m}$  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  $70\text{-}90\%$  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-III) 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 were 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% were 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 Quang Nam SNR was conducted between July and December 2015. The approach in Quang Nam 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 Quang Nam SNR were coupled with those in Hue SNR as the areas are contiguous. In the Quang Nam portion of this transboundary PA, a total of 25 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 Quang Nam SNR is relatively complete, as shown in Figure 5. Total survey effort included 3,323 Camera Trap Nights, which is measured as the sum of 24 hour periods each camera is active during the survey period.

### SURVEY RESULTS

The survey in the Quang Nam Saola NR was conducted at the same time with the surveys in Hue Saola NR. In total 17 ground-dwelling mammal species and 8 ground birds (Table 3) (18 mammal species and 10 bird species in total, Appendix 1) were recorded. Some species were recorded more frequently than in other study sites and therefore had comparatively higher naïve occupancy estimates. Number of species detected was similar to adjoining Hue SNR, however frequency of detection was lower. In contrast, species diversity measured as the number of species per 100 trap nights was higher than in most of the other areas. Overall, the results indicate that the faunal community in Quang Nam Saola Nature Reserve is broadly similar to all other sites, with the ground-dwelling mammal and bird communities having been severely impacted by past hunting pressure. Many species historically known from the landscape are missing (see Threats section below) and, 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. However, there are some indications that for some species the community has not been as negatively impacted as neighboring Bach Ma NP. This difference is possibly a result of the intensive snare-removal efforts by the WWF supported Forest Guards.

**TABLE 3 - SPECIES LIST, NUMBER OF DETECTIONS AND NAIVE OCCUPANCY ESTIMATES OF ALL GROUND DWELLING MAMMAL AND BIRD SPECIES IN QUANG NAM SAOLA NATURE RESERVE.**

Species	No. detection	No. station	Naïve P	SE.p	Psi	SE.Psi
Mammal						
Stump-tailed macaque	31	14	0.560	0.279	0.071	0.689
Northern pig-tailed macaque	8	5	0.200	0.233	0.129	0.231
Yellow-bellied weasel	1	1	0.040	-	-	-
Yellow-throated marten	4	2	0.080	0.345	0.176	0.095
Ferret badger species	80	13	0.520	0.353	0.075	0.531
Masked palm civet	6	5	0.200	0.431	0.329	0.127
Common palm civet	4	2	0.080	0.233	0.183	0.116
Spotted linsang	4	3	0.120	0.211	0.164	0.183
Crab-eating mongoose	49	15	0.600	0.346	0.068	0.715
Leopard cat	14	7	0.280	0.312	0.104	0.299
Eurasian wild pig	52	14	0.560	0.436	0.074	0.528
Dark muntjac	3	3	0.120	-	-	-

**TABLE 3 - SPECIES LIST, NUMBER OF DETECTIONS AND NAIVE OCCUPANCY ESTIMATES OF ALL GROUND DWELLING MAMMAL AND BIRD SPECIES IN QUANG NAM SAOLA NATURE RESERVE.**

Species	No. detection	No. station	Naïve	P	SE.p	Psi	SE.Psi
Red muntjac	15	9	0.360	0.197	0.081	0.580	0.218
Serow	11	6	0.240	0.218	0.101	0.362	0.165
Malayan porcupine	2	1	0.040	-	-	-	-
Asiatic brush-tailed porcupine	28	6	0.240	0.406	0.104	0.269	0.098
Annamite striped rabbit	30	6	0.240	0.514	0.013	0.252	0.090
<b>Bird</b>							
Annam partridge	3	2	0.080	0.285	0.207	0.103	0.079
Rufous-throated partridge	1	1	0.040	-	-	-	-
Bar-backed partridge	2	2	0.080	-	-	-	-
Silver pheasant	1	1	0.040	-	-	-	-
Crested argus	6	3	0.120	0.466	0.163	0.128	0.070
Emerald dove	5	3	0.120	0.276	0.149	0.158	0.097
Orange-headed thrush	2	2	0.080	-	-	-	-
Scaly thrush	4	2	0.080	-	-	-	-

Naïve occupancy: the proportion of sites at which the target species was detected;

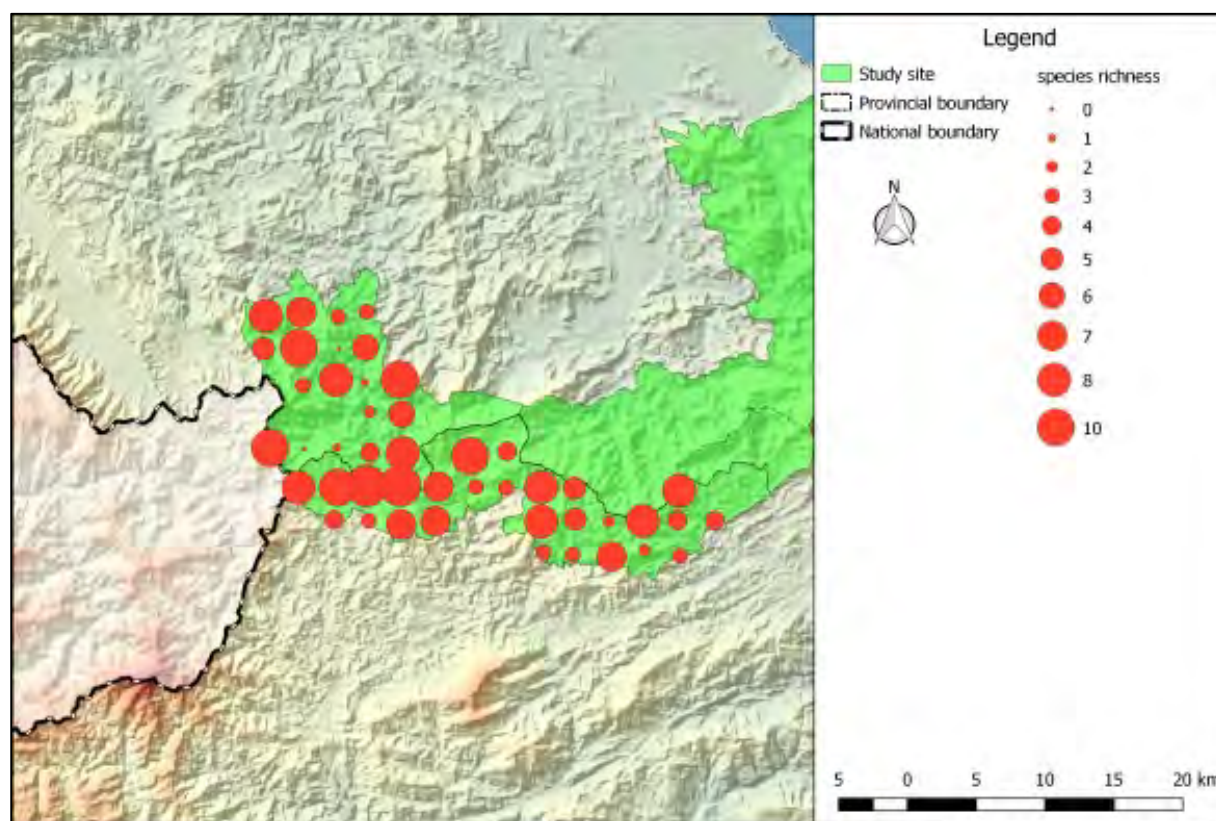
P: Detection probability;

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 (*Muntiacus 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 Bac Hai Van.

**Figure 8** - Male crested argus *Rheinardia ocellata*.



## THREATS

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 rewilding remains an option in the longer term, when snaring is brought under control, which will likely require concerted enforcement, arrests and convictions and demand reduction approach.

Despite the significant camera-trapping effort in Quang Nam 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 nebulosa*, 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 in recent years (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.

## PART 4. RESULTS: SMALL MAMMALS

### COMPLETENESS OF COVERAGE

Small mammal surveys in Quang Nam Saola Nature Reserve were conducted between the 13<sup>th</sup> and 19<sup>th</sup> of March, 2018. The survey area was from the A Tep station to Bhalee village, and from A Tep station to the border of Quang Nam and Thua Thien Hue Provinces, along Ho Chi Minh road. The survey area also connects to the Sao La – Hue Nature reserve (Thua Thien Hue) in Huong Nguyen and A Roang communes. Monsoon tropical broad-leaf evergreen forests were dominated. Main habitats were mostly rich primary forests which were regenerated after cultivation. Forests have a large number of large trees (diameter higher than 1m).

Survey effort included 25 hours for observation in the day time and 18 hours for observation in the night time. For sampling of bats, shrews, and rodents, we used 1,620 m<sup>2</sup>h of mist net, 398 m<sup>2</sup>h of

harp trap sampling, 80 trap nights of pitfall traplines and 270 trap nights of box and local cage trap. Survey effort is presented in

**TABLE 4 - SURVEY EFFORT FOR SMALL MAMMAL SURVEYS.**

Date	Site	Day observation Start/finish: hrs	Mist net (m <sup>2</sup> nh)	Harptrap (m <sup>2</sup> th)	Mole trap (trap nights)	Pitfall trapline (trap nights)	Box and Cage traps (trap nights)	Night observation Start/finish: hrs
13/3/2018	Trapline #9	7:30-11:30: 4.0	-	27	-	-	20	18:45-21:45: 3.0
14/3/2018		-	-	-	-	-	20	-
15/3/2018		-	-	-	-	-	20	-
16/3/2018		-	-	-	-	-	20	-
17/3/2018		-	162	-	-	-	20	-
14/3/2018	Trapline #10	5:30-8:30: 3.0	-	-	-	20	30	18:45-21:45: 3.0
15/3/2018		7:30-11:30: 4.0	-	-	-	20	30	-
16/3/2018		7:30-10:30: 3.0	162	-	-	20	30	18:45-21:45: 3.0
		5:30-8:30: 3.0	162	-	-	20	30	18:45-21:45: 3.0
14/3/2018	Trapline #11	-	270	54	-	-	-	18:45-21:45: 3.0
15/3/2018		-	108	54	-	-	-	18:45-21:45: 3.0
17/3/2018	Trapline #12	-	108	54	-	-	-	-
17/3/2018	Trapline #13	5:45-9:45: 4.0	270	54	-	-	40	-
18/3/2018		5:30-9:40: 4.0	270	54	-	-	40	-
19/3/2018		7:30-11:30: 4.0	270	54	-	-	40	-
19/3/2018		Trapline #14	-	-	54	-	-	-
Effort		25	1,620	398	-	80	270	18

## KEY SPECIES ACCOUNTS

A total of 37 species were recorded in Quang Nam SNR, including 5 Orders Chiroptera (16), Rodentia (15), Soricomorpha (3), Scandentia, Erinaceomorpha and Dermoptera (1 species for each) and 13 Families (see Annex I). Records were collected through species trapping, field observations and examination of specimens in local house, restaurants and from local traders. Four species are listed in Vietnam's Red Data Book (MoSt, 2007) including one endangered species, the Sunda Flying lemur *Galeopterus variegatus* and three Vulnerable species. Three species are also listed in the IUCN Red List (IUCN, 2018) including two Data Deficient (DD) species, and one Near Threatened (NT) species. Quang Nam SNR showed intermediate diversity of the five PAs surveyed (see ).

**TABLE 5 – TOTAL SMALL MAMMAL SPECIES RECORDED AT EACH SITE AND DIVERSITY INDICES.**

Areas	Species Recorded	# Individ.	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%). Dominant species are presented in



**TABLE 6 – DOMINANCE INDICES – SMALL MAMMALS**

Common Name	Scientific Name	Dominance Index
Hoary Bamboo Rat	<i>Rhizomys pruinosus</i>	14.55%
Large Brown Flying Squirrel	<i>Petaurista philippensis</i>	9.09%
Cambodian Striped Squirrel	<i>Tamiops rodolphii</i>	6.67%
Andersen's Leaf-nosed Bat	<i>Hipposideros pomona</i>	6.06%
Pallas's Squirrel	<i>Callosciurus erythraeus</i>	5.45%
Intermediate Horseshoe Bat	<i>Rhinolophus affinis</i>	5.26%
Northern Treeshrew	<i>Tupaia belangeri</i>	4.85%
Hardwicke's Woolly Bat	<i>Kerivoula hardwickii</i>	4.85%
Small-toothed Mole	<i>Euroscaptor parvidens</i>	4.24%
Greater Shortnosed Fruit Bat	<i>Cynopterus sphinx</i>	4.24%
Least Horseshoe Bat	<i>Rhinolophus pusillus</i>	3.64%

### **Sunda Flying Lemur** *Galeopterus variegatus* (Least Concern)

The species is only known from Indochina (Vietnam, Laos, Cambodia), Thailand, Malaysia and Indonesia. However, populations are in because of hunting activities. In Vietnam, the species is distributed in the Centre and Central Highlands. During our surveys, this species was directly observed in Song Thanh NR (Trapline #8), Quang Nam SNR (Trapline #10) and Phong Dien NR (Trapline #25) only after 19:00 because they are only active at night. Local interviews and skulls held in local households also confirmed its occurrence in survey areas. Especially, there were still many skulls kept in local households in A Tep 1 and A Tep 2 villages of Sao La – Quang Nam NR, and La Bo B village, Cha Val commune of Song Thanh NR. The species is listed as Least Concern on the IUCN Red List (IUCN, 2018) and Endangered on the Vietnam Red Data Book (MoST, 2007).

### **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 SNR (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 was believed to previously only be distributed 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°23'38N; 107°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*.



**Black Giant Squirrel *Ratufa bicolor* (Near Threatened)**

The species is widely distributed in Vietnam, and often observed/captured in primary forests or regenerated forests with many large trees which are good for its movement. This species usually lives and moves in tall trees. Its activities often happen in daytime, especially in early morning and late afternoon. During our surveys, 2 individuals were observed at 7:48 am in Bac Hai Van NR (Trapline #2, 16°11'42N, 108°07'52E). It was also observed in Song Thanh NR in Trapline #4 (15°36'17N; 107°38'48E) and Trapline 8 (15°34'35N; 107°27'47E), in Quang Nam SNR at 17:35 in Trapline #14 (16°01'10N; 107°30'21E) when it was moving back to its home. The species is listed as Near Threatened on the IUCN Red List (IUCN, 2018) and Vulnerable on the Vietnam Red Data Book (MoST, 2007).

**Particolored Flying Squirrel *Hylopetes alboniger* (Least Concern)**

During our surveys, the species was confirmed to occur in the survey areas. We observed this species one time in Song Thanh NR at 19:20 in Trapline #4 (15°36'17N; 107°38'48E), and one individual was trapped by local people. In Quang Nam SNR, this species was observed in Trapline #10 (16°01'15N; 107°30'00E) where there were many large trees along streams; we also found its tails in local household when they kept tails for decoration. In Phong Dien, its occurrence was confirmed by interviewing local people. However, the habitats in Phong Dien still have a lot of large trees, then it can be a good living habitat for the species. The species is listed as Vulnerable on the Vietnam Red Data Book (MoST 2007).



**Figure 10 - Particolored Flying Squirrel *Hylopetes alboniger***



**Millard's Rat *Dacnomys cf. millardi* (Data Deficient)**

This poorly-known species has been recorded from eastern Nepal, northeastern India, southern China (southern and western Yunnan) and from adjacent areas of Lao PDR and Vietnam in Southeast Asia. It is known only from a small number of specimens from a few scattered localities in South Asia, although it is known from only a few locations in the region, it is presumed to be very widely distributed. This montane species occurs from around 1,050 (South Asia) to 3,000 m asl. During our survey, only one individual was captured in a small hole along stream in Trapline #10 (16°01'15N-107°30'00E, 679m) in Quang Nam SNR. Two individuals were captured in trapline #16 (16°04'40N-107°29'12E, 797m) and three were collected in Mo To stream (Trapline #20: 16°02'13N-107°29'58E, 752m). Local people are more likely to trap or hunt this species for foods because it is large (400-500gr weight). These activities threaten the population of this species. In addition, the status of this species has not yet been carefully evaluated in Vietnam and Indochina region.

**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 sounds during our survey, but we confirmed that hunting small mammals using guns still happens, especially Quang Nam SNR (A Tép I, 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 Mustelidae 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**

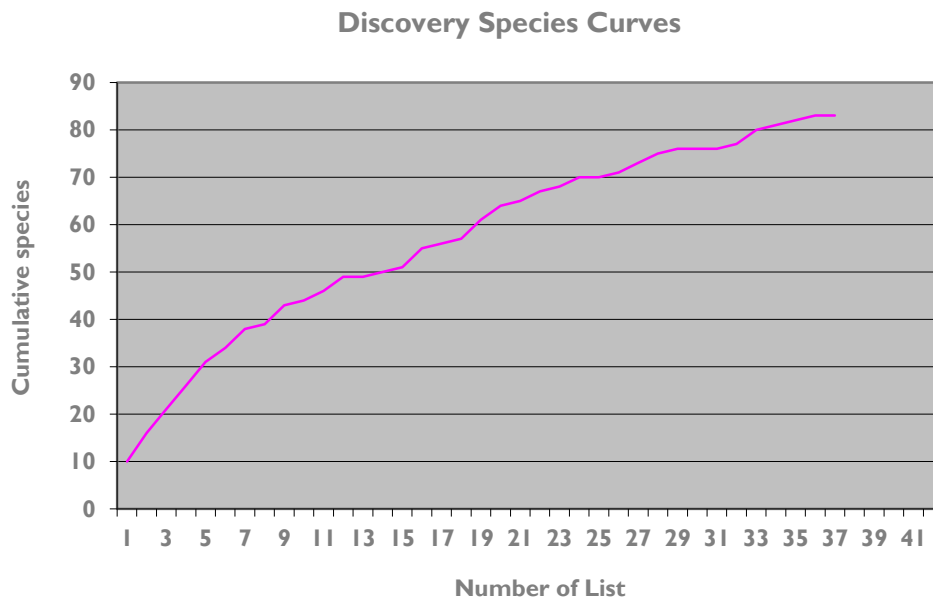
### **COMPLETENESS OF COVERAGE**

There have been no official avifauna surveys for the Quang Nam Saola Nature since it was establishment in 2011. The only records of the birds of the nature reserve were made by Nguyen Cu and Nguyen Tran Vy (2006) under the Green Corridor project. They recorded a total of 61 bird species belonging to 22 families and 08 orders, including 04 species on the Vietnam Red List (MoST, 2007) and 06 species listed in the IUCN Red List (IUCN, 2006).

The survey was conducted at two selected sites including the forest areas around sub-zones 12 and 13 (UTM 0767733-1772755) (border with Hue Saola Nature Reserve) and sub-zone 14 (UTM 0769571-1770858), Quang Nam Saola Nature Reserve, Bhalee commune, Tay Giang district, Quang Nam province. The main habitats at the forest areas around sub-zones 12 and 13 are lowland evergreen forest distributed at an elevation from 500-800 m asl. Small part to the south of an area (close to the A Tep Quang Nam forest guard station) are scrub and plantation forest. Habitat in sub-zone 14 is almost the same as sub-zones 12 and 13 with the cover of degraded lowland evergreen forest. However, it is surrounded by secondary forest of A Vuong upstream protection forest and the elevation is lower than sub-zones 12 and 13 (from 550-700 m asl). The current survey was conducted between the 14<sup>th</sup> ad 19<sup>th</sup> of March, 2018. The anthropogenic habitats surrounding those two sites (near to A Tep Quang Nam forest guard station) have also sureveyed *ad hoc* during 13<sup>th</sup> and 20<sup>th</sup> of March, 2018.

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

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



### KEY SPECIES ACCOUNTS

A total of 126 bird species were recorded during the field survey which when added to available historical records and birds caught on camera traps under the current survey takes the bird species list in Quang Nam SNR to 140 (Annex I). Most of these were directly recorded by observation, photography and identification of calls. Of these 140 bird species recorded, four species are listed in the IUCN Red list (IUCN, 2018), which includes Indochinese Wren Babbler *Jabouilleia danjoui* (Near-Threatened), Annam Partridge *Arborophila merlini* (Near-Threatened), Austen’s Brown Hornbill *Ptilolaemus austeni* (Near-threatened), Great Hornbill *Buceros bicornis* (Near-threatened). Six species are also listed in Vietnam Red Data Book (MoST, 2007) such as Indochinese Wren Babbler (Threatened), Long-tailed Broadbill *Psarisomus dalhousiae* (Threatened), Austen’s Brown Hornbill (Threatened), Great Hornbill (Threatened), Silver Pheasant *Lophura nycthemera* (Threatened) and Ratchet-tailed Treepie *Temnurus temnurus* (Threatened). Of note, three species are listed in Decree 160/2013 of the Vietnamese Government (Nguyen The Cuong *et al*, 2015) – the list of rare and endangered species, including Great Hornbill, Austen’s Brown Hornbill and Wreathed Hornbill *Aceros undulatus* (Annex I).

A total of 11 species recorded in compiled from previous surveys (WWF, 20170, were not found during this survey, therefore, the total number of species recorded in Sao La Quang Nam Nature Reserve to date stands at 137 (Annex I).

The bird community recorded at the forest areas of Sao La Quang Nam Nature Reserve is characteristic of lowland evergreen forest which is characterized by the presence of a large number of species in the Sylviidae, Pycnonotidae and Megalaimidae. The species most frequently recorded in this habitat during the survey included 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*, 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 fairly large number of wintering and migratory species has been recorded including Oriental Honey Buzzard *Pernis ptilorhynchus*, Grey-faced Buzzard *Butastur indicus*, Black Baza *Aviceda leucophotes*, Japanese Sparrowhawk *Accipiter gularis*, Long-tailed Shrike *Lanius schach*, Asia Brown Flycatcher *Muscicapa dauurica*, Grey-headed Canary Flycatcher *Culicicapa ceylonensis*, Blue and White Flycatcher *Cyanoptila cyanomelana*, Blue Rock Thrush *Monticola solitarius*, Barn Swallow *Hirundo rustica*, Red-jumped Swallow *H. daurica*, Yellow-browed Warbler, Black Drongo *Dicrurus macrocercus*, Spangle Drongo *D. hottentottus*.

During the survey, 37 MacKinnon lists were made with a total of 83 species recorded on one or more list (Figure 11). The eight most commonly recorded bird species were Puff-throated Bulbul which was recorded on 21 lists (56.8%), Pin Striped Tit Babbler on 20 lists (54%), Asian Fairy Bluebird *Irena puella* on 16 lists (43.4%), Red-vented Barbet and Black Drongo on 15 lists (40.5%), Blue-winged Leafbird and Black Bulbul on 13 lists (35.1%), Crimson Sunbird *Aethopiga siparaja* on 12 lists (32.4%). The next 25 commonly recorded species were Scarlet Minivet *Pericrocotus flammeus*, Ashy Drongo *Dicrurus leucophaeus* and Red-headed Trogon *Harpactes erythrocephalus* on 11 lists (29.7%), White-winged Magpie *Urocissa whiteheadi* and Dark-necked Tailorbird *Orthotomus atrogularis* on 9 lists (24.2%), Green-eared Barbet on 8 lists (21.6%), Ratchet-tailed Treepie *Temnurus temnurus*, Grey-throated Babbler, Mountain Fulvetta and Drongo Cuckoo *Surniculus lugubris* on 7 lists (18.9%), Black-winged Cuckoo-shrike *Coracina melaschistos*, Greater Yellownape *Picus flavinucha*, Mountain Imperial Pigeon *Ducula badia*, Greater Jacket-tailed Drongo *Dicrurus paradiseus*, White-tailed Flycatcher *Cyornis concretus*, Large Scimitar Babbler *Pomatorhinus hypoleucos*, Spot-necked Babbler and White-bellied Erpornis on 5 lists (13.5%), Greater Coucal *Centropus sinensis*, Yellow-browed Warbler, Grey-throated Babbler, Grey-capped Pygmy Woodpecker *Dendrocopos canicapillus*, Bay Woodpecker *Blythipicus pyrrhotis*, Streaked Spiderhunter *Arachnothera magna* and Silver-backed Needletail *Hirundapus cochinchinensis* on 04 lists (10.8%).

#### **Austen's Brown Hornbill** *Anorrhinus austeni* (Near-threatened)

A group of six birds were observed and photographed in lowland evergreen forest habitat (sub-zone 12) on 13 March 2018 at an elevation of 680 m asl when moved for feeding in the fruiting trees (UTM 0767733-1772755). Another 14 birds were also been recorded and photographed on 17 March 2018 in sub-zone 13 (UTM 0766860-1772223) at an elevation of 720 m asl. Currently, Austen's Brown Hornbill is threatened in Vietnam as a result of habitat loss, logging the large size trees and hunting. This species is listed as Near-Threatened in IUCN Red List (IUCN, 2018) and Threatened in the Vietnam Red Data Book (MoST, 2007) and is also recorded in the Decree 160/2013 of Vietnam Government (Nguyen The Cuong et al. 2015).



**Figure 12** - Austen's Brown Hornbill was detected in large groups in Quang Nam Saola Nature Reserve.



**Indochinese Wren Babbler** *Jabouilleia danjoui* (Near-threatened)

Indochinese Wren Babbler is an uncommon species in Sao La Quang Nam Nature Reserve. Only two birds were recorded by calls. One was on 16 March 2018 (UTM 0768147-1771678) and other was on 18 March 2018 (UTM 0769571-1770858). Both of them were recorded within lowland evergreen forest habitat and at an elevation from 630 to 680 m asl. Indochinese Wren Babbler is one of the restricted range species and is currently listed in IUCN Red List (IUCN, 2018) under the category Near-Threatened. This species is also recorded in the Vietnam Red Data Book (MoST, 2007) as Threatened.

**Annam Partridge** *Arborophila merlini* (Near-threatened)

Annam Partridge is rare species at Sao La Quang Nam Nature Reserve. Only one bird was recorded by call on 19 March 2018 (UTM 0766860-1772223) in a fairly intact lowland evergreen forest habitat (at an elevation of 710 m asl). Annam Partridge is an endemic species and is currently under threat of habitat loss and trapping. This species is also listed in IUCN Red List (IUCN, 2018) under the category of Near-Threatened.

**Great Hornbill** *Buceros bicornis* (Near-threatened)

Great Hornbill was not directly recorded during the survey. However, it was reported from several forest rangers at A Tep Forest Guard Station (Pers Comm. Mr. Nguyen Quang Hai and Tran Huu Phuoc), there were a group of three to four individuals lived in the sub-zone 20 of Sao La Quang Nam Nature Reserve (close to Nam Dong district of Thua Thien Hue province). Presently, Great Hornbill is highly threatened in Vietnam as an results of habitat loss and hunting. This species is listed as Near-Threatened on the IUCN Red List (IUCN, 2018) and Threatened in the Vietnam Red Data Book (MoST, 2007). Great Hornbill are also recorded in Decree 160/2013 of the Vietnamese Government (Nguyen The Cuong et al. 2015).

**THREATS**

The main threat to Quang Nam Saola Nature Reserve is hunting and trapping pressures from local people. During the survey period, local people with homemade guns were quite regularly seen along

the Ho Chi Minh trail, going to the forest for hunting and trapping. Their targets species including bamboo rat, wild pig, civets, squirrels, lizards as well as large and medium size birds. Hunting in some areas was openly conducted with no aoparent control from forest rangers. Some hunters live nearby the A Tep forest guard station and they mainly come from A Tep 1 and A Tep 2 villages. While hunting for rats, squirrels, civets and birds are for local consumption, other species such as bamboo rat, wild pig and lizards were mainly sold to restaurants. There are three restaurants trading those kinds of products in the A Zip town (**Figure 14**).

During the survey, many local people had also been observed walking in the forest, some of them collected non-timer forest products such as rattan, mushrooms, others went for fishing, catching frogs and lizards. Those activities also disturbed birds as well as other mammals in the area.

*Figure 13 - Local hunters with gun (left) and flavescent bulbul (right).*



*Figure 14 - Hunted bamboo rat at a local restaurant (left) and small carnivore in sub-zone 13 of Quang Nam SNR (right).*



The other threat to the biodiversity in the area is the conversion of forest to agricultural land. On 18 March 2018, a fairly large area near to the A Tep forest guard station was burned (Figure 15).



This area is outside the boundary of Quang Nam Saola Nature Reserve, however, impacts the SNR more generally.

**Figure 15** - Forest conversion for agriculture outside the boundary of the Quang Nam SNR.



## PART 6. RESULTS: REPTILES AND AMPHIBIANS

### COMPLETENESS OF COVERAGE

The survey when combined with historical records returned 194 Amphibian and Reptile species from 29 Families and three Orders including six Vulnerable, 15 Endangered species on the Red Data Book of Vietnam (MoST, 2007) and five Vulnerable and five Endangered and one Critically Endangered species on the IUCN Red List (IUCN, 2018) for Quang Nam Saola Nature Reserve. This included 103 amphibian species, belonging to nine Families and one Order; 91 species of reptiles, belonging to 20 families, two orders including 23 species of lizards belong to six Families and 56 species of snakes belonging to nine families and 12 species of turtles belonging to four Families (See Annex I)

The survey locations in Quang Nam SNR started from Aun village, A Vuong commune, Tay Giang district, Quang Nam province, with work divided across five transects. The fieldwork was conducted over eight days (from 28/03/2018 to 04/04/2018). The survey routes are described in detail in **TABLE 7** included 51 hours 21 minutes of surveys across 81.9km of transects.

**TABLE 7 - SURVEY EFFORT FOR AMPHIBIANS AND REPTILES**

Transect Location	Habitat descriptions	Coordinates	Alt. (m)	Transect length (km)	Date	Survey duration			
						Start	End	Hrs	
T3.1	Aun trail	Swidden fields and secondary forest.	776291/1764949 779333/1771621	550-620	13.2	28/03/18	13:38	17:40	4:01
T3.2	Doach	Steep, fast	779555/1771847	610-	6.2	29/03/18	7:59	12:18	4:18

**TABLE 7 - SURVEY EFFORT FOR AMPHIBIANS AND REPTILES**

Transect Location	Habitat descriptions	Coordinates	Alt. (m)	Transect length (km)	Date	Survey duration		
						Start	End	Hrs
trail	flowing; several 40-50 m waterfalls.	781140/1773512	1200					
T3.4	Doach stream	781119/1773511 781166/1773537	910-980	2.1	29/03/18	18:43	20:19	1:35
T3.5	Tam Gia Vua trail	781136/1773489 781129/1773506	820-1200	15.7	30/03/18	8:00	19:37	11:36
T3.6	Doach trail I	781147/1773509 779334/1771619	610-930	7.1	31/03/18	9:03	14:27	5:24
T3.7	Cho Do stream	779336/1771627 779235/1769618	690-1120	18.3	01/04/18	8:04	15:49	7:44
T3.8	Tam Gia Vua stream	779367/1771623 779443/1771754	540-1120	16.3	02/04/18	7:31	17:34	10:02
T1.8	Bai Chuoi - Dinh Deo stream	194226/1794589 193320/1792540	4 - 400	3.0	09/03/18	17:32	0:13	6:40

**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 indicators of habitat types and forest health.

**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 7 - ENCOUNTER RATES FOR GRANULAR SPINY FROGS BY PROTECTED AREA**

Transects	No. encounters	Km surveyed	Encounters / km
Quang Nam Saola NR			
T3.3	3	2.1	1.41

*Figure 16 - Granular spiny frog.*



**Hasse spadefoot toad** *Leptobrachium hasseltii* (Least Concern)

Hasse spadefoot 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 spadefoot 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 8 - ENCOUNTER RATES HASSE SPADEFOOD TOADS BY PROTECTED AREA**

Transects	No. encounters	Km surveyed	Encounters / km
Saola Quang Nam Natural Reserve			
T3.3	6	2.1	2.83

*Figure 17 - Hasse spadefoot 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 9 - ENCOUNTER RATES OF STAINE PITVIPER BY PROTECTED AREA**

Transects	No. encounters	Km surveyed	Encounters / km
Saola Quang Nam Natural Reserve			
T3.3	1	2.1	0.47

*Figure 18 - Staine pitvipiper.*



## 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

Field work was conducted from 2<sup>nd</sup> February, 2018 to the 11<sup>th</sup> February, 2018. Surveys were conducted across five survey routes in sub-areas of 12, 13, 14 (at Bhale commune of Tay Giang district) and 37 (at Song Kon commune of Dong Giang district). Survey results show that there are 575 named species, belonging to 157 families of vascular plants. As for use values, there are 337 medicinal plant species recorded (making up 65.5% of the total number of species recorded). This survey has contributed to considerably extends the species list for the protected area.

### KEY SPECIES ACCOUNTS

Survey results identified 45 species of rare and endangered plants in the nature reserve, including; 42 species listed in Vietnam's Red Data Book (MoST, 2007) of which three species are Critically Endangered, 20 species are Endangered and 19 species are Vulnerable. Ten species were also listed on Government Decree No 32/2006; including one species in Group IA and nine species included on Group IIA. On the IUCN Red List, one species is listed as Critically Endangered, one as Endangered and two as Vulnerable (IUCN, 2018). See [redacted] for a full listing of species of conservation concern in Quang Nam Saola Nature Reserve.

**TABLE 10 - PLANT SPECIES OF CONSERVATION CONCERN IN QUANG NAM SAOLA NR**

No.	Latin name	Local name	Red Data Book	Decree 32/2006	IUCN 2018
1.	<i>Acanthopanax trifoliatum</i> (L.) Voss	Ngũ gia bì 3 lá	EN		
2.	<i>Aglaia spectabilis</i> (Miq.) Jain & Bennet.	Gội nếp; Gội tía	VU		
3.	<i>Anoectochilus setaceus</i> Blume	Kim tuyến tơ	EN	IA	
4.	<i>Aquilaria crassna</i> Pierre ex Lecomte	Trầm hương	EN		
5.	<i>Ardisia silvestris</i> Piard	Lá khô	VU		
6.	<i>Canthium dicocum</i> (Gaertn.) Teysm. & Binn.	Xương cá	VU		VU
7.	<i>Cinnamomum parthenoxylon</i> (Jack) Meisn.	Re hương	CR	IIB	
8.	<i>Codonopsis javanica</i> (Blume) Hook. f.	Đảng sâm	VU	IIA	
9.	<i>Cosciniium fenestratum</i> (Gaertn.) Colebr.	Vàng đắng		IIA	
10.	<i>Dalbergia oliveri</i> Gamble ex Prain	Cắm lai	EN	IIA	EN
11.	<i>Dendrobium chrysotoxum</i> Lindl.	Hoàng lan thủy tiên	EN		
12.	<i>Dendrobium devonianum</i> Paxt.	Phượng dung	EN		
13.	<i>Dendrobium nobile</i> Lindl.	Hoàng phi hạc	EN	IIB	



**TABLE 10 - PLANT SPECIES OF CONSERVATION CONCERN IN QUANG NAM SAOLA NR**

No.	Latin name	Local name	Red Data Book	Decree 32/2006	IUCN 2018
14.	<i>Dioscorea dissimulans</i> Prain et Burk.	Nần gừng	VU		
15.	<i>Dipterocarpus retusus</i> Blume	Chò nâu	EN		VU
16.	<i>Drynaria fortunei</i> (Kuntze ex Mett.) J. Smith	Cốt toái bổ	EN		
17.	<i>Embelia parviflora</i> Wall. ex A. DC	Thiên lý hương	VU		
18.	<i>Enicosanthellum petelotii</i> (Merr.) Ban	Nhọc trái khớp lá mác	EN		
19.	<i>Erythrophleum fordii</i> Oliv.	Lim xanh		IIA	
20.	<i>Euonymus chinensis</i> Lindl.	Đỗ trọng tía	EN		
21.	<i>Fibraurea recisa</i> Pierre	Hoàng đằng	VU		
22.	<i>Gynostemma pentaphyllum</i> (Thumb.) Makino	Giao cổ lam	EN		
23.	<i>Hedyosmum orientale</i> Merr. & Chun	Mật hương	CR		
24.	<i>Homalomena pierreana</i> Engl.	Thần phục	VU		
25.	<i>Hopea hainanensis</i> Merr. et Chun	Sao hải nam	EN		CR
26.	<i>Hopea pierrei</i> Hance	Kiền kiên	EN		
27.	<i>Illicium petelotii</i> A.C. Sm, 1947	Hồi núi	EN		
28.	<i>Lithocarpus fenestratus</i> (Roxb.) Rehd.	Dẻ lỗ	VU		
29.	<i>Macrosolen annamicus</i> Dans.	Đại cán việt	EN		
30.	<i>Madhuca pasquieri</i> (Dubard) H. J. Lam.	Sến mật	EN		
31.	<i>Markhamia stipulata</i> (Roxb.) Seem.	Đinh	VU		
32.	<i>Melanorrhoea laccifera</i> Pierre	Sơn huyết	VU		
33.	<i>Murraya glabra</i> Guillaum.	Vương tùng	VU		
34.	<i>Pachylarnax praecalva</i> Dany	Mỡ vạng	VU		
35.	<i>Parashorea stellata</i> Kurz	Chò đen	VU		
36.	<i>Quercus setulosa</i> Hickel et A. Camus	Sồi dưới	VU		
37.	<i>Rauvolfia cambodiana</i> Pierre ex Pitard	Ba gác cam bột	VU		

**TABLE 10 - PLANT SPECIES OF CONSERVATION CONCERN IN QUANG NAM SAOLA NR**

No.	Latin name	Local name	Red Data Book	Decree 32/2006	IUCN 2018
38.	<i>Rauvolfia micrantha</i> Hook. f.	Ba gạc lá mỏng	VU		
39.	<i>Renanthera annamensis</i> Rolfe	Hồng nhung nam	EN		
40.	<i>Schisandra chinensis</i> (Turcz.) Baill.	Ngũ vị bắc	VU		
41.	<i>Sindora siamensis</i> Teysm. ex Miq.	Gụ mật	EN	IIA	
42.	<i>Sindora tonkinensis</i> A. Chev. ex K. & S. Larsen	Gụ lau	EN	IIA	
43.	<i>Stephania rotunda</i> (Lour)	Bình vôi		IIB	
44.	<i>Tacca integrifolia</i> Ker-Gawl	Cỏ râu hùm	VU		
45.	<i>Telectadium dongnaiense</i> Pierre ex Cost.	Vệ tuyến đồng nai	CR		

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.

## THREATS

Due to increasing demand for agricultural land and plantations, at some places along the NR boundaries, people have girdled trees (i.e. removed bark) to kill them and gradually change the land-use purpose illegally. This was recorded in sub-areas 12 (Bhale commune, Dong Giang) and 37 (Song Kon commune, Dong Giang). Additionally, there was even illegal clearing of land by fire.

Exploitation of NTFPs rarely happens inside the NR with common activities like collecting of firewood, bamboo shoots, and bee honey having little impacts on the resources in the NR. However, we need to consider this as potential risks for the NR. Specifically, during the survey routes along sub-areas numbered 13 and 14, only one individual of *Paris polyphylla* was recorded while tens of adult and young individuals of this species were recorded here in 2014. *Stephania rotunda* was also frequently found before in sub-area 14 while only young plants with little commercial value were recorded during this survey. Similarly, only young individuals of *Scaphyrum macropodum* were recorded.

Logging inside the NR is not anymore common thanks to effective patrolling from the community forest protection members under Payments for Forest Environmental Services (PFES) program and inspections from Forest Protection officials. During the survey there was no recent logging spotted, even though evidence indicates the site was quite intensively logged in the past.

While actions against illegal logging prove to be more and more effective with PFES policy engaging households, the efforts to prevent wildlife hunting among local communities has brought little progress. We saw an elderly of over 60 carrying a dead wild boar (of about 30kg) walking from the forest towards the village. Illegal hunting inside the NR is, apart from livelihood purposes, a traditional custom that is not easy to change among local community. The most common hunting activity is trapping.

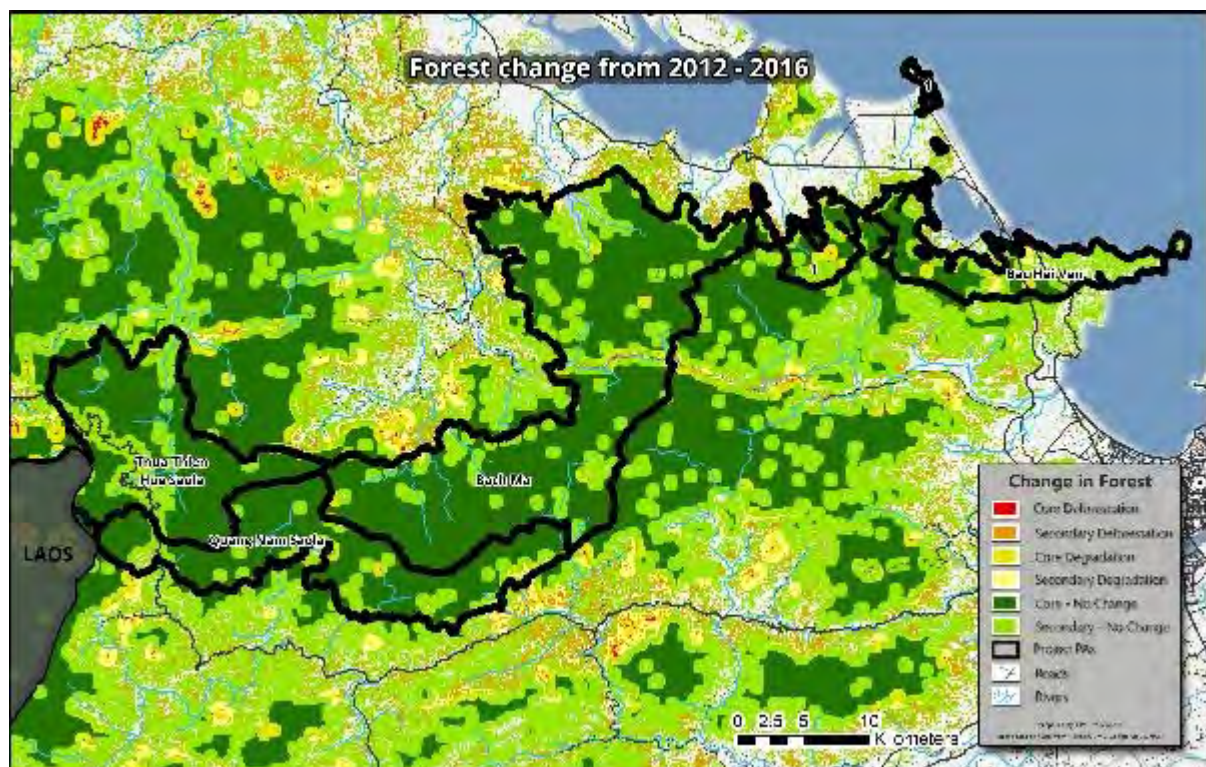
## PART 8. RESULTS: FOREST COVER AND FRAGMENTATION

Quang Nam Saola Nature Reserve is performing considerably better than other target PAs, with the exception of Hue SNR, showing low relative amounts of forest change over the course of four years (2012-2016). Very little forest loss occurred; only 53 ha (0.34%) between 2012 and 2016 which compares favourably with other sites (see [Error! Reference source not found.](#)). Most forest loss was in secondary forest areas rather than in core areas. Likewise, forest functionality in terms of connectivity of core forests declined only marginally. The biggest pressure on Quang Nam Saola NR comes from the outside, where the deforestation around the road to the southeast of the protected area seems to expand into its boundaries. In general, forest cover and status was stable in Quang Nam SNR between 2012 and 2016 (see [Figure 19](#)).

**TABLE 11 – FOREST COVER CHANGE QUANG NAM SNR**

PA Name	Year	Non-Forest (%)	Total Forest (%)	Frag. Forest	Edge Forest	Core Forest	Core Defor.	2ndry Defor.	Core Deg.	2ndry Deg.
Quang Nam SNR	2012	0.61%	99.39%	349	3,432	11,975				
	2016	0.94%	99.06%	470	3,531	11,701	1	52	272	145

**Figure 19 - Map showing the Deforestation/Degradation of Quang Nam Saola NR (bottom left) Thua Thien Hue Saola NR, Bach Ma NP, Quang Nam Saola NR, and Bac Hai Van PNR.**



## PART 9. RECOMMENDATIONS

1. The current species totals for Quang Nam Soala Nature Reserve after the completion of this survey and assessment of historical records stands at: 37 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 mammal species; 140 bird species from 105 Genera and 30 Families including four species listed on the Red Data Book of Vietnam as Vulnerable (MoST, 2007); 194 Amphibian and Reptile species from 29 Families and three Orders including six Vulnerable, 15 Endangered species on the Red Data Book of Vietnam (MoST, 2007) and five Vulnerable and five Endangered and one Critically Endangered species on the IUCN Red List (IUCN, 2018); and 575 plant species from 157 Families including three Critically Endangered, 20 Endangered and 19 Vulnerable species on the Red Data Book of Vietnam (MoST, 2007) and one Critically Endangered, one Endangered and two Vulnerable species on the IUCN Red List (IUCN, 2018).
2. Inventories for Quang Nam 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 saola records since 2013, 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 fairly stable within the Quang Nam Saola Nature Reserve, with only 0.34% forest loss in the period 2012-2016. Forest loss is however higher than in the contiguous Hue Saola Nature Reserve (0.02% in the same period), but lower than other PAs studied. 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, as this activity is occurring around the border of the protected area. 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 and this reduced connectivity with other forested areas.

6. Hunting with snares continues to be a major threat, probably the most significant threat, to biodiversity in Quang Nam Saola Nature Reserve. Snare removal through the community-ranger model has been successful in the past under the WWF 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 Hue 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.
8. Communication and education activities on forest protection should continue to be updated and disseminated to local people, restaurant owners and wildlife traders. Awareness raising of local communities about the importance of biodiversity at the Hue 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 LISTS

### SPECIES RECORDED BY CAMERA TRAP

TABLE 12 - MAMMAL SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS

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

**TABLE 12 - MAMMAL SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS**

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN Red List
26	<i>Nesolagus timminsi</i>	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 13 - BIRD SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS**

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

**TABLE 13 - BIRD SPECIES RECORDED FROM SYSTEMATIC CAMERA TRAPPING SURVEYS IN FIVE PAS**

	Scientific name	Common name	HSNR	QNSR	STNR	BHV	PDNR	IUCN red list
23	<i>Garrulax monileger</i>	Lesser necklaced Laughing thrush						LC
24	<i>Garrulax leucolophus</i>	White-crested Laughing thrush			x	x		LC
25	<i>Pomatorhinus hypoleucos</i>	Large scimitar babbler	x	x				LC
26	<i>Stachyris striolata</i>	Spot-necked babbler						LC
27	<i>Alcippe rufogularis</i>	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 RECORDS

**TABLE 14 – SMALL MAMMAL SPECIES RECORDED IN QUANG NAM SAOLA NATURE RESERVE**

TT	Scientific name	English Name	Record	Location	# indiv.	Location	Elevation (m)
	I. SCANDENTIA Wagner, 1855						
	I. Tupaiidae Gray, 1825						
1	<i>Tupaia belangeri</i> (Wagner, 1841)	Northern Treeshrew	C,O C,O	Trapline #9 Trapline #10	1,4 1,2	15°59'48N; 107°30'33E 16°01'15N; 107°30'00E	607 679
	II. DERMOPTERA Illiger, 1811						
	2. Cynocephalidae Simpson, 1945						
2	<i>Galeopterus variegatus</i> (Audebert, 1799)	Sunda Flying lemur	O Os	Trapline #10 House near ATép station	1 2 (Skull)	16°01'15N; 107°30'00E 15°59'48N; 107°30'33E	679 607
	III. SORICOMORPHA Gregory, 1910						
	3. Soricidae G. Fischer, 1814						
3	<i>Suncus murinus</i> (Linnaeus, 1766)	House Shrew	B	Trapline #9	2	15°59'48N; 107°30'33E	607
4	<i>Chimarrogale</i> cf. <i>varennei</i> Thomas, 1927	Water Shrew	O	Trapline #10	2	16°01'15N; 107°30'00E	679
	4. Talpidae G. Fischer, 1814						
5	<i>Euroscaptor parvidens</i> (Miller, 1940)	Small-toothed Mole	I,M	A Vương, Tà Lu	4 3	15°57'54N; 107°36'06E 15°57'47N; 107°40'54E	450 450
	IV. CHIROPTERA Blumbach, 1779						
	5. Pteropodidae Gray, 1821						
6	<i>Cynopterus sphinx</i> (Vahl, 1797)	Greater Short-nosed Fruit Bat	M M,H	Trapline #10 Trapline #12	6 1	16°01'15N; 107°30'00E 16°00'47N; 107°30'29E	679 741
7	<i>Macroglossus sobrinus</i> Andersen, 1911	Hill Long-tongued Fruit Bat	M M,H	Trapline #10 Trapline #12	2 1	16°01'15N; 107°30'00E 16°00'47N; 107°30'29E	679 741
8	<i>Sphaerias blanfordi</i> (Thomas, 1891)	Blandford's Fruit Bat	M	Trapline #13	1	16°00'44N; 107°30'04E	635
	6. Rhinolophidae Gray, 1825						
9	<i>Rhinolophus affinis</i> Horsfield, 1823	Intermediate Horseshoe Bat	M M,H	Trapline #10 Trapline #11	4 4	16°01'15N; 107°30'00E 16°01'50N; 107°30'22E	607 749
10	<i>Rhinolophus microglobosus</i> Csorba, Jenkins, 1998	Indo-Chinese Lesser Brown Horseshoe Bat	M	Trapline #10	3	16°01'15N; 107°30'00E	679
11	<i>Rhinolophus pearsonii</i> Horsfield, 1851	Pearson's Horseshoe Bat	M	Trapline #10	1	16°01'15N; 107°30'00E	679

12	Rhinolophus pusillus Temminck, 1834	Least Horseshoe Bat	M	Trapline #10	3	16°01'15N;	679
			M,H	Trapline #11	3	107°30'00E 16°01'50N; 107°30'22E	
7. Hipposideridae Lydekker, 1891							
13	Hipposideros armiger (Hodgson, 1835)	Great Himalayan Leaf- nosed Bat	M	Trapline #10	1	16°01'15N; 107°30'00E	679
14	Hipposideros grandis Allen, 1936	Grand Leaf- nosed Bat	M	Trapline #10	2	16°01'15N; 107°30'00E	679
15	Hipposideros pomona K. Andersen, 1918	Andersen's Leaf-nosed Bat	M,H	Trapline #10	2	16°01'15N; 107°30'00E	679 741 635 773
			M,H	Trapline #12	2	16°00'47N; 107°30'29E	
			M,H	Trapline #13	4	16°00'44N; 107°30'04E	
			H	Trapline #14	2	16°01'10N; 107°30'21E	
8. Megadermatidae H. Allen, 1864							
16	Megaderma spasma (Linnaeus, 1758)	Lesser False Vampire	M	Trapline #10	1	16°01'15N; 107°30'00E	679
9. Vespertilionidae Gray, 1821							
17	Pipistrellus coromandra (Gray, 1838)	Coromandel Pipistrelle	M	Trapline #10	(1),(-)	16°01'15N; 107°30'00E	607 635
			M,H	Trapline #13	(2),(-)	16°00'44N; 107°30'04E	
18	Scotomanes ornatus (Blyth, 1851)	Harlequin Bat	M	Trapline #12	1	16°01'15N; 107°30'00E	741
19	Tylonycteris malayana Chasen, 1940	Greater Flat- headed Bat	M,H	Trapline #10	2	16°01'15N; 107°30'00E	679 635
				Trapline #13	1	16°00'44N; 107°30'04E	
20	<i>Murina fcae</i> (Thomas, 1891)	Ashy-gray Tube-nosed Bat	M	Trapline #10	1	16°01'15N; 107°30'00E	679
21	Kerivoula hardwickii (Horsfield, 1824)	Hardwicke's Woolly Bat	H	Trapline #11	2	16°01'50N; 107°30'22E	749 741 773
			M,H	Trapline #12	2	16°00'47N; 107°30'29E	
			H	Trapline #14	4	16°01'10N; 107°30'21E	
22	<i>Kerivoula titania</i> Bates, Struebig, Hayes, Furey, Mya, Thong, Son, Harrison, Csorba, Francis, 2007	Titania's Woolly Bat	H	Trapline #14	2	16°01'10N; 107°30'21E	773
V. RODENTIA Bowdich, 1821							
10. Scuridae Fischer de Waldheim, 1817							
23	Ratufa bicolor (Sparrman, 1778)	Black Giant Squirrel	O	Trapline #14	1	16°01'10N; 107°30'21E	773
24	Hylopetes alboniger (Hodgson, 1836)	Particolored Flying Squirrel	I,O	Trapline #10	1	16°01'15N; 107°30'00E	679
25	Hylopetes spadiceus (Blyth, 1847)	Red-cheeked Flying Squirrel	In				
26	Petaurista cf. philippensis (Elliot, 1839)	Large Brown Flying Squirrel	O O	Trapline #10	2	16°01'15N; 107°30'00E	679 606
				House near A Tép station	8 (skull) 5 (skull)	15°59'48N; 107°30'33E	
27	Callosciurus erythraeus (Pallas, 1779)	Pallas's Squirrel	C,O	Trapline #10	(2),(4)	16°01'15N;	679
			O	Trapline #14	3	107°30'00E	

						16°01'10N; 107°30'21E	
28	<i>Dremomys rufigenis</i> (Blanford, 1878)	Asian Red- cheeked Squirrel	C,O B,O	Trapline #10 Trapline #14	(1),(1) (1),(3)	16°01'15N; 107°30'00E 16°01'10N; 107°30'21E	679 773
29	<i>Menetes berdmorei</i> (Blyth, 1849)	Indochinese Ground Squirrel	C,O O	Trapline #10 Trapline #14	(1),(1) 1	16°01'15N; 107°30'00E 16°01'10N; 107°30'21E	679 773
30	<i>Tamiops rodolphii</i> (Milne- Edwards, 1867)	Cambodian Striped Squirrel	B,O O	Trapline #10 Trapline #14	(1),(4) 6	16°01'15N; 107°30'00E 16°01'10N; 107°30'21E	679 773
11. Spalacidae Gray, 1821							
31	<i>Rhizomys pruinosus</i> Blyth, 1851	Hoary Bamboo Rat	O	Trapline #9 AZich1 Azich2 Bhalee school	2 14 8	15°59'48N; 107°30'33E 15°55'40N; 107°32'04E 15°57'13N; 107°31'44E	607 405 407
12. Muridae Illiger, 1811							
32	<i>Berylmys bowersi</i> (Anderson, 1879)	Bower's White- toothed Rat	C	Trapline #9	1	15°59'48N; 107°30'33E	607
33	<i>Dacnomys cf. millardi</i> Thomas, 1916	Millard's Rat	C	Trapline #10	1	16°01'15N; 107°30'00E	679
34	<i>Maxomys surifer</i> (Miller, 1900)	Indomalayan Maxomys	C,B	Trapline #10	(1),(1)	16°01'15N; 107°30'00E	679
35	<i>Leopoldamys edwardsi</i> (Thomas, 1882)	Edwards's Long- tailed Giant Rat	C	Trapline #10	6	16°01'15N; 107°30'00E	679
13. Hystricidae G. Fischer, 1817							
36	<i>Atherurus macrourus</i> (Linnaeus, 1758)	Asiatic Brush- tailed Porcupine	I, O	Near Bhalee school	1	15°55'40N; 107°32'04E	
37	<i>Hystrix brachyura</i> Linnaeus, 1758	Malayan Porcupine	I	Trapline #14		16°01'10N; 107°30'21E	773

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 RECORDS

**TABLE 15 - BIRD SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No.	English name	Scientific name	Records		Habitats			Status
			TS	HS	A	S	D	
<b>Galliformes</b>								
<b>Pheasants</b>			<b>Phasianidae</b>					
1	Scaly-breasted Partridge	<i>Arborophila choloropus</i>	H				X	
2	Annam Partridge	<i>A. merlini</i>	H	2			X	NT
3	Rufous-throated Partridge	<i>A. rufogularis</i>		2				
4	Bar-backed Partridge	<i>A. brunneopectus</i>		2				
5	Red Junglefowl	<i>Gallus gallus</i>	O			X	X	
6	Silver Pheasant	<i>Lophura nycthemera</i>	I	1,2			X	T
7	Crested Argus	<i>Rheinardia ocellata</i>		1,2				NT,V
<b>Piciformes</b>								
<b>Woodpeckers</b>			<b>Picidae</b>					
8	Grey-capped Pymy Woodpecker	<i>Dendrocopos canicapillus</i>	O				X	
9	Greater Yellownappe	<i>Picus flavinucha</i>	O	I			X	
10	Lesser Yellownappe	<i>P. chlorolophus</i>	O	I			X	
11	Bay Woodpecker	<i>Blythipicus pyrrhotis</i>	H	I			X	
12	Greater Flameback	<i>Chrysocolaptes lucidus</i>	O				X	
<b>Barbets</b>			<b>Megalaimidae</b>					
13	Red-vented Barbet	<i>Megalaima lagrandieri</i>	P	I			X	
14	Green-eared Barbet	<i>M. faiostricta</i>	P				X	
15	Golden-throated Barbet	<i>M. franklinii</i>	O	I			X	
<b>Bucerotiformes</b>								
<b>Hornbills</b>			<b>Bucerotidae</b>					
16	Austen's Brown Hornbill	<i>Anorrhinus austeni</i>	P				X	NT, V NI60
17	Great Hornbill	<i>Buceros bicornis</i>	I					NT, V, NI60
18	Wreathed Hornbill	<i>Aceros undulatus</i>	I	I				NI60, V
<b>Trogoniformes</b>								
<b>Trogons</b>			<b>Trogonidae</b>					
19	Red-headed Trogon	<i>Harpactes erythrocephalus</i>	O	I			X	
<b>Coraciiformes</b>								
<b>Rollers</b>			<b>Coraciidae</b>					
20	Dollarbird	<i>Eurystomus orientalis</i>	P	I			X	
<b>Kingfishers</b>			<b>Alcedinidae</b>					
21	Common Kingfisher	<i>Alcedo atthis</i>	O	I	X	X		
22	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	O		X			
<b>Cuculiformes</b>								

**TABLE 15 - BIRD SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No.	English name	Scientific name	Records		Habitats			Status
			TS	HS	A	S	D	
<b>Cuckoos</b>		<b>Cuculidae</b>						
23	Large Hawk Cuckoo	<i>Hierococcyx sparverioides</i>	H				X	
24	Indian Cuckoo	<i>Cuculus micropterus</i>	H					X
25	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	O		X	X		
26	Asian Emerald Cuckoo	<i>Chrysococcyx maculates</i>	P					X
27	Drongo Cuckoo	<i>Surniculus lugubris</i>	P					X
28	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	O		X	X	X	
29	Greater Coucal	<i>Centropus sinensis</i>	O		X	X		
		<b>Apodiformes</b>						
<b>Swifts and Needletails</b>		<b>Apodiidae</b>						
30	Silver-backed Needletail	<i>Hirundapus cochinchinensis</i>	P					X
31	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	O			X	X	
32	Fork-tailed Swift	<i>Apus pacificus</i>	O			X	X	
		<b>Stringiformes</b>						
<b>Owls</b>		<b>Stringidae</b>						
33	Mountain Scops-owl	<i>Otus spilocephalus</i>	H	I				X
34	Collared Scops-owl	<i>O. bakkamoena</i>	H					X
35	Collared Owlet	<i>Glaucidium brodiei</i>	H	I				X
36	Asian Barred Owlet	<i>G. cuculoides</i>	H	I				X
		<b>Columbiformes</b>						
<b>Doves, Pigeons</b>		<b>Columbidae</b>						
37	Red Collared-dove	<i>Streptopelia tranquebarica</i>	O	I	X	X		
38	Spotted Dove	<i>S. chinensis</i>	O		X			
39	Barred Cuckoo Dove	<i>Macropygia unchall</i>	H	I				X
40	Emerald Dove	<i>Chalcophaps indica</i>	O	2				X
41	Thick-billed Green Pigeon	<i>Treron curvirostra</i>	P	I				X
42	Mountain Imperial Pigeon	<i>Ducula badia</i>	P	I				X
		<b>Ciconiformes</b>						
<b>Eagles, Kites, Buzzards</b>		<b>Accipitridae</b>						
43	Black Baza	<i>Aviceda leuphotes</i>	P			X	X	
44	Crested Serpent Eagle	<i>Spilornis cheela</i>	O	I		X	X	
45	Crested Goshawk	<i>Accipiter trivirgatus</i>	O			X	X	
46	Japanese Sparrowhawk	<i>A. gularis</i>	O			X		
47	Black Eagle	<i>Ictinaetus malayensis</i>	O	I				X
48	Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	P			X	X	
49	Grey-faced Buzzard	<i>Butastur indicus</i>	P		X	X	X	
50	Mountain Hawk-Eagle	<i>Nisaetus nipalensis</i>	P					X
<b>Herons, Egrets, Bitterns</b>		<b>Ardeidae</b>						



**TABLE 15 - BIRD SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No.	English name	Scientific name	Records		Habitats			Status
			TS	HS	A	S	D	
51	Little Egret	<i>Egretta garzetta</i>	O		X	X		
52	Chinese Pond Heron	<i>Ardeola bacchus</i>	O		X	X		
<b>Passeriformes</b>								
<b>Pittas</b>			<b>Pittidae</b>					
53	Blue-rumped Pitta	<i>Pitta soror</i>		I				X
<b>Broadbills</b>			<b>Eurylaimidae</b>					
54	Silver-breasted Broadbill	<i>Serilophus lunatus</i>	H	I				X
55	Long-tailed Broadbill	<i>Psarismus dalhousiae</i>	O					X
<b>Leafbirds</b>			<b>Irenidae</b>					
56	Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	O	I				X
57	Golden-fronted Leafbird	<i>C. aurifrons</i>	O					X
58	Orange-bellied Leafbird	<i>C. hardwickii</i>	P	I				X
59	Asian Fairy Bluebird	<i>Irena puella</i>	P	I				X
<b>Ioras</b>			<b>Aegithinidae</b>					
60	Great Iora	<i>Aegithina lafresnayei</i>	O			X	X	
<b>Shrikes</b>			<b>Laniidae</b>					
61	Burmese Shrike	<i>Lanius colluriooides</i>		I				
62	Long-tailed Shrike	<i>L. schach</i>	O	I	X	X		
<b>Crows, Magpies</b>			<b>Corvidae</b>					
63	White-winged Magpie	<i>Urocissa whiteheadi</i>	P	I				X
64	Indochinese Green Magpie	<i>Cissa hypoleuca</i>	H	2				X
65	Racket-tailed Treepie	<i>Crypsirina temia</i>	O			X	X	
66	Ratchet-tailed Treepie	<i>Temnurus temnurus</i>	O	I			X	T
67	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	P	I		X	X	
68	Ashy Woodswallow	<i>Artamus fuscus</i>	O	I				X
69	Large Cuckoo-Shrike	<i>Coracina macei</i>	O					X
70	Black-winged Cuckoo-shrike	<i>C. melaschistos</i>	P	I				X
71	Maroon Oriole	<i>Oriolus traillii</i>		I				
72	Grey-chinned Minivet	<i>Pericrocotus solaris</i>	O	I				X
73	Scarlet Minivet	<i>P. flammeus</i>	P	I				X
74	Bar-winged Flycatcher Shrike	<i>Hemipus picatus</i>	O	I				X
75	Black Drongo	<i>Dicrurus macrocerus</i>	P			X	X	
76	Bronzed Drongo	<i>D. aeneus</i>	O	I				X
77	Ashy Drongo	<i>D. leucophaeus</i>	O	I				X
78	Spangled Drongo	<i>D. hottentottus</i>	O					X
79	Lesser Racket-tailed Drongo	<i>D. remifer</i>	O	I				X
80	Greater Racket-tailed Drongo	<i>D. paradiseus</i>	P	I				X
81	Black-naped Monarch	<i>Hypothymis azurea</i>	O	I		X	X	

**TABLE 15 - BIRD SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No.	English name	Scientific name	Records		Habitats			Status
			TS	HS	A	S	D	
82	Asian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	O	I			X	
83	Large Woodshrike	<i>Tephrodornis gularis</i>		I				
<b>Old world Flycatchers</b>		<b>Muscicapidae</b>						
84	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	O	I			X	
85	Blue Rock-thrush	<i>Monticola solitarius</i>	O			X	X	
86	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	O	I		X	X	
87	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	O	I		X	X	
88	White-tailed Flycatcher	<i>Cyornis concretus</i>	P				X	
89	Blue-throated Flycatcher	<i>C. rubeculoides</i>	O				X	
90	Blue and White Flycatcher	<i>Cyanoptila cyanomelana</i>	P			X		
91	Oriental Magpie Robin	<i>Copsychus saularis</i>	O		X			
92	White-rumped Shama	<i>C. malabaricus</i>	O			X	X	
93	Slaty-backed Forktail	<i>Enicurus schistaceus</i>	O	I			X	
<b>Starlings, Mynas</b>		<b>Sturnidae</b>						
94	Common Myna	<i>Acridotheres tristis</i>	O	I	X	X		
95	Hill Myna	<i>Gracula religiosa</i>	O	I			X	
<b>Nuthatches</b>		<b>Sittidae</b>						
96	Yellow-billed Nuthatch	<i>Sitta solangiae</i>		I				NT
<b>Tits</b>		<b>Paridae</b>						
97	Sultan Tit	<i>Melanochlora sultanea</i>	P	I			X	
<b>Swallows</b>		<b>Hirundinidae</b>						
98	Barn Swallow	<i>Hirundo rustica</i>	O			X	X	
99	Red-rumped Swallow	<i>H. daurica</i>	P	I			X	
<b>Bulbuls</b>		<b>Pycnonotidae</b>						
100	Black-crested Bulbul	<i>Pycnonotus melanicterus</i>	P			X	X	
101	Red-whiskered Bulbul	<i>P. jocosus</i>	P	I	X	X		
102	Stripe-throated Bulbul	<i>P. finlaysoni</i>	O				X	
103	Flavescent Bulbul	<i>P. flavesces</i>	O			X	X	
104	Puff-throated Bulbul	<i>Alophoixus pallidus</i>	P	I		X	X	
105	Grey-eyed Bulbul	<i>Iole propinqua</i>	O				X	
106	Black Bulbul	<i>Hypsipetes leucocephalus</i>	P	I			X	
<b>Thrushes</b>		<b>Turdidae</b>						
107	Orange-headed Thrush	<i>Zoothera citrina</i>	O	2			X	
108	White's Thrush	<i>Z. dauma</i>		2				
		<b>Sylviidae</b>						
109	Common Tailorbird	<i>Orthotomus sutorius</i>	O		X	X		
110	Dark-necked Tailorbird	<i>O. atrogularis</i>	P			X	X	
111	Yellow-browed Warbler	<i>Phylloscopus inornatus</i>	P			X	X	

**TABLE 15 - BIRD SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No.	English name	Scientific name	Records		Habitats			Status
			TS	HS	A	S	D	
112	Yellow-bellied Warbler	<i>Abroscopus superciliaris</i>		I				
113	Hill Prinia	<i>Prinia superciliaris</i>	O			X		
114	Buff-breasted Babbler	<i>Trichastoma tickelli</i>	O	I				X
115	Spot-throated Babbler	<i>Pellorneum albiventre</i>	H					X
116	Large Scimitar-babbler	<i>Pomatorhinus hypoleucos</i>	H	2				X
117	White-browed Scimitar-babbler	<i>P. schisticeps</i>	H	I				X
118	Streaked Wren Babbler	<i>Napothera brevicaudata</i>	H	I				X
119	Eyebrowed Wren Babbler	<i>N. epilepidota</i>		I				
120	Indochinese Wren Babbler	<i>Jabouilleia danjoui</i>	H					X NT,T,RRS
121	Grey-throated Babbler	<i>Stachyris nigriceps</i>	P	I				X
122	Spot-necked Babbler	<i>S. striolata</i>	H					X
123	Pin-striped Tit-babbler	<i>Macronous gularis</i>	P	I		X	X	
124	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	H					X
125	Black-throated Laughingthrush	<i>G. chinensis</i>	O	I				X
126	Black-hooded Laughingthrush	<i>G. milleti</i>		I				NT
127	Rufous-throated Fulvetta	<i>Schoeniparus rufogularis</i>	H	I				X
128	Mountain Fulvetta	<i>Alcippe peracensis</i>	O	I				X
129	Black-browed Fulvetta	<i>A. grotie</i>	O	I				X
130	White-bellied Erpornis	<i>Erpornis zantholeuca</i>	O	I				X
<b>Flowerpeckers, Sunbirds</b>		<b>Nectariniidae</b>						
131	Thick-billed Flowerpecker	<i>Dicaeum agile</i>		I				
132	Plain Flowerpecker	<i>D. concolor</i>	O	I				X
133	Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	O					X
134	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	O			X		
135	Crimson Sunbird	<i>Aethopyga siparaja</i>	P			X	X	
136	Fork-tailed Sunbird	<i>A. christinae</i>		I				
137	Streaked Spiderhunter	<i>Arachnothera magna</i>	P	I				X
<b>Sparrows</b>		<b>Passeridae</b>						
138	Eurasian Tree Sparrow	<i>Parus montanus</i>	O			X		
<b>Munias</b>		<b>Estrildidae</b>						
139	White-rumped Munia	<i>Lonchura striata</i>	O			X		
<b>Wagtails</b>		<b>Motacillidae</b>						
140	Grey Wagtail	<i>Motacilla cinerea</i>	O	I				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 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 = Nguyen Cu & Nguyen Tran Vy, 2006; 2 = Nguyen The Truong An, 2018 (this survey using camera traps)  
TS = This survey

## REPTILE AND AMPHIBIAN SPECIES RECORDS

**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
<b>Amphibians</b>						
<b>1. Bufonidae</b>						
1	Aisan common toad	<i>Duttaphrynus melanostictus</i>	*		LC	
2	Cambodian toad	<i>Ingerophrynus galeatus</i>	*		LC	VU
<b>2. Dicroglossidae</b>						
3	Paddy frog	<i>Fejervarya limnocharis</i>	*		LC	
4	Common lowland Frog	<i>Hoplobatrachus rugulosus</i>	*		LC	
5	Bana frog	<i>Limnonectes bannaensis</i>	*		-	
6	Green puddle frog	<i>Occidozyga lima</i>	*		LC	
7	Granular spiny frog	<i>Quasipaa verrucospinosa</i>	*		NT	
8	Martents oriental frog	<i>Occidozyga martensii</i>	*		LC	
9	Giant spiny frog	<i>Quasipaa spinosa</i>		4	VU	EN
10	Annan frog	<i>Quasipaa delacouri</i>		5, 6	LC	EN
11	Crab eating frog	<i>Fejervarya cancrivora</i>	*		LC	
12	Blyth frog	<i>Limnonectes blythii</i>		8	NT	
13	Daba frog	<i>Limnonectes dabanus</i>		4	LC	
14	Dori frog	<i>Limnonectes doriae</i>		6	LC	
15	Khammon wart frog	<i>Limnonectes khammonensis</i>		4	DD	
16	Limbo frog	<i>Limnonectes limborgi</i>	*		LC	
17	Bourret paa frog	<i>Nanorana bourreti</i>		5	LC	
18	Striped oriental frog		*		LC	
19	Vita frog	<i>Occidozyga vittata</i>		4	LC	
20	Kuhl's creek frog	<i>Limnonectes kuhlii</i>		4	LC	
21	Poilan frog	<i>Limnonectes poilani</i>	*		LC	
<b>3. Hylidae</b>						
22	Annam frog	<i>Hyla symplex</i>	*		LC	
23	Assam treefrog	<i>Hyla annectans</i>		6	LC	
<b>4. Ichthyophiidae</b>						
24	Bana blind frog	<i>Ichthyophis bannanicus</i>		4	LC	
<b>5. Megophryidae</b>						
25	Anderson spadefood toad	<i>Megophrys major</i>	*		LC	
26	Han's mountain toad	<i>Ophryophryne hansi</i>	*		DD	
27	Mou hot spadefood toad	<i>Leptobrachium mouhoti</i>		8	LC	
28	Tuberosus toad	<i>Leptolalax tuberosus</i>		8	LC	
29	Gerti toad	<i>Megophrys gerti</i>		8	-	
30	Hasse spadefood toad	<i>Leptobrachium hasseltii</i>		4	LC	
31	Bana spadefood toad	<i>Leptobrachium banae</i>		4	LC	
32	Yellow spotted spadefood toad	<i>Leptobrachium xanthospilum</i>		3	DD	
33	Apple toad	<i>Leptolalax applebyi</i>		1	EN	
34	Minimus toad	<i>Leptolalax cf. minimus</i>		6	LC	
35	Croceus toad	<i>Leptolalax croceus</i>		2	DD	
36	Palpe toad	<i>Megophrys palpebralespinosa</i>		6	LC	CR



**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
37	Sapa spadefood toad	<i>Leptobranchium chapaense</i>	*		LC	
38	Aereus toad	<i>Leptolalax cf. aereus</i>		6	LC	
39	Firthi toad	<i>Leptolalax firthi</i>		3	EN	
<b>6. Microhylidae</b>						
40	Vietnam rice frog	<i>Microhyla annamensis</i>		4	VU	
41	Painted rice frog	<i>Microhyla picta</i>		8	DD	
42	Quangdong rice frog	<i>Microhyla pulchra</i>		8	LC	
43	Berdmo-narrow-mouthed frog	<i>Microhyla berdmorei</i>	*		LC	
44	Ornate pigmy frog	<i>Microhyla fissipes</i>	*		LC	
45	Heymon frog	<i>Microhyla heymonsi</i>	*		LC	
46	Marble pigmy frog	<i>Microhyla marmorata</i>	*		LC	
47	No-thumb piny frog	<i>Microhyla nanapollexa</i>		4	DD	
48	Burmese squat frog	<i>Glyphoglossus guttulatus</i>		6	LC	
49	Spotted narrow-mouthed frog	<i>Kalophrynus interlineatus</i>		8	LC	
50	Banded bullfrog	<i>Kaloula pulchra</i>		4	LC	
51	Dusty speckling venter pigmy frog	<i>Microhyla pulverata</i>		4	DD	
52	Balloon frog	<i>Glyphoglossus molossus</i>		6	NT	
53	Butler rice frog	<i>Microhyla butleri</i>		8	LC	
54	Deli paddy frog	<i>Micryletta inornata</i>	*		LC	
<b>7. Ranidae</b>						
55	Chinese sucker frog	<i>Amolops ricketti</i>	*		LC	
56	Guenther emoy frog	<i>Sylvirana guentheri</i>	*		LC	
57	Black striped frog	<i>Sylvirana nigrovittata</i>	*		LC	
58	Green Cascade frog	<i>Odorrana chloronota</i>		4	LC	
59	Tiananan frog	<i>Odorrana tiannanensis</i>		8	LC	
60	Absitus frog	<i>Odorrana absita</i>		6, 10	LC	
61	Johns' frog	<i>Rana johnsi</i>	*		LC	
62	Similar frog	<i>Hylarana attigua</i>	*		LC	
63		<i>Amolops spinapectoralis</i>		4	LC	
64	Livid frog	<i>Odorrana livida</i>		6	DD	
65	Morafka frog	<i>Odorrana morafkai</i>		6	LC	
66	Millet's frog	<i>Indosylvirana milleti</i>		8, 10	LC	
67	Anderson's frog	<i>Odorrana andersonii</i>	*		LC	VU
68	Sauteri frog	<i>Rana sauteri</i>		4	EN	
69	Compotrix frog	<i>Amolops compotrix</i>	*		LC	
70	Tonkin Huia frog	<i>Odorrana nasica</i>		6	LC	
71	Yellow frog	<i>Hylarana lateralis</i>		6	LC	
72		<i>Amnirana nicobariensis</i>			LC	
73	Three triped grass frog	<i>Hylarana macrodactyla</i>	*		LC	
74	Langbian Pleateau frog	<i>Sylvirana montivaga</i>		4	-	
75	Two striped grass frog	<i>Sylvirana taipehensis</i>	*		LC	
76	Chapa frog	<i>Odorrana chapaensis</i>		8	NT	
77	Laotian sucker frog	<i>Amolops cremnobatus</i>	*		LC	

**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
78	Cuc's frog	<i>Amolops cucae</i>		6	EN	
79	Chapa frog	<i>Babina chapaensis</i>		6, 4	LC	
80	Bana frog	<i>Odorrana banaorum</i>		8	LC	
81	Vietnam sucker frog	<i>Odorrana chapaensis</i>		6	NT	
<b>8. Rhacophoridae</b>						
82	Spotted leg tree frog	<i>Polypedates megacephalus</i>	*	*	LC	
83	Java whipping frog	<i>Polypedates mutus</i>	*	*	LC	
84	Kuri tree frog	<i>Kurixalus banaensis</i>	*		DD	
85	Philippine flying frog			8	LC	
86	Spiny bottom treefrog	<i>Rhacophorus exechopygus</i>	*		LC	
87	Orlov tree frog	<i>Rhacophorus orlovi</i>	*		LC	
88	Vietnam flying frog	<i>Rhacophorus calcaneus</i>	*		NT	
89	Kio whipping frog	<i>Rhacophorus kio</i>	*	*	LC	
90	Nigro tree frog	<i>Rhacophorus nigropalmatus</i>		4	LC	VU
91	Belly spotted frog			6	-	
92	Horned buddle – nest frog	<i>Aquixalus supercornutus</i>		8	-	
93	Doria asian tree frog	<i>Chiromantis doriae</i>		4	LC	
94	Smith Asian tree frog			6	DD	
95	Vietnamese buddle nest frog	<i>Feihyla palpebralis</i>		8	NT	
96	Annam flying frog	<i>Rhacophorus annamensis</i>	*		LC	
97	Gordon bug eyes frog	<i>Theloderma gordonii</i>	*		LC	
98	Peter' tree frog	<i>Philautus petersi</i>		6	LC	
99	Stripped Asian tree frog	<i>Feihyla vittata</i>		6	LC	
100	Bisacu tree frog	<i>Kurixalus bisacculus</i>	*		LC	
101	Buonluoi Bubble tree frog	<i>Philautus abditus</i>		4	DD	
102	Truongson Bubble –nest frog	<i>Theloderma truongsonense</i>		6	DD	
103	Thao whipping frog	<i>Rhacophorus feae</i>		8	LC	EN
<b>Reptiles</b>						
<b>9. Agamidae</b>						
104	Scalled belly tree lizard	<i>Acanthosaura lepidogaster</i>		8	LC	
105	Emma forest lizard	<i>Calotes emma</i>		4	-	
106	Garden fence lizard	<i>Calotes vericolor</i>	*		-	
107	Indochinense water dragon	<i>Physignathus cocincinus</i>	*	*	-	VU
108	Natalie tree lizard	<i>Acanthosaura nataliae</i>	*		-	
109	Indochinese forest lizard	<i>Calotes mystaceus</i>		6	-	
110	Spotted flying lizard	<i>Draco maculatus</i>	*	*	LC	
<b>10. Gekkonidae</b>						
111	Tokay	<i>Gekko gekko</i>		6	-	VU
112	House gecko	<i>Hemidactylus frenatus</i>	*		LC	
<b>11. Lacertidae</b>						
113	Asian Grass lizard	<i>Takydromus sexlineatus</i>		8	LC	
<b>12. Scincidae</b>						
114	Common sun skink	<i>Eutropis multifasciata</i>	*		-	
115	Long -tailed mabuya	<i>Eutropis longicaudatus</i>	*		-	

**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
116	Tridigital forest skink	<i>Sphenomorphus tridigitus</i>		4	-	
117	Berdmo water skink	<i>Tropidophorus berdmorei</i>	*		-	
118	Conchinchine water skink	<i>Tropidophorus cocincinensis</i>		6	-	
119	Bronze Mabuya	<i>Eutropis macularia</i>		6	-	
120	Bowring skink	<i>Lygosoma bowringii</i>	*		-	
121	Four - stripped skink	<i>Plestiodon quadrilineatus</i>		4	-	
122	Starry forest skink	<i>Sphenomorphus stellatus</i>		6	-	
123	Hainam water skink	<i>Tropidophorus hainanus</i>		6	-	
<b>13. Anguidae</b>						
124	Sokolov's grass lizard	<i>Ophisaurus sokolovi</i>		8	-	
<b>14. Varanidae</b>						
125	Clouded monitor	<i>Varanus nebulosus</i>		4	-	EN
126	Water monitor	<i>Varanus salvator</i>		4	LC	EN
<b>15. Typhlopidae</b>						
127	Indochinese blind snake	<i>Typhlops diardii</i>		8	LC	
128	Common blind snake	<i>Ramphotyphlops braminus</i>		8	-	
<b>16. Cyliodrophiidae</b>						
129	Red tailed pipe snake	<i>Cylindrophis ruffus</i>		8	LC	
<b>17. Pythonidae</b>						
130	Asiatic rock python	<i>Python molurus</i>		8	-	CR
<b>18. Colubridae</b>						
131	Buff - tripped keelback	<i>Amphiesma stolatum</i>		8	-	
132	Magrove snake	<i>Boiga dendrophila</i>		4	-	
133	Drapiez cat sanke	<i>Boiga drapiezii</i>		8	LC	
134	Quangxi cat snake	<i>Boiga quangxiensis</i>		6	LC	
135	Kelung cat sanke	<i>Boiga kraepelini</i>		6	LC	
136	Large spotted - cat snake	<i>Boiga multomaculata</i>		6	-	
137	Lowe reed snake	<i>Calamaria lovii</i>		8	LC	
138	Radiated rat snake	<i>Coelognathus radiatus</i>		6	LC	
139	Many -banded snake	<i>Cyclophiops multicinctus</i>		8	LC	
140	White -banded wolf snake	<i>Lycodon multifasciatus</i>		6	LC	
141	Green tree racer	<i>Rhadinophis prasina</i>		8	LC	
142	Gunther reed snake	<i>Liopeltis frenata</i>		6	-	
143	Common wolf snake	<i>Lycodon capucinus</i>		8	LC	
144	Banded wolf snake	<i>Lycodon fasciatus</i>		8	-	
145	Laotian wolf snake	<i>Lycodon laoensis</i>		8	LC	
146	Chinese Kukri snake	<i>Oligodon chinensis</i>		10	LC	
147	Dao van tien mountain keelback	<i>Opisthotropis daovantieni</i>		6	NT	
148	Tonkin mountain keelback	<i>Opisthotropis lateralis</i>		9	LC	
149	Beauty snake	<i>Orthriophis taeniurus</i>		9	LC	
150	Annam keelback	<i>Parahelicops annamensis</i>		9	DD	
151	White-spotted slug snake	<i>Pareas magarritophorus</i>		9	LC	
152	Big eyes bamboo snake	<i>Pseudoxenodon macrops</i>		8	LC	
153	Indochinese rat snake	<i>Ptyas korros</i>		7	-	EN

**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
154	Common rat snake	<i>Ptyas mucosa</i>		9	LC	EN
155	Chinese mountain snake	<i>Sibynophis chinensis</i>		10	LC	
156	Oriental whip snake	<i>Ahaetulla prasina</i>		9	LC	
157	White-lipped keelback	<i>Hebius leucomystax</i>	*		LC	
158	Modest keelback	<i>Hebius modestum</i>		7	LC	
159	Prasi keelback	<i>Amphiesma prasina</i>		6	-	
160	Green cat snake	<i>Boiga cyanea</i>		10	-	
161	Collared reed snake	<i>Calamaria pavementata</i>		9	LC	
162	Northern reed snake	<i>Calamaria septentrionalis</i>		9	LC	
163	Golden tree snake	<i>Chrysopelea ornata</i>		10	LC	
164	yellow - stripped snake	<i>Coelognathus flavolineatus</i>		6	LC	
165	Common bronzeback	<i>Dendrelaphis pictus</i>		9	-	
166	Mountain bronzeback	<i>Dendrelaphis subocularis</i>		4	LC	
167	Keeled slug snake	<i>Pareas carinatus</i>		10	LC	
168	Hamston slug snake	<i>Pareas hamptoni</i>		10	LC	
<b>19. Elapidae</b>						
169	Banded krait	<i>Bungarus fasciatus</i>		8	LC	EN
170	King cobra	<i>Ophiophagus hannah</i>	*		VU	CR
171	Blue krait	<i>Bungarus cadidus</i>	*		LC	
172	Red river Krait	<i>Bungarus slowinskii</i>			VU	
173	Monocled cobra	<i>Naja kaouthia</i>		4	LC	
174	MacCellands coral snake	<i>Sinomicrurus macclellandi</i>		8	-	
<b>20. Viperidae</b>						
175	Vongel pit viper	<i>Viridovipera vogeli</i>		6	LC	
<b>21. Homalopsidae</b>						
176	Blumbeos water snake	<i>Enhydris plumbea</i>		9	LC	
<b>22. Natricidae</b>						
177	Speckle belly keelback	<i>Rhabdophis chrysargos</i>		6	LC	
178	Grooved necked keelback	<i>Rhabdophis nuchalis</i>		8	LC	
179	Red – necked keelback	<i>Rhabdophis subminiatus</i>		10	LC	
180	Yellow spotted keelback	<i>Xenochrophis flavipunctatus</i>		8	LC	
181	Triange water snake	<i>Xenochrophis trianguligerrus</i>		9	-	
<b>23. Xenopeltidae</b>						
182		<i>Xenopeltis unicolor</i>		9	LC	
<b>24. Platysternidae</b>						
183	Big head turtle	<i>Platysternon megacephalum</i>		10	EN	EN
<b>25. Geoemydidae</b>						
184	Black breasted leaf turtle	<i>Geoemyda spengleri</i>		10	EN	
185	Annam leaf turtle	<i>Mauremys annamensis</i>		10	CE	CR
186	Chinese tripped neck turtle	<i>Mauremys sinensis</i>	*		EN	
187	Four eyes turtle	<i>Sacalia quadriocellata</i>		10	EN	
188	Bourret box turtle	<i>Cuora bourreti</i>		10	CE	
189	Keeled box turtle	<i>Cuora mouhotii</i>		10	EN	
<b>26. Testudinidae</b>						

**TABLE 16 – AMPHIBIAN AND REPTILE SPECIES LIST FOR QUANG NAM SAOLA NATURE RESERVE**

No	English name	Scientific name	TS	HS	Status	
					IUCN	National
190	Impresse Tortoise	<i>Manouria impressa</i>		10	VU	VU
191	Elongated Torstoise	<i>Indotestudo elongata</i>	*	*	EN	EN
<b>27. Trionychidae</b>						
192	Chinese solfshell turtle	<i>Pelodiscus sinensis</i>		6	VU	
193	Wattle neck softshell turtle	<i>Palea steindachneri</i>		8	EN	VU
<b>28. Emididae</b>						
194	Seben Snake	<i>Siebenrockiella crassicollis</i>		4	VU	

HS = Historical surveys: 1 = Rowley & Cao Tien Trung (2009); 2 = Rowley et al. (2010); 3 = Rowley et al. (2012); 4 = Đinh Thị Phương Anh & Trần Duy Linh (2005); 5 = Thái Trần Bái et al. (2003); 6 = Ngô Đắc Chứng & Nguyễn Văn Lanh (2009); 7 = Hồ Thu Cúc (2002); 8 = Nguyễn Phạm Hùng, & Lê Vũ Khôi (2012); 9 - Lê Vũ Khôi (2000); 10 = Trần Kiên & Hoàng Xuân Quang (1992).

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 RECORDS

**TABLE 17 - PLANT SPECIES OF CONSERVATION CONCERN IN QUANG NAM SAOLA NR**

No.	Latin name	Local name	Red Data Book	Decree 32/2006	IUCN 2018
1.	<i>Acanthopanax trifoliatum</i> (L.) Voss	Ngũ gia bì 3 lá	EN		
2.	<i>Aglaia spectabilis</i> (Miq.) Jain & Bennet.	Gội nếp; Gội tía	VU		
3.	<i>Anoectochilus setaceus</i> Blume	Kim tuyến tơ	EN	IA	
4.	<i>Aquilaria crassna</i> Pierre ex Lecomte	Trầm hương	EN		
5.	<i>Ardisia silvestris</i> Piard	Lá khô	VU		
6.	<i>Canthium dicoccum</i> (Gaertn.) Teysm. & Binn.	Xương cá	VU		VU
7.	<i>Cinnamomum parthenoxylon</i> (Jack) Meisn.	Re hương	CR	IIB	
8.	<i>Codonopsis javanica</i> (Blume) Hook. f.	Đảng sâm	VU	IIA	
9.	<i>Coscinium fenestratum</i> (Gaertn.) Colebr.	Vàng đắng		IIA	
10.	<i>Dalbergia oliveri</i> Gamble ex Prain	Cắm lai	EN	IIA	EN
11.	<i>Dendrobium chrysotoxum</i> Lindl.	Hoàng lan thủy tiên	EN		
12.	<i>Dendrobium devonianum</i> Paxt.	Phượng dung	EN		
13.	<i>Dendrobium nobile</i> Lindl.	Hoàng phi hạc	EN	IIB	
14.	<i>Dioscorea dissimulans</i> Prain et Burk.	Nần gừng	VU		
15.	<i>Dipterocarpus retusus</i> Blume	Chò nâu	EN		VU
16.	<i>Drynaria fortunei</i> (Kuntze ex Mett.) J. Smith	Cốt toái bổ	EN		
17.	<i>Embelia parviflora</i> Wall. ex A. DC	Thiên lý hương	VU		
18.	<i>Enicosanthe petelotii</i> (Merr.) Ban	Nhọc trái khớp lá mác	EN		
19.	<i>Erythrophleum fordii</i> Oliv.	Lim xanh		IIA	
20.	<i>Euonymus chinensis</i> Lindl.	Đỗ trọng tía	EN		
21.	<i>Fibraurea recisa</i> Pierre	Hoàng đằng	VU		
22.	<i>Gynostemma pentaphyllum</i> (Thumb.) Makino	Giao cổ lam	EN		
23.	<i>Hedyosmum orientale</i> Merr. & Chun	Mật hương	CR		

**TABLE 17 - PLANT SPECIES OF CONSERVATION CONCERN IN QUANG NAM SAOLA NR**

No.	Latin name	Local name	Red Data Book	Decree 32/2006	IUCN 2018
24.	<i>Homalomena pierreana</i> Engl.	Thần phục	VU		
25.	<i>Hopea hainanensis</i> Merr. et Chun	Sao hải nam	EN		CR
26.	<i>Hopea pierrei</i> Hance	Kiền kiền	EN		
27.	<i>Illicium petelotii</i> A.C. Sm, 1947	Hồi núi	EN		
28.	<i>Lithocarpus fenestratus</i> (Roxb.) Rehd.	Dẻ lỗ	VU		
29.	<i>Macrosolen annamicus</i> Dans.	Đại cán việt	EN		
30.	<i>Madhuca pasquieri</i> (Dubard) H. J. Lam.	Sến mật	EN		
31.	<i>Markhamia stipulata</i> (Roxb.) Seem.	Đinh	VU		
32.	<i>Melanorrhoea laccifera</i> Pierre	Sơn huyết	VU		
33.	<i>Murraya glabra</i> Guillaum.	Vương tùng	VU		
34.	<i>Pachylarnax praecalva</i> Dany	Mỡ vạng	VU		
35.	<i>Parashorea stellata</i> Kurz	Chò đen	VU		
36.	<i>Quercus setulosa</i> Hickel et A. Camus	Sồi dưới	VU		
37.	<i>Rauvolfia cambodiana</i> Pierre ex Pitard	Ba gác cam bột	VU		
38.	<i>Rauvolfia micrantha</i> Hook. f.	Ba gác lá mỏng	VU		
39.	<i>Renanthera annamensis</i> Rolfe	Hồng nhung nam	EN		
40.	<i>Schisandra chinensis</i> (Turcz.) Baill.	Ngũ vị bắc	VU		
41.	<i>Sindora siamensis</i> Teysm. ex Miq.	Gụ mật	EN	IIA	
42.	<i>Sindora tonkinensis</i> A. Chev. ex K. & S. Larsen	Gụ lau	EN	IIA	
43.	<i>Stephania rotunda</i> (Lour)	Bình vôi		IIB	
44.	<i>Tacca integrifolia</i> Ker-Gawl	Cỏ râu hùm	VU		
45.	<i>Telectadium dongnaiense</i> Pierre ex Cost.	Vệ tuyến đồng nai	CR		

## ANNEX 2: GLOSSARY

<b>Core Forest:</b>	in the forest cover assessment, core forest consists of intact interior forest pixels 1.25km from the forest edge.
<b>Edge Forest</b>	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.
<b>EBA</b>	an EBA is an Endemic Bird Area, which 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.
<b>IBA</b>	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.
<b>Medium Forest</b>	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 101-200 m <sup>3</sup> .
<b>Naïve Occupancy</b>	the proportion of locations from which a species was detected, not taking into account imperfect detection (see also occupancy and true occupancy).
<b>Occupancy</b>	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).
<b>Poor Forest</b>	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 10-100 m <sup>3</sup> .
<b>Rich Forest</b>	a government of Vietnam classification under Circular 34/2009, where total volume of standing trees is 201-300 m <sup>3</sup> .
<b>Shannon Diversity Index</b>	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.
<b>Simpson's Diversity Index</b>	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.
<b>SOP</b>	a standard operating procedure is a set of step-by-step instructions designed to help workers carry out complex routine operation.
<b>SMART</b>	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).