Ecology
Introduction to Ecology

This component will encompass the introductory portion to the subject of ecology. In this we will firstly examine the **meaning of ecology** and secondly the **ecosystem** as a whole.

The structure and functioning of an ecosystem will be determined as the ecosystem is “analysed” or broken down into its respective parts. These parts or components will then be studied in some detail.
Why is the Study of Ecology Necessary?

An understanding of ecology is necessary for the following reasons:

1. **Students of ecology** can obtain a **holistic understanding** of the ecosystem in which they find themselves - plants and animals do not exist in a vacuum in nature.

2. Ecology is the means of **linking together** the components of the environment, emphasising the **interrelatedness** that is found in the ecosystem.

3. **Users** of the ecosystem are made aware of their **impact** on the ecosystem.

4. **Efficient management** of the ecosystem is only possible once the ecosystem is thoroughly understood.

5. It gives students of ecology a **framework** on which to build a scientifically based knowledge of the entire ecosystem.
**Definition of Ecology**

Ecology is defined as:

> The study of the interrelationships and interactions between organisms and their environment of both biotic and abiotic components.

**Interrelated** means that components of the ecosystem are **closely connected** and will therefore influence **each other**. Interactions imply that some **form of exchange** occurs between different components.

An example to illustrate the definition of ecology is the relationship that exists between a **herbivore** (an animal that feeds on plants) and the **plant** it uses as its food source. The herbivore and plant **interact** when the plants tissues are consumed by the herbivore. Therefore, an **interrelationship** will exist between the plant and the herbivore.

It should be noticed that the definition includes not only interactions **between living organisms**, but also **between living organisms and the non-living components of the ecosystem**. An example of this could be **plants** utilising the **nutrients** and **water** located in the soil.

The non-living components of the ecosystem also interact and will be interrelated. This is seen in the effect of **climate** (rainfall and temperature) on the formation of soils.

The word ecology is derived from the two **Greek** words:

- **Oikos (eco)** meaning house or place to live
- **logy** meaning the study of

Think about this the next time you see any word with the **prefix – eco** attached to it. Example. ecotourism, eco-friendly, eco-washing powder.
Subdivisions in Ecology

Ecology may be subdivided in several ways. The first subdivision we will consider is based on **habitats** - these include three main **habitats** (i.e. places where living organisms may be found).

**Terrestrial ecology** is concerned with the **land habitat**. It covers +/− 30% of the earth’s surface. This habitat has specific characteristics:

- Water - which is frequently a limiting factor.
- Temperature - may fluctuate widely.
- Atmospheric gases - which are abundant.
- Geographical features - which may hamper movement.
- The soil substrate - which forms an important aspect in this habitat.

**Freshwater ecology** deals with **rivers, dams, lakes, streams** and other bodies of **fresh water**. It constitutes <1 % of the surface of the earth, but is perhaps the most important aspect of all terrestrial ecosystems. It has characteristics that can be compared with those of other habitats:

- Water - generally not a limiting factor
- Temperature - with little fluctuations
- Gases - not abundant

Bodies of freshwater tend to be isolated compared to terrestrial and marine habitats.

**Marine ecology** deals with **oceanic regions**. These comprise about 70% of the earth’s surface and can influence terrestrial and freshwater habitats. Characteristics include:

- Water - not a limiting factor.
- Temperatures - vary considerably across the oceans.
- Gases - are not evenly distributed in the oceans.
- Salinity (level of saltiness) varies throughout the oceans of the world.

Marine habitats are mostly continuous, permitting circulation of winds and currents.
The second way in which ecology can be subdivided is into Autecology and Synecology.

**Autecology**: deals with the study of individual organisms and individual species. This will concern the life history (how the organism develops, reproduces and dies) and the behaviour of the organism. The study will focus on the individual organism and how it fits into and is adapted to its environment – known as its Ecological Niche. An example of autecology is the territorial behaviour of the leopard in the Sabie river thickets.

**Synecology**: is the study of groups of different organisms which are associated together as a unit. Here the approach is to examine an entire region looking at all the living organisms in that particular area. An example could be the study of the vegetation of the Pilanesberg Game Reserve.

The third approach to studying ecology is via the taxonomic approach. This entails studying the ecology of a specific group of plants or animals. An example of this is mammal ecology.
**Levels of Organisation in Ecology**

There are six levels of organisation in ecology:

- **Individuals**
- **Populations**
- **Communities**
- **Ecosystems**
- **Biomes**
- **Biosphere**

The first is the individual which comprises a single organism of a certain species (e.g. a single Marula tree). These individuals are composed of cells and tissues. Individuals form the most basic ecological unit.

When single organisms in a certain area are grouped together with other members of the same species, this is referred to as a population (e.g. all the giraffes in the Sabi Sand Game Reserve).

All the populations found within a given area are collectively called a community. Another way to understand this term is to think of all the living organisms within a given area, both plants and animals.

The word ecosystem has been used extensively so far in this text. It is derived from the term “ecological system”. The ecosystem consists of all the living organisms (i.e. the community) and the non-living components in the environment consisting of soil, water, rocks, atmosphere, temperature, light and solar energy among others.

An accepted definition:

**Ecosystem:** “A self-contained entity consisting of biotic and abiotic components”

A biome is defined as follows:

**a major group of regional terrestrial communities** with its own climate, vegetation and animal life, covering a relatively large area. Examples of biomes include grasslands, deserts, temperate forests and tropical forests.

The biosphere is the portion of the Earth’s surface where all living organisms are likely to be found. The term ecosphere is often used synonymously with biosphere. The biosphere consists of:

- atmosphere (gases)
- hydrosphere (water)
- lithosphere (soils and rocks) [on or surrounding the earth]

These levels of organisation will be discussed in more detail throughout this module and in later modules.
The Ecosystem Concept

To simplify the understanding of ecological principles, the ecosystem is separated into **structural components** and **functional aspects**. This is an artificial means of separation and it should clearly be understood from the outset that the **structural and functional components** are not separated in reality, but are interconnected.
Structural Components of the Ecosystem

Earlier in this component, we discovered that the ecosystem consists of all the living organisms found in each area and all the non-living components including soil, water and the atmosphere. The non-living portions are referred to as the abiotic aspects. The living components of the ecosystem (i.e. the plants and animals) are referred to as the biotic component (derived from bio meaning life).

Abiotic Aspects

The abiotic components of the ecosystem are the non-living aspects. These can be divided into four groups:

- **Climatic** factors which include rainfall, temperature, humidity, wind, seasonality and solar radiation.
- **Edaphic** factors which include soils, geological parent material, nutrients and water.
- **Physiographic** factors which include topography, aspect, latitude and altitude.
- **Fire** which is an important additional aspect worth mentioning as it plays a major role in African ecosystems.

These topics are all examined in great detail in the Component # 2 of this Module.
Biotic components

The biotic components of the ecosystem that will be studied are the individuals, populations and communities that make up the ecosystem.

These and other related topics can be found in Component # 3 of this Module.
Functional Aspects of the Ecosystem

The functional aspects of the ecosystem relate closely to the structure of the ecosystem. As stated earlier, these two have been separated for ease of understanding. The functional aspects deal with the way the ecosystem functions from the following points of view:

- The productivity and energy flow in the ecosystem.
- Limiting factors in the ecosystem.
- Cycling of nutrients and chemicals in the ecosystem.

These topics fall under the broad headings of dynamics and development of the ecosystem. This will be discussed in the final component of this Module.
The Structure and Functioning of Associations

When considering the structure, and functioning of an ecosystem the individual components and aspects should not be seen as separate entities, but should be viewed as a functional unit. In a later component, these functional units (associations) will be examined in more detail, but to understand the ecosystem concept fully they will be briefly mentioned here.

An association is a distinct combination of abiotic factors (climate, soils, geological parent material, topography etc.) and biotics (flora and fauna) that make the association a unique entity.

The shape of the land’s surface (topography) may be hilly or consist of flat plains; the climate could be hot and wet; the vegetation could be a forest of tall trees or grasslands; the animal life would vary, according to these factors. This means that any combination of these and other factors combined, could give rise to a distinct association.
A **biome** is an **example of an association**. The **climate** will be the major factor deciding the structure of a biome and the **characteristics that the biome** will possess. **Deserts**, for example, are situated on the earth’s surface where dry air masses tend to sink, depriving the desert of moisture. Therefore, the desert biome receives little rainfall and this has obvious implications for the vegetation and animal life found there.

Other associations of this nature include the **veld types** of South Africa. The entire country is divided into a **mosaic of regions** (87 distinct functional areas), with each region having a **particular vegetation type**. The purpose of this was to designate areas in South Africa with the **same agricultural / land-use potential**.

In the Kruger National Park, a system of **landscapes** was developed. This entailed designating areas with a similar geological parent material, soils, climate, vegetation and resulting animal life. These landscapes were designated to allow **different management approaches** to be implemented on each different landscape.
Holism

The most important lesson for the introduction of ecology is one of holism. This means that all aspects of an ecosystem are not only connected and interrelated by also affected by one another. This could mean that if one pygmy shrew dies in a gigantic forest all other components of that forest (biotic and abiotic) will be affected to some degree. Although different branches of ecology may have their own specific focus, all ecologists must look at the ‘bigger picture’ and strive to explain the interconnectedness.
Open and Closed Systems ~ A conservation lesson

The study of physics put forward the idea of open and closed systems. An open system freely allowed the flow of energy in and out of that system, while a closed system would not. Ecologists argue that closed systems do not exist. All systems (although they may be self-contained to a degree) interact with surrounding systems. This does not matter whether you are discussing our Solar system or your nearest fishing hole.

For many years, conservationists treated our national parks and reserves as closed systems. They selected a good piece of land, uprooted anybody living there, threw up fences, stocked it with game and tourists and allowing no outside interactions.

Latter day ecologists recognise that this is not a sustainable practice. Without taking into consideration the needs of surrounding areas your ‘closed system’ will deteriorate. Today, the vast majority of formal conservation areas are recognised as open systems to a degree (i.e. the game is still fenced in), a policy that works most of the time (poaching remains problematic) and surrounding communities are deriving benefits.

Read more on including local communities in Module # 11.

One would have thought that conservationists would have learnt from ecologists a lot sooner.