STANDARD OPERATIONAL PROCEDURE FOR BIODIVERSITY SURVEY IN CONSERVATION AREA

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Center for Climate Change and Policy Research and Development
Forestry Research and Development Agency
Ministry of Forestry, Indonesia
In Cooperation with
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Bogor, 2011

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SUMMARY

To support REDD + activities, biodiversity survey is required as a baseline and for monitoring the impact of REDD activities on population dynamics and biodiversity. This is required by voluntary standard, such as the CCBA (Climate Community and Biodiversity Alliance). In the REDD + mechanism, the survey is part of the biodiversity monitoring plan to assess the impact of REDD + during project activities.

For the purposes of REDD + activities monitoring and accuracy of the results of biodiversity survey, it is necessary to develop scientific method as SOP (Standard Operating Procedure). In this SOP, biodiversity includes only the elements of animals and plants and does not include micro-organisms. With the existence of this SOP, the community can be involved in biodiversity survey to support the REDD + programs. The involvement of the community to access the biodiversity is expected and needed to increase public awareness and to more actively participate in REDD + activities that will ultimately benefit to the community, environment and biodiversity conservation.

In this SOP, the biodiversity survey covers vegetation surveys, surveys of mammals, birds, hepertofauna, insect and turtles. It is also informed records of important information for the implementation of the survey. This SOP will continue to be improved in line with the experience in implementation of the survey in Meru Betiri National Park (MBNP) as a pilot project REDD +

Keywords: Biodiversity, flora and fauna, REDD +, Merubetiri NP

1. INTRODUCTION

1.1. Background

Reducing emissions from deforestation and degradation (REDD) is the initiation of global climate change in which the developed countries and the private sectors are expected to provide payment as compensation for developing countries in managing their forests sustainably. REDD is a new approach to climate change mitigation, which gives greater recognition of the importance of resource protection and management of tropical forests in developing countries. Further development expanded the scope of REDD + that included the aspects of conservation, sustainable forest management and enhancement of carbon stock.

Although main activity of REDD schemes is the reduction of emissions, biodiversity conservation is regarded as one important co-benefits of REDD + activities and is recognized worldwide. Because, it is seen that biodiversity plays an important role in maintaining ecosystems at present and in the future.

Survey of biodiversity is required to demonstrate the existence or non-existence of values of ecosystem quality and conservation such as species that regionally and globally threatened its population. In addition, data and information of biodiversity is required as a baseline and basic activities of monitoring the impact of REDD project activities to the population dynamics and biodiversity as required by voluntary standards, such as the CCBA (Climate Community and Biodiversity Alliance). In the REDD + mechanism, the survey is part of the biodiversity monitoring plan to assess the impact of REDD + activities during project activities.

Biodiversity refers to species, the abundance of species, genetic composition and communities, ecosystems and landscapes that exist. Another definition simplifies the biodiversity of the life in all its forms and all levels. Life in all its forms including plants, animals, fungi and other forms of micro-organisms. At various levels of biodiversity refers to the level of genes, species and ecosystems.

For the purposes of monitoring REDD + activities and the accuracy of the results of the survey biodiversity, it is necessary to develop scientific method as SOP (Standard Operating Procedure). In this SOP, biodiversity includes only elements of animals and plants and does not include micro-organisms. With the existence of this SOP, community can be involved in biodiversity surveys to support REDD + programs. The involvement of the community to access biodiversity is expected and needed to increase public awareness and to be more

actively participate in REDD + activities that will ultimately benefit to the community, environment and biodiversity conservation.

1.2. Objectives

Survey of the biodiversity in REDD + program is conducted to obtain required basic data of biodiversity, namely for (1); identification of priorities and indicators of ecosystem quality and conservation efforts in the future (2); requirements for validation, and (3) create a monitoring plan of biodiversity on the site during the term of REDD project.

This SOP is based on literature review and the results of biodiversity study, knowledge, learning, and field experience. This SOP is intended as general guidance in the implementation of biodiversity surveys, particularly in conservation areas to support REDD + activities in a way that can be measured, reported and verified (MRV).

2. IMPORTANT NOTES IN THE IMPLEMENTATION OF BIODIVERSITY SURVEY

2.1. Determining Location of Survey Area

Determination of the biodiversity survey area is conducted by the following considerations:

- Biodiversity surveys are carried out mainly in the area of *High Conservation Value Forest* (HCVF) (If it has been determined, according to decree of Director General of PHKA)
- If HCVF has not been determined, a survey is carried out in areas that represent zones of National Parks such as the Core Zone, Wilderness Zone, Utilization Zone and Rehabilitation Zone.
- In each zone, the location of the observation can be used as a Permanent Sample Plots *(*PSP), taking into account the criteria, namely: representation of survey area, condition of the biophysical landscape, ecosystem type, region compactness, the existence of flora fauna habitat and biodiversity indicators, accessibility and the level of vulnerability.
- The next survey is conducted in the area as the location of PSP that represent each zone of the National Park
- In addition to observations of biodiversity, the PSP can also be developed into a demonstration plot for the utilization of flora or fauna in a particular zone.

2.2. Preparing Tally Sheet and Documentation

Tally sheets should be prepared to ensure that any required parameters can be collected and recorded properly. Data and information that need to be well documented including tally sheet/data, and photographs. A basic understanding of making specimens also needs to be understood. Specimens should be labeled with information, such as location, date, sex, description of habitat, collector and catalog number.

2.3. Setting up Field Maps and GPS

The maps should be collected because it is required to any survey of biodiversity. Maps of basic information, vegetation, topography, and other maps are used to determine the location and placement of sample plots or transects. The use of GPS is very helpful in determining the location coordinates and produce an accurate map of the field.

2.4. Preparing Field Equipment

Prior to the implementation of the survey, it is important to prepare the necessary equipment. Such equipment must be checked and calibrated previously to be ready to use. Members of the survey should ensure that the equipment can function properly. Basic equipment i.e. survey maps, altimeter, compass, measuring tape, rope, knives, scissors, markers (tags), hammer, clinometer, hagameter, plastic bags, calipers, cameras, binoculars, GPS, safety equipment (flashlights, raincoats , drugs, etc.) and communications equipment (HT, HP, Computer, etc.)

2.5. Determining the duration and time of Survey

Comprehensive biodiversity surveys require a relatively long time, especially in areas with diverse habitat. It is important to determine strategies that can maximize the results of the survey and to identify wildlife or flora that is important in their respective habitats. Considerations may include criteria such as geographic position, forest type or land cover. Time and limited budget can be a limiting factor that affects the type of fauna that can be surveyed. Season is also important to consider. During the dry season in some places are dry up so that some species of mammals and birds that depend on water, will gather in a location that still provide water. This is a good time to do the survey because some kinds of animals can be easily found and documented.

2.6. Safety considerations

Implementation of the survey can be conducted in remote areas far from the source of treatment. The survey work contains of a high risk of accidents. Therefore some tips regarding safety are as follows:

- Always worked side by side. This is important so that when an accident happens there are friends who provide help. Also the possibility of getting lost would be reduced if work is not alone.
- Tell someone approximately time when a team is back, in order to ensure the survey team is back in time.
- Complete with safety equipment. Use a compass if it deviates from the existing tracks on the map. Bring a flashlight if forced to return to camp after dark. Bring protective equipment, first aid and GPS.
- Be prepared for emergencies, by providing communication tools such as HT, mobile or satellite phones.
- Avoid toxic or harmful organisms. Know the dangerous of species of plants that cause itching, also avoid animals such as scorpions, bees, or other sting animals. Be aware of wild animals such as tigers, lions, crocodiles etc..
- Cleanliness is essential. Small wounds can be dangerous and fatal. Therefore, use an antiseptic, and clean every slightest wound to prevent infection.
- Should be available at the camp medical equipment or firs aid.
- Be aware of some harmful chemicals such as formalin, alcohol, fuel and so on.
- Always be alert and use common sense. A lot of accidents because people do stupid things, such as crossing the river in the wrong place, panicked when lost, weak to climb trees and so on. Accidents like this can actually be avoided. It is important to understand their own abilities, and always avoid some dangerous activities.

2.7. Knowing Source of Bias

Biodiversity survey is basically to conduct the observation of natural conditions. Natural conditions can be a source of bias for the observations. Some sources of bias that must be known in the observations are: habitat conditions, wildlife activity, errors or limitations of the observer, methods and equipment used, the speed of survey, the type or species observed, population density, season or weather and time of day, morning, noon , afternoon, or evening

3. VEGETATION SURVEY

3.1. General Information

Despite that rain forest vegetation can be divided into various strata, this analysis is carried out by dividing the vegetation into the level of vegetation growth, according to the following criteria:

- Seedlings: seedlings with a height of not more than 1.5 m
- Saplings: seedlings that have grown by more than 1.5 m height and trunk diameter of less than 10 cm
- Pole: woody plants with stem diameters between 10 cm - 20 cm
- Tree: woody plants with a trunk diameter of more than 20 cm

Analysis of natural forest vegetation is carried out to determine the composition and structure of forest vegetation. Analysis is generally performed by the method of transect plots. Analysis is conducted on the seedlings, saplings, poles and trees.

3.2. Survey Methods

The method commonly used in vegetation survey is plots in transects. The transect is made by crossing the contour lines. Determination of transect length and the distance between transects depending on the intensity of sampling set for the area to be surveyed and the availability of resources.

On each transect, plots of observations are made, 2 x 2 m plots are used to analyze seedlings and undergrowth, 5 x 5 m plots to analyze saplings, 10 x 10 m plots to analyze poles and 20 x 20 m plots are used to analyze tree

Untuk jenis yang tidak dikenal pada hutan alam, dilakukan identifikasi melalui koleksi contoh herbarium. Identifikasi dapat dilaksanakan di laboratorium seperti LBN atau Bagian Botani Puslitbang Konservasi dan Rehabilitasi.

On each plot, measurement is made for height, diameter at breast height and the identification of species of trees, poles, saplings, seedlings and undergrowth. For unknown species in natural forests, identification is made through the collection of herbarium. Identification can be done in the laboratory such as LIPI or Center for Conservation and Rehabilitation Research and Development (Puskonser).

3.3. Data Analysis
Parameters in the analysis of vegetation

1. Density

$$Density\ (K) = \frac{\sum individuals}{Area\ of\ plot}$$

$$K\ Relatif\ (KR) = \frac{K\ of\ a\ species}{K\ total\ of\ all\ species}\ x\ 100\%$$

2. Frequency

$$Frequency\ (F) = \frac{\sum of\ plots\ a\ species\ found}{\sum all\ plots}$$

$$F\ Relatif\ (FR) = \frac{F\ of\ a\ species}{F\ total\ of\ all\ species}\ x\ 100\%$$

3. Domination

$$Domination\ (D) = \frac{Basal\ area\ of\ a\ species}{Area\ of\ plot}$$

$$D\ Relatif\ (DR) = \frac{D\ of\ a\ species}{D\ total\ of\ all\ species} x\ 100\%$$

$$Important\ Value\ Index\ (IVI) = KR + FR + DR\ (for\ poles\ and\ trees\ )$$

$$IVI = KR + FR\ (for\ seedlings\ and\ saplings$$

4. Diversity Index

$$Shannon\ Index:\ H = -\sum_{i=1}^{s} p_i\ l_n\ p_i$$

H = Shannon-Wiener biodiversity index
s = number of species
$p_i = ni / N$
$n_{i:}$ = number of individuals of species I and
N = total individuals in the entire plot.

4. WILDLIFE SURVEY (MAMMALS)

4.1. General Information

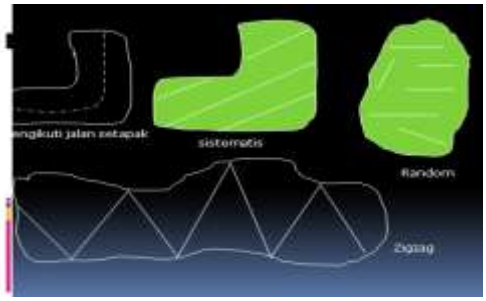
The existence of wildlife populations and biodiversity is an indicator of the quality of vegetation or forest habitats. Animals that serve as indicators generally are mammals, primates, birds and herpetofauna. Mammal is one of the vertebrate classes that have characteristic of *homoitherm* (warm-blooded). Special characteristics of mammals include having mammary glands, giving birth and have hair.

Data should be collected in mammal survey includes wildlife species observed or based on track and sound, number of individuals, gender (male or female), age groups (infants, young, or old), animal activity, utilization of space (location of wildlife forest strata), time of animals observed, and wildlife habitat condition.

4.2. Methods of Mammal Survey

4.2.1. Transect method

Transect method is a method of observing animals and large mammals, herbivores (buffalo, deer and primates) by creating a line or transect lines in selected sites (areas of PSP). The number and length of transects depends on the extent of area to be used as sample plot observations. Surveys are carried out by tracking transect or path and record the location, number and activity of wildlife encountered along the transect. The placement of these transects can be randomly or placed in areas of habitat which wildlife are found for inventory (based on preliminary results of the survey or the results of literature study). Transect placement can be done at random, systematic, stratification following the path or zigzag as shown in figure below.

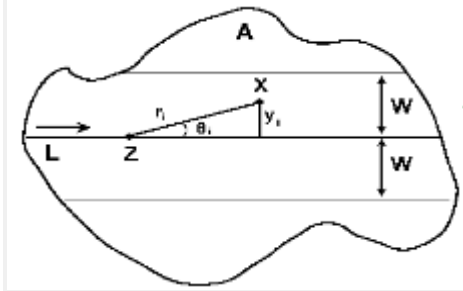


Stratification

Figure 1. Pattern of transects placement

4.2.1.1. Line transect method (Strip Transect).

This method is one way that is often used in data collection of the species and number of individual of wildlife. The length and width of the path used are adjusted to the topography and density of vegetation at the site of observation. Data are recorded from a direct encounter with wildlife mammals that are in transects. Observations are made on a single transect and repeated three times, namely in the period of morning (at 5:30-08:00 pm), afternoon (at 16.00 - 18.00 WIB) and evening (21.00 - 23.00). Observations are made by walking at a constant speed of approximately 25 meters / minute.



Note:
L: line transect
Z: the position of the observer
X: animals observed
$r_{i:}$ the distance of observation
W = width of the transect
θ_i = angle of observation
y_i = perpendicular distance ($y = r \sin \theta$)

Figure 2. Method of strip transect observation

- M**ethod of line transect**

Basically the line transect method is similar to the transect line. Method and procedure are also the same as the method of line transect. The fundamental differences that the line transect method does not determine the distance to the right and left, it must determine the distance between the animal and the observer (straight distance) or the distance of observation and it should determine the contact angle between the detected position of wildlife to the transect observation or observation angle.

The line transect method is carried out by observers who walked along the transect line and record any necessary data. By using this method, the width or extent of indirect observation location is specified. Observer can record every type of mammal that is observed in accordance with the visibility capabilities of each observer.

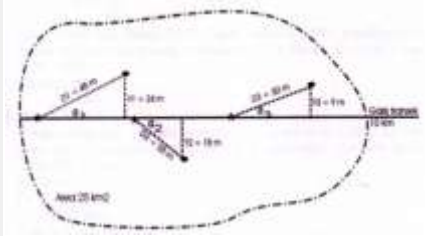
	Description: * The position of observer ○ Wildlife observed α Angle of view, the angle formed between the direction of the transect to the position of wildlife

Figure 3. Method of transect line observation

4.2.2. Method of Concentration count

Observations are carried out concentrated at a point predicted to have higher chance to encounter animals. For example, places of available food, water for drinking and sleeping locations. Observations can be performed on a hidden place so that does not interfere wildlife activity. This method can also be used to survey populations of herbivores, primates and carnivores.

4.2.3 Method of Center Point Count

This method is used to observe primates in groups that are difficult to know the number of group members in quick time. With this method the observer taking notes based on sound such as gibbons, leaf-eating monkeys and other primates. Stages of the observations are; to determine the distance that sound can be heard well, for gibbons between 750-1100 m, and leaf-eating monkeys 500 m.

Recording is done through individual sound in a group of primates that are in a circle with a radius of primate sounds and observer located at the center of the circle. Voice directions are known and recorded by using a compass. These samples are carried out at several points with distance of more than the diameter of the circle with sample area of each $\pi R^{2.}$

4.2.4, Method of Trapping

This method is used for the inventory of small mammals on the forest floor, like rats. Traps are mounted a deliberate (purposive) in particular habitats thought to be prime habitat for a variety of small mammals, such as caves, holes in trees, old hole in the ground, the former garbage and others like. This is meant to have greater chance of catching the animals.

Life traps are used so that the animal caught will not dead. If the animal trapped is difficult to be identified, these animals can be preserved for identification

purposes e.g. by LIPI. The use of live traps are also carried on research by the method of escape capture. Wildlife captured, tagged, released and captured again.

Figure 4. Life trap for small mammals

4.2.5 Method of Camera-trapping

The use of cameras in the inventory of animals is carried out in order to get the data without the presence of observers (e.g. tigers). The camera must have a good sensor (including *autofocus).* Cameras are left in locations suspected to be the area of wildlife home range or commonly crossed by animals to be inventoried

4.2.6. Rapid Assessment Method

This method is used to determine the type mammals found on site observations. Observations do not always being done on a special track or a special location. Observer simply makes records of species of mammals found, for example, during site survey, walking out of observation time, and so on. This method can be used to determine species of mammal that are on-site observation, but cannot be used to calculate population estimates.

4.3. Tricks on Mammal Observation and Supporting Data Collection

4.3.1. Observations tricks

- Recommended that observations are made by 3 observers (at least 1 person male) separately to avoid disturbance of wildlife, as well as the concentration of the observer.
- Find a place that is relatively open, canopy tree canopies that are not too dense, road tracks, forest edges, river banks, cliffs, near the rocks, to facilitate
  wildlife observation and discovery. Tree species such as *Ficus* sp, sp, *Syzigium, Garcinia* sp, are fruit tree species often visited by wildlife.
- Use dark colored clothing, not striking, or patterned, and do not use fragrance.
- Walk slowly and stop 10 minutes for observation. Do not move too much, do not make noise, and always careful
- If the animal is found, keep your distance, use naked eye to identify the species and if it is too far away, use binoculars
- Record all information obtained. Whether it's eaten fruit etc.. Asked to guide the species of trees where animals are found
- Match with the *field guide* during a break, if it takes long time to open the identification book, it can easily forget
- *Footprints* of mammals are probably easy to find in places such as muddy place and its surroundings, soft soil, or fine sandy. These places are commonly found near the river / creek, and puddles in the middle of the road.
- *Footprints* to be made from gypsum, may be cleaned as needed, provided it does not damage the original form of footprints. Gips that have hardened are coded back side, which refers to the note records (type, location of discovery, other information)
- Installation of traps should near the path trajectory of wildlife, near water sources, trails, near a large tree and with hollow. Bait can be applied to the outer side of the device, especially near the trap door.
- Secondary data can be supplemented by interviewing the villagers, guide, or forest ranger. To complement the data, direct interviews with villagers and show pictures on a field guide for species that present on site
- Not all of the villagers are good observers. Therefore, memory accuracy may vary. Hunters are usually good and reliable observers
- Avoid the estimates that make no sense, this is to avoid under or over estimate.
- Data is very important but safety is more important therefore to be careful while making observations.

4.3.2. Taking Supplementary Data

Interview

Collecting data is carried out by interviewing local people or field officers about the existence of species of mammals found on observation site. Description from officers or community can be verified by matching with guidebooks such as the introduction of species of mammals. Some examples of questions presented to respondents are:

- Knowledge of the existence of mammals and any species of mammal ever encountered by the respondents
- Knowledge of respondents about the species of mammals have ever been encountered, physical characteristics, behavior and activity patterns (diurnal, nocturnal, terrestrial, arboreal, and so on).
- The location where the encounter with mammals: Location of mammals often found, the presence of nests, the presence of marks (scratches, dirt), and movement patterns of mammals (relatively sedentary or migratory, relatively can be found at various locations or only at one location only).
- When was the last time mammals had been encountered.
- Knowledge of the abundance of mammals: for example, mammals are often found or not, whether the mammal is found in large quantities or small.

Some examples of questions to find out the traditional wisdom of the people associated with the conservation of mammals at the study site, namely;

- Are there frequent hunting of mammals, or is there a certain time according to customary
- Are mammals in the area often used by the community for ceremonial
- Are there myths associated with one or perhaps several species of mammals
- Do mammals as a source of feed, drugs, or pets.

Literature study

Literature studies are used as reference material to obtain preliminary data on the existence of various species of mammals on the location of the observations based on the results of previous studies. As a secondary data to make comparison with the results of research to be done, so it can be known whether there is a decrease or increase the number of species, as well as increasing and decreasing of population.

Printing tracks and identify the presence of wildlife

Tracks are all things left behind by wildlife that became the marker of the presence of wildlife in a particular habitat. Traces can be footprints, feeding signs, scratches, mudding places, hair and feathers, nests, the smell left behind, and so on. Trail left by mammals may help to determine the presence of mammal species in one place even though these mammals are not found directly. Traces found should be recorded to help strengthen the identification. How to make a record of trace species of mammals:

- Feeding signs

Marks left by animals eating a fruit, a former bite, bits of food remains can be taken and preserved for further identification purposes. Bites and food left can be preserved by soaking wet the remains food in alcohol (70%). Before preserved it can be photographed (shape of fruit, bite marks, color pattern, etc.) by using a size comparison (ruler).

- Scratches and mudding pools

Scratches also photographed in detail by using a size comparison. For capturing images of mudding pool, if it is big enough, the comparison may use an adult with attention to photo such as type, soil conditions, former trail, food scraps, feathers and so on.

- Former hair, feathers, nests, and smell.

Former hair, feathers, and nests that have been used are also taken and placed in a plastic bag or airtight container, and it was previously photographed using a size comparison. If the odor is left behind this may be asked to the field guide.

- Footprint

How to print footprints using plaster casts is by stirring with water until the dough forms a smooth and not too watery (textured like toothpaste). The batter is poured on the surface of the footprint until flat with the surface of the ground beside the footprint. The footprints were previously cleaned from dirt such as leaves, gravel, soil and so on. The printed footprints are removed after the plaster mold is quite hard (15-30 minutes). Label of identification is made by stating the time (day, month, year), location / forest block, wildlife species (if known); the feet where the trail is printed (if known), and footprint imprint.

4.4. Data Analysis:

4.4.1. Estimating population density and population

The strip and line transect

Population density or abundance

$$\hat{D} = \frac{n}{2Lw}$$

where:

D = Density of population (number of individuals / ha)
n = number of animals observed
L = total length of transects
w = width of the transect

Estimation / assessment of the population

- Using the average distance to the observer (D),

$$\mathbf{P_D = \frac{A\,xn}{2\,LW_D}}$$

Where:
Pd = Number of population
n = number of animals observed
L = total length of transects
w = width of the transect
A = area of region

- Using the average distance to the nearest (Y),

$$\mathbf{P\,Y = \frac{A.\,n}{2\,LW\,Y}}$$

Where:
P Y = Number of population
n = number of animals observed
L = total length of transects
w = width of the transect
A = area of region

Calculation of Concentration Count:

- to determine the density or abundance of populations:

D = Σ y location of research
L area involved
where:
D = density (population / ha)
y = the observed wildlife
L = area

- to determine the number of population:

P = n Σ Xi

Description:
P = Population
Xi = the number of individuals found in the observations to - i (individual)
n = number of repeated observations

4.4.2. Animal biodiversity

Diversity of wildlife species are known by using the Shannon biodiversity index, namely:

$$H' = -\sum \frac{ni}{No} \ln \frac{ni}{No}$$

Where:
H '= index of biodiversity (Shannon and Weaver)
ni = number of individuals in one species
N 0 = number of individuals in one community
Frequency of animals

The frequency of the existence of the species at a site is estimated to calculate the relative frequency (%):

$$\text{Relative Frequency (FR, \%)} = \frac{\text{Plots a species are found}}{\text{Total plots}} x\ 100\%$$

5. BIRD SURVEY

5.1 General Information

Birds are divided into two groups according to the time of activity, which is diurnal (active during the day and most birds are active during the day, usually at certain hours the birds do break), and nocturnal (active at night), usually in groups of Strigiform (owl). The characteristics of birds : Most of the body is covered by feathers, there are two pairs of limbs, one pair anterior to the wing, and 1 pair posterior to the foot for walking / paw (Galliformes & Ciconiiformes), scratching (Falconiformes & Strigiform) or swim with membrane on the toes (Pelecaniformes & Anseriiformes). Each foot has four toes, delicate frame, strong, formed of true bone. The mouth is a beak (the substance of horn), no teeth, and a flexible neck.

General body shape of birds in both ends are sharp to facilitate the birds when flying through the air, or when swimming through the water. The color of bird feathers mixed. The birds of the dry areas tend to be more pale color, whereas in the moist areas darker. In general, color is shinier for male birds than female birds. Wings in birds are generally used to fly, and its tail to steer and balance the body.

Observations of birds made in the open is known as *bird watching.* Aspects of the observation starting from the identification of species based on morphology, identification by voice, behavior, population, distribution, etc.. Things that must be considered when conducting *bird watching:*

- Equipment: Map of the region, the tally sheet, record books, stationery, guidebooks introduction of bird species (Field Guide), binoculars (monocular), range finder, the meter roll, compass, GPS, cameras and tape recorders. The most prioritized equipment if there is not entirely available is the tally sheet, stationery, and compass.
- Bird observation method is carried out by tiptoeing, looking for a good place to hide, using the attribute / clothes that are not flashy, does not conduct activities that may disturb the birds, do not release a binoculars until the description of bird species can be known for identification and sketching the seen birds and describe the characteristics
- Notes usually include: (name of observer, time and date of observation, observation location, type of habitat, weather, number of birds found, activity, distance to the bird watchers, and so on, depending on the research conducted)

5.2. Bird Population Survey Methods

Bird survey methods in principle are the same as the method for surveys of mammals including, line transect, strip transect, and methods of concentration count. Specific methods are performed for bird's survey:

5.2.1. Method of Mapping

Mapping method is an effective way to calculate the size of bird populations and measuring its cruising areas. Mapping can be implemented for the type of bird that has a territory and a clear breeding season. Observations are carried out repeatedly every morning on the location of bird territories. Usually it is done on an individual breeding season when birds are on a limited location, actively defend their territory and spend time around the nest. If the exact location can be plotted on a map, it is possible to calculate the number of pairs of birds of each species present.

Application of this method is an intensive field work and data analysis. The observations can produce a detailed map of the distribution and size of territory and can be used to understand the habitat conditions. Also produces a more consistent calculation, and is not influenced by time of observation. Some disadvantages of this method, requires a quality map for the study area, it takes up to 10 times the observations, covers a relatively small area (1-4 km2), requires high skill of the observer to identify and record the birds, difficulties in the interpretation of the results and usually effective for temperate regions and are rarely applied in the tropics.

5.2.2. The point transect method

The point transect method is performed by walking on a transect, mark and record all bird species found during a predetermined period of time (10 minutes), before moving to the next point. Transect point different from the line transect, where the observer walked along the transect line and stop at points that have been set, allow time for birds to be observed and record all birds seen and heard at a given time ranging between 2-20 minutes.

5.3. Data Analysis

Analysis of data survey on bird survey can be performed using methods as for mammals.

6. SURVEY OF HERPERTOFAUNA (REPTILE AND FROGS/ AMPHIBIAN)

6.1. General Information

Fauna that belong to herpertofauna include amphibian (including frogs, salamanders, etc.), and reptiles (including snakes, lizards, turtles, and crocodiles). In general there are two methods used for the survey namely the direct method and indirect methods.. Direct sampling for herpetofauna include observations of animals that exist in the sample sites. While the sampling is done indirectly by obtaining information without seeing the animal species directly, for example through the trail or sound

6.2. Survey Methods

6.2.1. Road cruising

By walking or moving the vehicle at the location of observation and record all herpetofauna encountered. This method cannot be done at all locations and only for areas that have path and can be traversed by vehicles.

The weaknesses of this method include, it takes relatively long time, generates limited data, only able to verify the species that migrate by crossing the road, the sample is bias because only limited areas that have road, sometimes dangerous for observers, especially in crowded routes and it effectives only at locations with available road.

6.2.2. Visual Encounter Surveys *(VES)*

Surveys are carried out in a certain area or habitat for a predetermined period of time to look for wildlife. VES is used to determine the species richness of a region, compiled a list of the types and estimate the relative abundance of species. This technique is not the appropriate method for determining the density because not all individuals in that area can be seen in the survey. VES can be done along the transects, along streams, around ponds and others.

6.2.3. Squares Sampling

This method is done by placing various series of squares at random at the specified location within a habitat and carefully look for herpetofauna in the square. Usually it is used to study the forest floor herpetofauna contained or the species that inhabit the area around the river. This method is less effective to be

done on the habitat that has a dense closure of the land and steep locations because of the difficulty of putting the squares randomly

6.2.4. Line Transect

Line transect can be used for observations of herpetofauna on a variety of habitats. Some of the herpetofauna often have different responses to the environmental *gradient* so that the transect line to identify change herpetofauna populations. Transect lines were randomly placed (e.g., length 200 m) in a habitat. Several transects*(multiple transects)* are generally better than a single transect. The length of each transect and the number of sampling points at each location will depend on the purpose of the survey and site conditions.

6.2.5. Straight line method usual pitfall traps and drift fence

Pitfall trapping is one of the most widely used method to retrieve data of herpetofauna. Generally these methods use a box or a round container that is stored under water or in soil with the top of the container located on the surface. The size and shape of the container generally varies depending on the species to be trapped. *Pitfall trapping* is generally combined with the *drift fence. Drift fence* is a short fence measuring 0.5 to 1 meter made of netting or plastic and are useful for guiding herpetofauna to enter into the *pitfall trap.* its length is usually between 5-15 m and every few meters *the pitfall traps* will be installed.

6.3. Data Analysis

The data taken in the research or field surveys can be either quantitative or qualitative data. The usefulness of this data depends upon various factors including: experimental design or sampling procedure used, the selection of tools and the ability to tools, and environmental conditions. Statistical analysis is used to help understand the data obtained. Statistical analysis of the simplest is a description of the analysis

Commonly used index is the index of biodiversity (Shannon-Weaver index). This index is used to measure the characteristics of the community at a location at a particular time

$$H' = -\sum \frac{ni}{No} \ln \frac{ni}{No}$$

Where:
H '= index of biodiversity (Shannon and Weaver)
ni = number of individuals in one species
N_0 = number of individuals in one community

Value of evenness (evenness) is used with the following formula:

E = H '/ ln S

where
E = evenness index type
H '= Shannon-index Wienner
S = number of species

7. INSECTS SURVEY

7.1. General Information

In contrast to vertebrates, insects are very diverse, so the identification of species is difficult. Entomologist usually first classified insects into orders. Primary orders of insects are Diptera (flies), Coleoptera (beetles), Hemiptera (bugs), homoptera (grasshopers), hymenoptera (ants), lepidoptera (butterflies) and isoptera (termites).

Information of insects available in particular place important to know, because the insects that can live in different habitats or environments can be used as indicators of different environmental conditions. For example the presence of insects can be used as indicators of primary forest, burned secondary forest, swamps, savannah, and so on. Insects can also be a sensitive bio-indicators that can reveal aspects of the environment that are not visible to the eye. To compare conditions in different areas is very important to use the same method in both locations.

7.2. Insect Survey Methods

7.2.1. Light Traps

This method is widely used to inventory of insects such as moths attracted to light such as moths. The results of the inventory can be used as general indicators of moth biodiversity. Locations with more number of moths will have a better biodiversity.

Moths are inventoried by collecting at the site survey. Usually located on the hill or the side of the river. This location is mounted with some white screens hung vertically in order to be detected by the moth. At night, lights and

ultraviolet lights are installed so that moths are attracted by a white sheet, approaching and trapped by ultraviolet light.

7.2.2. Sticky Traps

Sticky traps are papers with certain sizes and covered by a sticky material. When an insect touches this paper, it will stuck and observations can be made for the trapped insects.

7.2.3. Pitfall Traps

Pitfall traps is one of many methods used to obtain data of insects that exist on the surface of soil or litter. This method is also used for hepertofauna.

7.2.4. Flight Interceptors

There are several types of traps flying insects. Commonly used is mosquito netting with 1.5 meter length and 35 cm height and placed on the ground. Under this screen, a container with detergent water is placed to catch the insects. Some flying insects will hit the screen and fall into a container of detergent water and drowned. This method certainly cannot represent all the insects in the area, but it can provide a standard that can be repeated

8. TURTLE SURVEY

8.1. General Information

MBNP has beaches that become the landing beaches for sea turtles to lay their eggs. UPKP (Turtle Conservation Management Unit) has been formed with the task of making observations of sea turtles. Observation of turtles is a series of activities observing sea turtles landed with activities include; monitoring the sea turtles landing track, safeguarding turtle laying eggs activity, the identification of sea turtle species and habitats of landing as well as the relocation of turtle eggs. Turtle observations are conducted at night beginning at 18 to 5:00 pm by officers of UPKP. MBNP has developed SOP for sea turtle observation.

CLOSURE

Scientific method that can be used as an SOP (Standard Operating Procedure) is necessary for the purpose of monitoring REDD + activities in conservation areas, particularly to support the accuracy of the results of biodiversity surveys. Biodiversity is an additional benefit which is also the objective of REDD + activities as required by some voluntary standards such as the CCBA. Moreover, with the availability of SOP, the community can be involved in biodiversity surveys to support REDD + programs. Involvement of community to access the biodiversity is expected and needed to increase public awareness and to more actively participate in REDD + activities. This will ultimately provide benefit to the public, to the environment and biodiversity conservation. This SOP will continue to be improved along with experience from the implementation of biodiversity survey in MBNP, as a pilot project of REDD + in Indonesia.

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APPENDIX

STANDARD OPERATING PROCEDURE (SOP) FOR SURVEY OF BIODIVERSITY IN CONSERVATION AREA

1. SOP FOR VEGETATION SURVEY

1.1. General Information

Analysis is carried out by dividing the vegetation into the level of vegetation growth, according to the following criteria:

- Seedlings: seedlings with a height of not more than 1.5 m
- Saplings: seedlings that have grown by more than 1.5 m height and trunk diameter of less than 10 cm
- Pole: woody plants with stem diameters between 10 cm - 20 cm
- Tree: woody plants with a trunk diameter of more than 20 cm

Analysis of natural forest vegetation is carried out to determine the composition and structure of forest vegetation. Analysis is generally performed by the method of transect plots. Analysis is conducted on the seedlings, saplings, poles and trees.

1.2. Equipment

- GPS
- Maps of survey or vegetation scale 1 : 20.000
- Compass,
- Tape measure,
- Height gauges (haga or hypso meters),
- Ropes,
- Poles
- Machettes
- Herbarium equipment,
- Documentation
- Tally sheet
- Stationery

1.2. Procedures

1. Determine the location of vegetation analysis based on existing maps of zones of National Park or HCVF area
2. Determine the location of vegetation analysis in the filed using GPS
3. Prepare observation transect in thr field by crossing contour lines

4. Determine starting point, length and distance of transect that depend on sampling intensity based on extent of survey area and availability of resources.
5. Set plots on observation transects as follows (Figure 1):

- 2 x 2 m plots are used to analyze seedlings and undergrowth (A)
- 5 x 5 m plots are used to analyze saplings (B)
- 10 x 10 m plots are used to analyze poles (C)
- 20 x 20 m plots are used to analyze tree (D)

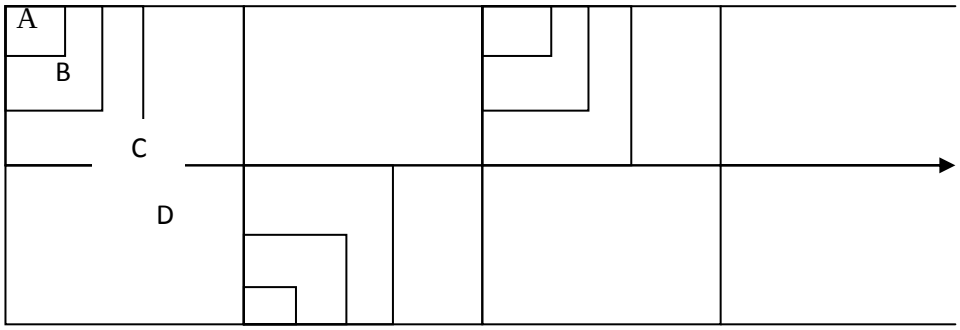

Figure 1. Design of transect for vegetation analysis

6. Conduct measurements of height, diameter at breast height and the identification of species of trees on 20 x 20 m plots.
7. Conduct measurements of height, diameter at breast height and the identification of species of poles on 10 x 10 m plots.
8. Make record and identification of saplings on 5 x 5 plots
9. Make record and identification of seedlings and undergrowth on 5 x 5 plots
10. Measure diameter at breast height (DBH) or 1.3 m using a diameter tape or regular tape and support of diameter stick
11. Measure height by using a tool *(clinometer),* or hagameter
12. Make record of data using tally sheets as follows:

Tally Sheet for Vegetation Analysis for Seedlings and saplings
Date:
Location:
Teams:
Coordinates:
Plot size

No.	Name of species	Local Name	Number of Individuals	Information

Tally Sheet for Vegetation Analysis for trees and poles
Date:
Location:
Teams:
Coordinates:
Plot size:

No.	Name of species/local name	Diameter (m)	Height (m)	Information

13. Identify the species of an unknown in natural forests through the collection of herbarium samples. Data that is important to note are: the location (administrative and geography), habitat description, latitude and longitude, altitude above sea level, the name and date of collection, the nature of tree properties such as skin, gums, etc. are recorded in the tally sheet and trees that have been recorded are numbered / tags from aluminum for the purposes of monitoring in the future.
14. Samples of herbarium are identified in the laboratory such as LIPI or Center for Conservation and Rehabilitation Research and Development (Puskonser).
15. Perform data analysis

2. SOP FOR WILDLIFE SURVEY (MAMMALS)

2.1. General Information

Special characteristics of mammals include having mammary glands, giving birth and have hair. Based on the size, the mammals are divided into two, namely large mammals that have a measure of adult body weight of > 5 kg and small mammals with the size of an adult body weight of < 5 kg. Examples of large mammals, including deer, tigers, and buffaloes, while small mammals, including mice, squirrels, and bats.

2.2. Equipment

- Field guide or manual field
- Tally sheets and stationery
- Compass (to measure the direction and angle of the animals observed)
- Binoculars (to observe wildlife from a distance)
- Equipment trap or net (to capture the animal)
- Gypsum (if the animal footprints want to be printed)
- Band (as a marker of observation points or animal locations)
- GPS (to determine the point in digital form)
- Hygrometer (to measure temperature and humidity)
- Camera (to take pictures, animals and their habitat)

2.3. Procedures

1. Determine the method to be used, the method of strip transect and transect line for large mammals such as, buffalo, deer and primates, the concentration point method on animals that tend to gather such as on the source of water, trapping method for small mammals, and camera trapping for animals which are difficult to be observed like tiger or leopard.

Strip and line transect method

2. Placing a transect randomly or it is placed on habitat where wildlife to be inventories are commonly found (result of survey or reference study). Transect placement can be done at random, systematic, with stratification follows the path or zigzag
3. Determine the length and width of the observation transect Width of the transect is affected by vegetation cover or visibility of someone in the field and species of observed wildlife. For instance, width of observation transect for arboreal primates is 50 m to the left and 50 m to the right of transect with length of 3-5 km.

4. Determine the number of parallel transect lines in systematic pattern or randomly by crossing contour lines and illustrate the location of each transect on the map. As an initial observation point, it can be a road or the existing markers and make a mark at each starting point the observation path (striking color ribbon, zinc, poles, etc.)
5. Determine the starting and ending time of observations simultaneously.
6. Determine the direction of trajectory observations by using a compass (so that each team does not collide or intersect). It is recommended that the trajectory crosses the contour and observations by walking quietly and slowly along the transect that has been created.
7. Record data and information in the tally sheets for;

    - ✓ Type of animals
    - ✓ The number of individual animals,
    - ✓ Sex (if known)
    - ✓ Number of individuals based on age class (adult, teen, child)
    - ✓ Plot position of animals on a simple map (use millimeters block).
    - ✓ Description: found time (hours, minutes), social features of solitary / group, directly or indirectly encounter (sound or voice), simply describe the condition of wildlife habitat where they are discovered.

    Notes:

    - ✓ Data are recorded from a direct encounter with wildlife mammals that are in transects. This method is one way that is often used in data collection of the species and number of individual of wildlife. The length and width of the path used are adjusted to the topography and density of vegetation at the site of observation.
    - ✓ Observations are made on a single transect and repeated three times, namely in the period of morning (at 5:30-08:00 pm), afternoon (at 16.00 - 18.00 WIB) and evening (21.00 - 23.00).
    - ✓ Observations are made by walking at a constant speed of approximately 25 meters / minute.
    - ✓ Basically the line transect method is similar to the transect line. Method and procedure are also the same as the method of line transect. The fundamental differences are:

        - o The line transect method does not determine the distance to the right and left
        - o The line transect method must determine the distance between the animal and the observer (straight distance) or the distance of observation.

- The line transect method should determine the contact angle between the detected position of wildlife to the transect observation or observation angle.

Method of Concentration count

- Conduct field observations or ask the staff about species of wildlife that is often found, gathered in one place and location of the gathering (pasture, water sources or *feeding ground).*
- Determine points of observation as well as starting and ending time of observation. Timing observations have to consider the behavior and activities of every species of wildlife and determine coverage of concentration area to estimate carrying capacity of the area.
- Record all wildlife encountered by sex and age level, social relations in the sub-groups, general condition of the area of concentration, such as vegetation, water resources, food resources and others on tally sheets.
- Observations are carried out concentrated at a point predicted to have higher chance to encounter animals. For example, places of available food, water for drinking and sleeping locations. Observations can be performed on a hidden place so that does not interfere wildlife activity.

Notes:

- ✓ This method can also be used to survey populations of herbivores, primates and carnivores.
- ✓ Data and information recorded: (Name of species, number of individuals, number of individuals in the group, social structure (if any), sex (if known), and the area of the location of the observations to estimate population density

Method of Center Point Count

1. This method is used to observe primates in groups that are difficult to know the number of group members in quick time.
2. With this method the observer taking notes based on sound such as gibbons, leaf-eating monkeys and other primates.
3. Stages of the observations are; to determine the distance that sound can be heard well, for gibbons between 750-1100 m, and leaf-eating monkeys 500 m.
4. Recording is done through individual sound in a group of primates that are in a circle with a radius of primate sounds and observer located at the center of the circle.

5. Voice directions are known and recorded by using a compass. These samples are carried out at several points with distance of more than the diameter of the circle with sample area of each $\pi R^{2.}$

Method of Trapping

1. This method is used for the inventory of small mammals on the forest floor, like rats.
2. Traps are mounted a deliberate (purposive) in particular habitats thought to be prime habitat for a variety of small mammals, such as caves, holes in trees, old hole in the ground, the former garbage and others like. This is meant to have greater chance of catching the animals.
3. Life traps are used so that the animal caught will not dead.
4. If the animal trapped is difficult to be identified, these animals can be preserved for identification purposes e.g. by LIPI.
5. The use of live traps are also carried on research by the method of escape capture. Wildlife captured, tagged, released and captured again.

Method of Camera-trapping

1. The use of cameras in the inventory of animals is carried out in order to get the data without the presence of observers (e.g. tigers).
2. The camera must have a good sensor (including autofocus). Also need to consider types of batteries to be installed in a camera trap for long-term observation (could be a whole month).
3. Activities in the field include: Leaving the camera in locations suspected to be the area of wildlife home range or commonly crossed by animals to be inventoried (note of the security of cameras from theft)
4. Set the date and hour of shooting, so that each picture will have information about the time when animals through the lane and caught by a different camera. Moreover, the use of camera traps can provide information the home range of animals based on information of same individual captured by a camera trap.
5. Carry out the experiment by installing a camera trap at some height from ground level. This is to determine the optimal height of position of the camera, to get a good picture (head and body can be recorded). Also measured the distance between tracks of animals with a camera trap.

Rapid Assessment Method

1. This method is used to determine the type mammals found on site observations.
2. Observations are not always be done on a special track or a special location.
3. Observer simply makes records of species of mammals found, for example, during site survey, walking out of observation time, and so on.
4. This method can be used to determine species of mammal that are on-site observation, but cannot be used to calculate population estimates.

3. SOP FOR BIRD SURVEY

3.1. General Information

Birds are divided into two groups according to the time of activity, which is diurnal (active during the day and most birds are active during the day, usually at certain hours the birds do break), and nocturnal (active at night), usually in groups of Strigiformes (owl). Observations of birds made in the open is known as *bird watching.* Aspects of the observation starting from the identification of species based on morphology, identification by voice, behavior, population, distribution, etc.

Bird survey methods in principle is the same as the method of surveys for mammals including, strip transect, line transect and method of concentration count.

3.2. Equipment:

Map of the region, the tally sheet, record books, stationery, guidebooks introduction of bird species (Field Guide), binoculars (monocular), range finder, the meter roll, compass, GPS, cameras and tape recorders. The most prioritized equipment if there is not entirely available is the tally sheet, stationery, and compass.

3.3. Procedures

Bird survey procedure similar to mammal observations.

Note:
Mapping and point transect method are other methods that can be done for bird survey.

Mapping method

1. Mapping method is an effective way to calculate the size of bird populations and measuring its cruising areas. Mapping can be implemented for the type of bird that has a territory and a clear breeding season.
2. Observations are carried out repeatedly every morning on the location of bird territories. Usually it is done on an individual breeding season when birds are on a limited location, actively defend their territory and spend time around the nest.
3. If the exact location can be plotted on a map, it is possible to calculate the number of pairs of birds of each species present.

4. Application of this method is an intensive field work and data analysis. The observations can produce a detailed map of the distribution and size of territory and can be used to understand the habitat conditions. Also produces a more consistent calculation, and is not influenced by time of observation.
5. Some disadvantages of this method:
   - ✓ Requires a quality map for the study area.
   - ✓ It takes up to 10 times the observations.
   - ✓ Covers a relatively small area (1-4 km2)
   - ✓ Requires high skill of the observer to identify and record the birds.
   - ✓ Difficulties in the interpretation of the results
   - ✓ Usually effective for temperate regions and are rarely applied in the tropics.

The point transect method

1. The point transect method is performed by walking on a transect, mark and record all bird species found during a predetermined period of time (10 minutes), before moving to the next point.
2. Transect point different from the line transect, where the observer walked along the transect line and stop at points that have been set, allow time for birds to be observed and record all birds seen and heard at a given time ranging between 2-20 minutes.
3. Some important things to consider in the point method are:
   - ✓ Walking speed according to the recommendations
   - ✓ The applicability of the full distance estimates (from the recorder and the bird is visible or audible) or line spacing intervals (e.g. band width of lines 0-25 m and> 25 m)
   - ✓ Both methods require the skills and expertise of the observer because the majority of contacts and identification based on the chirping or noise.
   - ✓ The data included: (name of observer, time and date of observation, observation location, type of habitat and vegetation, weather, the number of birds found, activity, distance to the bird watchers, and so on, depending on the research conducted)

4. SOP FOR HERPERTOFAUNA SURVEY (REPTILE AND FROGS/ AMPHIBIAN)

4.1. General Information

Fauna that belong to herpertofauna include amphibian (including frogs, salamanders, etc.), and reptiles (including snakes, lizards, turtles, and crocodiles). In general there are two methods used for the survey namely the direct method and indirect methods. Direct sampling for herpetofauna include observations of animals that exist in the sample sites. While the sampling is done indirectly by obtaining information without seeing the animal species directly, for example through the trail or sound

4.2. Equipment

Equipment used to survey herpertofauna are: GPS, compass, flashlight / head-lamp, plastic / sacks, permanent markers, binoculars, watches, calipers, tape meter, digital scales / spring, cameras and herpetofauna identification Book.

4.3. Procedures

Depending on survey objectives and available resources, herpertofauna survey procedures can be implemented by several methods as follows

Road cruising method

1. Determine path / road to be traversed using a vehicle or by walking.
2. Walking or moving at low speed using vehicles on-site observations and record all herpetofauna encountered.

Notes:

- ✓ Searches can be done at random, opportunistic (if there is a chance), or systematic in time and area of interest.
- ✓ Search during the day will find the existence of these animals that are active during daytime (diurnal), whereas at night, which is conducted from sunset until about 2-3 hours later will find an active night animal (nocturnal).
- ✓ The weaknesses of this method are:
  - o Take relatively long time
  - o Generates limited data
  - o Only able to verify the species that migrate by crossing the road
  - o The sample is bias because only limited areas that have road

- Sometimes dangerous for observers, especially in crowded routes
- Effective only at locations with available road.

Visual Encounter Surveys (VES)

1. Determine location of observation
2. Observing all microhabitats encountered by exploring the forests
3. Looking for herpetofauna of the above vegetation and hiding behind fallen logs, rocks or litter.
4. Determine the search time, such as a total of 2 hours per person per observation.
5. Make Record for each individual: species, substrate, habitat, activity, position, time, morphometric, weight and sex.

Notes:

- ✓ Surveys are carried out in a certain area or habitat for a predetermined period of time to look for wildlife.
- ✓ VES is used to determine the species richness of a region, compiled a list of the types and estimate the relative abundance of species.
- ✓ This technique is not the appropriate method for determining the density because not all individuals in that area can be seen in the survey. VES can be done along the transects, along streams, around ponds and others.

Squares Sampling

- Determining the location of the square before the survey. Generally it is carried out systematically for example based on the shortest distance from the river up towards the forests away from the river, but sampling should be taken randomly
- Setting the number of squares, for example, 80 squares that will be checked for 4 days, day and night (every day consists of 20 squares).
- Marking the location of the square with a flag with the square code.
- Sampled by stratified sampling.
- When the square is made for litter herpetofauna observations, it is advisable to use a tool (drain, sticks, gloves) when moving the litter to prevent being bitten by animals that exist in the litter.
- Creating a quadratic variation in different microhabitats, such as the square of 2 x 2 m to the mainland and the square of the volume on the banks of the pond. The size square of the volume used is 1 x 1 x 1 $m^{3.}$ Before start doing this method, check the depth of the pool, check the locations that may be hazardous (e.g. soft mud)
- The recommended data taken for each square include:
  - ✓ Species and number of species found

- ✓ Date and time of sampling begins and ends,
- ✓ General weather conditions (temperature and relative humidity),
- ✓ Habitat condition (vegetation type, degree of slope, canopy closure, litter coverage, closure by herbs and coverage by rocks and felling timber.

Notes:
This method is done by placing various series of squares at random at the specified location within a habitat and carefully look for herpetofauna in the square. Usually it is used to study the forest floor herpetofauna contained or the species that inhabit the area around the river. This method is less effective to be done on the habitat that has a dense closure of the land and steep locations because of the difficulty of putting the squares randomly

Line Transect

1. Determine survey location
2. Determine the number of line transect, transect length (eg, 200 m) and the number of sampling points that will depend on objective of survey and site conditions.
3. Place of line transect in the field randomely or systematically.

Notes:
Line transect can be used for observations of herpetofauna on a variety of habitats. Some of the herpetofauna often have different responses to the environmental *gradient* so that the transect line to identify change herpetofauna populations.

Method of straight line drift fence and pitfall traps

1. Determine location of samples
2. Placing *Pitfall traps* in parallel line with design adjusted to habitat conditions.
3. Closing or give pieces of wood / twigs sticking out so that animals can get out of the trap when not in use.
4. Opening the trap at night and check in the morning.
5. Protect from direct sun trap so that if it does not have time to check in the morning, animals trapped in it do not die because of overheating.
6. Prevent deaths due to trapping of animals such as drowning, dehydration, predation.

Notes:

- ✓ Pitfall trapping is one of the most widely used method to retrieve data of herpetofauna. Generally these methods use a box or a round container that is stored under water or in soil with the top of the container located on the surface. The size and shape of the container generally varies depending on the species to be trapped. *Pitfall trapping* is generally combined with the *drift fence.*
- ✓ *Drift fence* is a short fence measuring 0.5 to 1 meter made of netting or plastic and are useful for guiding herpetofauna to enter into the *pitfall trap*. its length is usually between 5-15 m and every few meters *the pitfall traps* will be installed. Traps and steering fences only able to capture some kinds of herpetofauna only. Climber frogs or strong jumpers are more difficult to catch using this method compared to terrestrial species. That should keep in mind that to make this trap required time, effort and considerable expense.
- ✓ When the survey is carried out in the short term, making a trap may not be effective. This method is suitable for long-term monitoring because the holes can be re-used when needed.
- ✓ The data taken in the research or field surveys can be either quantitative or qualitative data. The usefulness of this data depends upon various factors including: experimental design or sampling procedure used, the selection of tools and the ability to tools, and environmental conditions. Statistical analysis is used to help understand the data obtained. Statistical analysis of the simplest is a description of the analysis.
- ✓ Commonly used index is the index of biodiversity (Shannon-Weaver index) and evenness index.

5. SOP FOR INSECT SURVEY

5.1. General Information

In contrast to vertebrates, insects are very diverse, so the identification of species is difficult. Entomologist usually first classified insects into orders. Primary orders of insects are Diptera (flies), Coleoptera (beetles), Hemiptera (bugs), homoptera (grasshopers), hymenoptera (ants), lepidoptera (butterflies) and isoptera (termites).

Information of insects available in particular place important to know, because the insects that can live in different habitats or environments can be used as indicators of different environmental conditions. For example the presence of insects can be used as indicators of primary forest, burned secondary forest, swamps, savannahs, and so on. Insects can also be a sensitive bio-indicators that can reveal aspects of the environment that are not visible to the eye. To compare conditions in different areas is very important to use the same method in both locations.

1.3. Equipment

Depend on method used and insect to be surveyed.

1.4. Procedures

Using Light Traps

1. Determine the location of traps, usually located on the hill or the side of the river.
2. Install light trap consisting of white screens hung vertically and light or ultra violet light.
3. Counting and making record of trapped insects

Notes:

- ✓ This method is widely used to inventory of insects such as moths attracted to light such as moths.
- ✓ The results of the inventory can be used as general indicators of moth biodiversity. Locations with more number of moths will have a better biodiversity.

Using Sticky Traps

1. Determine where to place the sticky traps in places that flying insects are often found
2. Place the sticky traps
3. Calculate and record the types of insects that are trapped

Notes:

- ✓ Sticky traps are papers with certain sizes and covered by a sticky material. When an insect touches this paper, it will stuck and observations can be made for the trapped insects.
- ✓ Sticky traps can be either bright colors to attract insects that fly in the daytime. It can also be given a scent that may attract insects or placed near the bait or flowers.
- ✓ Sticky paper sizes can be standardized so that the units represent standard sampling. Solvent is required, so that the insects caught can be released for preparation of specimens.

Methods usual pitfall traps

1. Determine where to place the *pitfall traps*
2. Placing *Pitfall traps* in line with design adapted to the habitat conditions.
3. Opening the trap at night and check in the morning.

Notes:

Pitfall trapping is one of the methods used to obtain data of insects that exist on the surface of soil or litter.

Method of flight Interceptors

1. Determine where to place the flight Interceptors *traps*
2. Determine the type of trap (usually mosquito netting 1.5-meter length and 35 cm height above the soil
3. Put container with water detergent to catch insects and sink
4. Some flying insects will hit the screen and fall into a container of detergent water and drowned
5. Open the trap at night and check in the morning.

Note:

This method certainly can not represent all the insects in the area, but can provide a standard that can be replicated

6. SOP FOR TURTLE SURVEY

6.1. General Information

MBNP has beaches that become the landing beaches for sea turtles to lay their eggs. UPKP (Turtle Conservation Management Unit) has been formed with the task of making observations of sea turtles. Observation of turtles is a series of activities observing sea turtles landed with activities include; monitoring the sea turtles landing track, safeguarding turtle laying eggs activity, the identification of sea turtle species and habitats of landing as well as the relocation of turtle eggs. Turtle observations are conducted at night beginning at 18 to 5:00 pm by officers of UPKP.

6.2. Standard Equipment for Turtle Observation

- Wearing UPKP uniform
- Tool bag
- Tag and tag applicator
- Bucket or bag to store eggs
- Long iron stick (120 cm)
- Stationery (tally sheet, ball point),
- HT, communication tool and camera
- Personal equipment (tents, guns, raincoats, etc.)
- Thermometer, hygrometer, soil pH.

6.3. Procedures

Monitoring of Turtle Landing Tracks

- Four patrol officers of UPKP carry out monitoring tracks of turtles by walking along the landing beach ± 3-4 km, divided into two groups.
- Where the trail of turtle is found, locations of turtles are observed by following turtle's tracks to ensure their existence.
- Conduct intensive communication with other groups.

Identifying the Locations of Turtle laying eggs

- Where the turtles are laying eggs, an officer UPKP make observations from a certain distance
- Other officers make observations in the vicinity of sea turtles and take action if it is found activities that can disturb the nesting of sea turtles
- If confirmed there is no interference, another officer may continue the activities of another observation of turtle trail

- Conduct intensive communication with other groups

Turtle Identification Activity

- Identification is done after turtle nesting activity is finished
- Officer conduct shell measurements, installation of tags and make record (type, location / sector, and other supporting data)
- Documenting the identification

Relocation of Sea Turtle Eggs

- Turtle egg relocation is performed to support the success of turtles breeding by moving the turtle eggs to a safer place.
- Officers have to ensure the existence of turtle eggs by using egg detection equipment *(egg detector)*
- Officers perform excavation and taking of sea turtle eggs carefully
- Officers make calculations, make record, and relocate turtle eggs uses relocation bag
- Relocation of turtle eggs to the hatchery should be done in less than 4 hours

Activities of Population Management

Observations of turtle

- Observation is made by keeping safe distance when encountering sea turtles; the distance is about 20 m for Green Sea Turtle, 15 m for Lekang Turtle and Hawksbill, Turtle and 25 m for Leatherback Turtles
- Conduct periodic observations for every 15 minutes with a position behind the turtle, distance of 1-3 m with caution by not turning on the light, and not making a noise.
- When turtles laying eggs are found, the officer give the sign (marker) and installed in the hole of eggs (for easy retrieval of eggs)
- The action taken when encounter nest of turtle eggs (the sea turtles have gone to the sea), marking the location of the sector, habitat, vegetation.

Techniques of Taking the Turtle Eggs

- Digging the hole of eggs
- Taking the eggs carefully (not bounced)
- To take the eggs of sea turtle, especially for lekang, leatherback and hawksbill turtles, the relocation should be put on the bucket to avoid shaking
- Counting the number of eggs (noted on the tally sheet)

- Once inserted into the bag, relocation is made to semi-natural hatching.
- Make record on data of nest depth, temperature, humidity and pH.

Identification of the Turtle

- Checking the presence of tag (if no tag is found, the officer doing the tagging on the left flipper, two scales from the armpit using applicator and mounting the tag in accordance with the order.
- Marking / tagging is done after turtle nesting
- Measurement of turtle shell
- Identification of damage to shell (barnacles, barnacles drillers, moss, disability, and disease of three fins)
- Documentation of tagging, damage to shell (barnacles, barnacles drillers, moss, disability, and disease of three fins