PRACTICAL GUIDELINE

TERRESTRIAL ECOLOGY

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INTRODUCTION

This practical guideline edition has undergone development and is accompanied by profile learning outcomes (PLO) and course learning outcomes (CLO) to be achieved from this practicum activity. It is also a guideline for students in carrying out a series of practicum events. The aim of the Terrestrial Ecology Practical Guideline is to increase understanding of how and why living things interact with their environment in the context of scientific organisms. In addition, students are also expected to have the ability to cooperate, be responsible, creative, communicative, have initiative, have a leadership spirit, and be honest in collecting and analyzing ecological data in practicum activities in groups. During the terrestrial ecology practicum activities, you are requested to comply with the following rules:

A. Students are required:

1. Understand the practicum methods (theoretical basis and procedures) that will be done before doing the practicum.
2. Arrive 5 minutes before the practicum begins.
3. Put bags and other objects belonging to practitioners that are not needed in the place provided (do not put them on the laboratory table).
4. Obey and carry out instructions given by the assistant.
5. Wear a lab coat if the activity is carried out in the laboratory.
6. Take a pretest or posttest regarding the practicum session to be carried out.
7. If you are unable to attend the practicum session, there must be a letter of permission from parents or a doctor's permission letter if you are sick.
8. Borrow and check the equipment to be used.
9. Report immediately if there is damage or defects in the equipment.
10. Replace damaged or lost equipment according to the brand and specifications (in groups or individually); if not replaced, you will not be allowed to take the response or final practicum exam.
11. Cleaning the equipment used.
12. Take the response after completing the entire practicum program and submitting the reports.
13. Always follow announcements, both written and oral.

B. Students are not allowed to:

1. Smoking, eating, and drinking in the laboratory
2. Intentionally dirtying the laboratory table
3. Disturbing the peace and order both within one's own group and other groups.

C. Additional rules:

Other matters that have not been listed in this order will be resolved specifically.

SESSION I
INTRODUCTION OF TERRESTRIAL ECOLOGY EQUIPMENTS AND THEIR IMPLEMENTATION

1. Learning Outcome

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation
b. CLO: using software applications and/or basic instruments for sampling and analysis in terrestrial ecology
c. SubCLO: implementing the use of terrestrial ecology practicum tools with the demonstration method

2. Principle

In terrestrial ecological practice, several tools are needed to measure biological, physical, and chemical parameters found in the environment. Laboratory equipment commonly used for terrestrial ecosystem measurements includes a thermohygrometer (THM), sound level meter, luxmeter, anemometer, Global Positioning System (GPS), soil tester, auger or soil digger, binoculars, clinometer, slap rope (50 meters and 10 meters), and paralon plot (1x1 meter). Each tool has a specific function. Thermohygrometer is used to measure the temperature and humidity in the air. The sound level meter is used to measure the sound noise level in an area. Luxmeter is used to measure light intensity, either indoors or outdoors. An anemometer is used to measure the intensity of wind speed in the atmosphere. GPS is used to determine the coordinates, altitude, and slope of a geographical area. A soil tester is a tool used to measure soil pH and moisture, while to take soil samples, you can use an auger or soil digger. Binoculars are used for wildlife observation (birds, primates, etc.). Clinometers are used to measure the height of an object, such as trees, cliffs, etc.

Ecological data on flora and fauna can be collected using the plot method. The equipment used in this method is a slap rope and a 1x1-meter paralon plot.The way each tool works is specific, so to be able to operate it requires a correct

understanding. A correct understanding of the function of the tool, the components that make up the tool, and the mechanism of action of the tool will support the achievement of accurate data. Tools that require calibration before use are GPS (with special techniques). Maintenance of the tool after use is also important so that the tool remains in good condition. For example, a soil tester after use must be wiped with a soft cloth (tissue).

3. Equipments

1. Thermohygrometer
2. Luxmeter
3. Soundlevel meter
4. Global Positioning System (GPS)
5. Anemometer
6. Soil tester
7. Auger atau Soil Digger
8. Binocular
9. Clinometer
10. Sheet and paralon 1x1 m

4. Procedure

a. Do observations of the tools available
b. Do measurements using these tools in the surrounding environment.

5. Discussions

a. Write the name, type, and function of the tool;
b. Explain how the tool works;
c. Write down the measurement results that have been obtained;
d. Make a practicum report of this event.

SESSION 2

ADAPTATION OF ORGANISMS TO ENVIRONMENTS

1. Learning Outcome

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation
b. CLO: using software applications and/or basic instruments for sampling and analysis in terrestrial ecology
c. SubCLO: Observing the adaptation pattern of organisms to the environment using field and laboratory observation methods

2. Sub-Session Adaptation of Plants to Environments

2.1. Principle:

Humidity in nature has a range that ranges from very wet in one place to very dry in another. Based on this difference in humidity directly, plants that live in it have adapted both morphologically and physiologically. From the type with different levels of moisture, we recognize the types of plants: hydrophytes, mesophytes, and serophytes. As the name implies, hydrophytic plants are found in habitats that are submerged in water for a long time. Mesophytic plants grow in habitats where water capillaries are available in the top layer but the soil is not saturated and water is never above the surface. While serophytic plants are found in habitats where there is almost or absolutely no water vapor in the surface layer for a long time. Each of these plants, in an effort to adapt to its habitat, shows differences in structure, both morphological and anatomical, so that they can be distinguished from each other.

2.2. Equipments:

a. Microscope
b. Deg glass
c. Cover glass
d. Clear nail polish
e. Plastic trays
f. Pinset
g. Two species of hidrofit, serofit dan mesofit plants

2.3. Procedure

1. Collect two plants each that represent hydrophytes, mesophytes, and serophytes.
2. Morphologically, examine the growth form, leaves, branching, stem, and root system.
3. Observe the structure of water storage, water absorption, and preventive or supportive adaptations to their environment.
4. To examine its anatomical structure, observe under a microscope the development of the cuticle and epidermis and the number and distribution of stomata.
5. To observe the stomata: paint the leaf surface with a thin layer of translucent nail polish; then peel it off after drying and examine it under a microscope.

2.4. Data Analysis

Analyze the morphological structure observation as qualitative descriptive.

2.5. Discussions

1. Make comparisons of the types of plants mentioned above based on your observations.
2. Is there a close relationship between the plants for each category? Do unrelated plants use the same adaptation measures for specific environments?

3. Sub-Session Adaptation of Animals to Environments

3.1. Principle:

As living creatures, animals have the ability to respond to environmental stimuli uniquely and variably. The response ability of animals is highly dependent on the type of animal, the intensity, and the type of stimulus of environmental factors (such as light, temperature, humidity, food, etc.). Thus, there are animals that are active during the day (diurnal) and those that are active at night (nocturnal). Animal body colors are often used as a means of disguise to protect themselves from predators or to trick prey. Changing backgrounds and habitats throughout the life of an organism and species encourages color changes to adapt them to their habitat. For example, chameleons are able to camouflage their body color with the color of their environment. Leafhoppers approach light, while earthworms "fear" light. Komodo dragons are able to capture stimulus in the form of the smell of prey blood 1 km away. The ability of animals to respond to their environment is a form of strategy so that they survive in accordance with their adaptive abilities, both structural and functional.

3.2. Tools

1. Cardboard box
2. Plastic bucket
3. Wooden board
4. Frog cage
5. Frog

3.3. Procedure

1. Prepare six frogs, randomly separating the frogs into two groups (each group consists of three frogs).
2. Put the first group into box A; ventilate the air by blocking the bottom of the lid with a small piece of wood. Take this jar to a place where there is sunlight.
3. Put the second group in box B and also put a plastic bowl filled with water. Then place them in a dark place.
4. Observe and record the behavior of the frogs. After about 10–15 minutes, observe the changes in the pigments of the frogs.

3.4. Data Analysis

Analyze the morphological structure observation as qualitative descriptive.

3.5. Bahan Diskusi

1. Are there any color changes in the two groups of frogs? Why is this the case?
2. Are there any differences in the behavior of the two groups of frogs?

SESSION 3-5
POPULATION

1. Learning Outcome:

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation

b. CLO: using software applications and/or basic instruments for sampling and analysis in terrestrial ecology

c. SubCLO: Determining the distribution pattern of the population of organisms using the morisita index and application-based geographic information system (GIS)

2. Principle:

A population is a group of similar individuals that have the ability to mate among themselves in a limited geographical area. The individuals that make up a population carry their biological traits individually, but when gathered into a population, these characteristics coalesce into population characteristics.

Population characteristics include density, natality, mortality, age distribution, sex ratio, and distribution pattern. Density is the number of individuals or population biomass per area or per unit volume of medium or per unit weight of the medium in which they live. Natality is the innate capacity of a population to increase in size through the production of new breeding individuals. The natal rate is the number of new individuals produced per individual or per female per unit time. Mortality refers to the number of individuals that die per unit time. Age distribution is the number of individuals grouped by different age groups that include pre-reproductive, reproductive, and post-reproductive groups. The sex ratio is the ratio of the number of male and female individuals in the population.

Distribution pattern is the spatial arrangement of individuals in relation to each other in an area. Dispersion reflects the interaction between the population and the environment. Population size or density is dynamic, which changes over time. These

changes are caused by many factors, including the process of population growth, mortality, immigration, or emigration.

3. Session 3. Determining Distribution Pattern using Plot Methods

3.1. Tools

1. Raffia sheet with size 10 m
2. Paralon plot with size 1x1 m

3.2. Procedure

1. Determine the sampling area with grasses and shrubs around the campus. Select one of the shrub or herb populations that are individually easy to calculate density (e.g., populations of Sida rhombifolia, Sida acuta, and Ageratum conyzoides L. species).
2. Determine the main axis to lay 5 transects with a length of 10 m each. Next, place 1 x 1 m2 plots of raffia rope on each transect alternately;
3. Record data such as the presence of populations of target species and count the number of individuals.

3.3. Data Analysis

Data analysis of distribution patterns using the Morisita distribution index calculation. The Morisita Index is one of the indices used to determine the distribution pattern of a species. According to Krebs (1989), the Morisita Index can be used to calculate and determine distribution patterns with the following formula:

$$I\delta = n\left[\frac{\sum X^2 - \sum X}{(\sum X)^2 - \sum X}\right] \quad \text{.....3.1}$$

Notes:

$I\delta$ = Morisita Index

n = Total of plots

$\sum X$ = Total number of individuals in the plot

$(\sum X)^2$ = Total squares of the number of individuals i in the plot

The Morisita index has criteria for determining the value of the distribution pattern as follows (Krebs, 1989):

$I\delta = 1$, is random distribution pattern

$I\delta < 1$, is dispersed distribution pattern

$I\delta > 1$, is clustered distribution pattern

3.4. Discussions

Explain briefly and systematically the distribution of these flora and fauna, along with supporting references.

4. Session 4. Determining Distribution Pattern using GIS methods

4.1. Tools

1. GPS Garmin 64s or Avenza application on smartphone
2. Computer/ Laptop and ArcGIS software

4.2. Procedure

Mapping for animals and plants consists of three stages:

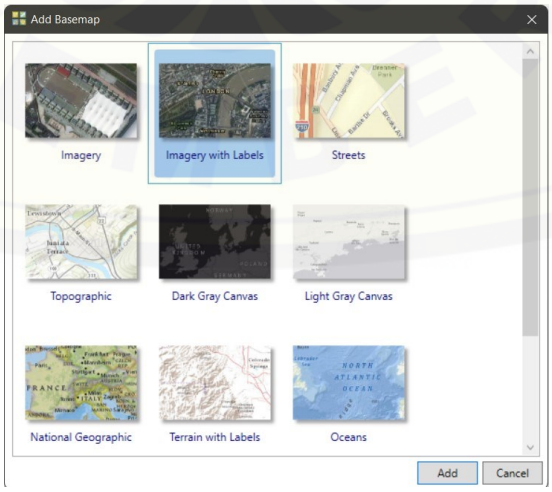
a. Determine the sampling area that has trees around the campus. Select one of the tree populations for which density will be calculated (e.g., populations of mahogany, trembesi, flamboyant, etc. species).
b. Mark the coordinate point of each individual in the species that has been determined.
c. Map creation using ArcGIS 10.1 software, with stages:
    1. Convert coordinate points from GPS to Google Earth or ArcGIS2.
    2. **Rectification.** Consists of several stages, i.e., creating basic data, then activating several tools (especially editors) in ArcMap, and activating the digitizer extension in ArcGIS version 10.1. This practicum uses a base map from aerial photography. In addition, several sites also provide base maps, such as www.bakosurtanal.go.id, www.gisiana.com, or www.googleearth.com.3.

3. **Making spatial data**. There are steps in creating spatial data, including registering maps, creating shapefiles for determining geographic targets or themes (rivers, lakes, roads, buildings, etc.), digitizing, and entering coordinate data for the distribution of flora and fauna, which is first converted in "csv" format (Microsoft Excel) with a formula: Or you can directly enter the converted data from GPS. Next is the visualization of animal distribution using ArcGIS 10.1.4.
4. **Layout and printing**. This stage consists of two important main steps. The first is to create a map display layout. Layout page settings and layout area are determined based on the type of paper you want to use in the printing process. Map coordinates can be displayed using the settings on the grids that will guide through five stages, including scale, coordinates, directions, map titles, and legends displayed based on the data obtained. The last step is to export the file to various formats, such as PDF, JPEG, TIFF, and others.

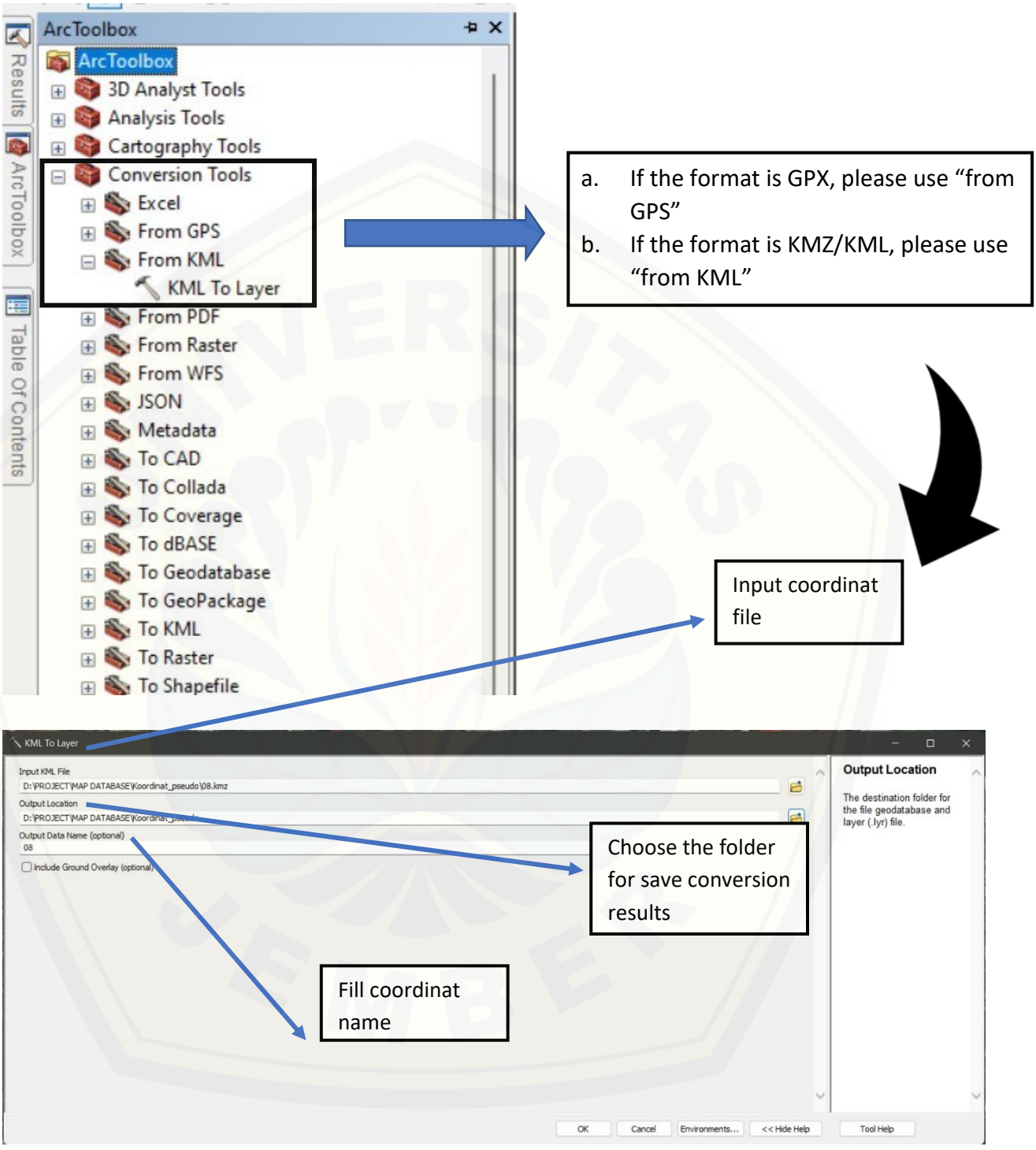
4.3. Data Analysis

Perform data analysis using the Neirest Neighbor Analysis (NNA) approach in the ArcGIS program, the steps are as follows:

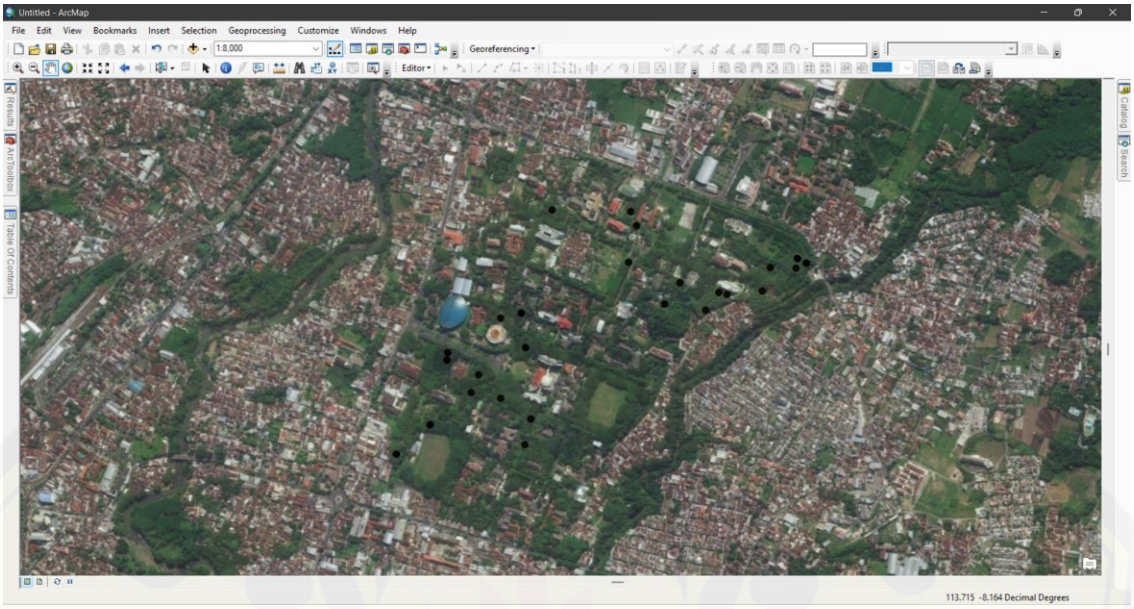
1. Input the basemap of the work area. The basemap can be a self-reconstructed “shp” of the area boundaries or use the basemap provided by ArcGIS. If possible, also know the size of the area.



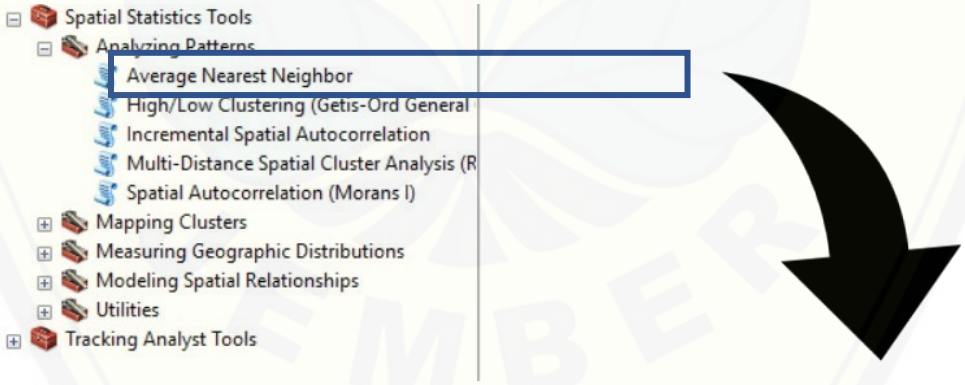
Input the coordinat through *conversion tools*:

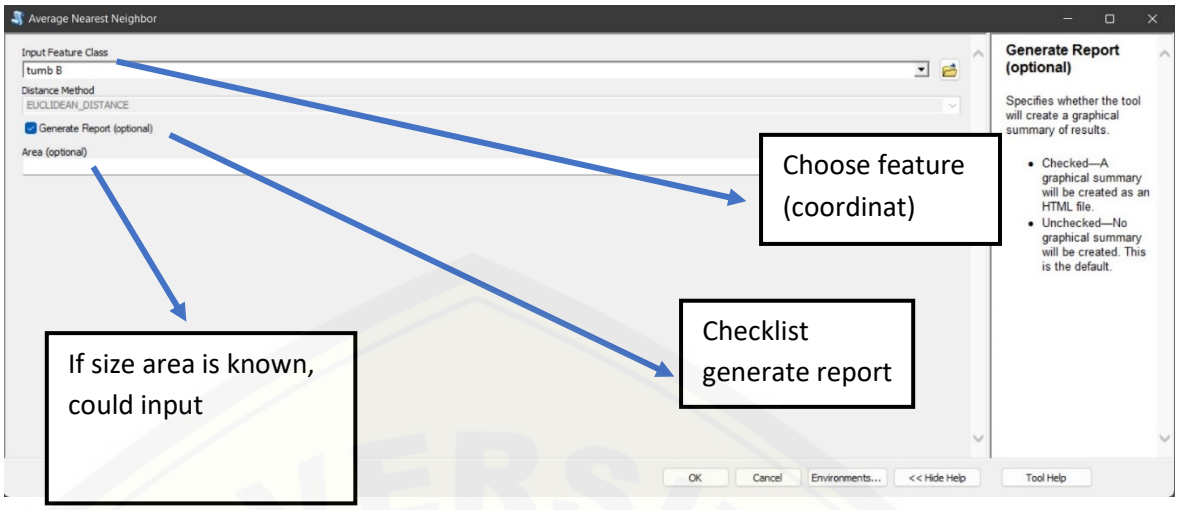


- The coordinat point appears in the base map (black dots).

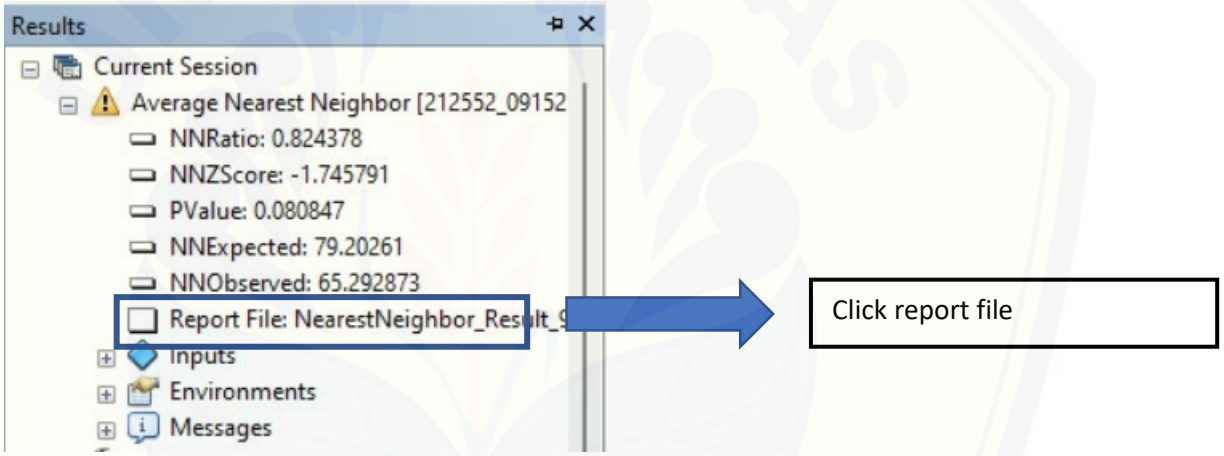


2. Analyze the distribution pattern of population using *Spatial analysis tools*. Choose *Analyzing patterns -> Average Nearest Neighbor*.

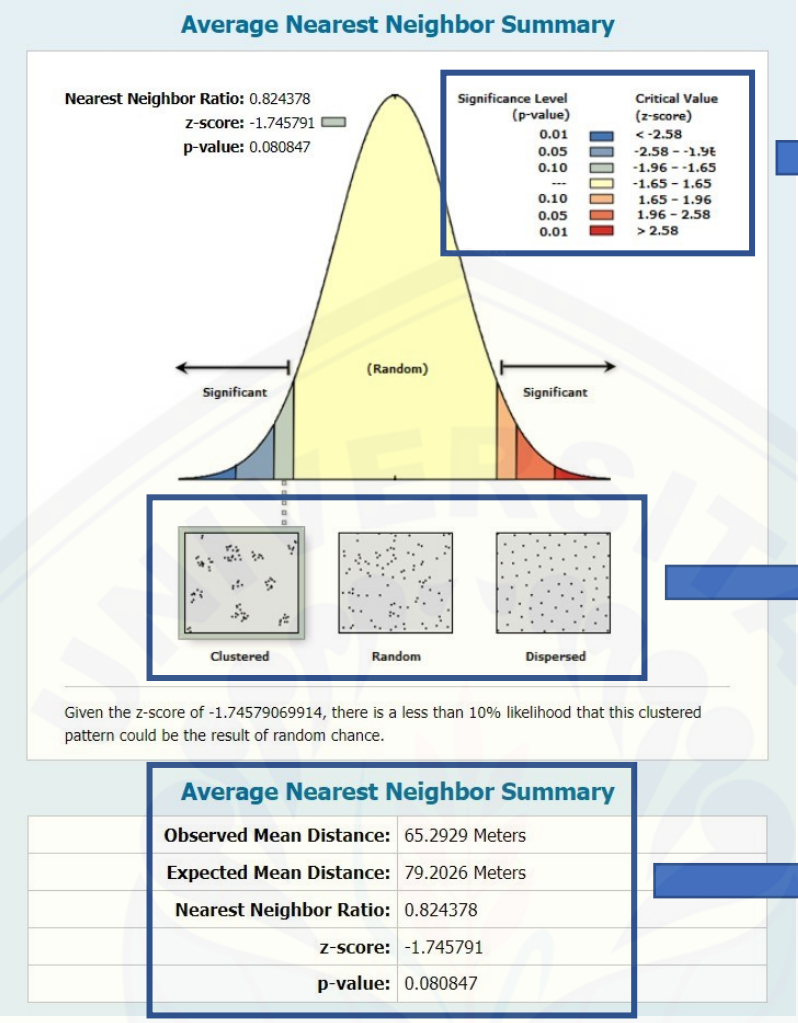




3. Hasil dapat ditemukan pada bagian result



4. Average Nearest Neighbor results. The distribution pattern can be determined from the zscore and p-value. In addition, the distribution pattern has been visualized on graphs and images, making it easier to understand the analysis results.



p-value and zscore for determine the distribution pattern

Distribution pattern result. This result show clustered distribution

Average Nearest Neighbor Summary

Observed Mean Distance:	65.2929 Meters
Expected Mean Distance:	79.2026 Meters
Nearest Neighbor Ratio:	0.824378
z-score:	-1.745791
p-value:	0.080847

The results of p-value and zscore from *Average Nearest Neighbor*

4.4. Discussions:

Explain briefly and systematically the distribution of these flora and fauna, along with supporting references.

SESSION 6
COMMUNITY

6.1. Vegetation Community

1. Learning Outcome:

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation
b. CLO: Using software applications and/or basic instruments for sampling and analysis in terrestrial ecology
c. SubCLO: Implementing data collection and analysis methods of plants (herbs, schrub, tree)

2. Principle:

Vegetation is all species of plants found in an area (flora), with each type showing its distribution in space and time. Vegetation analysis is an activity of studying vegetation that will produce qualitative and quantitative data. There are two methods that can be used to collect ecological plant data, namely the plot method and the plotless method. The data collected after being analyzed can describe the structure of the community (vegetation), which includes species diversity and species dominance.

3. Tools

a. Metlein
b. Tampar sheet with size 25 m or 50 m and 10 m
c. Pencil
d. Notes
e. Ziplock
f. Plastic
g. Label name 5 x 10 cm
h. Garden scissors
i. Paralon plot 1 x 1 m

4. Procedure

a. Vegetation sampling:

- Using two (2) plots measuring 10 x 10 m for tree stands, 4 plots measuring 5 x 5 m for shrubs, and 8 plots measuring 1 x 1 m for herbs, a schematic drawing of plot laying can be seen in the figure below.

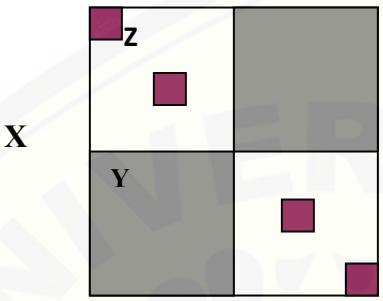


Figure 1. Plot size: X = tree plots (10 x 10 m^2), Y = scrub plots (5 x 5 m^2), and Z = herbs plots (1 x 1 m^2).

- Collect the data as follow:
  - **Tree,** data collection was conducted in 10 x 10 m2 plots as follows: (1) Record the name of the tree species; if the name of the species is unknown, then name it with a code that shows the special characteristics of the species; (2) count the number of individuals of each tree species; (3) measure the circumference of the trunk at the breast height of each individual tree to obtain dbh (diameter breast height) data. Record in Table 3 data on species name, number of individuals, and trunk circumference.
  - **For shrubs**, data collection was conducted in 5 x 5 m2 plots as follows: (1) Record the name of the shrub species; if the name of the species is not known, then name it with a code that shows the special characteristics of the species; (2) calculate the percent cover of each shrub species. Record in Table 4 the data of species name and percent cover.
  - **Herbs**, data collection for shrubs was carried out in 1 x 1 m2 plots as follows: (1) Record the name of the herbaceous species; if the name of the species is not known, then give the name with a code that shows the

special characteristics of the species; (2) calculate the percent cover of each herbaceous species. Record in Table 4 the data on species name and percent cover.- Take specimens of tree, shrub, or herb species with unknown species names (twigs with attached leaves and flowers and fruits if present) for laboratory identification, and code the specimens with names that match the name codes in the species name records;

Tabel 1. Species name of tree, scrub, and herbs

Date: Practical Group:

No	Tree Species	Plot 1 tree circumference (cm)	Plot 2 tree circumference (cm)	And soon	
1					
2					
dst					

No	Scrub Species	Plot 1 tree circumference (cm)	Plot 2 tree circumference (cm)	And soon	
1					
2					
dst					

No	Herbs Species	Plot 1 tree circumference (cm)	Plot 2 tree circumference (cm)	And soon	
1					
2					
dst					

5. Data Analysis:

a. Plant species identification is carried out based on the results of the description of each specimen and then matches it with supporting literature. The results of identification in the form of species names, and then look for the classification of each species;

b. The trunk circumference data (K) of each tree species was converted to basal area (BA = trunk area) with the following steps.

$d = K/\pi \longrightarrow BA = 0.25\ \pi\ d^2$

(d= diameter, K= circumference, π= 3,14, and BA= basal area)

c. Calculation of the important value index (IVI) to determine the dominant-codominant species in the sampling area with the following steps:

- Absolute Dominance $_{\text{Species Tree a}}$ = BA $_{\text{Species Tree a}}$ / sampling area
- Relative Dominance $_{\text{Species Tree a}}$ = (Absolute Dominance $_{\text{Species a}}$ / Absolute Dominance of all species) x 100 %
- Absolute Dominance $_{\text{scrub/herbs species a}}$ = percent cover $_{\text{scrub/herbs species a}}$ / sampling area
- Relative Dominance $_{\text{scrub/herbs species a}}$ = (Absolute Dominance $_{\text{scrub/herbs species a}}$ /Absolute Dominance of all species) x 100 %
- Absolute Frequency $_{\text{Species a}}$ = Total of plot that found $_{\text{species a}}$/ Total of plot
- Relative Frequency $_{\text{Species a}}$ = (Frequency Absolute $_{\text{species a}}$/Absolute Frequency all of species) x 100 %
- Absolute Density $_{\text{Species a}}$ = ∑ Individu $_{\text{Species a}}$ / Sampling area
- Relative Density $_{\text{Species a}}$ = Absolute Density $_{\text{Species a}}$/ Absolute Density all of species) x 100 %
- IVI $_{\text{tree species a}}$ (%) = Relative dominance $_{\text{tree species a}}$ + Relative density $_{\text{tree species a}}$ + Relatif frequency $_{\text{tree species a}}$
- IVI $_{\text{scrub/herbs species a}}$ (%) = Relative dominance $_{\text{scrub/herbs species a}}$ + Relative density $_{\text{scrub/herbs species a}}$ + Relatif frequency $_{\text{scrub/herbs species a}}$

b. Calculate the species diversity index using Shannon Wiener (H') as follow:

H' = -∑ pi ln pi

pi= n/N or total of individual $_{species\ a}$ divided total of individual all species.

According to Wilhm & Dorris (1968) in Masson (1981) that value H' ≤ 1 is low diversity, then value 1≤ H' ≤ 3 is medium diversity, and H'>3 is high diversity.

6. Discussions:

What is the structure of plant community composition in the sampling area? (Compare the results of data analysis in the form of species composition, importance index, and plant diversity in tree, shrub and herbaceous habitus).

6.2 Animal (Invertebrata) Community

1. Learning Outcome:

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation
b. CLO: Using software applications and/or basic instruments for sampling and analysis in terrestrial ecology
c. SubCLO: Implementing data collection and analysis methods of animal (invertebrates)

2. Principle:

Animals have varied characteristics, so their collection techniques also vary. Invertebrate animals are a group of invertebrate animals that are generally small in body size. This group of animals has high mobility (e.g., insects), low mobility (e.g., Mollusca), or is sedentary (e.g., Porifera). Based on these characteristics, the techniques used for sampling this group of animals are different. Direct searching is done by directly searching for animals in preferred habitats or microhabitats. Terrestrial invertebrate groups require resting places and moist microclimate environments and can be found under rocks, fallen trunks, around plants, in litter, and others. Collection of invertebrates can also be done using traps.

3. Tools

1. Pitfall trap
2. Soil digger or shovel
3. Stick
4. Plastic tray
5. Water and soap
7. Paralon plot with size 1x1m
8. Pinset
9. White cloth
11. Notes and pencil

4. Procedure

a. Collection of invertebrates in the soil (infauna) using direct searching technique:
   1. At the practicum site, dig the soil with a soil digger or shovel (do it 5 times).
   2. Measure the volume of soil with a plastic jar.
   3. Pour the soil in a plastic tray and sort the soil animals with tweezers and put them in a plastic bag.
   4. Determine the name of the animal species found and count the number of individuals of each species.

b. Collection of ground surface invertebrates (epifauna) using direct searching technique with quadrat sampling method:
   1. At the practicum site, place a 1 x 1 m plot;
   2. Observe and collect animals in the plot with tweezers and put them in a plastic bag so that all animals are caught. If there are stones or litter in the plot, then turn over the stones or litter, which may be a hiding place for some types of animals. Perform this activity on three plots at different locations;
   3. Determine the name of the animal species found and count the number of individuals of each species

c. Collection of ground surface invertebrates (epifauna) with the Pitfall Trap device:

1. At the practicum site, dig the soil with a shovel with a depth adjusted to the height of the pitfall trap device;
2. Insert the pitfall trap tool that has been filled with water with a little detergent into the excavation, cover with a lid, and leave the tool for 24 hours;
3. After 24 hours, remove the trap and observe whether there are any animals trapped in the detergent solution; If there are, pick up the animals with tweezers, determine the name of the species, and count the number of individuals of each species.

d. Collection of bush or tree invertebrates using the beating trays technique:
   1. At the practicum site, look for dense shrub vegetation or low branching trees;
   2. Perform beating with a wooden stick on the leaves and branches of the bush or tree by previously placing a piece of calico cloth under the part to be beaten; beating is done by moving around the bush or tree;
   3. Collect the animals contained in the piece of cloth and store them in a plastic bag.
   4. Determine the name of the animal species found and count the number of individuals of each species.

5. Data Analysis

a. Invertebrate species found are described and identified using an invertebrate identification guideline.

b. Based on the type and number of individuals, animal data were analyzed to determine
   1. ***Simpson Dominance Index***: $\mathbf{D = \sum Pi^2}$

      (D= Dominance index; Pi= ni/N, ni= total of individual species i and N= total individuals of each species) and relative density: (ni/N) x 100%

      The dominance index value is close to one (1) if the community is dominated by a particular species, and if the dominance index is close to zero (0), then no species dominates (Odum, 1971).

2. Indeks Keanekaragaman Jenis Shannon-Wiener (refer to formula in H')

6. Discussions:

What is the community structure of invertebrate infauna, epifauna, and shrubs or trees for which different techniques were used to collect data?

6.3 Animal Community (Vertebrates)

1. Learning Outcome:

a. LO: able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation
b. CLO: Using software applications and/or basic instruments for sampling and analysis in terrestrial ecology
c. SubCLO: Implementing data collection and analysis methods of animal (vertebrates)

2. References:

Vertebrate animals are relatively large in size and have a high ability to move or locomote. Vertebrate animal groups that occupy terrestrial habitats include amphibians, reptiles, birds, and mammals. Based on the different characteristics and behavior of each group of vertebrate animals, the techniques used for sampling these animal groups are also different. Data collection of vertebrate animals can be done directly or indirectly (traps). In this practicum, using direct or active methods with observers actively recording data in the field. Some commonly used methods are point count, concentration count, and line survey. In this event, the point count method was used to collect data on bird communities in an ecosystem. Point counts use a radius of 20–50 m using binocular and monocular tools. The time used for this observation is about 20-30 minutes per count point.

3. Tools

1. Binocular and Monocular

2. Notes and Pencil

4. Procedure

1. Students observe birds at a predetermined point using binoculars and field notes.
2. Observations were made within a radius of 20-50 m for 20-30 minutes.
3. Observers must record bird community data including: day of observation, time of observation, weather conditions, coordinates, habitat type, bird species observed, and number of individuals of each species.

5. Data Analysis

Data analysis shows the species composition table, and then calculates the Shanon Wiener dominance and species diversity indices (the same as the formula in the invertebrate subchapter).

6. Discussions:

What is the structure of vertebrate animal communities, in this case bird communities, using species diversity and species dominance approaches?

SESSION 7

ECOSYSTEM CHARACTERISTICS IN BALURAN NATIONAL PARK

1. Learning Outcome

a. LO: Able to do laboratory work and/or in the field independently and/or in groups for biological concepts implementation

b. CLO: Practicing laboratory and field works related to terrestrial ecology

c. SubCLO: Reporting the results of field studies related to ecosystem types in Baluran National Park through group presentations

2. Principle

Baluran National Park is located at the eastern end of East Java province, or between 7045' - 7056' S and 113059' - 114028' E. Administratively, this National Park is included in Situbondo Regency. The topography varies from gentle in the coastal area to hilly at the foot of the mountain, even a ravine occurs at the top of Mount Baluran. There are no rivers that flow throughout the year in this area. The water system is so poor that it only has water in the rainy season and becomes dry in the dry season. Rainfall averages 900-1600 mm per year with an average number of dry months of 9 months per year. There are five ecosystem types in the Baluran National Park, including:

- **Mountain Forest**, in the Musapah-Gunung Baluran block area, this forest is located at an altitude of 800 meters above sea level. In this area, 24 tree species were recorded with a density of 640 trees/ha. The diversity of trees in this area is quite high based on the results of research the frequency is less than 5%. The types of trees such as Pterospermum diversifolium, Streblus asper, and Polyalthia laterifolia. At the shrub level, 18 species were recorded with a density of 1240 shrubs/ha, with the dominant species being Streblus asper, and Sumbaviopsis albicans.
- **Seasonal Forest**. Seasonal forests in Baluran generally stretch at altitudes above 300 meters above sea level, scattered in the area of Mount Montor 40 meters above sea level, Mount Periuk 211 meters above sea level, Mount

Glengseran 124 meters above sea level and Mount Twin 160 meters above sea level. Seasonal forests lack diversity in both structure and species composition. The forest canopy layer is generally thin, consisting of only one or two layers, so this part of the seasonal forest is generally covered by shrubs, grasses, or other herbs. Common tree species found in seasonal forests are Grewia eriocarpa, Acasia leucophlea, Acasia tomentosa, Tamarindus indica, etc.

- **Savannah**. Savanna in Baluran extends from the north, east, south, and a little in the west about 10,000 ha or approximately 40% of the Baluran NP area. Baluran savanna can be distinguished from its topography, namely flat savanna and hilly savanna. Flat savannas are found near the coast with an altitude of 50 meters above sea level, while hilly savanna areas are scattered in the Kerosot and Kembar mountain areas. The Bekol-Bama savanna area is very open and flat. Dichantium caricosum is the most dominating grass species.
- **Evergreen Forest**. This is the most fertile type of nabatah because ground water is always available and drainage is sufficient. The basic components of this forest are tall trees with a maximum height of 50 meters, besides that there are shrubs, lianas, epiphytes, and parasites. Generally, the types of vegetation that grow here have evergreen leaves because the shedding of leaves and the changing of leaves often take place continuously throughout the year. Commonly found plant species are Uraria logopodioides, Sterblus sp., Strychnos lucida, etc.
- **Coastal Forest**. Coastal forests are generally behind and continuous with mangrove forests, but in some places these forests are directly adjacent to the coastline. Based on their habitat coastal vegetation can be divided into two, namely:
  1. Vegetation that grows on sandy beaches that are not affected by the tides. Such as Vigna marina, Euphorbia atoto, Cyperus maritima, etc.

2. Vegetation that grows on beaches that are heavily influenced by the tides. Such as Rhizopora apiculata, R. stylosa, R. mucronata, Bruguiera gymnorrhiza, etc.

3. Tools

Refer to tools that display in the session plant and animal (vertebrates) community

4. Procedure

Data collection including:

a. Abiotic factors = soil pH, air temperature, humidity
b. Stratification: draw or schets the forest stratification
c. Collect the plant and animal (vertebrates) community
d. Food web: draw and explain food chain and food web refer to plant and animal community in the ecosystem

5. Analisis Data

Analyze data of plant and animal (vertebrate) communities using IVI, Shannon Wiener, and Dominance Index. Furthermore, correlate the community and abiotic factors qualitatively and explain the food web.

6. Discussions:

Explain the ecosystem types in the Baluran National Park referring to the results.