NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: SED 321

COURSE TITLE: INTRODUCTORY GENETICS AND GENERAL ECOLOGY

INTRODUCTORY GENETICS AND GENERAL ECOLOGY

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MODULE 1: INTRODUCTORY GENETICS

Introduction

In this module, you will be exposed to some concepts of genetics, as well as scientific knowledge and its application to everyday experiences. The module is expected to expose students to gain the understanding of certain observable occurrences in their lives and in the environment.

This knowledge gained is expected to place them in position to counsel and guide others in making choices that may have lifelong impact on the individual. The module would also expose students to advancement in biological sciences, in view of this, module one is divided into five (5) units as follows:

UNIT 1: Structure of Cell
UNIT 2: Cell Division: Mitosis and Meiosis
UNIT 3: Mendelian Laws and Key Genetic Terms
UNIT 4: Concept of Multiple Alleles
UNIT 5: Applications of Genetics in Agriculture and Medicine

UNIT 1: STRUCTURE OF CELL

CONTENTS

1.0 Introduction

The cell concept is one of the important concepts in biology which talks about living things and what they are made up off. The cell has always being described as the basic unit of structure and function in the living organisms. In this unit, the

structure and the functions of the organelles that make up the cell as a living unit is discussed. The study of the cell as a basic unit of life was made easy because of the work of great scientists like Schleiden 1838 and Schwann 1839.

2.0 Objectives

By the end of the study of this unit, you should be able to:

1. describe the cell
2. state the structure and functions of the major organelles of the cell
3. describe chromosome and describe the different types
4. explain that the gene is located on the chromosome and responsible for carrying and transmitting characters.

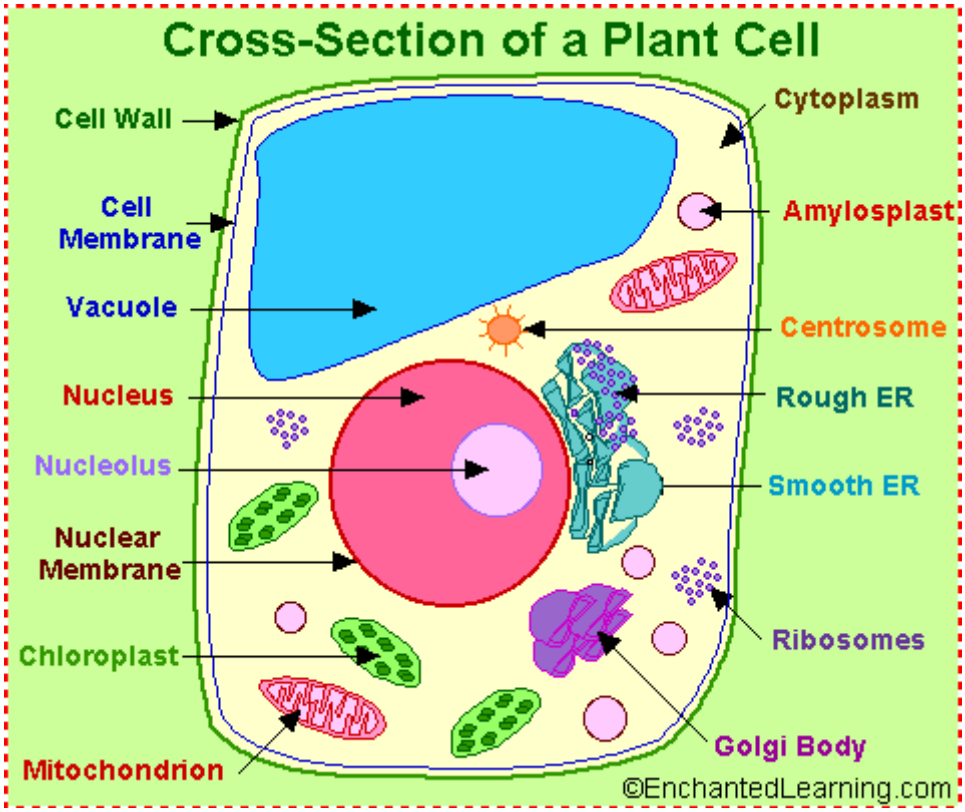
3.0 MAIN CONTENT

3.1 Concept of Cell and Cell Structure

Living things are made up of cells, and it is for this reason that the cell is described as the basic functional unit of life. The cell cannot be seen with the naked eye. However, the use of the light microscope helps in the understanding of the cell and its components

Structure of the Cell

The internal structure of the cell under the light microscope reveals a number of organelles. The diagram that follows is a drawing of the cell.



(Cell with Organelles)

The fluid part of the cell is referred to as the cytoplasm a uniformly homogenous substance which when closely looked at on staining with dye shows it to contain granules and inclusions etc. the cytoplasm is enclosed by the cell membrane also called plasma membrane.

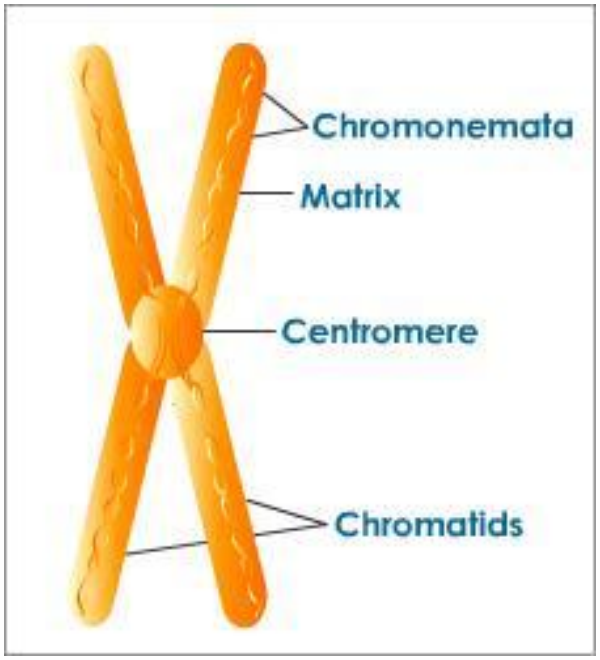
The plasma membrane encloses the protoplasm.
Nucleus – This is in the centre of the cell and enclosed by a nuclear membrane. The nucleolus and chromosomes are found in the nucleus.
Chromosomes – These carry hereditary materials in the form of DNA.
Ribosomes – Tiny organelles in the cytoplasm, they are sites for protein synthesis.

Other organelles include centriole and secretory granules. Centrioles are useful during cell division.

3.2 Chromosome and Genes

The chromosomes carry hereditary materials, which determines the character of the organisms and transmits these characters to subsequent generations. Genes are located on the chromosomes.

Chromosomes are visible under the microscope as uniform threads. Genetists see the gene as being invisible entities hidden within the structure of the chromosome. Genes have the ability to replicate without losing any of the information they are carrying.



Structure of Chromosome

4.0 Conclusion

The cell as a functional unit of life contains organelles which are very vital in the life of the cell. Some of these vital organelles include the chromosome, which carry the gene and both are responsible for transmission of character from parent to offspring.

5.0 Summary

In this unit, you have learnt that;

- the cell is the basic unit of life,
- chromosomes are located within the nucleus of the cell, and are seen as threads within the nucleoplasm
- genes are located on the chromosomes and are responsible for the transmission of character from parent to offspring.
- Major organelles of the cell include the cytoplasm, nucleus, plasma, chromosome, genes, etc.

6.0 Tutor-Marked Assignment

1. Make a clear drawing to show the structure of an animal cell. Describe the functions of five of the major organelles you can see under the light microscope in an animal cell.
2. What are the differences between animal cell and plant cell
3. Describe the chromosome as an entity in the cell of a living organism. What are its functions

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

UNIT 2: CELL DIVISION: MITOSIS AND MEIOSIS

CONTENTS

1.0 Introduction

Scientists discovered by the end of the nineteenth century that two types of nuclear division occur in the cells of living organisms. These two types of cell division are necessary if the organisms are to reproduce in life. They are mitosis and meiosis. Multicellular organisms grow from an original single cell, which has the capacity to divide several times to form the cells of adult organisms with hundreds of cells forming the tissues, organs, etc. This type of cell division is referred to as mitosis. The second type, called, meiosis occur only in the reproductive cells of the organisms and the process leads to production of another new organisms. This process involves the type of nuclear division which reduces the number of chromosomes. The other process (mitosis) does not, rather, number of chromosome remain the same. These two processes of cell divisions are discussed in this unit.

2.0 Objectives

By the end of the discussion of this unit, you should be able to:

- name the two types of cell divisions that takes place in living organisms.
- describe each of the two types of cell divisions i.e. mitosis and meiosis
- state the significance of mitosis
- state the significance of meiosis

3.0 MAIN CONTENT

3.1 Mitosis in Cells

This is a type of cell division that leads to the formation of new cells. We already learnt that multicellular organisms grow from their original single cell to form cells of the adult as a result of repeated cell divisions. The nucleus is the first part of the cell that divides before the entire cell divides. The daughter cells formed from the division of the cell contain the same number of chromosomes as the parent cells. Thus all the cells of the body contain same number of chromosome. This type of cell division is called mitosis, and it results in increase in cell number. Thus, leading to growth or repairs. This can be described as follows;

Five distinct phases are involved:

i. **Interphase**

This is the stage that the DNA of each chromosome replicates, thus each existing as a pair of chromatid joined together by a centromere. At this stage, chromosome is in form of loose coiled threads. The centriole also replicates.

ii. **Prophase**

This is the longest phase of division. The chromosome shortens and thickens with a tight packaging of their components. Each chromosome consists of two chromatids held together by a centromere. The centrioles move to opposite poles of the cell. The nucleoli disappears, nuclear envelope disappears too and spindles are formed.

iii. **Metaphase**

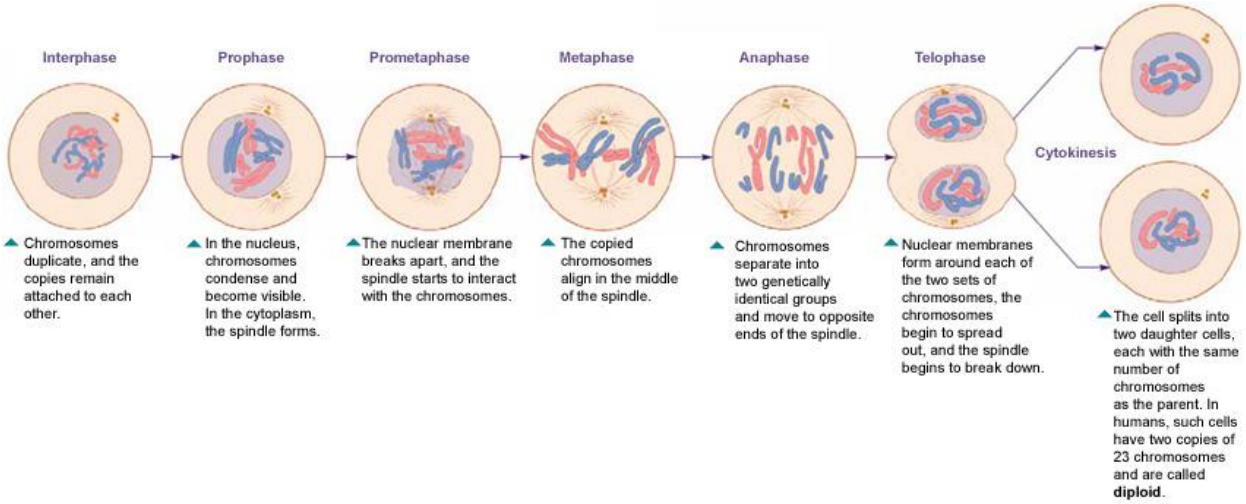
The chromosomes line up around the equator of the spindle attached by their centromeres to the spindle fibres.

iv. **Anaphase**

This phase is rapid, the centromere splits into two and spindle fibres pull the daughter centromere to opposite poles. This also pulls the separated chromatids along behind the centromere.

v. **Telophase**

- Chromatids now reach the poles of the cells
- It uncoils and lengthens to form chromatin again, thus can no longer be seen easily.
- Nuclear envelop re-forms around the chromosomes at each pole.
- The nucleoli re-appears
- This may lead to division of the cytoplasm by a process of invergination of the cytoplasm and contents now forming two separate cells



Stages of mitosis interphase to telophase

3.1.1 Significance of Mitosis

We have learnt that the process of cell division which leads to formation of new daughter cells from the parent cell is called mitosis. The process is very important in living organisms as it:

- leads to growth as a result of multiplication of the cells
- leads to cell and tissue replacement. As cells die or are damaged they are being replaced by a process of mitosis.
- Ensures genetic stability – chromosomes derived from parent by exact replication of their DNA carry same hereditary information in their gene. These are exactly transferred from the parent cell to the daughter cell. Thus ensuring genetic stability
- Leads to regeneration of some parts of the animals that is missing e.g. starfish that looses the arm can regenerate them by the process of mitosis producing new cells.

- Is the basis for asexual reproduction. A number of species of organisms reproduce asexually this takes place by mitosis.

3.2 Meiosis in Cells

Meiosis is a type of nuclear division in which the chromosome number is halved i.e. from the diploid umber (2n) to haploid number (n).

The stages in meiosis are two stages i.e. the first meiotic division and the second meiotic division. As a result of the divisions a single diploid cell gives rise to four haploid cells.

Meiosis occurs during the formation of sperms and eggs in animals, and spore formation in plants. The processes that occur in meiosis are continuous however for convenience it is divided into prophase, metaphase, anaphase and telophase. These stages occur in the first and second meiotic divisions.

Prophase I

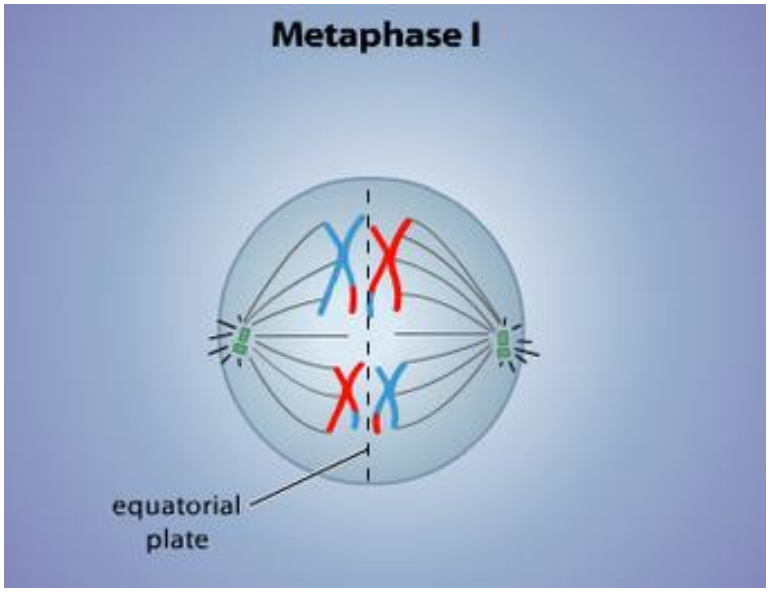
This is the longest phase. The chromosomes become short and are seen as single structures. The homologous chromosomes pair up each pair is called a bivalent. Each pair has same gene and same length. The bivalents, shortens and thickens and can be seen clearly.

The homologous chromosomes repel each other and partially separate. Each chromosome is now seen to compose of two chromatids. The chromatids are seen to be joined at several points along their lengths called chiasmata. At this point genes from one chromosome may be seen as crossing over to the other chromosome. The chromatids of homologous chromosomes continue to repel each other. Centrioles move to the poles, nucleoli and nuclear envelop disappear and spindles are formed.

Prophase I Meiosis

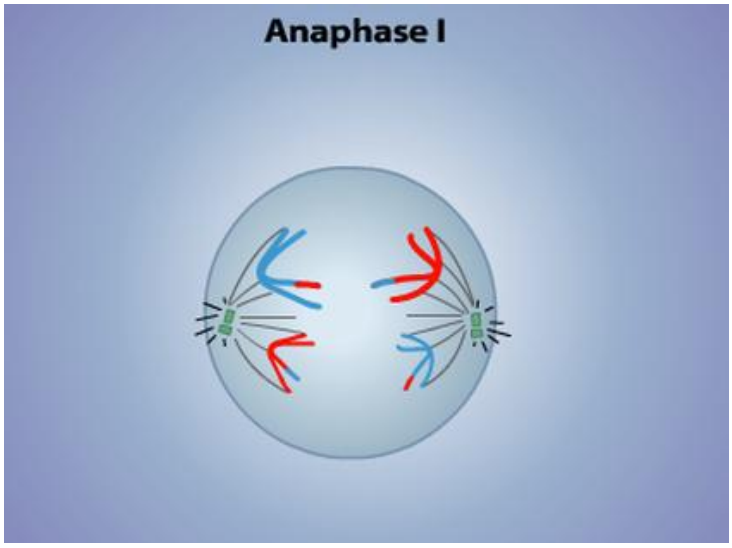
Metaphase I

The bivalent chromosomes arrange themselves around the equator and spindles attached to their centromeres



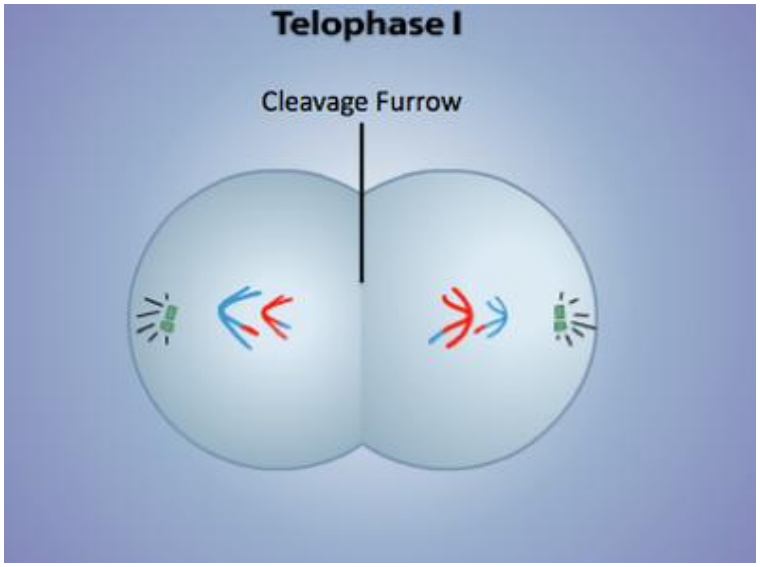
Anaphase I

The spindle fibres pull homologous chromosomes towards opposite poles of the spindle. This process separates the chromosomes into two haploid sets.



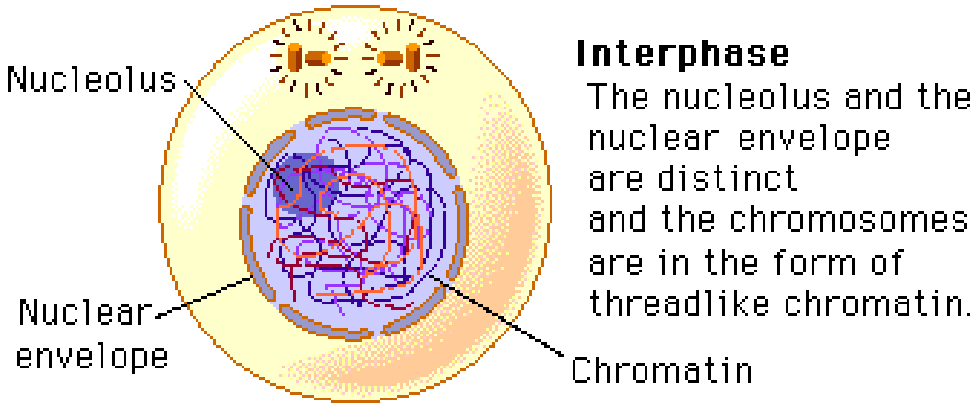
Telophase I

The end of meiosis I finishes, with the appearance of the homologous chromosomes at the opposite poles. The chromosomes still have two chromatids. This sets in the second meiotic division as the chromatids are not genetically identical.



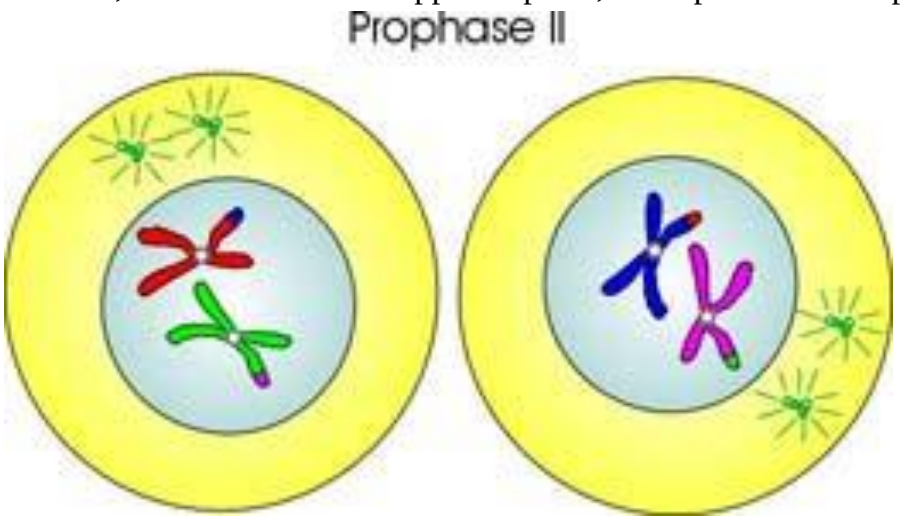
Interphase II

This stage is only observed in animal cells. No more replication of DNA occurs



Prophase II

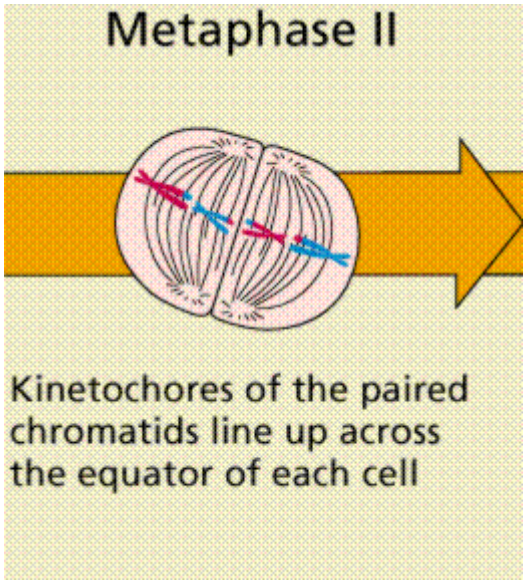
The nucleoli and nuclear envelopes disappears the chromatids shorten and thickens, centriole moves to opposite poles, new spindle fibres appear.



Prophase II

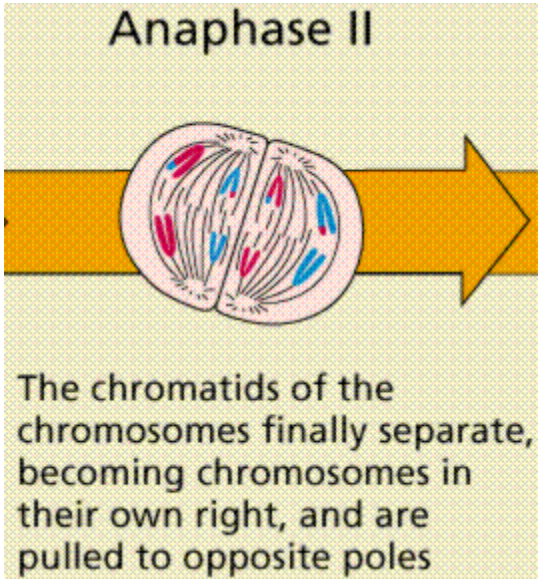
Metaphase II

Chromosomes line up separately around the equator of the spindle



Anaphase II

Centromere divides and spindle fibre pulls the chromatids to opposite poles



At the end of this phase the telophase II stage leads finally to four haploid daughter cells, spindles firbres disappear, chromosome uncoils becoming distinct. Nuclear membrane reforms around each of the four nuclei i.e. with haploid chromosome (n).

3.2.1 Significance of Meiosis

- Very important in sexual reproduction as it leads to formation of gametes with haploid number of chromosomes. These combine male and female during fertilization to form the zygote with 2n chromosomes (diploid). Without meiosis zygote formed as a result of fertilization would have resulted in the doubling of the chromosome for each sexually reproduced generation.
- Meiosis occurring provides opportunities for new combinations of genes thus giving rise to genetic variations. These variations occur because of the crossing over and independent assortment that occur in meiosis I.

4.0 Conclusion

In this unit, you have learnt that two types of cell divisions occur in living organisms these are mitosis and meiosis. The two are very important in the life of organisms as one leads to growth and development of the organism while the other ensures the production of the haploid chromosome sex cell. The two ensures cell development and cell reproduction.

5.0 Summary

In this unit, you have learnt that;

- two types of cell divisions occur in living things, they are mitosis and meiosis.
- mitosis leads to formation of new cells
- 5 distinct phases are involved in mitosis
- The phases include interphase, prophase, anaphase, metaphase and telophase
- Meiosis leads to formation of sex cells with haploid number of chromosomes
- Meiosis involved first and second mitotic divisions.
- Both mitosis and meiosis are significant in the life of the organism.

6.0 Tutor-Marked Assignment

1(a) Describe the stages involved in mitosis

(b) Describe the differences between mitosis and meiosis

2(a) Explain fully the significance of mitosis and meiosis in the life of living organisms

(b) What is the significance of crossing over in meiosis

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

UNIT 3: MENDELIAN LAWS AND KEY GENETIC TERMINOLOGIES

CONTENTS

1.0 Introduction

The work of Gregor Mendel in genetics continued to give explanations to how variations occur and their courses among living organisms. Gregor Mendel was born in Moravia in 1822. He studied natural history and mathematics in University of Vienna. He worked on inheritance in pea plants i.e. hybridization in plants and the different forms in which hybrid offspring appear and the statistical relationships between them. The pea plant that Mendel used had the advantage that the plant was easy to cultivate, also have varieties with distinct characteristics. In addition, pure breeds could be obtained from the plants. In this unit, Mendel's work on his first and second laws of inheritance would be discussed.

2.0 Objectives

By the end of the study of this unit, you should be able to:

- describe Mendel's experiment using the green pea and how Mendel came up with his first law i.e. principle of segregation.
- state the first law exactly
- describe the second law of Mendel i.e. the law of independent assortment
- use Mendel's principles to solve certain genetic problems
- explain the application of genetics to agriculture and medicine.

3.0 MAIN CONTENT

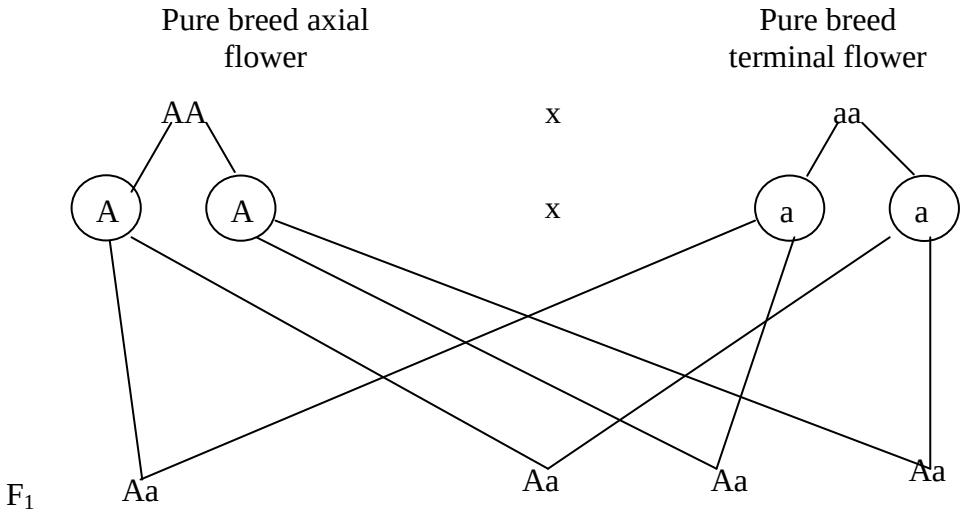
3.1 Mendel's First Law

Mendel selected plants of two varieties which had clear different characteristics i.e. plant with flower on the tip of the stem (terminal) and flower along the main stem (axial). He grew the plant for a number of generations and found that seeds from axial plant produced axial flowers while those from terminal plant produced terminal flowers. Using these pure breeds of plant he crossed and got the first generation hybrids which he called **First Filial Generation** or F_1 generation. He crossed pollinated the F_1 generation the following season, with that he produced the F_2 generation, which bore the character not shown in the F_1 generation. He counted 651 with axial flower and 207 with terminal of the 858 F_2 plants he got. Using several characteristics, same results were revealed. From here he summarized his work on inheritance involving single inheritance as follows.

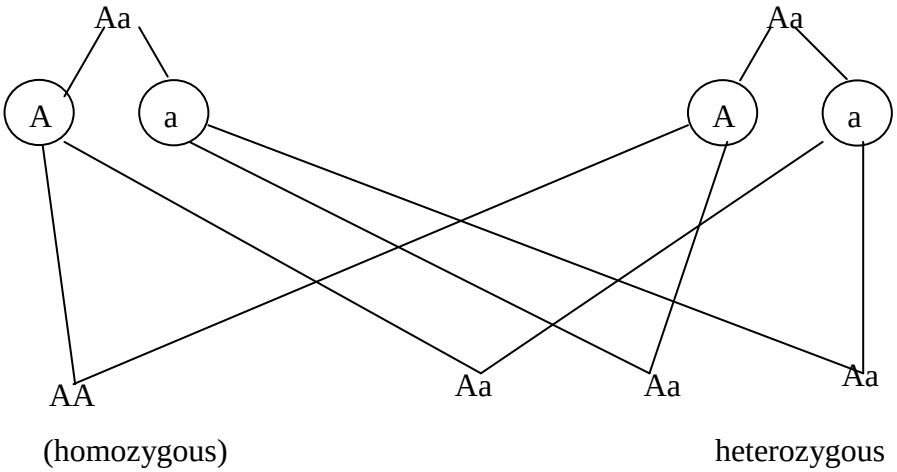
Parents	Axial Flower	x	Terminal flower
F_1		all axial flower	
F_2	651	axial flowers	207 terminal flowers
F_2 ratio	3	:	1

From these results Mendel concluded that each of the factors for both terminal and axial in each of the plants must have two factors each determining their characters. These were not shown in F_1 generation and one of the factors must be dominant over the other which he called the recessive. From these he drew his first law of principle of segregation that: the character of an organism are determined by internal factors which occur in pairs. Only one of a pair of such factors can be represented in a single gamete.

Today, these factors are called genes and the crossing described as monohybrid cross example:



When F_1 is self-crossed we have



With ratio 3:1

3.2 Mendel's Second Law

Having worked on a single pair of contrasting characters and that it was possible to predict the outcome of the cross, Mendel then worked on inheritance of two pairs of contrasted characteristics. This he called dihybrid inheritance. This time

around he used shape and colour as the characteristics. He crossed pure breed of homozygous with round and yellow pea with pure breed with wrinkle and green. F_1 generation were all round and yellow. The result of self pollination F_1 generation with 556 F_2 seeds he got:

315 round and yellow
101 wrinkled and yellow
108 round and green
32 wrinkled and green

The proportion thus is 9:3:3:1. This he called the dihybrid ratio from this result he concluded that the two new combinations of characters that appeared in the F_2 generation are wrinkled and yellow, and round and green. From this result he concluded that any one of a pair of characteristics may combine with either one of another pair in law of independent assortment.

3.2.1 Key Genetic Terms

Genetics is a subject that uses terminologies that are specific to it and very useful for the understanding of it. Some of these terms can be described as follows:

Genetic Term	Meaning
Gene	The basic unit of inheritance for a character
Chromosome	These carry hereditary materials and are found in the nucleus of the cell. Genes are located on the chromosomes.
Allele	One of a number of alternative forms of the same gene responsible for determining contrasting characters.
Homozygous	A diploid condition with alleles being identical
Heterozygous	A diploid condition in which alleles at a given locus are different
Locus	A position of an allele with a DNA molecule
Phenotype	Observable characteristics of an individual
Genotype	The genetic constitution of an organisms
Dominant	The allele that influences the appearance of the phenotype even in presence of an alternative allele
Recessive	The allele which influences the appearance of the phenotype only in the presence of another identical allele

4.0 Conclusion

In this unit, the work of Gregor Mendel on monohybrid and dihybrid cross was described. These are the bases of variation among organisms. The roles of dominant and recessive genes are shown.

5.0 Summary

In this unit, you have learnt that;

- Mendel is the scientist that worked on variations in characteristics
- the first law, the law on principle of segregation came up as a result of his experiments using pure breeds. The F_1 generation revealed heterozygous flowers
- the F_2 generation gave a ration of 2 heterozgous to 2 homozygous of AA and aa.
- the dihybrid in the F_1 generation gave all round and yellow while F_2 gave 9:3:3:1 ration results
- some terminologies are used in genetics. These include; gene, chromosome, allele etc.

6.0 Tutor-Marked Assignment

1(a) State and explain Mendel's first law of inheritance

(b) Construct an F_1 and F_2 generation for a pure breed of plant with characteristics tall and dwarf. Explain the results in each case.

2 Using the dihybrid crossing of Mendel, show the result of F_1 and F_2 generation for pure characters of long winged fly and vestigial-wringed fly

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

UNIT 4: CONCEPT OF MULTIPLE ALLELES

CONTENTS

1.0 Introduction

Genes are responsible for carrying character and they are located on the chromosomes. The genes present in the chromosomes are found in pairs, these are called alleles, and the coexistence of two or more genes in the same chromosome is called linkage. In this unit, blood groups, sex linkage and sex-linked characters will be discussed. Mutation which results from the different types of behavior of the genes on the chromosomes is also discussed. The advantages and disadvantages are highlighted.

2.0 Objectives

By the end of the study of this unit, you should be able to:

- state the different types of blood groups among human beings
- describe the different types of blood transfusion among human beings
- name the antibody/antigens in the different blood groups
- explain the rhesus group of blood types
- describe sex linkage and sex-linked character.
- list the different types of mutation
- state the advantages and disadvantages of mutation in organisms.

3.0 MAIN CONTENT

3.1 Blood Groups

There are four different groups of blood and the grouping is on the bases of the reactions between the blood of different individuals when mixed together, especially during blood transfusion.

3.1.1 Types of Blood Groups

These include type A, B, AB and O. These groupings are designated in capital letters, these capital letters stands for the types of antigens present in the person's red blood cell. The corresponding antibodies are carried in the plasma and are represented by small letters, a, b, ab, and o.

Suppose an individual has an antigen in his/her red cells, he cannot have the corresponding antibody in his plasma, otherwise agglutination will occur. This therefore means that a person belonging to group A has red blood cells containing type A antigens and the plasma will not contain type a antibodies but it contains type b antibodies. This can be summarized thus;

Blood	Type of Antigens (red blood cells)	Antibody type Plasma
A	A	b
B	B	a
AB	AB	Nil
O	O	ab

3.1.2 Use of Blood Grouping

Blood grouping is very important in blood transfusion. When blood of different groups, are mixed in a transfusion, what happens can be described in the table below.

Donor ↑

Recipient				
	Oab	Ab	Ba	ABo
Oab	✓	✓	✓	✓
Ab	+	✓	+	✓
Ba	+	+	✓	✓
ABo	+	+	+	✓

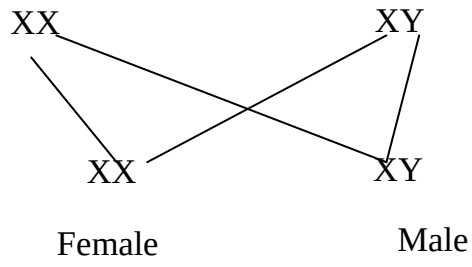
Those with ✓ are acceptable while those with + will not, as the blood will agglutinate when mixed. Based on this O group is referred to as universal donor while AB is regarded as universal recipient.

Another blood group was recognized and found common among white people. This is called Rhesus System. The red blood cells of the Rhesus individual contain antigen called Rhesus factor. Thus the blood is described as Rhesus positive. The other lacks the Rhesus antigen and as such called Rhesus negative. When Rhesus positive blood finds its way into a Rhesus negative recipient, the latter responds by producing the corresponding Rhesus antibody.

No agglutination happens, where a Rhesus negative recipient subsequently receives another dose of Rhesus positive blood, the Rhesus antibodies will cause agglutination of the donor's red cells thus resulting in fatal condition. This is a common situation during pregnancy where a Rhesus negative mother bears a Rhesus positive child.

3.2 Sex Linkage and Sex-Linked Characters

The chromosome that determines the sex of the individual is called sex chromosomes. In female organisms the two sex chromosomes are identical and called X chromosome. The genotype of the female is thus XX. In the male the two sex chromosomes differ i.e. X and Y thus male genotype is XY during fertilization, the zygote receives X from female and X or Y from male as illustrated in the diagram.



All the genes that are carried on the sex chromosomes are transmitted along with those determining sex, these are said to be sex-linked. Y chromosomes are genetically empty. So a male child who received the Y from the father cannot inherit any of the father's sex-linked traits, however the female who received X from the father can inherit the father's sex-lined traits. She can also transmit such to her children. Colour-blindness is an example of sex-linked characters in human being, haemophilia is another, which is called bleeder disease.

3.3 Mutation

3.3.1 Types of Mutation

Mutation is a genetic mechanism which resulted in a change in characteristics that is strikingly different from the rest of the population e.g. haemophilia and cystic fibrosis in humans. White eyes and vestigial wings, in Drosophilia etc. it is however a rare situation. Usually, mutation results in disadvantages on the organisms that inherit them. There are two major types of mutations.

i. Chromosome mutation
ii. Gene mutation

Chromosome mutation, occur as a result of a gross change in structure of the chromosome. This can be detected under the microscope. Chromosomes may intertwine, breaks into two loosing part of the chromosome, thus changing gene arrangement on it. The gene mutation, occur as a result of chemical changes in individual genes. This cannot be detected by microscope. Usually, the change is as a result of change in the sequence of nucleotide (DNA) i.e. change, in order of amino acid that makes up the protein. Example is sickle shaped cells of the haemoglobin resulting in sickle cell anaemia.

3.3.2 Advantages and Disadvantages of Mutation

Advantages

- In plants polyploidy leads to greater hardiness, resistance to disease among species
- Helps in the production of characters that could be beneficial.

Disadvantages

Causes diseases like

i. Sickle cell anaemia
ii. Down's syndrome patient with mental deficiency
iii. Klinefelter's syndrome i.e. with extra sex chromosome in XXY such person is outwardly male but cannot produce sperm and has some female features.
iv. Turner's syndrome X and Y chromosome are absent and such XO gene is the result. Such a person is sterile female with immature genitals.

4.0 Conclusion

The knowledge of how chromosomes and the genes work helps the understanding of concepts like the blood, sex-linked characters and mutation. This has contributed medically and socially in understanding and avoidance of abnormalities in the life of human being.

5.0 Summary

In this unit, you have learnt that;

- Genes are responsible for carrying characters and are located in chromosomes
- Gene are found in pairs of chromosomes i.e. alleles
- Sex linkage and the sex-linked characters
- Include blood groups, mutation etc
- There are four major groups of blood namely A, B, AB, and O.
- Each of these groups have antigens which are found in the red blood cells of the individual
- The corresponding antibodies are carried in the plasma and represented by small letters, e.g a, b, ab, and o
- Agglutination can occur where antigen/antibodies are not correctly matched
- Rhesus type is another type of blood group though not common

- Mutation - a sex linked characteristics occur either as chromosome or gene type.
- Mutation could be fatal or advantageous.

6.0 Tutor-Marked Assignment

1. Describe the antibody/antigens relationship in the blood groups of human being
2. What is Rhesus factor? Explain its occurrence and effects on a pregnant woman and the unborn child.
3. List the different types of mutation among animals. Explain each stating clearly how they occur.

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UNIT 5: GENERAL IMPORTANCE AND APPLICATION OF GENETICS IN AGRICULTURE AND MEDICINE

CONTENTS

1.0 Introduction

Genetics is importance in studying any living organism. Farmers, Nurserymen, Doctors, Scientists all need to be concerned with genetics. Farmers and nurserymen need to be interested in genetics of insect pests, and disease organisms. Animals farmers have created problems by overuse of antibiotics which has led to bacterial strains.

Plant breeding has long been used to increase crop yield and a new and better cultivated varieties of foods and ornamental plants. Recently, Genetic Engineering has become widespread in food crops and may become more important in farm animals.

In a area of medicine, genetics has had an important impact on area of inherited disorders medical research and practice. It has been beneficial to parents and families. Thus, genetics has gone a long way to touch lives of all living things within the short space of time that it become known.

2.0 Objectives

At the end of this unit, the student is expected to able to:

- Enumerate the benefits that genetics has contributed to crop yield
- Explain the ways genetics has affected animals production
- Describe how it has affected medicine.

3.0 MAIN CONTENT

3.1 Genetics and Agriculture

Genetics which began less than 50 years ago has gained such advancement that it is believed that over the next 25 years according to California Agriculture, the next significant changes in crops will come about by applying genetic engineering tools.

Self Assessment 1

What do you understand by crop genetic resources?

Crop genetic resources are the results of conscious selection from the wide range of natural diversity. Farmers selected the areas where they wanted improvement. The first area of selection was that of high yielding variety of crops.

This means that the crops will be plenty with the same characteristics in terms of their resistance to diseases and pests.

Self Assessment 2

What is the consequence of having crops with low resistance to disease and pest?

Having crops with low resistance to disease and pest can lead to high crop failure. Today most of the breeding aims are to maintain the already achieved yield level. In addition, whenever a valuable characteristic is obtained, it is used by numerous breeding further narrowing the genetic bases of crops. In addition, consumers with their precise requirements and specific preferences, also contributed to reduce genetic variability in farmers crops.

Self Assessment 3

Give example of discoveries that have brought improvement to crop breeders.

The discovery of dwarfing genes of wheat and rice from the primitive land races from Japan, and China triggered the "Green Revolution" which enabled this world to feed its living population. The process of selection has continued with emphasis to breed diverse types for different agro-climates and agro-ecosystems to combat biological stresses, which continue replacing the old with new varieties adopted to local conditions.

Hence, different varieties of rice have been developed e.g. IRRI brought out IR8 which gave way to IR20, which was succeeded by IR26 and then IR36. The late 1970s IR36 was the world's popular rice, but by 1980s' it was found susceptible to a new strain of brown plant hopper. Meanwhile, IRRI developed IR56. Similarly, plant breeders and associated scientist have developed other variety of other crops like CIMNYT-wheat, maize, barley, CIP potato, sweet potato etc.

Self-Assessment Exercise 4
Why is traditional crop breeding method not so popular today?

Today transgenic organisms offers an attentive to traditional methods of animal and plant breeding, this is because improving crops or domestic animals by traditional methods is a slow process which relies a lot on chance because of crossing over in meiosis and random segregation of chromosomes during sexual reproduction.

For example, it took 7 – 12 years to develop a new cereal variety.
Genetic engineering offers the chance to add new genes directly without relying on sexual reproduction.

Self-Assessment Exercise 5
Apart from crop-breeding, are there successes recorded in animal breeding also?

Animal husbandry has been practiced for thousands of years since the first animal was domesticated. Selective breeding for desired traits was first established as a scientific practice by Robert Bakewell during the British Agricultural Revolution in the 18^{th} century. One of his most important breeding program was with sheep. Using native stock, he was able to quickly select for large, yet fine-boned sheep, with long lustrous wool. The Lincoln long-wool was improved by Bakewell and in turn the Lincoln was used to develop the subsequent breed, named the New Leicester. It was homeless, and had a square meaty barely with straight top lines. These sheep were exported widely and have contributed to numerous modern breeds.

Under Bakewell's influence, English farmers began to breed cattle for use primarily as beef for consumption. (Previously, cattle were first and foremost breed for pulling ploughs as oxen).

Long-horned heifers were crossed with West moorland bull to eventually the Dishley longhorn.

Within the next ten years farm animals increased dramatically in size and quality. In 1700, the average weight of a bull sold for slaughter was 370pounds (168kg). By 1786, that weight has more than double to 840 pounds (381kg).

Self-Assessment Exercise 6
What really do you understand by animal husbandry?

Animal husbandry is the management and care of farm animals by humans for profit, in which genetic qualities and behavior, considered to be advantageous to humans, are further developed. It can also be defined as the practice of selecting breeding and raising livestock to promote desirable braids in animals for utility, sport, pleasure or research.

Self-Assessment Exercise 7
What are the breeding techniques used in animals?

Techniques such as artificial insemination and embryo transfer are frequently used today not only as methods to ensure that females bread regularly, but also to help improve herd genetics. This may be done by transplanting embryos from high quality surrogate mothers freeing up to the higher-quality mother to be re-impregnated.

This practice greatly increases the number of offspring which may be produced by a small selection of the best quality parent animals. It also improves the ability of the animals to convert feed to meat, milk or fiber more efficiently and improve the quality of the final product.

The disadvantage of this I that it decreases genetic diversity, increasing the severity of certain disease outbreaks among other risks.

Development in genetics today has led to use of genetic engineering in bringing about improvement in plant and animal breeding. Organisms that have been genetically altered are generally referred to as transgenic.

Self-Assessment Exercise 8

What is the transgenic technique seemingly preferred to the tradition methods of plant and animal breeding.

The transgenic technique is now preferred because they offer an existing new way forward in agriculture , they are faster in producing new variety of crops and animals as all you do is addition of new genes directly without relying on sexual reproduction. It opens up the possibility of 'designer' plants and animals with desirable properties such as disease resistance. Animals and plants become living factories for useful products other than food. However, some ethical issues being raised include questions about the well-being of the animals and the fact that new genes are being released into the environment.

What has been the main disadvantage of the traditional methods of improving plants and animals?

Improving crops or domestic animals by traditional methods is a slow process which relies a lot on chance because of crossing over in meiosis and random segregation of chromosomes during sexual reproduction. For example, it takes 7 – 12 years to develop a new cereal variety.

Self-Assessment Exercise 9

What then will be the aims and advantages of plant and animal breeding which might be subject of transgenic?

The aims in plant and animal breeding which are subject of transgenic are not so different from those of the traditional methods of breeding and they include:

- Increased yield
- Improved quality of food from the point of view of health or digestibility for example oil, fat and protein.
- Resistance to pests and diseases genes for resistance can be transferred from one species to another.
- Increasing tolerance of or resistance to environmental stress such as drought, cold, heat or crowded continents, for crops tolerance to wind damage, acid or salty soil, water-logged soil. Genes controlling stress responses can be isolated and moved from one organism to another.

- Rate of growth – including time from birth of planting, to maturity – the range of some crops might be extended by shortening their growing seasons.
- Lastly, herbicide resistance.

The advantages of transgenic include:

- A gene for a desirable characteristic can be identified and cloned.
- All the beneficial characteristics of an existing variety can be kept and just the desired new gene can be added.
- Sexual reproduction is not necessary.
- Transgenic is much faster than conventional breeding.

3.2 Genetics and Medicine

Everyone will agree that the science of genetics has had an important impact on medicine, primarily on inherited disorders, but increasingly also in wider areas of medical research and practice. There have been many real benefits to patients and families. Genes are seen to be responsible for severe inborn defects, but next were impossible to sure so that those affected die young and relatively cheaply.

Self-Assessment Exercise 10

What are some of the inherited disease that medical science has taken care of?

About a hundred years ago our enemies came from outside and they included microbes, violence and starvation. Today we are at less risk from infection, and hunger, we are now faced with enemy within. More and more people are being killed by our inborn weaknesses which play a part in heart disease, diabetes, and cancer among other illness. About 10,000 distinct genetic constitutions were listed - by recessive, dominant and sex-linked loci, while others are due to many genes of small effect.

Although, most of the illness listed are rare, the incidence of genetic damage as a whole is quite high. In population of European descent, about one child in 2,500 is born with cystic fibrosis disease. In parts of West Africa, one person in three carries a single copy of the sickle-cell allele, and by 2050 one child in 15 worldwide, will bear one or more copies of genes associated with abnormal red blood cells.

Self-Assessment Exercise 11
With the discovery of these genetically diseases, has medical research given us solutions to the problems?

So far genetics seems to have been able to solve the problem. Homozygous sufferers of sickle cell often die before the reproductive age, the heterozygous carriers have a selective advantage over non-carriers, and so are more likely to survive and pass on their genes to the next generation, because he/she is less susceptible to malaria. The final frequency of the gene in the population varies according to the amount of malaria. This is called balanced polymorphism.

Cystic fibrosis (CF) is the most common genetic disease of northern European and white North Americans. The gene responsible is autosomal (not associated with a sex chromosome) and recessive. The disease gets its name from the fibrous cysts that appear in the pancreases. It is of particular interest, not just because it is so common but because it is one of the first genetic diseases for which a cure has been attempted.

SELF ASSESSMENT EXERCISE 12
What is the treatment for this disease, how far has this been effective?

The treatment is concentrated on the lungs. It usually involves physiotherapy, as much as five times a day, including slapping the back to dislodge mucus from the lungs. Enzymes supplements can be given to improve food digestion and antibiotics to fight infection. In severe cases heart and lung transplants may be used. Much of the viscosity of the mucus is caused by DNA of dead infectious bacteria and dead while blood cells.

Some success of reducing this has been achieved using the enzyme human DNase in the form of an aerosol to breakdown the DNA. This is the most desirable treatment though it is a gene therapy.

What other ways has genetics help to improve medicine.
In treating other sickness, it is by screening to predict future health. Doctors routinely check their patients for high blood pressure, or glaucoma, breast cancer, prostrate cancer in men can be checked. DNA research brings about better

diagnosis with tests for a variety of disease, both inherited illnesses, and those that are through mutations in body cells.

Genetic tests are also likely to be useful in assessing the effectiveness of drug treatments. "Pharmacogenomics" began with the discovery the suxamethonuum a muscle relaxant used in surgery, was lethal to those few patients who had a rare version of a gene involved in nerve transmission. Now all are tested before the drug is used. It may now be a common thing to tailor medicines to patients. Individuals show very wide variation in their ability to deal with anti-cancer drugs, and as such a dose helpful to one genotype may be fatal to another. On the other hand certain drugs found to be toxic now may be found to be safe for use by some people.

4.0 Conclusion

Genetics has been found to be of great impact in the life of man in the area of crop and animal breeding in the area of agriculture. It is strongly believed with the development in transgenic food scarcity will be a thing of the past. In the area of medicine discoveries about gene composition will help in treating some genetic diseases, and in the area of drug use, gene composition might help to vary the dose of drugs for individual users.

5.0 Summary

- ✓ Improvement in crop production and animal husbandry was formally by traditional crop and animal breeding.
- ✓ Crop breeding was found to be taking a longer time (7 – 12 years) before getting the desired changes.
- ✓ Animal husbandry was by artificial insemination and embryo transfer.
- ✓ In the next 25 years however, more changes would have taking place through genetic engineering.
- ✓ This will result into crops with modified kinds of starch, oils and high-value proteins.
- ✓ In the medical field, changes are taking place through transgenic.
- ✓ The researches in this area might help in the treatment of genetic diseases like cystic fibroses. Work is still going on.

6.0 Tutor-Marked Assignment

1. In the area of crop production and animal husbandry, what are some of the aims of transgenic and what are the advantages?
2. Explain what cleaning is and of what use it is. In area of treating diseases, name some diseases that are genetically in origin. How far has medical science gone in treating these diseases?

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MODULE 2: GENERAL ECOLOGY

Unit 1: Inter specific Relationship
Unit 2: Intraspecific Relationship
Unit 3: Pest control
Unit 4: Types of Rangeland and Management
Unit 5: Ecology of Human Resources Pollution Population

UNIT 1: INTER SPECIFIC COMPETITION

CONTENT

1.0 Introduction

Individual organisms do not live in isolation in a community. They are always interacting with each other. The competition may be between individuals of the same species which is referred to as intraspecific competition or it could be between individuals of different species this is referred to as interspecific competition. The unit will treat each type of competition and their general effect of the population in the area.

2.0 Objectives

By the end of this unit the student should be able to :

- Itemize the different classes of interactions.
- Describe each type
- Define inter specific relationships in terms of the effects of organisms on each other.
- Describe the benefits of mycorrhizal relationships.
- Differentiate between predation and parasitism.

- Understand the effect of each types of interactions on population
- Identify which of the interactions are beneficial to both organism an ones are not.

3.0 Content

3.1 Inter specific Interaction.

The most obvious types of interactions are those that occur between two different individuals in a group. This is referred to as **Inter specific Interactions**. There are many of them and are classified according to the effect that individual species have on each other.

Effect can be true for the two organisms it is designated ++ , or it might be that one is benefitting the other is losing = , when interactions are harmful to individuals of both species it is negative and when one is benefitting and the other is not it is + 0.

These interactions are referred to as relationships. They include parasitism, mutualism, predation, commensalism competition and allelopathy.

"Some of these relationships are casual and temporary or more intimate and permanent e.g the mutualistic relationship between a hermit crab and sea anemone it carries on its shell, is not permanents, and they can live independent of one another.

Some mutualistic relationship are so intimate that the cannot live without each other. E.g the lichens – a combination of algae (which provide photosynthetic product and fungi which conserve water and provide carbon dioxide and mineral salts).

Self-Assessment Exercise 1

What do you understand by facultative and obligate relationships?

Facultative organisms are those ones that do not adopt a particular mode of life e.g aspergillums ordinary is a saprophytic fungus, which infect dead organic materials, if however the spores are inhaled by man, it infect the lugs and it begins to lead a parasitic mode of life causing the disease aspergillusis. Hence we have an

organism which can live both saprophytic and parasitic life successfully depending on the situation.

The organisms described as obligate are those ones compelled to follow a particular mode of life i.e whether parasitic or any other e.g obligate relationship exist between cattle and rumen bacteria, and between leguminous pants and nitrogen-fixing root—nodule bacteria.

Self-Assessment Exercise 2
What really is the overall effect of intra and inter specific completion in an ecosystem?

This competition for food, shelter, water and mates, provides a types of control on the population size. If the population grows but the amount of resources stays the same, the resources become limiting.

This means that the population can no longer increase in size.

Self Assessment Exercise 3
Explain the mycorrhiza association between a mushroom (a saprophytic) and a flowering plant.

The different types of interspecific Association include.
Mycorrhiza: a mutualistic association. A mycorrhiza means "fungus-root". Is a mutualistic relationship between the roots of a flowering plant and a fungus. An example is the relationship between the roots of a plant and a fungus. Such as the relationship between the silver birch (betula pendula) and the fly agric fungus (amanita muscaria). The fungal hypha grow into the soil from the root, they breakdown organic matter, releasing soluble nutrients (like phosphates, calcium salts and potassium ions. Some of these are absorbed by the fungus and passed on to the plant.

Apart from breaking down organic maternal the extensive network of hyphae provides a much longer surface area for absorption than the plant roots alone. The flowering plant in turn provides food for fungus in some cases as much as 40% of the glucose synthesized by a tree may go to its fungal partner. It is estimated that more than ¾ of all plants have mycorrhizal relationships in many habitats,

including beech woods, hyphae from the same fungus can form interconnecting mycorrhizal relationships with several species of plants. Although mycorrhizal relationships are facultative, many plant species such as the citrus trees grow much better with mycorrhizal and more resistant to some pests than these without a fungal partner.

Predators and Parasitics

Self-Assessment Exercise 4
Both parasitism and predation are both the type of interaction whereby one partner benefits, in what way do they differ?

A predator is any organism that use other live organisms as food i.e as an energy sources, thus removing them from the population. This definition of predators includes both herbivores that eat grass and parasitoids (these pacific organism that kill their host) e.g inchneumon fly wasp which lays its eggs in insect larva such as the grub of beetle. When the wasp which lays the larva emerges from the egg, it eats the grub alive. Thus it is not only big animals that are predators.

In the case of parasites they do not usually cause the death of their host directly but because them harm, in the process of obtaining food. Example is that of platihelminthes parasite living in mammalian hosts. The parasite gains food and shelter from the host, but causes the host to be malnourished.

Self-Assessment Exercise 5
Differentiate between commensalism and allocopathy.

Commensalism: One partner clearly benefits from the relationship and the other is not harmed. e.g hydractinia a small marine animal living in colonies on shell occupied by hermitcrab. It benefits from the relationship by being transported to new sources of food but the hermit crab neither gains nor lox anything. Though hydractinia belong to phylum nidana, and has shagging cells, it is probably too small to after crab any serious protection another type of interaction is allelopathy also a positive negative into reaction. One organism releases a chemical into the environment which is elemental to the other e.g sunflower plant releases chemicals from their roots and fallen leaves into the soil which prevent the germination of any other seeds apart from sunflower seeds in that place, thus giving the sun

flower a competitive advantage. Allelopathy is more common in plants than any other organism.

These interactions as described can be summarized in a table as shown below:
A table showing some Interspecific Relationships

Relationship	**Type of interactions**	**Comments**
Mutualism	+ +	Both partners benefits
Predator	+ -	One organism kills another for food
Parasitism	+ -	The parasite obtains nourishment from living tissue (it does not kill its host)
Competition	- -	The relationship is harmful to both species because they are unable to explain the resources as fully as they would in the absence of competition.
Commensalism	+ 0	One organism benefits, but there is no apparent effect on the other one
Allelopathy	+ +	One organism produces a chemical substance which has a harmful effect on another organism.

4.0 Conclusion

Thus it can be seen that in a community or an ecosystem, different kinds of relationships do occur between the different species. A number of these relationships are summand in a table. The interactions after help to check the population of a group as not allow it to grow exponentially.

5.0 Summary

The most obvious type of interaction are these one occurring between individuals in a competitions.

Interspecific interaction is that competition which occur between individuals of different species.

Some of the interactions are casual while other are facultative. Competition for resources can become limiting in a population.

Mycorrhiza association is a type of association which result in giving benefits two the two individuals involved. In predation and parasitoid one of the organism dies.

In parasitism the host still continue to live while the parasite eat out of the hosts food.

6.0 Tutor-Marked Assignment

What is the meaning of symbiosis?

Describe any two types of symbiotic association you know in this unit.

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UNIT 2: INTRASPECIFIC COMPETITION

CONTENT

1.0 Introduction

Intraspecific competition in an interaction in population ecology, whereby members of the same species compete for limited resources. Since member of the same species have very similar resources requirement, it makes intraspecific competition a stronger force in limiting population than interspecific competition. This type of competition can occur directly or indirectly. This unit will explain to us the different ways competition takes place and the outcome of this type of competition on the general population.

2.0 Objectives

By the end of this unit, the student would be able to:

- Define clearly what intraspecific competition is.
- Differentiate between direct and indirect competition.
- Explain what resources partitioning is.
- Explain the consequences of intraspecific competition.

3.0 MAIN CONTENT

3.1 Mechanisms of intraspecific completion

Organism in an environment often compete for shared resources such as food, water, space, light, mates or any other resources which is required for survival. These resources must be limited, and this why they have to compete. If the resources are not limited and it is in sufficient amount, then exponential growth of population follows. Exponential growth is rare in nature because resources are

finite and so not every individual in a population can survive, and this is what leads to intra specific competition increase growth rate of population also reduces making it a negatively density dependent process. As time goes on the rate of change rate of population density eventually falls to zero, this is the point ecologist refer to as the carrying capacity (k) the carrying capacity is the maximum number of individuals that can live stably in a population. If population is more than carrying capacity it will reduce until it get back to it, and it is less it will continue to increase until reaches the carrying capacity (k).

Self-Assessment Exercise I

Why do we have organisms competing for resources?

Self – Assessment Exercise 2

By what mechanism does intra specific competition occur.

Intra specific completion occur in two ways – by direct interactions between members of the same species (such as male deer locking horns, when competing for males) or by indirect interactions when an individual depletes a shared resources (such as grizzly bear catching a salmon that can then no longer be eaten by bears at different points along a river). This reducing the amount of food that can be available for the bear and thereby leading to reduction in population of bears, the terms used to described mechanisms by which competition occurs are divided in direct and indirect.

DIRECT: this is described as interference competition.

Self – Assessment Exercise 3

How does direct interference competition false place?

Interference Competition is the process by which individuals directly compete with one another in pursuit of resources it can be by aggression, fighting, stealing or ritualized combat. Direct intra specific competition also include animals claiming a territory which then excludes other animals from entering the area, to forage, survive or reproduce, or physically establish in a portion of the habitat. Such, organisms encountering each other during interference competition are able to evolve behavioral strategies and morphologies to out-compete rivals in their population.

For example populations of the northern slimy Salamander (Plethodon Glutinosis) have evolved varying levels of aggression depending on the intensity of intra specific competition. The more aggressive salamanders are more likely to obtain to require so to reproduce, where as the timid salamanders may store before reproducing, so aggression can spread through the population.

Self-Assessment Exercise 4
What other example of direct intra specific interaction do we have?

Another example of direct mechanisms is that of Chilean flamingos (Phoenicopterus chilensis) found that birds in a bond were much more aggressive than single bird. The paired birds were more likely to start on agonistic encounter to defend their mate or young ones, where as the single birds were typically non-breading and less likely to fight. Not all flamingos can mate in the population because of an unsuitable sex ratio r some dominant flamingos mating with multiple partners. In many species of animals mates are fiercely contested resources as production of offspring is important for an individual to propagate its genes.

Self-Assessment Exercise 5
How does indirect competition occur?
Indirect competition can occur by exploitative or apparent competition.

Exploitative competition occurs when one individual depletes a shared resource, and resulting in suffering of fitness of both organisms. The organisms involved may not actually come into contact and only interact through shared resources indirectly.

E.g. Juvenile Wolf Spiders (Schizocosa ocreata). Food is a limiting resources among these organisms. The food increase the density of the population of the juvenile ones, but the reducing available food lower the growth of individual spiders. So as population density of the juvenile increases, the growth rates continuous to fall and could potentially reach zero.

Exploitative competition also occurs in plants, they are rooted to a specific area and they utilize the resources in their immediate surroundings. The young plants

compete for light, most of which will be blocked and utilized by taller trees. These young plants can be out-competed by larger members of their own species.

Self Assessment Exercise 6
How does the plant avoid exploitative competition?

Plants over come this problem by their seeds being dispensed for away from the parents, seeds that grow close to their parent always stand a high chance of being out-competed and die.

Self-Assessment Exercise 7
Under what condition does apparent competition occur?

Apparent competition occurs in population that are predated upon. An increase in population of the prey species will bring more predators to the area, and this increases the risk of an individual being eaten therefore reducing its survivorship.

The individual here are not interacting directly but it suffers as reduction in fitness. This can happen in a situation where two different species of organisms in New Zealand, native skinks (Oligosoma) suffered a large decline in population when rabbits (oryatolagus cuniculus).

Both skinks and rabbits were eaten by ferrets (Mustela furo), so when rabbits resulted in immigration of ferrets to the area which reduced the population of skinks.

Self-Assessment Exercise 8
What other types of competition do we have?

3.2 Resources Partitioning

Other types of competition are that which is referred to as resources partitioning. There are also two types contest and scramble.

Contest competition takes place when a resources is associated with a territory or hierarchical structure within the population for instances white-faced capuchin monkeys (Cebus capucinus) have different energy in takes based on their ranking

within the group. Both males and females compete for territories with the best access to food and the most successful monkeys obtain a disproportionately large quantity of food and therefore have a higher fitness in comparison to the subordinate members of the group.

In some instance the contest for resources may not be dangerous like the case of male adders (Vipera berus) which undertake complex ritualized confrontations when counting females. The larger male will win and fights rarely escalate to injury to either combatant.

In some other cases, the resources may be so priced that potentially fatal confrontations can occur in order to acquire them. For instance the male elephant seals. Mirounga augustirostris, engage in fierce competitive display in order to control a large harem of females with which to mate. There is an uneven distribution of females and subsequent reproductive success among the males. The reproductive success of most of the males is zero, because they die before breading age, or are prevented from mating by higher ranked males. It is just a few dominant males that account for the majority of copulations.

Self-Assessment Exercise 9
What is the impact of contest competition on population?

Contest competition results in relatively stable population changes. The uneven distribution of resources results in some individuals dying off, but helps to ensure that the members of the population that hold a territory can reproduce. As the territories in an area stays the same over time, the breading population remains constant which produces a similar number of new individuals every breading season.

Self-Assessment Exercise 10
How can one differentiate scramble from contest competition?

Scramble competition occurs where there is a common resources pool that an individual can be excluded from. It however involves a more equal distribution of resources than contest competition. For instance, grazing animals compete more strongly for grass as their population grows and food becomes a limiting resource.

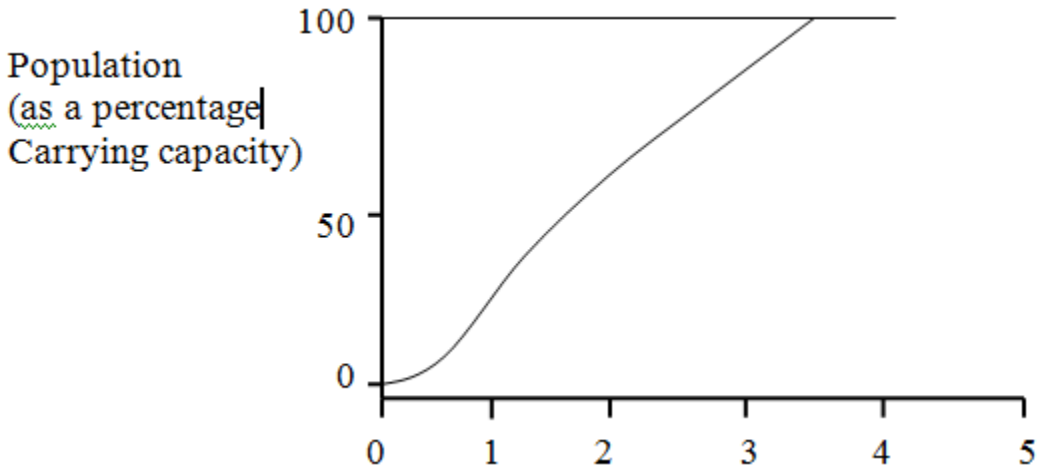
Each herbivores receives less food as more individuals compete for the same quantity of food.

Self-Assessment Exercise 11
What is the resultant effect of scramble competition?

Scramble competition results into instable population dynamics. The equal distribution of resources can result in very few of the organisms obtaining enough to survive and reproduce and this can cause population crashes, this is called over compensation. For example the caterpillars of cinnabar moths feed by scramble competition, when there are too many of them that are feeding very few of them develop into pupa and there is a large population crash. Subsequently very few cinnabar moths are competing intra specifically in the again grows rapidly before crashing again.

Self-Assessment Exercise 11
What are the consequences of intra specific competition?

The main effect of intra specific competition is reduced population growth rates as population densely increases. When resources are infinite, intra specific competition does not occur and population can grow exponentially. Through exponentials population growth is rare, it has been documented in humans since 1900. (May be due to advancement in food production and health facilities). Elephants (Laxodonta Africana) populations in Kruger National Park (South Africa) also grew exponentially in the mid – 1900 after strict poaching controls were put in place.



Population growth against line in a population growing logistically. The steepest parts of the curve are where the population growth is most rapid.

The logistic growth equation is an effective too for modeling intra specific competition despite its simplicity and it has been used to model many real biological system.

The equation is as follows:

$$\frac{dN(t)}{dt} = rN(t)\left(1 - \frac{N(t)}{k}\right)$$

Key

dN(t)	=	range of change of population density
N(t)	=	population size at time t
r	=	per capital growth rate
k	=	carrying capacity

At low population densities, N(t) is much smaller than k, and so the main determinant for population growth is just the per capital growth rate.

However as N(t) approach the carrying capacity the second term in the logistic equation becomes smaller, reducing the rate of change of population density.

Initially the logistic growth curve is similar to exponential growth curve, when population density is low, individuals are free from competition and can grow rapidly. As the population reaches its maximum (k) intraspecific becomes fiercer and the per capital growth rate slows until the population becomes stable. At the carrying capacity (k) the rate of change of population density is zero because the population is as large as possible based on the available resources.

Experiment on growth rate of Daphnia showed a notable adherence to the logistic growth curve. The inflexion point in the Daphnia population density graph occurred at about half the carrying capacity as predicted by the logistic growth model.

4.0 Conclusion

This unit has nearly exhaustively treated intra specific competition, which occurs organisms of same species it occurs as form of Direct and Indirect mechanism and as resources portion consequently it was seen that when there is a large amount of resources population can grow exponentially. Growth slows down when the environment reaches its carrying capacity.

5.0 Summary

Intraspecific competition is that which occurs within species. Organisms compete for resources like food, shelter, mates, qur, light space, water.

Direct competition organisms struggle with one another for resources it could be by aggression, fighting, stealing or ritualized combat.

Indirect competition occurs by exploitative or apparent competition resources partitioning has to do with fighting to dominate the resource within a territory or a hierarchy.

Intraspecific competition leads to reduced increases, as this will lead to depletion of resources.

6.0 Tutor-Marked Assignment

- How will you define intra specific interactions? How has this affected man?
- Describe in your own way various ways in which it occurs in man.

7.0 Reference/ Further Readings

Kent, M. (2006) Adavnced Biology Oxford University Press.
Wikipedia (2014) Intraspecific competition.

UNIT 3: PEST CONTROL

1.0 Introduction

A pest is any organism that people find undesirable. They can destroy a large percentage of crops. In tropical countries where high temperatures allow pest populations to grow quickly, pests can destroy 8% of Irish potatoes, 25% of cereal grains, 44% of carrots, and 95% of sweat potatoes, either in the field or in storage. In the field many insects such as locusts cat leaves reducing the leaf-area index, and lowering the primary production efficiency.

Leaf are index or LAI, is the total leaf area exposed to sunlight for photosynthesis. Thus it is clear the machinery must be put in motion to control these pests, in order to minimize their bed effect in order to reduce economic losses in a settlement. This unit will now look at the various methods used to control pests and their effectiveness.

2.0 Objectives

By the end of this unit the student should be able to:

- Explain what a pest is.
- Describe the various methods of pest control
- Explain the advantages and the disadvantages of each type.

3.0 Content

3.1 Cultural and Chemical Control

A pest is any organism that people find undesirable. Ti may cause harm economically or affect some one's health.

Self Assessment Exercise I

What condition in Agriculture favor pest infestation?

The most noticeable area of pest infestation is in area of agriculture agricultural pests cause great damage to crops and livestock in farming the condition monocultures in which only one crop is grown favours pest infestation one reason is that with just one crop type being grown, the system lack natural predators of pests.

Most pests cause economic losses only if they reach economic INJURY LEVEL. Thus the famer should net allow them to reach this level before they are being controlled if pest are not controlled they will not be able to produce enough food to feed the teaming world population.

How do you control fast growing pest populations from reaching economic injury level?

Graph

This can be done by controlling the pest before they reach economic injury level. That is control starts for all pest at the economic DAMAGE THRESHOLD.

There are different methods of pest control they include chemical. Biological cultural and integrated pest management. In this subunit we shall discuss the chemical and cultural methods.

Self Assessment Exercise 2

What do you understand by chemical control of pest?

This is the use of toxic chemicals to control pest population such chemicals are referred to as pesticides. There are many of and they include fungicides, herbicides and insecticides. Some kill the pest on having contact and are called CONTACT PESTICIDE they pendrate the cuticle. We also have the systematic pesticides

these are taken into the plant trans located within the plant, and kills the pest when it eats the plant or sap.

Self Assessment Exercise 3
What are the characteristics of a good pesticide?

The ideal pesticide is cheap, effective, specific (i.e affects only the target species) and is broken down quickly to form harmless substances.

Modern pesticides have planed on essential part in feeding an increasing world population, but most of them have one or more undesirable features.

Some pesticides are of broad spectrum an thus affecting a wide ranges of pest, it may also kill some harmless of the pest.

Self Assessment Exercise 4
State some of the disadvantages of using chemicals methods to control pests?

- Some of the chemicals may be non-specific (broad-spectrum) and kill the beneficial ones.
- Pest may develop resistance to the pesticide.
- Pesticide like DDT which are quite stable may enter the food chain, accumulate and harm other organisms that eat the plants.
- Chemical residues may cause harm to humans.

Self Assessment Exercise 5
What are scientist doing in order to find solution to the problems of chemical pest control?

Scientists are continually searching for other methods of pest control of agricultural crops. One of such method is the cultural methods such as weeding, tillage and crop rotation among others.

SELF ASSESSMENT EXERCISE 6
How do weeding and tillage help to control pest?

Weeding and tillage help to remove weeds which can attract pest to crops, while tillage help to overturn the soil and may expose pest like worms and grubs of some beetles to predatory birds.

Crop rotation help to prevent the build up of pests that occur in monoculture. But it is only effective when pest cannot affect successive crops. Crop rotation can be done by interchanging root crop like potatoes with grains like maize or sorghum.

SELF ASSESSMENT EXERCISE 6

Are there other cultural practices for pest control?

Crop damage can be reduced by growing crops at a particular time in the life cycle of the pest. These crop is sowed or harvested at times when the pest can do little damage stage. For instance infestations of maize crop by the maize weevil (sitophilus zeamays) can be reduced by harvesting the maize before the adult beetle emerges from stores of maize.

Still other cultural methods of pest control include:

- Removing the remains of crops and badly damaged plants which might harbor pests.
- Creating physical barriers (for example apple trees are protected from codling moth caterpillars by putting sticky bands on their trunks).
- Covering the soil with organic material (mulching) which prevents light from reaching weeds.
- Inter cropping planting two different crops in the same field; for instance mixing soya bean with grains may cause the predators of grains aphids like lady bird to eat the aphids, as they have a voracious appetite for aphids.

Self Assessment Exercise 7

What do you understand by biological pest control measure?

Biological Pest Control

This is the use of natural enemies to control pests. This can be done by introducing various predatory insects or mites or parasitic wasps on pest by infecting the nemadodes which is the pest with bacteria disease.

Self Assessment Exercise 8
What is the aim of biological control?

The aim of biological control of pest is not wipe out the pest as this will also wipe out the predator, but it in to reduce the pest to below economic injury level.

Self Assessment Exercise 9
What are example biological control?
Examples of biological control organisms in natural environment include:

The introduction of the caterpillars of the moth cacto blastis which have been used to control the population of prickly pear cactus successfully. Prickly pear is a desert plant native to Arizona, but was introduced into all the desert of the world. It has become a pest today because it has crowded out the natïve species. In Australia, by 1925 it has occupied 240, 000km^2 of what was previously regarded as rangeland. By the introduction of the caterpillars the cactus has been successfully controlled.

A bacterium – bacillus thuringiensis, applied as a spray to cabbage plants infected with caterpillars. The bacterium infect and kills the caterpillars without harming other insects.

Home Assignment read more about other examples of biological control.

SELF ASSESSMENT EXERCISE 10
What do suppose would be the advantages of biological control of pest?

Pests in whatever form whether insects weeds or worms, can be annoying, they can devastate the world's ecosystems and agriculture by disrupting the fragile balance sustained by the natural diversity of organisms. Biological control is an alternative to pesticides and poisons that can offer some distinct advantages and disadvantages.

Advantages

1. In most cases, the predator introduced only control the population of pest they are meant to target, making it better than using chemical or chemicals can also destroy fruit-bearing plant.

2. The natural enemies introduced to the environment are capable of sustaining themselves.
3. Biological control can be cost effective in the long run. Although it may be costly initially to introduce a new species into the environment, it only need to be applied once because of its self-perpetuating nature.
4. It is an effective method, as whatever pest population you want controlled will be controlled, because the predator introduced will be naturally in dined to target the pests and very often the pest population will dwindle.

Self Assessment Exercise 11

What are the disadvantages of biological control?

1. It can be fickle. Ultimately you cannot control whatever natural enemy you release into an ecosystem. While it is suppose to manage one pest, there is always the possibility that your natural enemy will switch over to some thing else. Also by introducing a new species to an environment, there is the risk of disrupting the natural food chain.
2. It's a slow process. It takes a lot of time and patience for the biological agents to work their magic on a pest population, whereas other methods like pesticide work provide immediate results. The good thing is that biological control has long term effect.
3. Biological control does not wipe out all the pest completely because the can only survive if they have something to eat, so lalling all the pest will risk their own safety.
4. While it is cheap in the long rain, setting up a biological control system is very costly, a lot of planning and money inside before it develop into a successful venture.

Self Assessment Exercise 13

What other type of management of pest do we have?

The next type of pest-control that we have is the integrated type. In practice, no single type of pest control is ideal. The food and united nations recommended the use of all suitable methods to maintain the pest population at a level below the economic injury. After considering fully the environmental context and biology of the pest. This is what Integrated Pest Management (IPM) is all about.

It is actually the blending of all effective, economical, and environmentally sound pest control methods into a single but flexible approach to managing pests.
Users of IPM approach understand the importance of the controls provided by nature.

When humans need to intervene the least invasive practices such as plant resistance biological control and cultural control should be used because these are the practices that fit best into sustainable agriculture. Highly disruptive or environmentally damaging practices should be used only as a last resort. When you need to is pesticides use products not dangerous to the natural enemy. The natural enemy population should be monitored so that their impact on pest can be determined.

IPM, is a dynamic and evolving practice specific management strategies will vary from crop to crop, location to location, and year to year, based upon changes in pest populations and their natural control. Practitioners must be current modern pest managers will be most effective if they are knowledgeable about their pests, and all of the control options available.

4.0 Conclusion

This unit has dealt with several methods of pest control. All of them with their various advantages and disadvantages have shown that the farmer must need to control best either on the farm or at the level of crop storage. He/she therefore need to be knowledgeable about the pest and the environment he/she is living in, so as to pick the right method in practice, the integrated pest management method is the best in which you compare a number of methods.

5.0 Summary

In this unit you have learn that what is:

- Pest cause economic damage to crops and farm animals.
- It is not possible to eliminate all.
- Meet pests cause significant/economic harm only when their population reaches economic injury level.
- Control must start at the economic damage threshold.
- Pest can be controlled by biological chemical, by cultural and integrated pest control.

- Chemical control involves the use of toxic chemicals called pesticides.
- Biological control involves control of pest weeds by use of natural enemy.
- Integrated pest control is the use of all suitable methods to maintain the pest population at a level below the economic injury level.

6.0 Tutor Marked Assignment

a. Explain what you understand by a brood-spectrum pesticide?

Whitefly is a common pest of green house crops that is parasitized by a wasp, Encarsia Formosa. The temperature requirements of the wasps are more critical than those of the whitefly;

- Wasp populations do not survive temperature below 10^0C.
- Wasp population growth matches that of the whitefly population above about 18^0C.
- Wasp reproduce much more rapidly than the whitefly at temperatures above 26^0C suggest the implications of these observation on the use of the parasitic wasp to control whitefly population in green house.

7.0 Further Reading/ References

Kent, M. (2010) Advanced Biology

Landis, D.A & Orr, D.B (2013) *Biological control: approaches and applications*. Radcliffs IPM WORLD TEXT BOOK. University of Minnesota. http://ipmworld.umn.edu/chapters/landis.htn.

BEEP BIOETHICS Education Project
http://www.beep.ac.uk/content/406.0.htm/

UNIT 4: RANGE LAND

1.0 Introduction

Range lands are vast natural landscapes in the form of grasslands, shrub lands, wood lands, wet lands and deserts. They are usually characterized y natural vegetation, and without any human interference. They are of different types and they include tall grass and shat grass prairies, desert grass land shat grass prairies and shrub lands, woodlands, savannas, chaparrals steppes and tundras. Range lands do not include barren deserts, farmland, closed canopy forest or land covered by solid rock, concrete and/or glaciers.

2.0 Objectives

By the end of this unit students should be able to:

- List the types of range land.
- State the characteristics of each type
- State the use of range land
- Explain the management practice in different rangeland in the different location.

3.0 MAIN CONTENT

3.1 General characteristics of range lands and the different types

Rangelands are different from pasture lands in that they grow primarily native vegetation rather than plants established by humans. They are managed principally with extensive practices such as managed livestock grazing and prescribed fire rather than more intensive agricultural practices of planting seed, irrigation and use of fertilizer.

Self-Assessment Exercise 1
What are range lands used for?
Why are they important?

Rangeland produce a wide vanity of goods and services desired by society, including livestock forage, wild life habitat, water, mineral resources, wood products, wild land recreation open space and natural beauty.

The geographic extent and the many important resources of range lands make their proper use and management vitally important to people everywhere.

Self-Assessment Exercise 2
What are the different types of range land in the world?

There are about eight recognized types of range lands in the world. This bit of the unit will focus on them and their characteristics they include:

- Prairie: These are considered part of the temperate grasslands, savannas and shrublands biomes by ecologist, based on similar temperate climates, moderate rainfall, and grasses, herbs and shrubs rather than trees are the dominant vegetation type. Temperate grassland regions include the Pampas of Argentina, and the Steppes of Eurasia.
- Grasslands: Grasslands are areas where vegetation is dominated by grasses (Poaceae) and other herbaceous (non-woody) plants (forbs). We also find sedge (cyperaceae) and rush (juncaceae) families can also be found. Grassland occur naturally on all continents except Antarctica. In temperate latitudes, such as northwest Europe and the Great Plains and California in North America, native grasses are dominated by perennial bunch grass species, whereas in warmer climates annual species form a greater components of the vegetable.

Steppe
In physical geography steppe refers to a biome region characterized by grassland plain without trees apart from those near rivers and lakes. The prairie (especially the short grass and mixed prairie) is an example of steppe, though it is not usually called such.

It may be semi-desert, or covered with grass or shrubs or both depending on the season and latitude.

Self-Assessment Exercise 3
In what way(s) will you say the steppe is different from a typical prairie?

The term steppe is usually used to denote the climate encountered in regions too dry to support a forest, but not dry enough to be a desert.

Pampas
Pampas are the fertile soil of South American lowlands that include the Argentina provinces of Buenos Aires, La Pampa, Santa i.e, Entre Rios and Cordoba, most of Uruguay, and the state of Rio Grande do Sul, in the southern most end Brazil covering more than 750,000km^2 (289,577)5qmi. These vast plains are only interrupted by the low ventana and Tandil hills near Bahia Blanca and Tandi/(Argentina) with a height of 1,300m (4,265ft) and 500m (1,640ft) respectively.

Self-Assessment Exercise 4
What makes the Pampas seems more productive the other rangelands so far discussed?

The climate is mild, with precipitation of 600mm (23.6inch) to 1,200m (47.2inch) more or less evenly distributed through the year, making the soil suitable for agriculture.

This area is also one of the distinct physiographic provinces of the Parana-Paraquay plain division.

These plains contain unique wildlife because of the different terrains around it. Examples of wildlife found in this area includes-rhea, the badger and the prairie chicken.

SELF-ASSESSMENT EXERCISE 5
What other rangelands still exist in the world?
Other rangelands include the shrub land wood land, savanna, desert and tundra.

Shrub land

This is a plant community characterized by vegetation dominated by shrubs often also including grasses, herbs and geophytes. It may either occur naturally or as a result of human activity-such as abandoned farmland. It may be the mature vegetation type in a particular region and remain stable over time, result of succession or a transitional community that occur as a result of a disturbance, such as fire. A stable state may be maintained by a regular natural disturbance such as fire or browsing. Shrub land may be unsuitable for human habitation because of danger of five which occur naturally.

Another type of rangeland is the wood land.

SELF-ASSESSMENT EXERCISE 6

How is wood land different from real forest?

Wood land is a low-density forest forming open habitats, with plenty of sunlight and limited shade. It may support understory of shrubs and herbaceous plants including grass. This is different from a high-density areas of trees, with largely closed canopy, which provide extensive and nearly continuous shade. This is called forest, and a forest is not referred to as a range land.

Savanna

This is a grassland area found in the tropics. They are characterized by small trees, and widely spaced so that we do have closed canopies. The open canopy allow enough light to reach the ground to support an unbroken herbaceous layer consisting primarily of C_4 grasses.

This type of grass land in Australia and west Africa is called savanna, but in south Africa it is referred to as veld.

Desert

A range land where the region receives an extremely low amount of precipitation less than enough to support the growth of most plants. The average annual rainfall is less than 250mm (10inch) per year or areas where more water is last by evapo-transpiration than falls as precipitation.

Self-Assessment Exercise
What do you understand by evapo-transpiration, of what use is it in nature? How is it different from precipitation?

Lastly we have the Tundra type of there tree growth is hundred by low temperatures and short growing seasons. The vegetation is composed dwarf shrubs, sedges and grasses, mosses and lichens. Scattered trees grow in some tundra. The ecological boundary between the tundra and the forest is known as tree line or timberline.

This content is an indication that range land is vast and extensive this made evident in the next section.
Below is the map of world range land

We shall look at some continents and their range lands.
North American range lands

Self-Assessment Exercise 7
What is the constitution of North America, and how much of it is mode up of range lands?
North America is made up of Canada and the united states of America, each has vast land as range lands.

Canada
Rangeland is a prominent feature of rural Canada and they have different laws and policy regarding the use of rangelands across the counting. Certain rangeland are preserved as provisionally protected areas, similar to parks while other are managed as community resources. The vegetation is composed dwarf shrubs, sedges and grasses, mosses and lichens. Scattered trees grow in some tundra. The ecological boundary between the tundra and the forest is known as tree line timberline.
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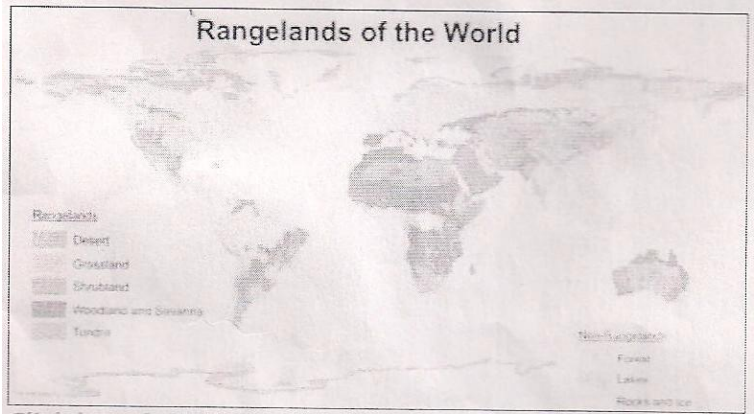


We shall look at some contents and their rangelands.
North American rangelands

Self-Assessment Exercise 8
What is the constitution of North America, and how much of it is made up of range lands?
North America is made up of Canada and the united states of America, each has vast land as rangelands.

Canada
Range is a prominent feature of rural Canada and they have different laws and policy regarding the use of rangelands across the country.
Certain rangelands are preserved as provisionally protected areas, similar to parks while others are managed as community resources.

Self-Assessment Exercise 7
Can you give examples of where rangelands are presented as parks and other as grazing lands.

In Alberta since 2003, there has been a legislation allowing the creation of "Heritage Rangelands" within the parks system. As at 2012, two more rangelands were created and 6 others of been proposed. There are also 32 provincial grazing reserves located through. Alberta, administered as public lands by Alberta sustainable resource development.

Self-Assessment Exercise 8
What can you say about range land in the United States of America?

In the United states of America (USA) 36% is considered rangelands. The western side of USA is 53% rangelands. Around 399 million acres of rangelands are privately owned. The Bureau of land management manage 167million acres (676,000) of publicly owned rangeland with the USA forest services managing about 95million acres (380,001k^2).

Ranchers may lease portions of this public rangeland and pay a fed based on the number and type of livestock and the period of which they are on the land.
Historically much of the land in Western USA was used for grazing and much of some states still is. In many of these state, such as Arizona, an open-range law applies which requires a land owner to fence cattle out rather than in, thus in theory cattle are allowed to roam free. In modem times open-range laws can conflict with urban development as occasional stray cows, bulls, or even hards wander into subdivisions or onto highways.

Self-Assessment Exercise 9
What can you say about the range lands in Australia?

About 75% of Australia's land mass is rangeland, 33 of Australia's 85 bioregions have rangelands. In Western Australia range land cover 87% of the state's 2.5million square kilometers Australian range lands plays a great note in the nations economy, including Australia valuable mining industry ($12billion/yr) tourism ($2billion/yr), pastoralism ($5.5billion/yr – cattle $4.4billion 8 & sheep & 1billion).

Self-Assessment Exercise 10
What is the importance of rangeland to

- Australia?
- Please take this up to the star.

Self-Assessment Exercise 11
What Characterize Australian rangeland.

Australia rangelands is characterized by low rainfall and variable climates which include semi and high rainfall areas.
They are important in biodiversity, income social and cultural heritage, sub-artesian water green food and fibre production, and carbon storage. It has up to 1,800 types of plants and 605 vertebrate animals which have currently been identified.

Range lands are managed by Australia's department of Agriculture, fisheries and forestry.

Self-Assessment Exercise 12
How can you describe the south American Range lands?

Rangelands cover about 33% of the total land area. South American rangelands are locate in regions with climate ranging from and to sub-humid, with annual precipitation in these areas ranges from approximately 150 to 1500mm (6-60 inches). They include grasslands, shrublands, savannas and hot and cold desert.

E.g Patagonian steppe, the Monte, the Pampas, the "Lianos" or "Cerrado", the "Choice" and the "Caatonga". The change in the intensity and location of tropical thunderstorms and other weather patterns is the driving force in the climates of southern south America.

Self-Assessment Exercise 13
Are the range lands in Africa like these we have earlier discussed?

Africa
Rangelands abound in Kenya Africa, it takes up about 85% of the land surface. It is largely inhabited by nomadic pastoralists who are largely dependent on livestock. African rangelands are characterized by a diverse floristic mosaic. Patches of edaphic grasslands and pure shrub thickers can be mixed with open canopy savannas and wooded Acacia steppes.

Lastly – Asia – China
In the past, range lands in western China supported a pasrtoral economy and large wildlife population. Now the rangelands have shrunk due to population growth,

economic, government, and social factors. Rangeland types in China include: Semi-desert, Dry Alpine Grasslands, Alpine Dwart shrub, wetland types.

3.2 Rangeland Management

One of the main problems facing researches today is the management of rangeland for sustainable development. This problem is more acute in developing nations likes in Africa, where both colonial and post independence governments have invested funds in rangelands with particular emphasis of developing pastoralism, but have in must cases failed to achieve sustainable resources use. Much of the problems is as a result of the ecological and climatic characteristics of rangelands and the urge to transform socio-economic institutions controlling rangelands under pastoralism, and equate them with institutions governing other farming system. However poverty coupled with the ever increasing human demands due to population growth has contributed to poor farming practices leaning to degradation of range lands.

Self-Assessment Exercise 1

What are the various uses of rangelands?

Uses of rangelands include grazing, mining, tourism, hunting and wildlife reserves and national parks.

Grazing is an important use of rangelands though rangeland is not synomous with grazing land and vice versa, as we can see there are other uses for rangelands.

However in vertically every nation where there vast range lands, there is no place where it is not used for grazing. Thus in talking about the management of rangelands it will be how it is managed for grazing more.

Self-Assessment exercise 2

In the light of the above how then can one manage grasslands and rangelands?

In managing grasslands and rangelands one must take into consideration the following:

Grassland development and rehabilitation, pasture development methods, herd management and socioeconomic and environmental factors.

Grasslands development, improvement and rehabilitation.

Self-Assessment Exercise 3

What grazing resources are needed to be taken into consideration in the development, improvement and rehabilitation of grasslands in rangeland management?

The resources include water management salt-licks and trees and shrubs. In managing water it is important to note that water is the major determining factor in stock management in most extensive grazing lands, in areas where they depend on seasoned surface water, stock most move out once sources have dried. Water availability is a factor in determining many migration patterns in mobile system. Improvement of water supply by creating water points or improving existing ones and clearing of undesirable vegetation to allow free access for stock and better grass growth, is one way of improving the situation. The community should be encouraged to participate in the management of communal dams and other water points. The stock should be limited to area as close to permanent sources of water through out the dry season. This calls proper design of watering point, like preferring the construction of several small dams scattered over a wide area to that of few big dams each serving a large area which can render the area susceptible to soil erosion and rapid silting, this method of creation of water points has been widely used in Africa.

Self-Assessment Exercise 4

What other means of getting water for grazing land can be used?

Water can sometimes be transported by truck, which is expensive, but if as is the case of Syria and Jordan as hard standing for herds fattened on bought feed, it can be profitable, whatever the effect on any remaining vegetation. Irrigation is frequently used, mainly in commercial system, to grow fodder usually for conservation.

Self-Assessment Exercise 5

What are salt-licks?

In addition to eating fodder animals also take in some minerals from the water they take in as the graze on the land. This natural salt deposit is called salt-lick or salt spring. Areas where the grassland is rich in this salt deposit is not great value. Where the herbs are deficient in this mineral deposit the productivity of the animal suffers. Phosphorus deficiency is wide spread and is especially acute in sub-saharan Africa.

Self-Assessment Exercise 6

What use will trees and shrubs be in grasslands?

Trees and shrubs are important features of many types of grassland especially savannas. Trees provide valuable shade in hot climates an seasons and give shelter in winter. Some trees are browsed and lopped for fodder-their fruits can also provide firewood for the people. Where serious environmental damage, as in the steppes, where much damage occurs to uprooting sub-shrubs for fuel. Some trees provide fruit eaten by the local people. Such tree may be selectively retained and protected.

Wood should not be allowed to be many however, especially in tropical and sub-tropical conditions as this is generally taken as a sign of poor management and overgrazing.

Self-Assessment Exercise 7

What are the steps of developing pasture?

After water supply clearing is another common part of developing extensive grassland for grazing. Where the land is being developed for crops or sown pasture, clearing may involve some removal of stones, temite hills, and other obstructions, but for extensive grazing clearing may involve removal or thinning woody vegetation to improve access and grass growth or reduce tsetse fly habitat.

In traditional system, fire is the commonest agent for clearing – tree – pushers, drog chains, bulldozers, root ploughs and root rakes for shrubs various rollers and shredder the debris may be burnt. The degree of clearing or thinning will depend upon the original vegetation and the use to which it is put, but it is usually partial and selective, leaving useful trees, shade and shelter. Strategic thinning of woody vegetation play a great role in pasture development and improvement, but it must be one within the context of the ecosystem involved.

This is because the removal of trees and their replacement by crops and animal pastures can make major changes to the hydrological cycle and can lead to serious salination of soils.

Self-Assessment Exercise 8

What is it necessary to control bush, as part of rangeland management practice?

Bush control is necessary in many grassland type as a maintenance activity, while bush clearing is development. Bush enrichment is an indication of a fault in the management system and is associated with high grazing pressures; several mechanisms are involved according to vegetation type and management system and is associated with high grazing pressures; several mechanisms are involved according to vegetation type and management system.

Unpalatable shrubs may increase when the more palatable ones are over graced.

Self-Assessment Exercise 9

How effective is fire in determining the composition of grasslands and a see fire.

Controlled fire is a major factor in determining the composition of grasslands and a widespread and powerful tool in grassland management. Its effect depends on its intensity, seasonality, frequency and type. The intensity depends on the types, structure and abundance of fuel. Fire is used to remove unpalatable grass and enable re growth and access to the young herbage by grazing stock.

It often stimulates re growth and supplies a green bite when most needed. Fire is also used, as discussed above, to control woody vegetation. Burning of grassland must be carefully controlled and timed, otherwise it can cause serious damage; this is not discussed in any of the studies, although planning burning and controlling fire is difficult and labour-consuming. Since fire has no severe an effect, burning must take the whole ecosystem into account, not only the grass and the grazing livestock. Ill-timed fire can have a devastating effect on wildlife, including nesting and young birds.

4.0 Conclusion

Rangeland is an extensive land which in most eases have grasses of folder for grazing animals. This makes it very important for the government of many nations to place a means of control over it for maximum benefit. Hence in some countries several legislation bind rangeland, and many management practices have been put in place to prevent overgrazing, and other misuse.

5.0 Summary

This unit has:

- Described the different range land types, of the world
- Described continents their rangelands and their uses in those countries.
- The management practice obtainable for the rangeland so that they are for maximum benefit.

6.0 Tutor-Marked Assignment

Described the management practices that have helped to maintain the rangelands of the world.

How is the rangeland in Chine different from other ones that you have learnt about.

7.0 Reference/Further Studies

http://www.webpage.uidaho.edu/what is range/ what is Range? Rangeland Ecology & Management, University of Idaho.

Rangeland

UNIT 5: ECOLOGY OF HUMANS

CONTENT

1.0 Introduction

Human being are another unique species with unique assignment of dominating every other thing living and non living on planet earth. Hence the need to study the specially. Thus human ecology is an approach to the study of human behaviour. It is the study of the interactions of humans with their environments or the study of the distribution and abundance of humans.

2.0 Objectives

By the end of this unit the student will be able to:

- Understand the difference between the humans environment and that of any other organism.
- Explain how the human social system interact with the ecosystem.
- Describe the ways in which humans exploit the environmental resources.
- Explain the consequences of this exploitation.

3.0 MAIN CONTENT

3.1 What is Human Ecology?

Ecology is the science of relationship between living organism and their environment. Thus human ecology is about the relationships between people and their environment.

Environment is defined as the circumstances, objects or condition by which one is surrounded. They usually include the complex of physical, chemical and biotic

factors (e.g climate, soil and living things) that act upon an organism or an ecological community and ultimately determine its form and survival.

Self-Assessment Exercise 1
What is the environment in the human context?

When discussion humans, "environment" often includes the aggregate of social and cultural conditions that influence the life of an individual or community. The environment is also regarded as an ECOSYSTEM. An ECOSYSTEM is anything in a specified area air, soil, water, living organism and physical structures including everything built by humans. The living part of an ecosystem microorganisms, plants and animals (including humans) are its biological community.

Ecosystem can be a small pond in a forest, and the entire forest is an ecosystem.
A single farm is an ecosystem and a rural landscape. Village, towns and large cities are and every the earth itself are all ecosystem.

Every living organism including humans extract resources from the environment. Most organism rely on ready made organic substance as food, e.g lions kill pray with their teeth, and monkeys grind hard nuts with theirs. Humans also behave almost similarly, but in their own case, they also use certain traditional skills which have been learnt from other (ancestors). Thus human populations have a given basic set of tools (technology), depending on their cultural traditional development settings. For instance, hunting societies that live in environment rich in aquatic resources will use harpoons, whereas desert drivellers will lacks such devices. Our technological traditions are as vanable from place to place and time to time that ecologically we function as if were many different species.

Thus in this respect it is useful to think of human environment interaction as interaction between human social system and the rest of the ecosystem. By the social system we mean everything about people the population and the psychology and SOCIAL ORGANIZATION that shape their behaviour. See below:
Fig 5.1 Interaction of human social system with the ecosystem.

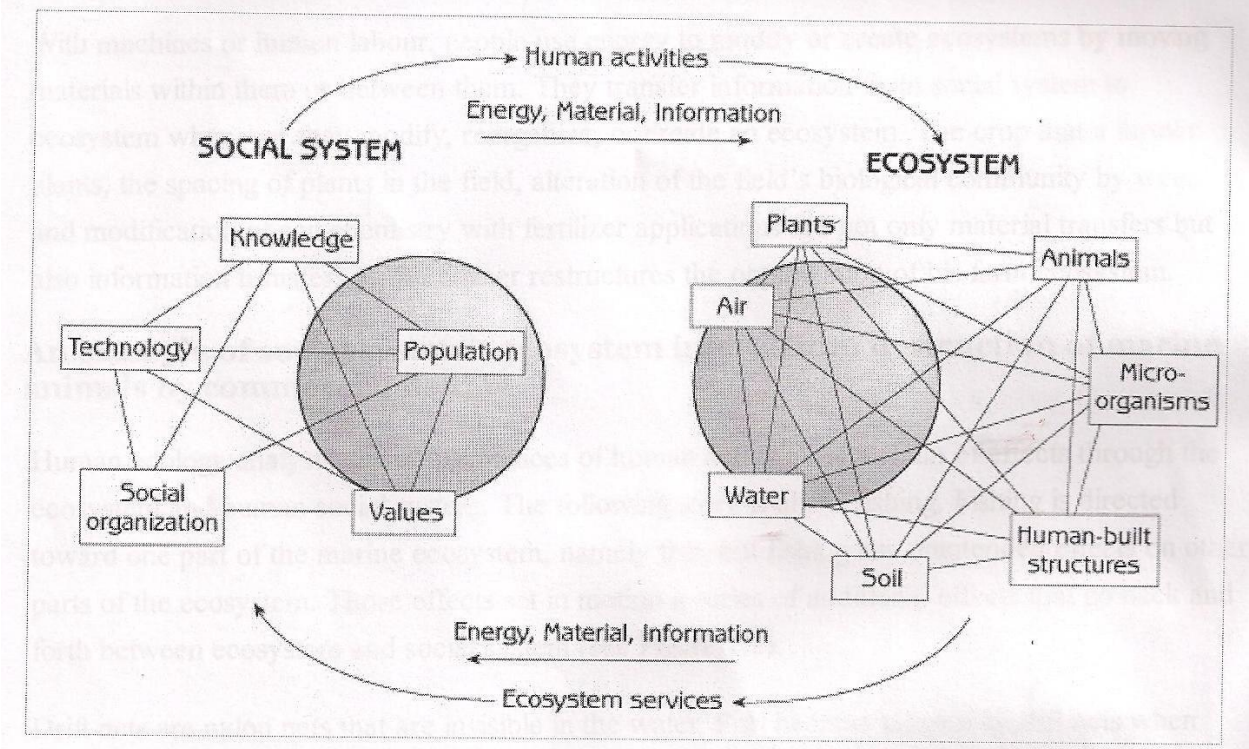


Figure 1.1 - Interaction of the human social system with the ecosystem

Self-Assessment Exercise 2

How is the Social system a central concept in human activity?

The social system is a central concept in human ecology, because human activities that affect the ecosystem are strongly influence by the societies we live in. values and knowledge – which together from the world vicio as individuals and as a society shape the way that we process and interprete information and translate it into action. Technology define our repertoire of possible actions. Social organizations and social institutions shape the possibilities into what we actually do. Like the ecosystem, social system can be on any scale – from a family to the entire human population of the planet.

Self-Assessment Exercise 3

What services does the ecosystem provide to the social system?

The ecosystem provides services to the ecosystem by moving materials, energy and information to the social system to meet peoples needs. The services/resources provide by the ecosystem include water, fuel, food, materials for clothing,

construction materials and recreation. Movement of materials are more obvious; than these of energy and information.

Every material object contains energy, which is very conspicuous in foods and fuels, and every object contains information in the way it is structured or organized.

Self-Assessment Exercise 4

How does information move from ecosystem?

Information can move from ecosystems to social systems independent of materials for example a hunter's discovery of his prey, a farmer's observation of his field, a city driveller's assessment of traffic when crossing the street are all transfers of information from ecosystem to social system.

Self-Assessment Exercise 5

What is the sign that information, material and energy have been transferred from social system to the ecosystem?

Material, energy and information move from social system to ecosystem as a consequence of human activities as follows:

- People affect ecosystems when they use resources such as water, fish, timer and livestock grazing land.
- After using the materials from the ecosystems people return the materials to ecosystem as waste.
- People intentionally modify reorganize existing ecosystems, or create new ones to better serve their needs.

With machines or human labour, people use energy to modify, reorganize, or create an ecosystem. The crop that a farmer plants, the spacing of plants in the field, alteration of the fields biological community by weeding and modification of soil chemistry with fertilizer applications are not only materials transfers but information transfers as the farmer restructures the organization of his farm ecosystem.

Self-Assessment Exercise 6

(How does human ecology analyzed the consequences of human activities through the ecosystem)

Human ecology analysis the consequences of human activities as a chain of effects through the ecosystem and human social system. This can be illustrated using the problem of deforestation in India.

For many years people in India have cut branches from trees and bushes to provide fuel for cooking their food just ad in Nigeria. This was not a problem as long as there were not too many people, but the situation changed with the explosion in population during the past 50years.

See fig. 5.2 below : Deforestation and cooking fuel (chain of effects through ecosystem and social system).

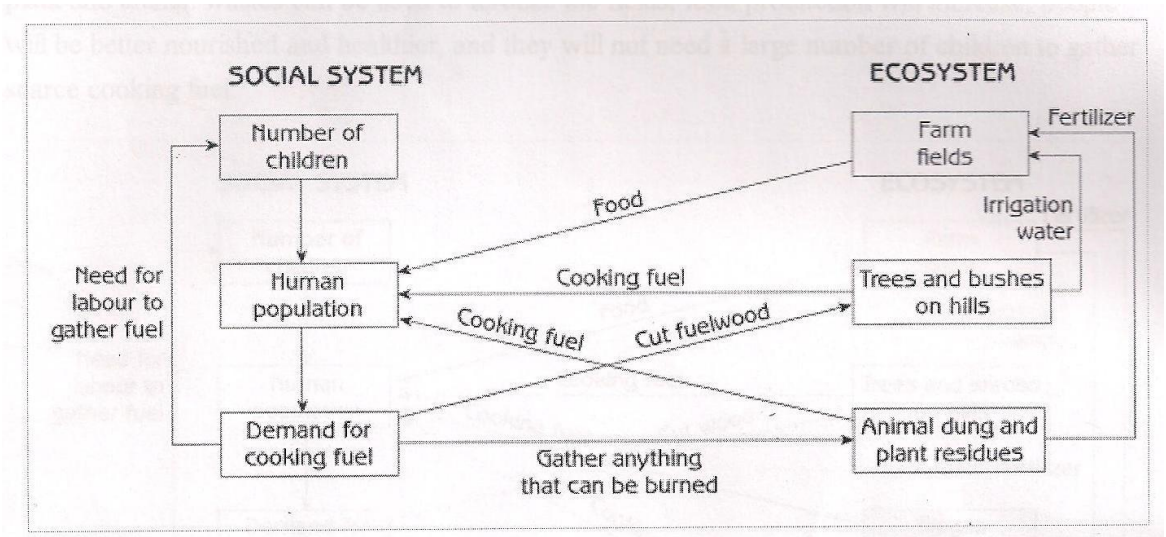


Figure 1.4 - Deforestation and cooking fuel (chain of effects through ecosystem and social system)

Many forests have disappeared in recent times and new there not enough trees to provide all the fuel needed.

Self – Assessment Exercise 7

People have responded to this 'energy crisis' by having their children search for anything that can be burned, such as twigs, crop residues, and cow dung. This fuel collection makes children become even more valuable to their families, so parents had more. This resulted into greater increase in population and therefore more demand for fuel.

What are the resultant effect of this intensive collection of fuel on the ecosystem.

This intensive collection of fuel has serious consequences on the ecosystem. Using cow dung as fuel reduces the quantity of dung available for use as manure of farm fields, and this leads to decline in food production, in addition, the flow of water from the hills to irrigate farm fields during dry season is less when hills f no longer forested. The quality of water is worse because deforested hills no longer have trees to protect the ground from heavy rain, so soil erosion is greater and irrigation water contains large qualities of mud that settle in irrigation canals and elorge the canals. This reduction in the quality and quantity of irrigation water reduces food production even further. This result in poor nutrition and health for people.

Self – Assessment Exercise 8

How do we hope to solve this chain of problems? How does biogas generator work?

This chain of effects involving human population growth, deforestation, fuel shortage and lower food production is a vicious cycle, that is hard to escape. One new invention which may be of help is the use of biogas generators. It is a new technology which consist of a large tank in which people place human waste, animal dung and plant residue to rot. The rating process creates a large quantity of methane gas, which can be used as gas to cook food. When the rotting process is over the remnant of plant and animal waste can be removed and put on the farm fields as fertilizers.

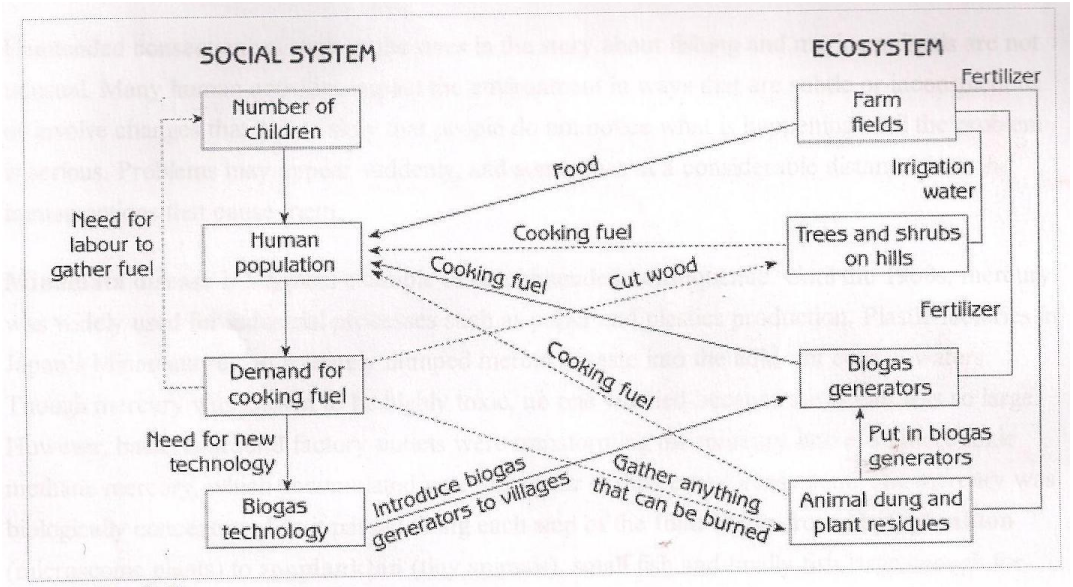


Fig 5.3

Figure 1.5 - Chain of effects through social system and ecosystem when biofuel generators are introduced to villages

Fig 5.3. Chain of effects through social system and ecosystem when bio fuel generators are introduced to villages.

Self – Assessment Exercise 9

How can the introduction of biogas be effective?

If the Indian government introduces biogas generators to farm villages, people will have methane gas for cooking, so they no longer need to collect wood. The forest can go back to provide an abundance of clean water for irrigation. After being used in biogas generation plant and animals wastes can be used to fertilize the fields, food production will increase, people will be better nourished and healthier, and they will not need a large number of children to gather scarce cooking fuel.

However the way that biogas generators are introduced to villages can determine whether this new technology will actually provide the expected ecological and social benefits. Most Indian villages have only few wealth farmers who own most of the land, and the rest are the poor people who own very little, if any land. This means that only few families will be able to afford to buy biogas generators if the price is high. Poor people who do not have money to buy biogas generators will earn money by selling cow dung to the rich ones for their biogas generators. The poor people may not care much about the ecological benefits from biogas

generators because the better supply of irrigation water will be more for the rich farmer who has large piece of land.

Self – Assessment Exercise 10
What may be the result of this to the society?

This means that the benefits of the biogas generators will go mainly to the wealthy, further widening the gap between the wealthy and the poor. The poor farmers who see only few benefits for themselves may continue to destroy the forests and the community as a whole might receive little benefits.

It therefore becomes important that the government creates an environment for every home to be able to obtain a biogas generator if the intervention is to be effective. It is only then that everyone will enjoy the benefits and the vicious cycle of fuel scarcity, and deforestation will be broken.

Home Assignment
Think about Nigeria, in what ways has our activities affected the ecosystem and vice versa. What land of intervention solved the problem?

3.2 Sustainable Development

From the above example we see the subtle ways in which many of man's activities slowly brig about changes and people do not notice until the problem become serious. Problems may appear suddenly and sometimes at a considerable distance from the human actions that cause them. The above situation can be illustrated by the Minamata disease. It is a typical example of an unintended consequence. Until the 1960s mercury was widely used for industrial processes such as paper and plastics production. Plastic factories in Japan's Minamata region routinely dump mercury waste into the nearby coastal waters. Though mercy was known to be highly toxic, it did not bother anyone since the ocean was large. However bacteria around the factory outlets were transforming the mercury into even more toxic methane mercury, which accumulated year after year in the coastal ecosystem. The mercury was biologically concentrated as it passed along each step of the food chain from phytoplankton (microscopic plants) to zooplankton (tiny animals) small fish and finally fish large enough for people to eat. No one realized that the mercury concentration in fish was more than a million times the concentration in the ocean water.

During 1950s more than 1000 people in Minamata region were afflicted with a illness that kill several hundreds, left survivors with devastating neurological damage, and baby's were born with severe deformities. It was discovered that mercury-contaminated fish was the cause of the problem.

Self – Assessment Exercise 1
What was the reaction when the cause of the problem was indentified?

As soon as the information reached the people that mercury-contaminated fish caused the problem, the local people mounted a campaign for the factories to do something about it. After several years the government finally ordered the factories to stop dumping mercury, but the large quantity of mercury already in the coastal ecosystem continued to circulate through the food web. It was only 50 years ago before fish in Minamata region were safe to eat again.

Self – Assessment Exercise 2
How did this incidence affect the global social system/

This dramatic incidence eventually led to worldwide elimination of mercury from large-scale industrial processes, though unfortunately mercury is still in use for gold mining in parts of Africa, Latin America and Asia.

There are some other incidences in parts of the world where they have experience things like starvation as a result of flooding due to deforestation. All these call for humans to find lasting solutions to the many problems of interactions. Hence the need for sustainable development.

Self – Assessment Exercise 3
What do you understand by sustainable development?
Sustainable development can be defined as meeting present needs without compromising the ability of future generation to meet their own needs (Marten, 2001). This will help our children and grandchildren to decent lives. In terms of ecology, it is about keeping the ecosystem healthy. It is about interacting with ecosystems in ways that allow them to maintain sufficient integrity to continue providing humans and other creatures in the ecosystem the food, water, shelter and other resources that they need.

Self – Assessment Exercise 4
What is the relationship between sustainable development and economic growth?

Sustainable development does not mean economic growth. As a matter of fact Economic growth cannot be sustained if it depends on the ever increasing quantities of resources from ecosystems with limited capacities to provide the resources.

A damaged ecosystem (like a deforested area) that lose their capacity to meet basic human needs close off opportunities for economic development and social justice.

A healthy society gives equal attention to ecological sustainability, economic development and social justice because they are all mutually reinforcing.

Self – Assessment Exercise 5
What is the connection between sustainability of human ecosystem interaction and the intensity of demands that people place on ecosystem?

We all depend on ecosystem for materials and energy resources. Some resources such as food, water and forest products are renewable, some such as minerals deposits and fossil fuels are non-renewable. People use these resources and return them to the ecosystem as waste such as garbage or industrial effluent.

Self – Assessment Exercise 6
What is the effect of use of resource of the ecosystem?

Generally speaking intense use of non-renewable resources exhausts the supply more quickly, while intense use of renewable resources can damage the ability of ecosystems to provide resources. Sustainable interaction with ecosystem is only possible is demands are kept within bounds. This has not been the case in recent decades, as human population growth, as well as industrial and economic growth and high material consumption, have dramatically increased the scale of natural resource use.

With increasing environmental awareness there are changes in the social system to reduce the intensity of demands on the ecosystems. In recent times the shift is

from technologies that are wasteful in use of resources towards technologies that use resources more efficiently and reduce pollution.

What is the formula for calculating intensity of demands on ecosystems?
Intensity of demands on ecosystems =
Population x Level of consumption x Technology
Intensity of demands on ecosystem is:

- The total quantity of material and energy resources required for industrial and agricultural production.
- Pollution generated by industrial and agricultural production.

Population = the number of people who use the industrial and agricultural products.

Level of consumption: the per capita quantity of industrial and agricultural production. It is closely connected to a society's material affluence.

Technology: the quantity of resource used and pollution generated per unit of industrial and agricultural production.

Self – Assessment Exercise 7
What is the implication of this to the ecosystem?

This formula on intensity of demands on ecosystems implies that a small population can enjoy high levels of consumption. Too many people can employ the most efficient technologies imaginable and still be forced to make unsustainable demands on the environment while living in poverty.

The level of consumption of wealthy nations is enormously greater than that of poor nations. The significance of the population in wealthy nations lies not only in the large numbers of people that they already have but also the fact that their heavy demands extend to ecosystem beyond their own boundaries.

Developing world nations aspire, to economic development with higher levels of industrial production and consumption, these aspirations are thwarted by rapid population growth now typical in that part of the world.

4.0 Conclusion

This unit explains how ecosystems and social systems function and interact as self-organizing complex adaptive system.

This is to say that human activities can cause a chain of effect within the ecosystem and social system. Thus the number of people who use industrial and agricultural production.

5.0 Summary

In this unit you have again learnt the meaning of ecology, and the ecosystem. You learnt human ecology is the relationship between people and their environment. Human environment interaction is seen as interaction between the human social system and the rest of the ecosystem. The social system is everything about people.

- Their population, psychology and social organization that shape their behaviour.
- Ecosystem provides services to the social system.
- Services provided include water, fuel, food, materials for clothing, construction and recreation.
- Interaction between social system and ecosystem leads to chains of reaction like that of deforestation and cooking fuel.
- Many human activities bring about subtle unexpected consequences, like the Minamata disease.
- Sustainable development is meeting the present needs without compromising the ability of future generations to meet their needs.

6.0 TUTOR-MARKED ASSIGNMENT

a. Explain the relationship between human activities and Ecosystem services.

b. What do you understand by sustainable development use a real life example to illustrate your answer?

7.0 REFERENCES/FURTHER READING

Marten, G. G. (2001). Human Ecology – Basic Concepts for Sustainable Development. Earth Sean, Publications.

Foley, R. (1987). Another Unique Species – Patterns in Human Evolutionary Ecology. Essex, England: Longman.

MODULE 3: POPULATION ECOLOGY

Introduction

This module discusses an important aspect of the study of organisms in their environment in relation to their increase or decrease in number over a specified period of time. This is referred to as population ecology. In this module, important factors that determine the size and structure of population dynamics and survivorship curves would be highlighted.

This module is thus divided into four units as follows.

UNIT 1: Population, Growth and Survivorship Curves
UNIT 2: Life Table, Age Structure and Carrying Capacity
UNIT 3: Environmental Resistance
UNIT 4: Control of Human Population

UNIT 1: POPULATION, GROWTH AND SURVIVORSHIP

CONTENTS

1.0 Introduction

In this unit, the meaning of population as it relates to organisms in a specified environment is discussed. In addition how population grows and are maintained are also highlighted. The different types of growth curves and survivorship curves are also described.

2.0 Objectives

By the end of the study of this unit, you should be able to:

- describe population ecology of a specific organism in a specified environment
- discuss the effects of death rate and birth rate on population growth of organisms
- state what growth curves are and their uses
- describe what survivorship curves are

3.0 MAIN CONTENT

3.1 The Meaning of Population Ecology

Population as it relates to ecology can be defined as a group of organism of one species occupying a particular place. These organisms are usually isolated to some extent from other similar groups by geographical or topographical factors. Examples of ecological populations include the total number of frogs living in a specific valley, total number of monkeys living in a specified vegetation area etc. In studying the population ecology of an area, it is not just all about the number of individual found at a particular time, but also important is how the population grows, are maintained and why they decline. The study of how and why population size changes over time is called population dynamics. To study the population ecology of an organisms in a specified environment therefore requires the knowledge of their density, birth rate (natality), death rate (mortality), survivorship, age structure, migration as well as the type of growth of the population. These factors will be discussed in this module.

3.1.1 Estimating Population of Organisms

In order to estimate the population of an organism in a giving community, it is important to first estimate the size of the population. The population size can be described as the number of individuals in the group. To estimate population size the method used would depend on the nature of the organism. Two major methods are available they are;

i. sampling method
ii. capture-recapture method

Sampling method are of different types, whatever type is used would depend on the specie being studied. For example when estimating population of a particular

plant e.g. weed or shrub in a field because the plant is static quadrat sampling is often used. This involves mapping out a specific area which is usually measured in square meters i.e. area. All the plants in question in the 1 m^2 are then counted and recorded. This procedure is then repeated several times in different parts of the area. Average number of the plants per unit area is then calculated. .

Capture-recapture method is used for organisms that are motile e.g. insects. Using the sweep-net (which is a trapping device) insects are captured and marked with a sport. They are then released. After about 24 hours when they would have intermingled randomly with the rest of the population, they are captured again. The total number of marked ones, are then recorded. The population can thus be estimated using the formula:

Population = $\frac{n_1 \times n_2`}{n_3}$

Where n_1 = number of individuals marked and released.

n_2 = total number of individuals recaptured.

n_3 = number of marked individuals recaptured

3.2 Population Growth and Survivorship Curve

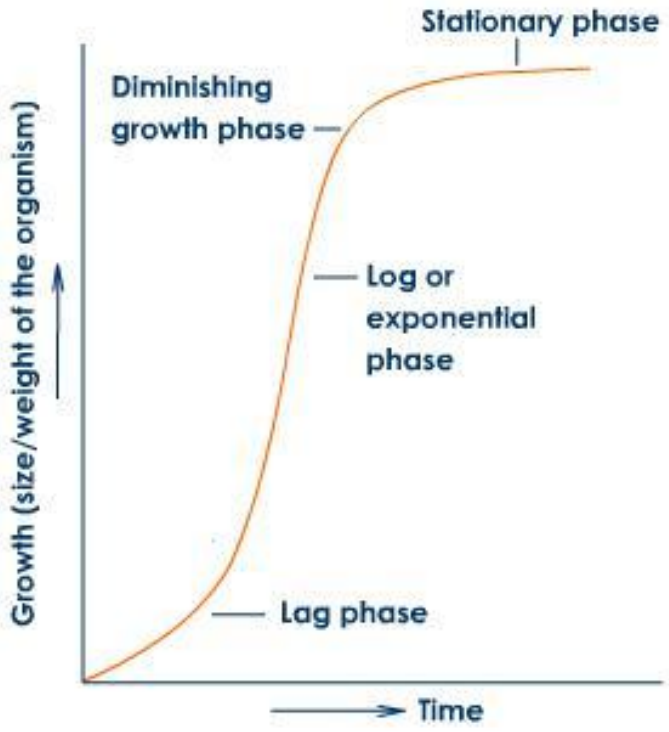
3.2.1 Population Growth Curve

Two types of growth curves can be identified they are;

i. J-shaped growth curve

ii. S-shaped growth curve

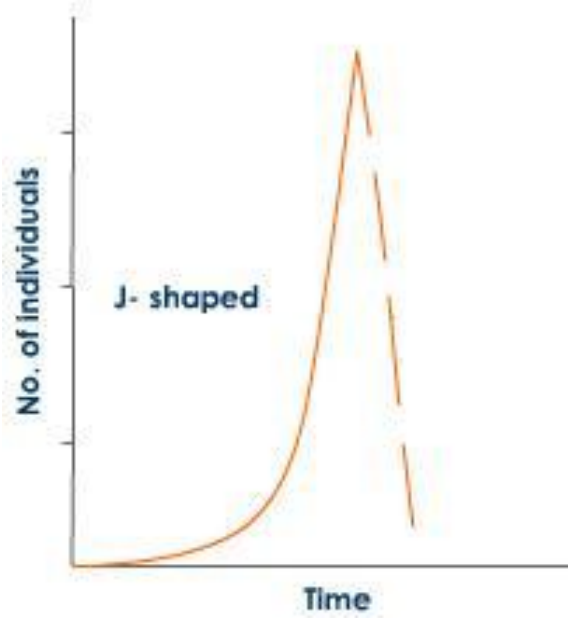
1. The S-shaped curve which is also referred to as the sigmoidal growth curve describes the situation in a new environment where the population density of the organisms increases slowly initially, as conditions becomes more favourable the organisms is fully established, population then increases rapidly i.e. an exponential growth. After this stage the population declines, until birth rate equal death rate. Increase in competition for food, water, space etc, leads to decline in growth rate. This decrease continues until other factors, reduces the growth rate to zero. This can be described with the graph that follows;



S-shaped Curve

* This S-shaped curve is common in plants, animals and micro-organisms.

2. The J-shaped curve describes the situation in which after the first initial establishment phase the growth continues in an exponential form until it stops suddenly as pressure from the environment becomes more, and population eventually crashes. This could be followed by a recovery pattern which gives the "boom" and "bust" characteristics. This can be represented as follows;



J-shaped growth curve

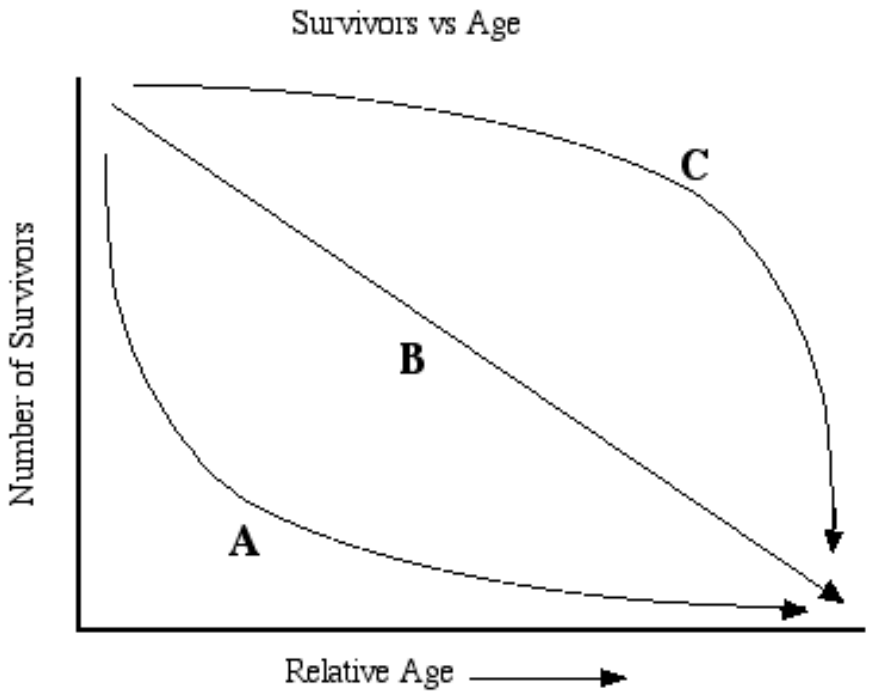
This type of growth curve is common in some species of insects associated with algal bloom.

3.2.2 Survivor Curve

A major factor that affects population size is the percentage of individuals that die before reaching reproductive age. In a population of newborn individuals if the number of individuals is plotted against time, the result is a survivorship curve. The vertical axis is the actual number of survivors or percentage survival which can be obtained thus:

$$\% \text{ survival} = \frac{No.of\ survivors}{No.in original\ population} \times 100$$

Each individual species have its own survivorship curve. Example



Survivorship Curve

Curve a) is an almost ideal curve for a population old age and death is a major factor

Curve b) is population with high mortality rate early in life e.g. for human where disease and starvation could occur.

Curve c) is a smooth curve obtained where there is constant mortality rate through out life.

Survivorship curves can be used to determine the mortality rates of individuals of different ages, thereby the age they are most vulnerable. When factors causing death are known, there will be an understanding of how population size is regulated.

4.0 Conclusion

Population dynamics, an aspect of population ecology deals with the study of the size or number of a particular specie of organisms occupying a specified community. A number of factors contribute to the size of population of organisms and these include the birth rate, death rate and some other factors of the

environment like competition etc. the different types of growth curves as well as survivorship curves of a population were highlighted and discussed.

5.0 Summary

In this unit, you have learnt that;

- Population as it relates to ecology is the group of organisms of a particular species occupying a particular space.
- Population is affected by death rate, birth rate and other factors of the environment.
- Population can be estimated for specified organisms in a specified environment
- Methods of estimating population are sampling method and capture-recapture methods.
- There are two types of population growth curves; S-shaped and J-shaped.
- The percentage of individuals of a population that die before reaching reproductive age affects population growth and can be used to plot the survivorship curve.
- Mortality rate of individuals of different ages can be obtained from the survivorship curve.

6.0 Tutor-Marked Assignment

1a. describe the term population as it relates to ecology

b. describe in detail how you will estimate the population of the weed plant called tridax on an abandoned farmland.

2a. describe the two types of growth curves

b. which of the two is more common among organisms of the world

c. compare and contrast the growth curve and the survivorship curve

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

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UNIT 2: LIFE TABLE, AGE STRUCTURE AND CARRYING CAPACITY

CONTENTS

1.0 Introduction

We have already learnt in unit one that in population ecology, the number of individuals in a population depends on the birth rate, death rate, emigration and immigration. These factors that determine population, are referred to as demographic data, these factors are important in determining the size and structure of population over time. Demographic data provides a very important tool to biologists who manage endangered species. Endangered species are animals that are on their way to being extinct. In conservation programmes the use of life tables and age structure of organisms are very important.

2.0 Objectives

By the end of the study of this unit, you should have learnt that:

- Life table, age structure are all important demographic data to biologists for use in conservation programmes.
- Carrying capacity is the maximum number of individuals in a population that can be supported at a given time.
- At the carrying capacity state, the birth rate equals death rate.

3.0 MAIN CONTENT

3.1 Life Table

Life table is one of the demographic data that biologists use in conservation programmes. Life table summarizes the probability that an individual will survive and reproduce in any given time interval over the course of its lifetime. Life tables were invented in ancient Rome and used to predict food needs. However, in the modern time, they are used by insurance companies to predict the likelihood of a person dying at a given age. They are also used to study the demography of endangered species.

3.1.1 Age Structure

Age structure talks about the proportion of individuals that are at each possible age. The population of individuals at each possible age has a great influence on population growth over time and this is why the understanding of it is very important key component of analyzing population dynamics in humans and other species. Age structure also helps researchers to predict the future of a population as well as to analyze the history of the population.

3.1.2 Carrying Capacity

Carrying capacity is the maximum number of individuals in a population that can be supported in a particular habitat, over a sustained period of time. At this point the birth rate equals the death rates. Carrying capacity of a habitat depends on a large number of factors which include food, space, water, soil quality, resting or nesting sites as well as intensity of disease and predation. The carrying capacity of a population is also described as the point of stabilization or zero growth rate, in the population of the organisms concerned in the given environment. It is very important to note that the pattern of growth of population is the same for all species of organisms.

4.0 Conclusion

Important demographic data that are used in the description of population of organisms in the specified environment include the life table, age structure, etc. the knowledge and understanding of the carrying capacity of a population also helps in the understanding of the pattern of growth in the population of organisms.

These demographic data are used by biologists in conservation programmes and life insurance companies to predict the likelihood of a person dying at a given age.

5.0 Summary

In this unit, you have learnt that;

- Life- tables and age- structures are demographic data used by conservationists and life insurance companies to predict life patterns.
- The carrying capacity of a population is the maximum number of individuals that can be supported in a given habitat.
- At the carrying capacity of a population death rate equals birth rate.

6.0 Tutor-Marked Assignment

1a) Describe the terms age structure and life table
b) of what values are these in the study of population.

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology*, *a Functional Approach* 4th Edition. Reprinted in India.

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UNIT 3: ENVIRONMENTAL RESISTANCE

CONTENTS

1.0 Introduction

Population has the ability to grow and decline in a characteristic ways. In a normal growing population the size of the population as it increases is determined by the reproductive potential of the organisms in question. Another major factor that can influence population size is the situations in the environment which is referred to as the environmental resistance. In this unit those factors of the environment that can influence the size of the population of organisms will be discussed.

2.0 Objectives

By the end of the study of this unit, you should be able to:

- State what environmental resistance means in relation to population study.
- Describe the factors of the environment that do affect population size.
- State ways that could be used in an environment to reduce the effects of these factors.

3.0 MAIN CONTENT

3.1 Meaning and Types of Environmental Resistance

3.1.1 Meaning of Environmental Resistance

Environmental resistance can be seen as a measure of how much a community is affected by a disturbance, such usually limits population growth. Environmental resistance can also be described as the sum total of limiting factors e.g. both

abiotic and biotic acting together to prevent the maximum reproductive potential of an organism.

3.1.2 Types of Environmental Resistance

Such factors could be external or internal. External factors include predation, food supply, heat, light, space/shelter, disease, etc. while internal factors include intraspecific competition, behavioural adaptations etc.

i. **Internal factors** that affect population size do occur usually after a population has finished its initial growth phase. There is usually a fluctuation in the population size over time after the initial growth phase, such factor that contribute to the fluctuations could be variations in climatic conditions (e.g. temperature), food supply or predation. These usually affect birth rate and death rate.

   a. Territorial behavior is an internal factor that affects population size. This is a situation where either the male or female or both defend their territory against intruders of the same species such. Behaviours e.g. among reptiles, birds, dogs, etc. usually as population grows, territories become smaller and this is able to support only fewer members of the population.
   b. Overcrowding is another internal factor that can affect population size. This results in reduction in population size due to lack of space, outbreak of disease due to overcrowding, infertility etc. the young could move away from their nest at early age, thereby reducing survival.

ii. External Factors

   a. Shortage of food, water or oxygen. There are obvious factors that checks population growth affecting the organisms concerned, the organisms compete for these resources and the larger the population, the more severe is the competition.
   b. Lack of light – It is an important factor in the growth of plants, as they rely on light for their production of food. Competition for light among plants is more common among areas of dense vegetation.
   c. Lack of shelter, i.e. shelter for predators as well as physical environmental conditions e.g. excessive heat.

d. Disease outbreak, rapid spread of an outbreak of disease which could be as a result of overcrowding can lead to a large number of organisms dying and reduction in birth rate
e. Accumulation of toxic waste can also occur e.g. high amount of carbon dioxide and nitrogenous waste and these can influence birth rate and or death rate.

All these factors i.e. internal and external environmental factors prevent population from growing indefinitely otherwise the tendency for population to grow out of control.

4.0 Conclusion

Factors of the environment which affect the normal environment thus affecting the normal growth of organisms in a given environment are called environmental resistant factors. These are classified into external and internal factors of the environment. This unit discussed the different types of internal and external factors of the environment that can influence normal population growth.

5.0 Summary

In this unit, you have learnt that;

- Factors of the environment which limits population growth are referred to as environmental resistant factors
- Two types of these factors are internal and external factors
- External factors include territoriality, overcrowding etc.
- Internal factors include food, shelter, light, disease etc.
- Both external and internal factors of the environment work together to prevent the population from growing indefinitely thus preventing population from growing out of control.

6.0 Tutor-Marked Assignment

1a. define the term environmental resistance as it relates to population ecology
b. describe the two major types of environmental resistance, for each state specific examples stating how the factor is acting as a limiting factor.

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

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UNIT 4: CONTROL OF HUMAN ECOLOGY

CONTENTS

1.0 Introduction

The rate of growth of human population is the same pattern with that of any other organism. Where there is enough food, no disease out break etc. reproduction occur leading to increase in number of individuals. Initially population grows slowly then exponentially and where there is no resistance of any form the tendency for population to continue to increase will be there. If this is allowed to happen, it could lead to disaster. In human being population is checked from time to time. Different countries developed different ways of controlling human population. This unit discusses some of the methods employed to control human population.

2.0 Objectives

By the end of the study of this unit, you should be able to:

- Describe the different methods of controlling population growth among human beings.
- Explain the need for birth control among human being.

3.0 MAIN CONTENT

3.1 Control of Human Population

It was estimated that within a period of five years (1975-1981). The population of the world increased by 500 million. In addition too it was estimated that between 1900 and 1950 population of the world doubled within 60 years, between 1960 and 1981, the population doubled with 25 years. It is therefore projected that if

there are no checks the population may rise by more than 15 million in the next hundred years. Which will make life uncomfortable with no room for movement at all. However, a lot has happened which has helped to increase the doubling time for world population from 25 years to 40 years. Some developing countries introduced birth control programmes which has contributed greatly to the rate of increase in the population of human beings. Examples of increase in the population of human beings. Examples of the birth control measures include;

i. Use of conventional contraceptives most especially the condoms
ii. Use of contraceptive pills
iii. Use of different types of intra-uterine devices.
iv. Sterilization of the male or female
v. Abortion.

Other methods include abstinence, rhyme method and coitus interruptus .

In many of the developing countries of the world, their government have sponsored birth control programmes which are designed to lower fertility rate.

However, a number of these of these control measures are faced with a number of problems i.e. short supply of contraceptives or expensive of it, shortage of qualified personnel to run the family planning services effectively, prejudice against sterilization etc. these have to a large extent contributed to its failure improved health care services have also contributed to the increase in human population. The need to continue to device means of controlling human population will continue to be of great concern to the government at state and national levels because of the dangers associated with it, such as economic and social problems.

4.0 Conclusion

This unit discussed rapid increases in population as a problem facing the human race. Different methods that could be used to control human population were also highlighted.

5.0 Summary

In this unit, you have learnt that;

- Human population can also grow to an alarming state if not checked.
- Different methods are available to control human population
- In some countries of the world, their government sponsor programmes on birth control measures
- A number of problems do militate against the success of birth control, like lack of good knowledge of the use of some contraceptives or its high cost.

6.0 Tutor-Marked Assignment

1a. discuss fully five methods of birth control measures in use in your environment.

b. which of the five methods is more commonly used

c. why is that method more common.

2a. Are you in support of the use of birth control as a means of controlling population. If yes, state your reasons and if you are not in support discuss why?

b. what other methods would you have preferred to use to control population of human being other than birth control. Why?

6.0 References/Further Readings

Roberts, M.B.V. (2005). *Biology, a Functional Approach* 4th Edition. Reprinted in India.

DeRoberts, E.D.P., Saez, F.A., & Robertis, E.M.F. Cell Biology 6th Edition. Toronto: Canada.

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