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| <b>COURSE CODE:</b>     | FIS201                               |
| <b>COURSE TITLE:</b>    | Introduction to Fisheries Management |
| <b>NUMBER OF UNITS:</b> | 2 Units                              |
| <b>COURSE DURATION:</b> | Two hours per week                   |

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### COURSE DETAILS:

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| <b>Course Coordinator:</b> | Prof. Yemi Akegbejo-Samsons |
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| <b>Other Lecturers:</b>    | Dr. (Mrs.) N.B. Ikenweiwe   |

### COURSE CONTENT:

The important fishes of West Africa with emphasis on Nigeria species. Classification, evolution, morphology and basic structure of fishes. The adaptation of fish to aquatic life. Life cycle of principal species of fishes. Significance of fishes in the life of Nigerians. The fish industries in Nigeria. Fundamental principles of fish management and production.

### COURSE REQUIREMENTS:

This is a compulsory course for all students in the University. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

### READING LIST:

The Fresh Water Fishes and Fisheries of Nigeria by D.H.J Sydenham Fish and Fisheries of Northern Nigeria

**Ikenweiwe, N.B, D. Odulate, B. Adigun (2011) *Ichthyology and Limnology: Tools In Fisheries Management Fisheries Management*. United Kingdom. Lap Lambert Academic Publishing. ISBN: 978-3-8433-9364-5. Available online at <http://dnb.b-nb.de> 127 pages**  
<http://www.fishbase.org/summary/species>

### LECTURE NOTES:

#### INTRODUCTION

Fish are poikilothermic or cold blooded animals that live in the aquatic environment Most fish, especially the recent species, have scales on their body and survive in the aquatic environment by the use of gills for respiration.

Another major characteristic of a typical fish is the presence of the operculum which covers the gills on the posterior.

Ichthyology is the scientific study of fish.

Fish, because of the possession of notochord belong to the phylum Chordata. Fish are the most numerous vertebrates in the world. About 20,000 species are known to science

### **FISH TAXONOMY**

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Taxonomy is the scientific classification of organisms

### **WHY TAXONOMY?**

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To know/identify the different components in a fish population.

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To study the population dynamics in a population.

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(Number of each species in a population.)

Important in fish culture – to know the species of fish that is most suitable for culture.

### **HOW TO IDENTIFY FISH?**

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#### **NAMES**

##### **Species**

Any group of fish, or of any other animal for that matter, whose members are similar in structure

and appearance and are capable of breeding among themselves belong to the same species.

##### **Genus**

A genus encompasses a group of species, which are closely related to one another and are therefore usually similar in appearance. Generic names begin with a **capital letter**, and both generic and specific names are *italics*.

#### **MERISTIC FEATURES**

The most vital external characteristic for identifying fish is the fin ray counts, especially those of the dorsal and anal fins.

##### **Head pore pattern in**

**a) Nasal, b) Suborbital, c) Postorbital, d) Mandibular, and e) Preopercular**

The number of spines and or rays in the dorsal and anal fins is generally the most consistent character in a species; and is seldom the same in different species.

##### **Rays**

Each fin is made up of a number of rays, which are usually bony and flexible, and may be either simple or branched

##### **Dorsal Fins**

Some West African species have two dorsal fins, the posterior of which is often soft, fleshy tissue and are thus termed an adipose fin. The size and shape of the adipose fin is sometimes given as a clue to the identity of a species.

##### **Caudal Fin**

The caudal fin (or tail fin) of most fish is lobed; i.e. it is forked and has the upper and lower lobes attenuated to points. It can also be rounded or truncate.

##### **Mouth**

The position of the mouth is sometimes given when describing a species.

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A mouth is said to be terminal when it is at the extreme tip of the snout.

It is a general rule that fish with mouths in an inferior position, like most catfish and carps feed on detritus, worms, algae and bottom dwelling organisms Fish with terminal mouths, such as perch and tiger fish, are usually predators or plankton feeders.

Cyprinodonts and others with oblique mouths usually feed on insects or their larvae which they take from the surface of the water.

##### **Teeth**

The position and character of teeth are sometimes important in the classification of fish.

Premaxillary- teeth in the front margin of the upper jaw,

Maxillary- teeth on the sides of the upper jaw on a separate bone;

Mandibular- teeth on the margin of the lower jaw;  
The terms used to describe positions of teeth are:

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Vomerine- teeth on the front part of the roof of the buccal cavity,  
Palatine - when further back on the palate and  
Pharyngeal - when they are situated in the throat.

Nostril

Most fish have two nostrils on each side of the head in front of the eyes. Cichlids are exceptions, with only one on each side.

Gills

The function of the gills is to extract oxygen from water, where it is usually abundant in a dissolved form, and to rid the blood of carbon dioxide.

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The large surface area of gill filaments and their thin membranous covering allows an interchange of gases to take place as the oxygenated water passes over them.

Lateral Line

This is the visible part of the extraordinary sensory system of fishes lateral line consists of a series of marks or pits, usually one on each scale, running along about the midline of each side of the body and also at times on the head.

Scales

Scales are protective coat of flexible armour that cover the body of some bony fish which are embedded below the skin

The different types of scales possessed by various fish are important for identification purposes.

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Polyterus alone among local fishes have ganoid scales.

Scales are termed Ctenoid when the exposed edges are ciliated or toothed. The surface of fish with ctenoid scales, such as climbing perches, is always rough.

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Most fish have Cycloid scales; that is, with the exposed margin evenly rounded, giving the skin a smooth surface.

Colour

Identification on the basis of colour can be quite misleading as these often differ strikingly according to the habitat, sex, breeding activity or other factors. Many members of the cichlid family have the ability to change colour.

Male *Hemichromis fasciatus*, for example, when in clear water during breeding activity, are canary yellow and have vivid black bands on the sides. At other times they are usually silvery on the sides and the bands are reduced to smaller black patches.

Sexual Differences

The sex of a fish can very seldom be determined from its external characters, but the anal fins of males and females of some species do differ in shape.

FISH CLASSIFICATION

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A system of classification provides the means for resolving the problem of the origin and evolution of life.

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Classification involves scientific philosophy that uses inductive procedures.

“Family tree” of the Nile tilapia”

**Phylum** Chordata – **Animals with Notochord**

**Subphylum** Vertebrate – **Animals with a backbone**

**Class** Osteichthyes – **Bony fishes**

**Order Perciformes – Perch-like fishes**

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**Family Cichlidae – Cichlid fishes**

**Genus *Oreochromis* – Mountain cichlid group**

**Species *niloticus* – Nile tilapia**

Name Authority

Thus “*Clarotes macrocephalus* Daget 1954” indicates that this species was first described by Daget in his publication

REASONS FOR CLASSIFICATION

To create order out of confusion by making accurate identification of every organism.

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MORPHOMETRIC CHARACTERS

They are characters that represent the morphology.

They are always measurable characters e.g. body depth, fork length, standard length, total length, front length etc. In using these morphometric characters for identification, the ratio

of these lengths are used which are peculiar to a certain species within a certain range. e.g. BD 0.4 –0.6

TL

ELECTROPHORETIC METHOD

This involves the analysis of component proteins in the blood or tissue in identifying fish.

RACIAL STUDY

It involves separation into different racial stocks. This is only relevant to a particular species of fish. The third name of a fish reflects its race.

METHODS OF CLASSIFICATION

Generally, seven standard categories form the internationally accepted groups of classification for all living organisms.

These standard categories are:

Kingdom

Phylum (phyla)

Class

Order

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Family

Genus ( Genera)

Species (species)

The complexity and diversity increase downward; from kingdom to specie.

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Therefore, we find fish names existing in the genera and species levels.

Sub-divisions

In a attempt to make the classification table more meaningful and to give room for major dissimilarities we have within the seven major divisions sub-divisions e.g. sub- phylum, super class, sub order etc.

RULES OF CLASSIFICATION

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In genera, generic name must always begin with capital letter while the specific name must begin

with small letter. E.g. *Lates niloticus* note “L” and “n” The generic and specific names must always be underlined e.g. *Clarias gariepinus*, *Oreochromis*

*niloticus* or italicized The naming system comprising of specific and generic names is called

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*BINOMIAL SYSTEM OF CLASSIFICATION.*

CHARACTERISTICS OF CHORDATES

The presence of notochord which runs longitudinally, from the anterior to the posterior end of the body. The possession of a nerve cord which is dorsally oriented except in the primitive fishes. The possession of holes in the pharynx (throat) called slits or clefts.

#### CHARACTERISTICS OF VERTEBRATES

They possess some form of cranium.

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They possess some trace of vertebral The front end of the nervous system is differentiated into an elaborate brain, associated with special receptors like eyes, nose etc.

#### **UNAAB, AQ&FM, FIS201 DR. IKENWEIWE**

The meter organisation of the body allows the performance of delicate movements to suit the situations that the receptors reveal.

Presence of heart, at least 3 chambers, assisting in circulation of blood. The presence of haemoglobin in the red corpuscles as a medium for carrying oxygen in the blood. The excretory system consists of meso-dermal funnel (kidney) which functions as osmo-regulator

#### CHARACTERISTICS OF ELASMOBRANCHII

They are cartilaginous.

They possess 5-7 gill slits

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They have spiracles.

#### CHARACTERISTICS OF CHONDRICHTHYES

They possess constricted notochord

They all have jaws

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The skeletons are cartilaginous

They have paired and unpaired fins

Nostrils are in pairs

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They have three semicircular canals in the ear

The cranium is not totally fused to the arch (not joined by connective tissues).

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They possess placoid scales

Mouths are inferior

#### CHARACTERISTICS OF OSTEICHTHYES

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They have bony jaws, skull and skeleton

Gills are usually 4 pairs in number

They possess operculum

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The scales are bony either cycloid, ctenoid or ganoid

The external features of a scaleless fish.

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1. Operculum 10. Lateral line
2. Cephalo-muchal shield 11. Pelvic fin
- 3 Dorsal spine 12. Pectoral spine
4. Dorsal filament 13 pectoral fin
5. Dorsal fin 14 Humeral process

#### **UNAAB, AQ&FM, FIS201 DR. IKENWEIWE**

6. Adipose fin 15 maxillary barbel
7. Caudal peduncle 16 Outer mandibular barbel
8. Caudal fin 17 Inner mandibular barbel
9. Anal fin

The external features of a scaly fish.

1. Dorsal fin 6. Lateral line

2. Adipose fin 7. Pelvic fin

3. Dorsal fin 8. Pectoral fin

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4. Caudal peduncle 9. Operculum

5. Anal fin

**FISH ANATOMY**

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The Basic Structure of a Fish

Like most animals, the fish has a body which includes the head, trunk and limbs.

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The body has generally an elongated shape.

The head, trunk and the tail follow each other without any separation, which enables the fish to wriggle easily in the water. Limbs are fins. The body is covered with the skin.

The Head

In the front part of the head is the mouth, of which the shape and features differ according

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to the feeding habits of the fish.

Some fish have large mouths with sharp teeth for seizing prey, while others have small mouths on the under surface

**MOUTH**

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of the head, suitable for scrapping up algae from the bottom. The shape of the teeth of fish depicts the feeding habits of the fish. Predatory

**TEETH**

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fish, such as the *Hydrocynus* are well supplied with sharp teeth. Vegetation eating fish may have teeth, each one with many more or less rounded points, arranged in bands along the side of the jaws (*Tilapia rendalli*).

The teeth of some omnivorous fish (*Alestes*) are quite similar to the molars of man. In many fishes, there is, in addition, a bony plate bearing teeth in the back of

the throat which are called pharyngeal teeth (*Tilapia*, Carp).

Nostril

On the snout, above the mouth, are the nostrils. The nostrils are not used for breathing but only for smelling.

Barbel

Some fish have filaments along the side of their mouth which can be longer than the head itself

e.g. (catfish) which are called barbels. Their number can vary between 2 and 8. They are sensory organs which help the fish to find its food.

Opercula

At the hind end of the head are two bony flaps called opercula or gills covers, which can be lifted; underneath are the gills.

Gills

Every gill is made of a bony arch carrying long red filaments on one side called the gill filaments and short teeth like, or longer comb like projections on the other side called gill rakers.

The gill filaments are the breathing organs of the fish and are also used as a strainer to sieve out food particles from the water

The trunk

The trunk is the part of the body in which are located a number of organs: the air bladder, the stomach, the intestine, the liver, the kidneys, the ovaries, the testicles. It starts from the head and includes the ventral cavity.

The tail – caudal fin

It is located behind the anus and ends with the caudal fin. An anal fin and sometimes a part of the dorsal fin can be found on the tail.

The fins

When identifying fish, the fins are the first things, which should be examined. The number of fins, their types, sizes, location on the body and position in relation to each other, are most important. The fins are similar to paddles made out of rays which would be joined together by a web.

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The rays can be either spiny or soft, ramified into a paint-brush and are then called soft rays.

Types of Caudal Fins

The caudal fin or tail of most fish is lobed, which means that it is forked and has the upper and lower lobes attenuated to points. But in some fish, it is round, pointed or truncated.

Adipose Fin

Some species of fish have two dorsal fins, the second of which is often an adipose fin, composed only of soft, fleshy tissue and usually without rays of any kind.

Body Forms

Commonly, the fish body is torpedoshaped (fusiform), and most often slightly to strongly ovoid in cross section. In free swimming species, the body approximates the theoretically perfect streamline form in which the greatest cross section is located close to 36 percent of the length back from the anterior tip globe shapes (globiform – e.g. puffers, tetraodontidae) serpentine (anguilliform – e.g. eels, *anguillidae*), threadlike in outline (filiform e.g. snipe eels, Nemichthyidae). Compressed: flattened but greatly elongated

Trachipteriform: flattened from top to bottom

Depressed – the skates, rajidae, and the batfishes

**FISH ADAPTATION TO AQUATIC LIFE**

**Shape** - streamlined, fusiform rounding edge of such shapes reduces resistance

**tapering** - of posterior part minimizes drag

**mucus cover** - further reduces drag, smoothens Laterally compressed body prevails in quiet water body of relatively dense cover.

Depressed body prevails among nmbottom dwellers

Dorso-ventrally flattened body characterized stream fishes.

Fins

Used by fishes to achieve all forms of locomotion, stabilization, balancing, change of direction and breaking in their aquatic environment

Used as gliding organ in some flying fishes

Used for terrestrial locomotion in some catfishes

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As organ for crawling: use of some modified fins e.g. paired fins like pectoral, pelvic fins

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Nigeria has diversity of fin and shell fish fauna consisting of over 250 species in Inland waters

There are about 101 species (22 families) in Kainji lake alone (Ita 1993)

86 in lake Chad (Hopson 1967),

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25 species (10 families) in Tiga lake (Ita 1985)

21 species (10 families) in Bakolori (Ita 1993)

32 species (11 families) in Oyan lake (Ikenweiwe, 2005) and

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199 species from 78 families in the brackish and marine waters (Tobor and Ajayi 1978).

**Significance of fishes in the life of Nigerians**

The topic will be treated with adequate reference to the role of fish and fish production (aquaculture) in rural development, through its relationship to food security and poverty alleviation, its contribution to rural development and other national attributes.

Aquaculture comprises diverse systems of farming plants and animals in inland and coastal areas, many of which have relevance for the poor. FAO defines aquaculture for statistical purposes as the “*farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc.. Farming also implies individual or corporate ownership of the stock being cultivated*” (FAO 2001)

In the context of the rural poor, aquaculture often complements catches from traditional fisheries. The latter continue to play an important role and, in many areas, remain adequate to satisfy subsistence needs and provide a valuable source of cash income for farmers. In many cases, the capture or culture of aquatic species forms the basis for food security, enabling the use of livestock or cultured fish as a source of income generation.

Aquaculture becomes an attractive and important component of rural livelihoods in situations where increasing population pressures, environmental degradation or loss of access, limit catches from wild fisheries (IIRR *et al.* 2001).



**The significance of fishes in the life of Nigerians include:**

- (i) Source of protein: - It's the cheapest when compared to other protein sources such as poultry, meat, beef, pork or mutton
- (ii) Employment:- creates employment in various sectors of the economy such as (a) jobs for over 500,000 fishermen in the coastal and riverine areas; (b) industrial trawling in vessels and small-scale shrimpers; (c) Sales of smoked fish, fresh fish, chilled fish in cold stores etc especially engaging the women fold; (d) employment for workers in the Research institutions, Universities and education centres.
- (iii) Income generation for Federal, State and Local government levels .
- (iv) Source of foreign exchange earnings for the Federal government in particular and individuals who are involved in its exportation.
- (v) It gives opportunities for international cooperation in Nigeria such as membership of International organisations (FAO, UNDP, IFAD, CEECAAF etc. These organisations are channels for the provision of developmental funds for rural development in the coastal areas and fisheries sectors.
- (vi) Assist in rural development through direct government interventions to improve the livelihoods of the fishermen and other related stakeholders. For example, the intervention through DIFFRI in the early 80s, FADAMA III, ADP etc

**Objectives of fisheries in Nigeria**

- (i) To increase fish production in the country by employing modern methods and techniques of fishing
- (ii) To exploit as profitably as possible the fisheries resources of the country.
- (iii) To improve the utilization of these resources by the introduction of modern methods of processing and marketing facilities
- (iv) To raise the standard of living and the socio-economic status of the fishermen, through the provision of outboard boats, nets, preservation methods etc
- (v) To train local fishermen and fisheries personnel in modern fishery management and operations
- (vi) To reduce the importation of fish to the barest minimum in order to conserve the much needed foreign exchange
- (vii) To increase fish production to the extent that we can export to other neighbouring countries, thereby earning foreign exchange
- (viii) To produce employment for fresh school leavers and other qualified cadres.

**The Fish Industries in Nigeria.**

Like most industries in the world, the fishing industry can be divided into 3 major sectors:

**(A) ARTISANAL**

This is the small scale sector, usually organised by family unit. It is labour intensive and made up of 4 sub-sectors:

- a) Riverine and Lake Canoe fisheries
- b) Flood pond fisheries based on the exploitation of flood plains. This is seasonal.
- c) Coastal Canoe fisheries (along the coast and its made up of fishermen scattered along the coast line)
- d) Brackish water Canoe fisheries (along the creeks, lagoons, estuaries)

## **(B) AQUACULTURE (FISH FARMING)**

This is the cultivation of fish in controlled environment for food purposes. It involves selection of sites for fish pond construction, proper construction, stocking and feeding of cultured species, management of pond water, pond bottom and harvesting of fish after culture period. This sector of the industry is very versatile and active involving many stakeholders and professionals such as pond engineers, fish health experts, nutritionists and geneticists.

## **(C) INDUSTRIAL FISHERIES**

This is the use of high technology in form of equipments in the harvest, delivery and distribution of fish and fish products. It is capital intensive and requires the use of highly sophisticated technology. It involves a highly organised processing and marketing facilities.

The Industrial has 2 main sectors, vis (a) Inshore and (b) Offshore

The inshore is within the territorial shore of Nigeria while the Offshore is in the distant water fishing zone of the country.

There are various Fish Industries in Nigeria.

The different industries can be divided into the various fish production and utilization options.

### **Type 1:**

Based on the production options, these industries include

#### **(a) The Aquaculture Industry**

(i) Fresh fish production Industry such as Fresh water, Brackish and marine fish production ventures. These could be small scale or large scale.

#### **(b) Harvesting Industry**

(i) Trawler subsector (trawler owners, fleet) artisanal groups in the rivers, creeks and lakes;

### **Type 2:**

Based on Fish utilization options:

(i) Industrial utilization sector- they convert the fish to either direct or indirect uses. Examples include the canning industries, Animal feed Industries (eg Pfizer Plc, Animal Care Plc etc

(ii) Direct utilization sector: These include (a) Fish Smoking sector, (b) Sundried/ salting sector, (c) Chilled sector eg packed (chilled)fish importers etc

Note: Visits will be paid to some industries within and outside the state of Ogun

**Industrial uses of fish**

- (a) Production of fish meal
- (b) Production of fish minced products
- (c) Production of fish protein concentrates
- (d) Fish silage production
- (e) Production of salted press cake
- (f) Production of patties
- (g) Production of oil products (OMEGA-3, Cod liver Oil etc)

**Fundamental principles of fish management and production.**

The practice of aquaculture and fisheries management is influenced by some basic principles. These include:

- (a) Aquatic animals are dependent directly or indirectly upon plants for food. The need to know the trophic level of the fish is very important.
- (b) Ability to produce plant is dependent upon factors such as solar radiation, temperature, oxygen, nutrient availability etc
- (c) Natural fertility of water is largely dependent upon fertility of its associated soil and its sources. Soils contain basic nutrients which aid vegetative production.
- (d) Water fertility may be increased by adding inorganic or organic fertilizers.
- (e) Phytoplankton is the primary and principal food production groups of plants for organic aquatic animal production in oceans, lakes and ponds.
- (f) The longer the food chain the greater the energy loss. If the food chain is long, the energy loss will be high.
- (g) The carrying capacity per unit area is different for different species of fish depending on the trophic level of the species.
- (h) The greatest weight of any one species can be raised and produced in ponds by culturing only that specie.
- (i) The greatest weight per area of the species is obtained by culturing a combination of different species which differ in food and feeding habits.

(j) The quality of feeds for a proper culture medium should contain the varying nutrients in the proper proportion.