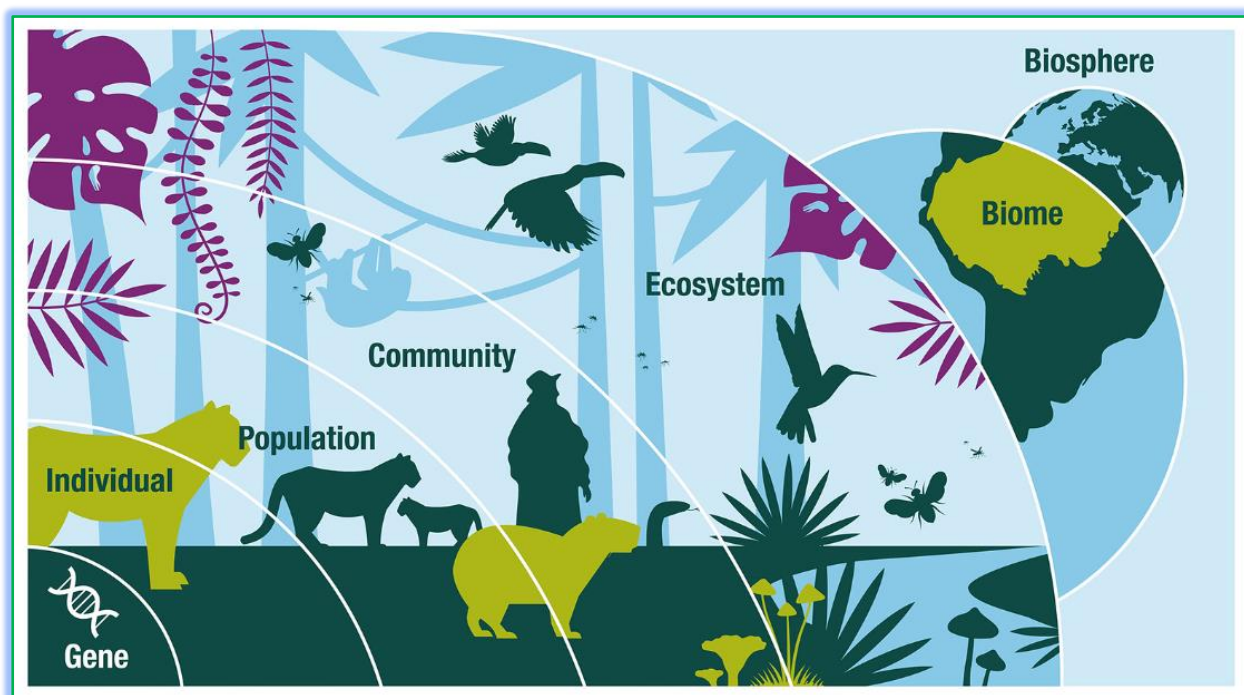


# LEVELS OF BIODIVERSITY

Topic:2.3.1.1.6



Source: <https://www.flickr.com/photos/191878461@N05/50888035817/in/photostream/>

## Table of Contents:

1. Learning Outcomes
2. Types of Biodiversity
  - 2.1 Genetic diversity
  - 2.2 Species diversity
  - 2.3 Ecosystem diversity
    - 2.3.1 Alpha diversity
    - 2.3.2 Beta diversity
    - 2.3.3 Gamma diversity

**1. Learning Outcomes:** On completion of this topic student should be able to.

- *Understand the importance of biodiversity and gain knowledge on different levels of biodiversity.*
- *Examine the variety of life on earth.*
- *Realize the role of each species and its importance in sustaining the biodiversity in the ecosystem.*
- *Explore the complexity of biodiversity.*

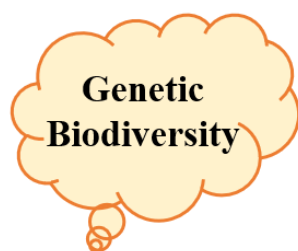
## 2. Biodiversity:

We are living on the planet earth which is a home of various life forms. Estimates on the number of earth's current species range from 2 million to 1 trillion, of which about 1.74 million species have been databased so far and over 80 percent have not yet been described <sup>(1)</sup>. The concise definition of biodiversity used by the biologists is "totality of genes, species and ecosystems of a region" <sup>(2)</sup>. Different types of diversities help in maintaining the balance of nature. Therefore, biodiversity and its proper maintenance is vital for the sustainable life in this planet.

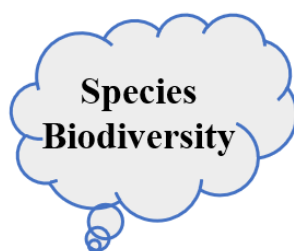
There are three essential levels of biodiversity, which include:

1. Genetic biodiversity
2. Species biodiversity
3. Ecosystem biodiversity

## TYPES OF BIODIVERSITY



Variety of genetic  
makeup with in a  
species



Variety of Species in  
a specific  
region



Variety of habitats,  
ecosystems &  
communities

\*Web reference(s): (1) <https://rb.gy/8if35m>  
(2) <https://rb.gy/jlbvyk>

## 2.1. Genetic Biodiversity:

Genetic diversity is denoted by the phrase “the diversity within species”. It is the genetic difference within living organisms, that is, the genetic variations among populations of a single species and those among individuals within a population <sup>(3)</sup>. Each individual of a particular species differs from others in their genetic composition. Hence, we humans belong to same species look differ from one another except in case of twins. Also, there are different varieties in the same species of dogs, frogs, fishes, birds, rice, potatoes etc.



Fig.1: genetic diversity in dogs  
Source: <https://rb.gy/arlx2>



Fig.2: genetic diversity in fishes  
Source: <https://rb.gy/zda4tr>



Fig.3: genetic diversity in rice  
Source: <https://rb.gy/uhvbqo>



Fig.4: genetic diversity in fruits  
Source: <https://rb.gy/c7z9rq>

\*Web reference(s): (3) <https://portals.iucn.org/library/efiles/documents/EPLP-no.030.pdf>

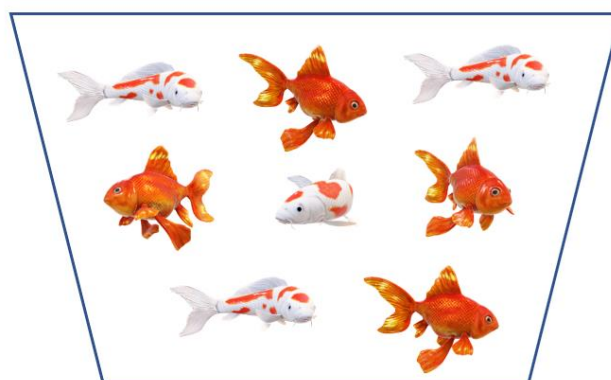


**Note:** **Genes** are the primary units of hereditary information transmitted from one generation to other. They either individually or in group, constitute a countless process in every living organism. They also contribute many different characteristics to an organism such as its physical appearance, its ability to prevent attack from other organisms or survive drought. A person might have a gene for brown eyes or dark hair. A butterfly might have a gene for wing colour or chemical scent that helps it to find a mate. A potato plant may have a single gene, or a group of genes, for resistance to a certain insect or for a particular large and nutritious tuber <sup>(3)</sup>.

[Click Here](#) to view animated video on **Genes** or  
Scan the QR code



One important feature of genetic diversity is that it permits species to adapt overtime to the environmental pressures they face. Not every population or individual has the gene or gene combinations that enable it to survive in a particular environmental context. The loss of individuals and populations through, among other things, habitat destruction narrows the gene pool of a species (sometimes called genetic erosion) and restricts its adaptational or evolutionary options. Therefore, genetic diversity increases the chances for a species' survival <sup>(3)</sup>.



#### High Genetic Diversity

large populations retain high genetic diversity

#### Low Genetic Diversity

small populations lose genetic diversity

The most effective way to counteract loss of biodiversity is to preserve large and well-connected populations. Small and isolated populations will progressively lose genetic variation resulting in lower adaptive capacity, weak potential for long time survival and loss of resilience.

\*Web reference(s): (3) <https://portals.iucn.org/library/efiles/documents/EPLP-no.030.pdf>

## 2.2 Species Biodiversity:

‘Species diversity’ refers to the variety of species with in a geographical area. It is the most basic level of biodiversity that includes wide range of species on earth from microorganisms to multi cellular plants and animals.



Fig.5: Species diversity in Birds  
Source: <https://rb.gy/yow3zq>

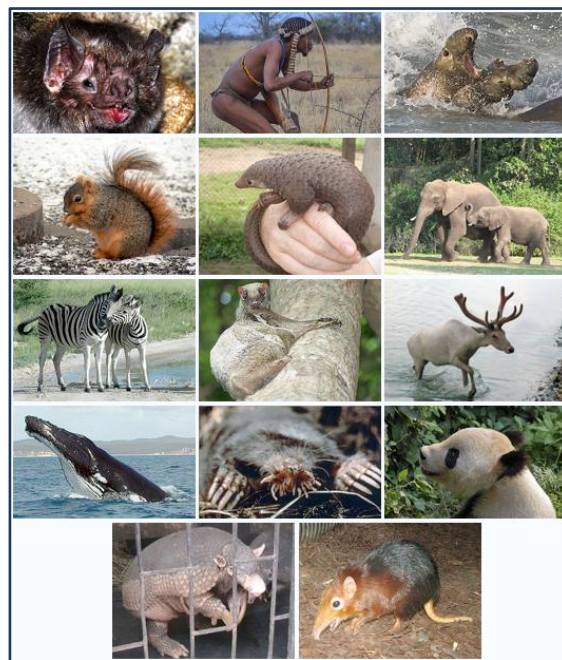


Fig.6: Species diversity in mammals  
Source: <https://rb.gy/trtnlj>

**Note:** A **Species** represents a group of organisms which has evolved distinct inheritable features that occupies a unique habitat. More specifically, “Species” is one of the levels used by taxonomists (the scientists who compare, classify and name organisms) to describe the hierarchy of life forms on planet earth. In descending order of ranking, the standard taxonomic hierarchy is kingdom (plants, animals, fungi, protista and blue-green algae), division (botany) or phylum (zoology), class, order, family, genus, species and sub-species, variety (botany) and form (botany). Species come below the level of genus and above the level of sub-species <sup>(3)</sup>.

[Click Here](#) for additional information about species

or

Scan the QR code



\*Web reference(s): (3) <https://portals.iucn.org/library/efiles/documents/EPLP-no.030.pdf>

The species diversity is measured in terms of 'species richness and species evenness'. **Species richness** is the number of species living in a habitat or a given area. **Species evenness** is based on relative abundance and is defined as the number of individuals in a species relative to the total number of individuals in all species with in a group. Two regions with same richness do not necessarily have same species evenness. For example, both communities in figure 7 have three different trees species and thus have species richness of three. However, there is a dominant species (represented by six individuals) in community #1. In community #2, there are three trees of equal abundance. Therefore, community #2 has a greater species evenness and greater overall species diversity<sup>(4)</sup>.

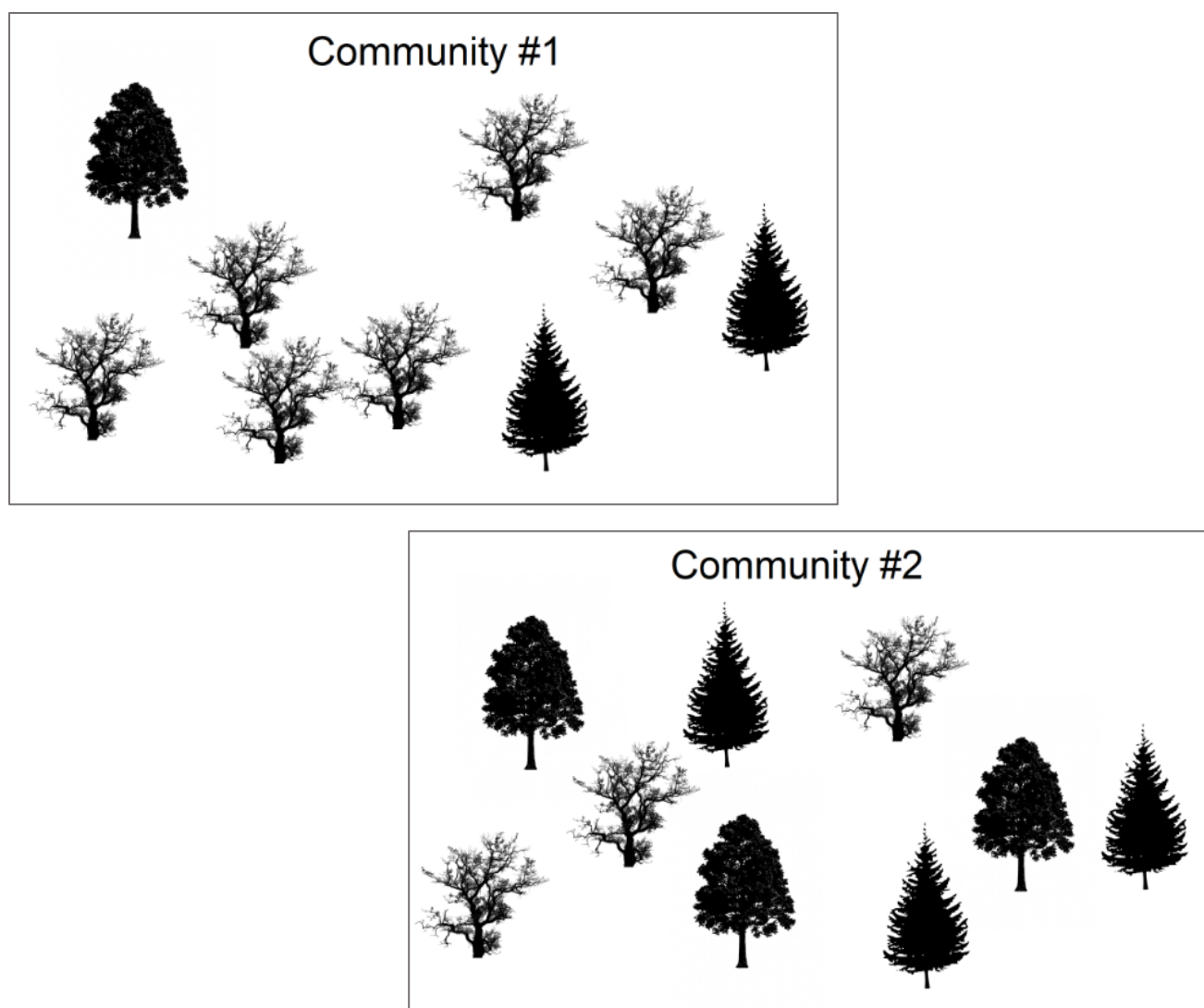


Fig 7: Two hypothetical tree communities have the same species richness but differ in their species evenness. Both communities have 9 trees with 3 different species. In community #1, one species is dominant. In community #2, there are three individuals from each species. **Source:** <https://rb.gy/orn2mw>

\*Web reference(s): (4) <https://rb.gy/orn2mw>

Some areas are richer in species than the other. Tropical and sub-tropical regions are rich in biodiversity than polar region of the earth. Areas with more species diversity are usually referred as 'hotspots' of biodiversity. There are currently 36 recognised biodiversity hotspots <sup>(5)</sup>. Healthy ecosystems are rich in species diversity and every species plays a particular role in ecosystem function. Thus, species as well as ecosystem diversities are significant in maintaining ecosystem services.

### **2.3 Ecosystem diversity:**

Ecological diversity or Ecosystem diversity includes variations among the species present in local ecosystems and the interactions within these levels. An ecosystem comprises of organisms of several species living in a region and their connections through food chain, flow of energy, nutrients and the matter. Thus, an ecosystem is an interacting system of both biotic (living) and abiotic (non-living) components, which together form a functional unit. Plants, animals and microorganisms include biotic (living) components of an ecosystem while, sunlight, nutrients, minerals, air and water are the abiotic (non-living) components. Each species in the ecosystem plays a particular role in its community. Loss of a single species can have a consequence to the entire community to a great extent. Ecosystems can be small and ephemeral (e.g., pond and puddle etc.) or large and long-lived (e.g., Forest and ocean etc.)



Fig.8: Pond ecosystem

Source: <https://www.flickr.com/photos/calliope/5907599218>



Fig.9: Forest ecosystem

Source: <https://www.flickr.com/photos/dfid/4115002439>

Ecosystem diversity is also known as community diversity which refers to the variety of habitats and ecosystem processes extending over a particular region. It includes different ecosystems like deserts, forests, lakes, oceans, mangroves etc.

\*Web reference(s): (5) <https://databasin.org/datasets/c7c0c790d1564d1eb27ea1b89bf3768a/>



The diversity of various species in a region is typically measured in three different perspectives. They include:

1. Alpha diversity
2. Beta diversity
3. Gamma diversity

### 2.3.1 ALPHA DIVERSITY:

Alpha diversity refers to the species diversity within a local habitat or community. Generally, it is represented as the total number of different species (or species richness) in that ecosystem. It can be well understood by the figure 10, which comprises of different species in three ecosystems/habitats. Number of species in ecosystem-1 is seven (i.e., seven different species in a community, thus alpha diversity is seven), ecosystem-2 is eight and in third ecosystem species richness and alpha diversity is equal to seven.

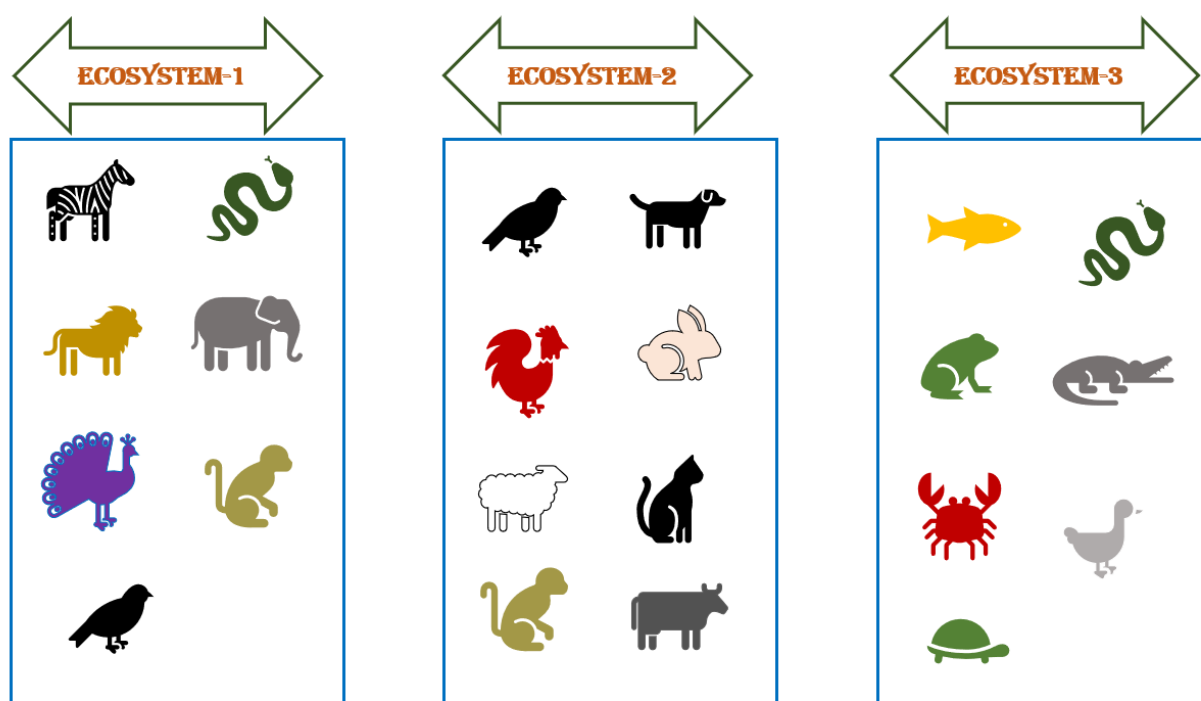


Fig.10: Alpha diversity in different ecosystems/habitats

### 2.3.2 BETA DIVERSITY:

A comparison of diversities among the ecosystems, usually measured as number of species change between the ecosystems. In simple words, it is the measure of species richness between two distinct ecosystems usually separated by a specific geographical barrier such as river or mountain. Beta diversity determines a quantitative measure of ecosystem diversities that experience the environmental changes.

The beta diversity can be measured between any two of the ecosystems (figure-11). Between first and second ecosystems, the beta diversity is measured as 13 (similar species in each ecosystem can be treated as one species). Among second and third ecosystems, the beta diversity is measured as 15. Similarly, between first and third ecosystems, it is measured as 13.

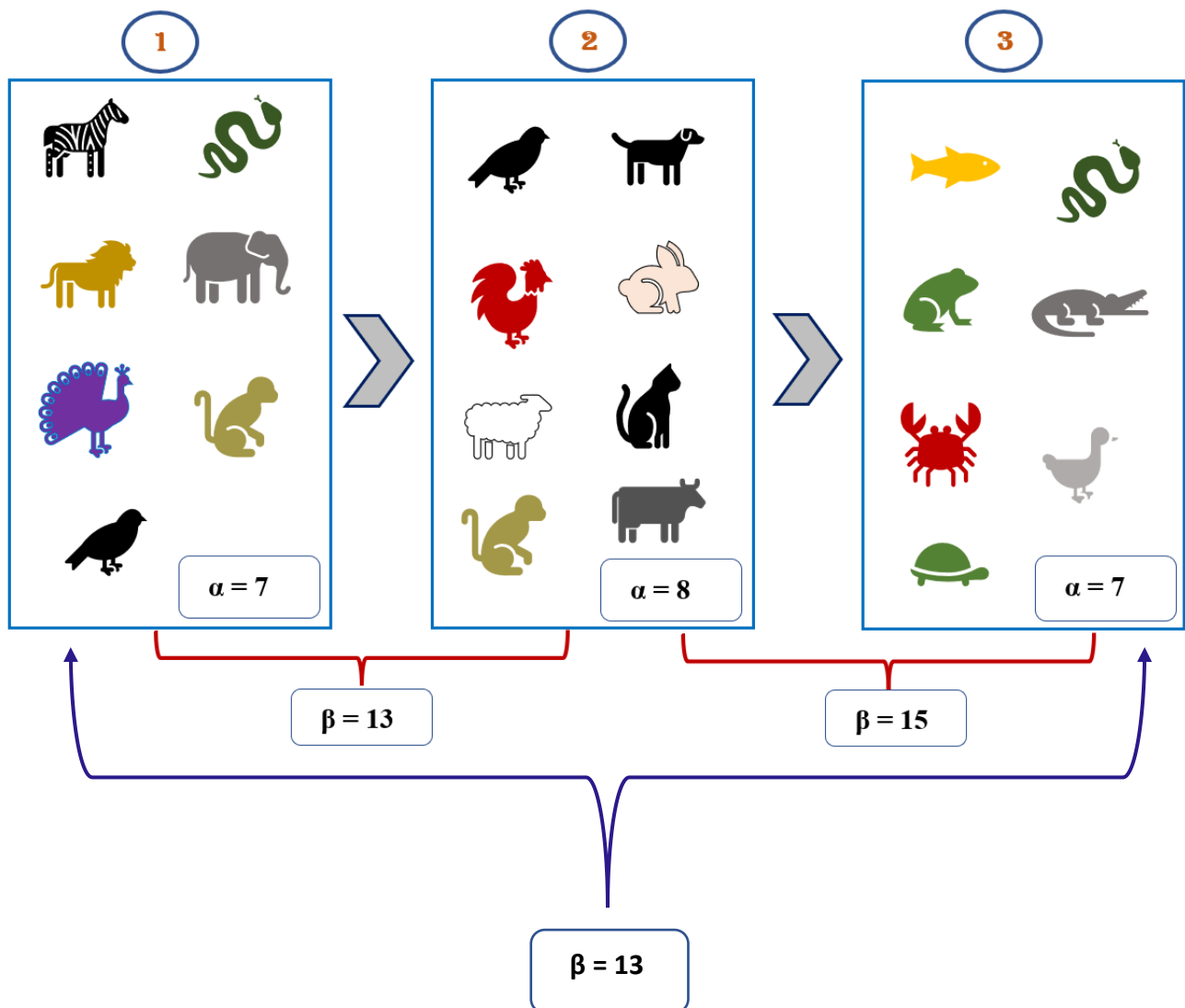
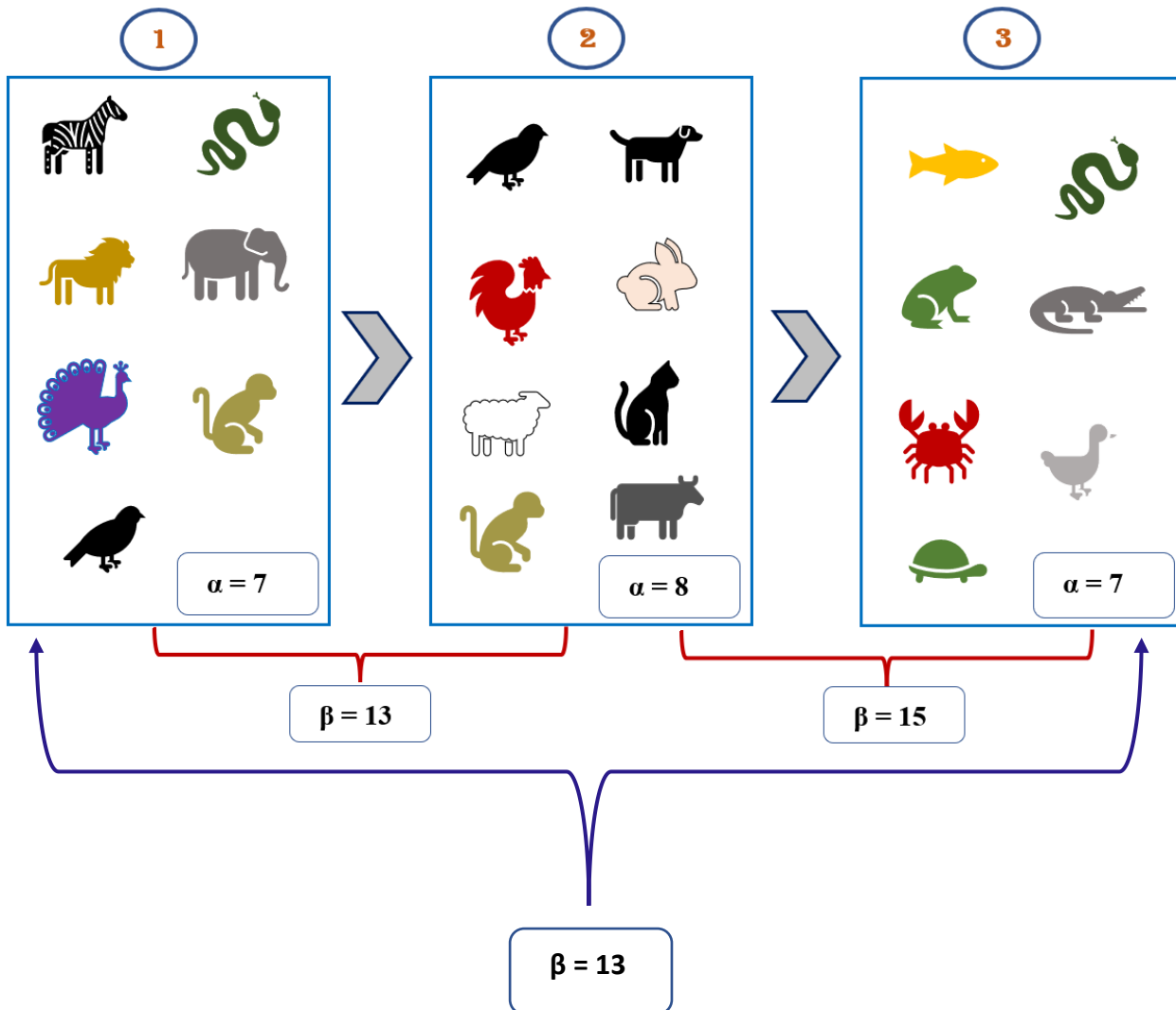


Fig.11: Beta diversity in different ecosystems/habitats

**GAMMA DIVERSITY:**

A measure of the total diversity for different ecosystems within a large area or region (at a vast scale) is denoted by the term ‘gamma diversity’. It is the complete biodiversity with all species richness for various habitats in a region. Let us understand this perspective with an example (figure 12). The gamma diversity of all the three ecosystems comprises of nineteen species.



1	✓	✓	✓	✓	✓	✓	✓												
2							✓	✓	✓	✓	✓	✓	✓						
3		✓												✓	✓	✓	✓	✓	✓

Fig.12: Gamma diversity within large area

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