# Introduction

# Purpose

# Objectives

**Objective 1: Identify wildlife-poacher interactions and evaluate if poachers target specific areas for hunting**

# Study area:

Saola Nature reserves, see previous reports.

# Methods

We tried to assess interactions of wildlife and poachers and and evaluate if poachers target specific areas for hunting in the Saola Nature reserves using three different approaches:

1. Single-species occupancy models for traps using species occupancy probability as occupancy covariate
2. Multi-species occupancy models for poachers and target species
3. Assess trap persistence from multi-year occupancy model results from SMART data

## Camera trapping

Camera trapping was conducted at a total of 46 stations in the Saola Nature reserves. Each station was comprised of two cameras. Camera trapping in the Saola Nature reserves was conducted from August to December 2015. During a total of 5930 trap nights the camera captured a total of 1287 unique wildlife records (after filtering for temporal independence to ensure at least 60 minutes between subsequent records of the same species).

Local people were photographed at 15 stations in the Saola Nature reserves, indicating forest encroachment and a potential for poaching in the study area.

Cameras captured photos of rangers at 7 stations in the Saola Nature reserves, indicating that there was spatial and temporal overlap between camera trapping and ranger patrols, which is a prerequisite for the multi-species model below.

Due to simultaneous camera trapping and forest patrols, we can combine these data sources to assess the effects of traps on wildlife (or vice versa).

## Single-species occupancy models for traps using species occupancy probability as occupancy covariate

We utilize single-species occupancy models (MacKenzie 2002) for traps with wildlife occupancy probabilities as a covariate on trap occupancy. We used predicted occupancy probabilities of individual species, taxonomic species groups, and the individual habitat covariates as input covariates to explain trap occupancy patterns. The species occupancy probabilities were taken from Tilker (2019). Occupancy probability of species groups was calculated as the mean occupancy probability of the species comprising the group.

Poaching data were provided by WWF Viet Nam. We used a subset of the “All traps” data set covering the years 2014-16 in order to roughly match the camera trapping period. We considered the 200m grid cells as sites and uses weekly occasions. All models use survey effort as a covariate on detection probability. For details on preprocessing of SMART data, see the previous report “Determining Indicators and Providing Conservation Baseline for CarBi II: Spatial Visualization of Snare Occupancies“.

## Multi-species occupancy models for poachers and target species

Multi-species occupancy models (Rota et al. 2016)are an extension of single-species occupancy models and can be used to assess co-occurrence of species and traps. Using multi-species occupancy models, it is possible to model occupancy of two or more potentially interacting species while accounting for imperfect detection. Habitat preferences and interaction parameters can be modelled as linear functions of covariates. Likewise, detection probabilities can be modelled as functions of covariates. The models don’t assume one species to be dominant over the other. Here, traps are considered a “species” for modelling purposes.

Camera trapping data and patrol data must match spatially and temporally for these models. The temporal match is ensured because we calculated daily patrol effort for each grid cell. To ensure the spatial match, we applied a 1000-m buffer to the camera trap locations and

The models require that both species must be sampled simultaneously. Therefore only occasions in which there are data for both “species” can be used, the rest is discarded. That means that only occasions which had simultaneous camera trapping effort and patrol effort at camera trap sites are used in these models, severely limiting the amount of usable data available for the models. Camera trapping data that had no simulatanoues forest patrols around that station were removed, and patrol data outside the camera trapping period were removed as well.

In addition, it is not possible to add the detections from the invertebrate-derived DNA (iDNA from leeches) in these models, since they have not matching counterpart in the patrol data.

10-day occasions.

## Trap persistence from trap occupancy model results

We used the results from the previous project “Determining Indicators and Providing Conservation Baseline for CarBi II: Spatial Visualization of Snare Occupancies“ to evaluate which areas hunters target for poaching.

In that project we developed Bayesian occupancy models with a random effect structure to estimate occupancy probabilities of five trap categories over a 9-year time frame from 2011-2019. Since data from 2011-2013 were sparse and not available for both Saola Nature Reserves, we here restrict the analyses to the years 2014-2019.

We calculated the mean occupancy probability of the “All traps” category (which gives equal weight to all years) and a weighted mean, which gives more emphasis on the recent years. The weights were the inverse of the years before present (2020), so 2019 had weight 1, ½ for 2018, 1/3 for 2017, etc.. This better highlights the areas that hunters targeted in the recent past, and also better takes into account the effects of snare removal and patrols.

# Results

## Single-species occupancy models for traps using species occupancy probability as occupancy covariate

## Multi-species occupancy models for poachers and target species

## Trap persistence from trap occupancy model results

Figure: Mean and weighted mean of occupancy estimates for category “All traps” from 2014-2019.

# Discussion

# Recommendations