BIOLOGY

POPULATION STUDIES BY SAMPLING.

Population is defined as the total number of organisms of the same species living together in a given area at a particular time.

Sampling is the act of taking any portion of a population or universe as a representative of that population or it is the method of studying the population in a habitat.

In population studies of a habitat, the following are usually studies:

i. Types of organisms: This involves the listing of the various types of populations that are found in the particular habitat.

ii**. Dominance:** In the course of sampling the species of an organism which appeared frequently is referred to as the dominant species.

Population size: This refers to the total number of the same kind in a given area or habitat.

Population density: It is defined as the number of individual organisms per unit area of habitat.

Population frequency: This refers to the number of times and I organism occurs within a given area of habitat.

Percentage cover: It refers to the space covered by a given species in its habitat and it is expressed in Percentage.

Population growth rate: This involves the increase of birth rate or death rate of an organisms in a given habitat.

Factors Affecting Population.

i. Natality or birth rate
Mortality or death rate
Immigration or dispersal
Emigration
Availability of food
Breeding period.

METHOD OF POPULATION STUDIES

a. Population studies by sampling method

Population studies can easily be carried in a habitat especially in terrestrial habitat by sampling method, using instrument called the quadrat.

How to Conduct Population Studies using quadrat.

i. Choose and locate the sample plot.

ii. Then identify the species in the plot.

iii. Measure the area with a measuring tape to know the area of the habitat.

iv. Throw the quadrat randomly at intervals for up to 10 or above.

v. After each throw, the number of species within area of quadrat is recorded.

Then the density of species is calculated by dividing the average number of times the species occurs within the quadrate by the area of the quadrate.

The calculation can be worked out this way:

i. Frequency of species = X
Number of tosses = Y
Average number of species per quadrate = $\frac{X}{10}$

Example 1: Estimate the population density and population size of a specific grasses using the quadrate.

Solution:

i. Total area of habitat = $15m^2$
Frequency of the organisms = 400times
Number of tosses = 50
Average number of organisms per quadrat tossed = 400/50 = 8
Area of quadrat = 1.6m2
Density of organisms = 8/1.6 = 5grasses x $15m^2$ = 80
Therefore, the population size of glasses in the habitat = 80.

b. Estimation of population using the transect method

Here, the tape should be stretched with marking at intervals. The plants within the various intervals are recorded. This procedure is repeated for a number of times until an accurate estimate of the number and types of plants in the habitat are obtained.

c. Capture and recapture method

This is another method of estimating the population of a particular animals in a habitat. Here, all the animals of a particular type in a known area are caught, counted, marked with a quick drying pen and released. Later, usually the next day the collection is repeated and in a number counted (S2). The number of marked individual in this second sample is recorded (S3). The estimated population of animals can be found by substituting in the following formula:

Pop. in area $= \frac{S_1 \times S_2}{S_3}$

Example 1: Suppose that 10 grasshoppers were caught in an area of $1m^2$, the next day 12 were caught in the same area and 6 were marked. Therefore, the population in the area $= \frac{10 \times 12}{6} = 20$ grasshoppers.

ECOLOGICAL FACTORS

Meaning of ecological factors: - These are factors in the environment which can influence living organisms or cause changes in any habitat, be it aquatic or terrestrial habitat.

Ecological factors are of two types namely;

Biotic factors
Abiotic factors.

Biotic factors

They are made up of the effects of other plants and animals on a given organism.

Examples of biotic factors are:

i. **Commensalism:** It is an association between two organisms living together in which only one benefits nor is harmed.

Parasitism: This is a close association between two organisms in which one called the parasites lives in or on, and feeds at the expense of the other organisms called a host.

iii**. Predation:** It is a type of association between two organisms in which the predator kills the other called the prey and feed directly on it.

Pathogens: These are micro-organisms which can cause diseases in plants and animals, leading to their reduction through death.

Mortality: It is the death rate of organisms (plants and animals) in an environment. Mortality decreases the population of organisms in any habitat.

Competition: It involves the interactions among two organisms of the same species or different species in which one outgrows the other and survives while the other cannot grow nor survive.

Abiotic factors

These comprise the following:

i. Chemical factors e.g, oxygen carbondioxide, mineral salt, water, e.t.c.

Climatic factors e.g, rainfall, wind, pressure, sunlight, e.t.c.

Edaphic factors: These consist of soil, its water, PH, nutrients, profile, structure, chemical and physical composition.

Topographic factors.

RELATIONSHIP BETWEEN SOIL TYPES AND WATER HOLDING EFFECT OF SOIL ON VEGETATION

Soil

The soil is an organic matter which gives support to plants, in addition of harboring animals and production of vegetation.

Types of Soil

Sandy soil: Their particles are coarse, loosely bound and have poor nutrient and water holding capacity. They have very low capillarity and are well drained.

Nature of vegetable: They are poor in plants crops, only the growth of grasses.

Loamy soil: They are mixtures of clay and sand particles, with higher proportion of organic matter. They are more fertile than either clay or sand. Nature of vegetation. As they are the richest form of soil, they support rainforest vegetation.

Clay soil: They are made up of smallest and finest particles that have water retaining capacity. It forms lumps when dry, their inability to make water available to plants make it difficult for some plants to survive here. Crops like yam and cocoyam grow strong in clay soil.

Laterites: It allows the growth of mostly grasses, they are earthly, granular, chiefly of iron etc. which occurs as a layer nodules in tropical soil and impervious to water and contain little nutrients.

Comparison of water retaining capacity of sandy, Loamy and clay soil

Type of soil	Vol. of water added to the soil	Volume of H_2O in the cylinder	Volume of H_2O retained
Sandy soil	50ml	X	50 – x
Loamy soil	50ml	Y	50 – y
Clay soil	50ml	Z	50 - z

ILLUSTRATION

Factors affecting water holding capacity of soils

Organic matter content: The organic matter content of the soil affects the rate at which water is retained.

Size of soil particles: The size of soil particles influences the ability of water to retain. The smaller the soil particles the higher the rate of water retained. Example clay soil has the highest ability of retaining water because it was the smallest size of soil particles.

Soil texture: Is the degree of fineness or coarseness of the soil particles and it influences the water holding of soil capacity clay soil has fine particles.

Clay content: Is the amount of clay in any soil type that determines the amount of water retained. The higher the amount of clay is the soil sample, the greater the ability to retain water.

S/N	INSTRUMENT	USES OR FUCNTIONS
1	Rain gauge	It is used for measuring the amount of rainfall
2	Minimum and maximum thermometer	Used to measure the lowest and highest temperature of the day
3	Anemometer	It is used for measuring the speed of wind
4	Wind vane	Used in measuring the direction of wind
5	Barometer	Used for pressure measurement
6	Hygrometre	Used in measuring relative humidity
7	Sacchi Disc	Used in measuring the turbidity or transparency of water
8	Tape	Used for measuring height and length of objects
9	Light metre/ photometer	Used to measure length intensity on land
10	Metre rule	Used for measuring the length of an object
11	Colorimeter or PH indicator	Used to increase acidity or alkalinity of soil or solution.

FOOD RELATIONSHIP

Plants and animals can only interact by feeding and providing food for one another. The feeding relationship between various organisms in a community can be represented by a word food chain.

Green plants start or originate a food chain, since it is only the green plant that can get sun energy, utilize it and convert it to chemical energy i.e (Stored energy). There are other organisms that are directly or indirectly depend on green plants.

Example: *Green plant – Insects – Birds*
In the food chain, green plants are known as Autotrophs (Producers).

Autotrophs

These are organisms that mature their own food. The insect is feeding directly on plant materials; it is called primary consumers. The bird is a secondary consumer.

Types of Autotrophs.

a. Photosynthetic autotrophs: They synthesize the organic food from simple inorganic substances, using sunlight as a source of energy. Eg: green plants

b. *Chemosynthetic autotrophs:* They utilize simple inorganic reaction as a source of energy to produce organic materials.e.g. Iron bacteria and thiobacillus.

Producers

They are same as the autotrophs:

Aquatic producers: These are phytoplanktons water, hyacinths, seaweed. e.t.c. They trap energy to produce food substances.

Terrestrial producers: Examples are grasses, trees and shrubs.

Heterotrophs

These are organisms that depend on the autotrophs for their food or energy requirement. Examples are holozoic, saprophytes and parasites.

***Consumers*:** They are the same as heterotrophs. They are subdivided into primary consumers, secondary consumers and tertiary consumers.

***Food Chain*:** It is defined as a feeding relationship involving the transfer of energy through food from producer to consumers. Examples: Grass – grasshopper-lizard – snake- hawk.

(Producer) --- ***(p.consumer) (s.consumer)---(t.consumer)***

Grasshopper---Antelope-----Lion

(Producer)*---*(primary consumer)---(secondary consumer)

The above *food chains* are examples of food chain in terrestrial habitat.

Diatoms----mosquito larva---tilapia fish---whales.

This as an example of food chain in aquatic habitat.

FOOD WEB

This can be defined as a complex feeding relationship that may exist between different animals or plants species in an ecosystem.

DIFFERENCES BETWEEN FOOD CHAIN AND FOOD WEB

FOOD CHAIN	**FOOD WEB**
1. It involves fewer organisms	It involves many organisms.
2. It involves one food chain	It involves two or more food chains.
3. It is a linear feeding relationship	It is a complex feeding relationship.
4. Organisms have lesser chance of survival	Organisms have greater chance of survival

NON – CYCLIC (CHEMICAL) NATURE OF ENERGY TRANSFER.

It is the movement of matter in a cyclic form in food chain. As decomposers converts dead organic materials back to minerals that are usable again, movement of energy is undirectional but flows from producers to consumers and decomposers.

NUTRIENT MOVEMENT: It can be described as the distribution of chemical energy among producers, consumers and decomposers in form of oil, starch, proteins, etc.

ENERGY FLOW

Pyramid is a diagrammatical representation of food chain in which producers form the base and the carnivores form the apex.

PYRAMID OF ENERGY: It indicates the rate of energy flow also the productivity at different level along a food chain. It can be defined as a diagrammatic representation of amount of energy present at each trophic level of a food chain. Here, there is a progressive decrease of energy at higher trophic levels.

PYRAMID OF NUMBERS: This indicates the numbers of individual organisms at each trophic level which decreases progressively from the first to the last trophic level in a food chain.

ENERGY LOSS IN THE ECO-SYSTEM

The solar radiation is used by plants during photosynthesis. Some are stored in plants parts such as leaves, stem, etc, are not used up. The principles of energy transformation in nature are governed by the laws of thermodynamics.

Laws of Thermodynamics:

The *first law of thermodynamics* states that energy can neither be created nor destroyed although it can be changed from one form to another.

The *second law of thermodynamics* states that in any conversion of energy from form to another, there is always a decrease in the amount of useful energy.

APPLICATION OF THE LAWS TO ECOLOGICAL PHENOMENA

Food chain, pyramid of energy and energy flow are some of the ecological phenomena which can be explained using the laws of thermodynamics.

Food chain:

Using the first law: Energy from the sun is transferred from the producer to the final consumers.The green plant transfers the energy to the primary consumers which again transfer the energy to the secondary consumers.

Using the second law: As the energy is being transferred from producers to primary, to secondary consumers and finally to the tertiary consumers, energy is lost as heat in each trophic level.

Pyramid of Energy*:*

Using the first law: According to the first law, energy is transferred into a variety of other forms in the successive Trophic level but the sum total is constant.

Using the second law: We observed that during energy transformation in the successive trophic levels, a proportion of it is converted into heat which is lost, causing a progressive drop in energy in successive trophic levels.

Energy flow:

Using the first law: Energy is lost as it flows from herbivores to carnivores. This indicates that lesser lives can be sustained at higher trophic level.

Using the second law: Each time one organism is consumed by another, energy is transferred alongside, with some being lost.

Agricultural Classification

In this classification, plants are grouped into the following categories based on their uses. Some of these are:

i. **Cereals plants:** They belong to the grass family and they provide carbohydrates e.g rice, maize, wheat.

Legumes (pulses): They are crops which provide protein for man and animal when eaten e.g beans, soyabeans, groundnuts, etc.

Roots and tuber crops: They are crops that produce tubers under the ground e.g yam, cocoyam, sweet potato, carrot, etc.

Vegetable crops: They provide vitamins to man and animals when eaten e.g tomatoes, onion, okro, etc.

Fruit plants: They also provide vitamins and minerals when consumed e.g orange, banana, mango, pawpaw, etc.

Beverage / stimulant: The vegetative parts, fruits or seeds of these crops serve as raw materials for beverages and stimulants e.g cocoa, tea, coffee, kola, and tobacco.

Latex crops: These produce a lot of fluid called latex which is important as a raw material for making rubber and other synthetic products e.g, para rubber.

Forage crops: These are pasture and fodder crops on which farm animals graze e.g grasses, and legumes.

Spices: These may have medicinal properties and some are also used as spices to add flavour to food e.g pepper thyme, onion, ginger, etc.

Cash crops: These are crops cultivated for export to earn foreign exchange. They include cocoa, oil palm, rubber, cotton, groundnut, etc.

CLASSIFICATION BASED ON LIFE CYCLE

Based on life cycle or life span, crops may be classified into three groups. These are:

Annual crops: These are crops which complete their life span in one year. They include maize, yam, groundnut, rice, beans, etc.

Biennial crops: These are crops which complete their life cycle in two years, examples; pineapple, cocoyam, cassava, plantain, pepper, etc.

Perennial crops: These are crops that take three or more years to complete their life cycle they include cocoa, orange, oil palm, mango, etc.

EFFECTS OF AGRICULTURAL ACTIVITIES ON ECOLOGICAL SYSTEMS.

The effects of some agricultural activities on ecological systems are listed below:

Bush burning: Reduces organic content of soil, increases inorganic content of soil and destroys soil micro organisms.

Over grazing: It is a situation where more animals that can be supported on a particular pasture are put there to graze.

Effects of Over Grazing

i. It exposes the soil to erosion.
It destroys soil structure.
Over grazing causes poor growth of vegetation.
It can expose the soil to heat which dries it out quickly.
Over grazing removes the vegetative cover of the soil.

Tillage: It is defined as a digging or breaking up of the soil in preparation for the planting of crops.

Effects of Tillage

It helps to loosen the soil.
It can lead to poor vegetation.
Tillage exposes soil organisms and may kill some.
It encourages leaching.
It increases the porosity of the soil.

Fertilizer Appilicaion: This involves the application of certain chemical into the soil to improves its fertility.

Effects of Fertilizer Application

It increases the porosity of the soil.
Excessive fertilizer application can cause soil acidity.
It can affect the life of plants and animals.
It increases the population of micro-organism in the soil.
Fertilizer application brings about less of organic matter of human.

EFFECTS OF DIFFERENT TYPES OF FARMING ON ECOLOGICAL SYSTEM

Mixed Farming: This is the type of farming in which the farmer cultivates his crops and rears animals on the same piece of land.

Effects of Mixed Farming

It minimizes the use of available land.
It adds nutrients to the soil through dungs produced by animals.
Cultivated crops may be eaten up by animals.

Continuous Cropping: This is the repeated cultivation of crops in one piece of land.

Effects of Continous Cropping

It encourages the spread of germs.
It results in low yields of crops.
It reduces the nutrients contents of soil.

Shifting Cultivation: It involves the cultivation of a land for one or two years after which it is abandoned for another.

Effects of Shifting Cultivation

It wastes valuable land.
It destroys valuable plants and animals in the areas.
Shifting cultivation decreases the activities of useful micro-organism.

Crop Rotation: It is the system of farming whereby different crops are grown on the same piece of land year after year.

Effects of Crop Rotation

It helps to control pest associated with soil.
Crop rotation controls erosion.
It helps to control the growth of weeds.
It helps to control diseases.

PEST AND DISEASES OF AGRICULTURE

Pests are living organisms that cause physical damage to man and crops.

Types of crop pests

Crop pests include:

Insects
Birds
Rodents
Monkeys
Man
Nematodes.

CLASSIFICATION OF INSECTS PESTS

Pests of crops are classified into various groups based on their mode of feeding. These are:

Biting and chewing insects: Examples: termites, locusts, grasshopper, and army worm.

Piercing and sucking insect: Examples: cotton strainers, mealybugs, scale insects.

Boring insects: Examples: stem borers, maize weevils, rice weevils, bean beetles.

CROPS AND MAJOR PESTS

Crops	Pests
Yam	Yam beetles and rodents.
Groundnut	Leaf worm, aphids, boll worms, snails.
Grasses and vegetables	Caterpillar.
Cassava	Mealy bugs.
Maize	Stem borers, army worm, weevils.
Rice	Stem borers,army worm, leaf rollers.
Cocoa	Black tea thrips, citrus, aphids, root mealybugs.

LIFE HISTORY OF CASSAVA MEALYBUG (Phenacoccus manihot)

The female insects lay eggs without fertilization by the male. The type of reproduction called parthenogenesis. The unfertilized eggs hatch into larvae which are carried with cassava stem cutting during planting because they hide in the buds of the stem. The larvae undergo 3 moulting stages before adult stage. One generation is completed in about 22 days and the adult has life span of about 145 days.

LIFE HISTORY OF YAM BETTLE (Heteroligus meles)

The mating of the male and female yam bettles takes place between November and December in riverine areas and fertilized eggs are laid between December and February, eggs hatch into larva that feed on the decayed organic substances. The larvae moult three times before developing into pupae in March the pupae develop into adults after moulting, the adults then fly to areas where yams are planted between April and June. They dig into the soil to search for the yam tubers. When they eventually come in contact with tubers they feed on them and damage the tubers. Between October and November, the adult yam beetles undergo breeding migration to the riverine areas again for mating.

CONTROL OF PESTS

Chemical control*:* Use of pesticides e. g, Insecticides to kill the pest.

Biological control: It involves the introduction of predators or diseases known to be natural enemies of the pests.

Cultural control*:* This method involves the use of farm practices to control pests, especially on the field. Examples are bush fallowing, regular weeding e.t.c.

Breeding resistant species*:* planting crops that can resist viruses or bacteria transmitted by the pests.

SOME DISEASES OF CROP PLANTS

Plant diseases	**Crops plants affected**	**Symptoms**	**Control**
Blight (B)	Cotton, cassava	Spotting of leaves, falling off of leaves and death of affected part	Use of resistant varieties and crop rotation.
Smut(F)	Rice, maize, guinea corn	Seeds covered with spores	Use of resistant varieties.
Mosaic(V)	Cassava	Mottling of leaves, stunted and growth reduced yield	Use of chemical to the vector and use of resistant varieties.
Rust (F)	Maize, guinea corn, rice	Red or brown spots and stripes on the leaves	Treating with fungicides before planting.
Root knot(N)	Tomato, yam, cassava	Knotting of roots and death	Use resistant varieties.
Leaf spot(F)	Maize	Spotted leaves, and stalks	Crop rotation.

SOME DISEASES OF FARM ANIMALS

Diseases	**Animals affected**	**Symptoms**	**Control**
Newcastle (V)	Poultry	Drop in feed consumption difficulty in breathing, neck twisting paralysis of legs and wings	Vaccination to prevent infection
Trypanosomiasis(P)	Cattles, goat, sheep etc.	Severe anaemia emanciation	Use of drugs and tse¬tse fly eradication.
Brucellosis (B)	Swine	High fever, diarrhoea and death.	Isolation of sick animals, proper sanitation.
Tuberculosis (B)	Cattle, poultry and pig	Constant coughing, loss of weight, sudden death.	Good sanitation, isolation and vaccination.
Anthrax (B)	Cattle, sheep, goats and pigs	High fever ,staggering ,and sudden death	Isolation of sick animals. Proper sanitation.

Rinder pest	Cattle, sheep, and goat	High fever, weakness, diarrhoea.	Regular vaccination, restriction of animals.

FOOD PRODUCTION AND STORAGE

Factors affecting food production are as follow:

i. Land Area: The quantity of food produced depend on the area of land under cultivation. Therefore, the bigger the land, the bigger the food production but the smaller the land the smaller the food production.

ii. Rainfall: Adequate rainfall increases food production while inadequate rainfall decreases food production.

Finance: Lack of money hinders mechanized agriculture in low food production but if farmers are rich, they will buy tractors and harvesters which would enable their increase the area of land under cultivation hence increases food production.

Transportation: Bad roads make the transportation of agricultural products from producing areas to urban areas difficult.

Storage and processing facilities: Good storage and processing facilities lead to an increased food production. Poor and inadequate/processing hinder food production.

HOW TO IMPROVE FARM YIELD

i. The crops must be stored in silos and barns to avoid pest infestation.

Viable seeds and grains: Viability of the seed or fruits go a long way in improving crop yield.

Improved soil fertility: The use of natural manure, fertilizer application and crop rotation help to improve soil fertility.

Plant breeders should aim at having improved varieties which possess qualities like early maturity, resistance to diseases, high yield and easy harvesting.

The ability to feed the livestock with high quality animals but also resistant diseases.

Improved farming techniques: Mechanized farming leads to an intensive and extensive agriculture giving rise to high crop yield.

CAUSES OF FOOD WASTAGE.

Inability to store properly due to inadequate facilities.

Microbial attack caused by bacteria, viruses, fungi on the food crops.

The destructive of stored fruits by larvae or worm.

Unavailability of market to dispose the crops.

Farm produces are inaccessible due to bad roads.

METHODS OF PRESERVATION AND FOOD STORAGE

Canning and bottling accompanied with some preservatives and pressure.

Smoking: Removes water from food and makes unfavourable for micro-organisms to grow on.
Examples: smoking of fish and meat.

Drying: removes water from the food and makes the environment unfavourable for growth of micro-
organism. Examples: dry fish, meat, and vegetables.

Pasteurization: Food is subjected to a high temperature to kill the organisms and the food is seal. e.g, pasteurization of milk and palm wine.

Salting: Introduces a high osmotic pressure within the food, kills or prevents growth of micro-organism. E.g salting of fish, meat and pork.

Refrigeration or **Freezing**: Food is kept at a very low temperature at which bacteria cannot grow or become active, e.g meat, fish, and fruits.

Sterilization through ultra heat treatment (UHT).

RELATIONSHIP BETWEEN AVAILABILITY OF FOOD SUPPLY AND HUMAN POPULATION IN POPULATION GROWTH AND SUPPLY.

The quality of food produced should increase in geometric progression in order to take care of the population, which is expected to increase to arithmetic progression. Human beings can control environmental factors that check their population growth to a certain extent. For example, better hygiene and sanitized and good treatment increase their average life and lower the mortality rate. Also, intensive and extensive agriculture result in an increase in production which would have normally checked growth.

EFFORTS MADE BY GOVERNMENT AT IMPROVING FOOD PRODUCTION

Availability of loan to farmers.

Provision of improved seeds and high breed animals.

Supply of drugs, chemicals on regular basis.

Provision of markets where agricultural products are sold.

Banning importation of certain crops in order to encourage local farmers.

Provision of amenities in the rural areas to discourage rural-urban migration.

Provide irrigation services for constant supply of water needed by plants.