LECTURE NNOTE

ON

FIS 201 (2Units)

INTRODUCTION TO FISHERIES MANAGEMENT

PREPARED BY

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INTRODUCTION

ICTHYOLOGY is the scientific study of fish. Fish, because of the possession of notochord belong to the phylum chordata. They are most numerous vertebrates. About 20,000 species are known to science, and compare to other classes, aves 98,600species and mammals 8600species, reptiles 6,000 spandamphibians 2,000species.Fish also in various shape and forms from the smallest niamoy17mmT.L the giant whale shark that measures 15m and heights 25 tonnes.

Fish are poikilothermic cold blooded animals that live in aquatic environment Most fish , especially the recent species, have scales on their body and survive in aquatic environment by the use of gills for respiration. Another major characteristic of a typical fish is the presence of gill slits which cover the gills on the posterior.

(1) FISH TAXONOMY.

Everyone is at heart a taxonomist whether by virtue or necessity or because of mere curiosity.

1. To know/identify the difference component in a fish population. That is to name and arrange.
2. To study the population dynamics in a population. (Number of each species in a population.)
3. Important in fish culture propagation – to know the species of fish that is most suitable for culture.
4. To exchange information to people in other parts of the world living known that both are dealing on the same species.
5. Reduce confusion as same Latin word generally acceptable worldwide are used while vernacular names differ form one location to another.
6. Information on the discipline like genetics, ecology comparative physiology, behavior, cytology, zoogeoy.

Biometncs and related fields are necessary in taxonomy study of meristic count tells of fish behavior and geographical location e.g. Northern clarias garie pinus have more gill rakes then southern ones and different in gill rakes number the two geographical locations collations indicate that the northern species are in general more of invert ebrate feeders and less psivorous than southern ones (Though all have long slender closely set gill rakers).

(2) HOW TO IDENTIFY FISH.

Fisheries workers are frequently accused of veiling other subject in complicated terminology but to describe a fish properly technical terms must be used. The most common ones are shown in figure 1. A glance at the illustrations should enable on to identify most species with a fair degree of accuracy. When doubt exists other anatomical details may have to be examined in giving measurements we have used total lengths throughout.

(3) NAMES

To know the correct name of a fish is satisfying for an angler or amateur naturalist. For professional fisheries workers it is far more important, for it might enable them to study investigations carried out on certain species, or to exchange information with people in other parts of the world, safe in the knowledge that both are dealing with the same species. Confusion can be avoided only by using the Latin scientific names for they are the same throughout the world, while vernacular names are often different in locations only fifty miles

apart. 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. A genus encompasses a group of species, which are closely related to one another and are therefore usually similar in appearance. Genetic names begin with a capital letter, and both generic and specific names are italized. Genera in turn form larger groups known as families and these form sub-orders and so on. But for general fisheries work it is sufficient to trace the species back only as far as its family name which always has the ending *idea*.

MERISTIC FEATURES

The most vital external characteristics for identifying fish are the fin ray counts, especially those of the dorsal and anal fins. The sizes and shapes of fins, their situation on the body and positions in relation to each other are also important. The number of spines and or rays in the dorsal and anal fins is generally the most consistent character in a species and seldom the same in different species. Each fin is made up of a number of rays, which are usually bony and flexible, and may be either simple or branched; that is, they divide or sub-divide part of the way along the ray. In many fish, strong and sharp spines replace some of the rays, especially of the dorsal fin and these are counted separately when describing a fish. It is customary to use Roman numerals for spine counts. Thus D XIV-XVI, 11-13; A 111, 7-10, the fin counts for *Tilapia zilli*, or italized indicate that this species has from 14 to 16 spines and from 11 to 13 rays in the dorsal fin, while the anal fin has 3 spines and between 7 and 10 rays. 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. 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. A mouth is said to be terminal when it is at the extreme tip of the snout. As the mouth is progressively posterior to this position on the ventral side it is described as being sub-terminal sub-inferior, inferior or ventral. A mouth which is dorsal to the terminal position is said to be upturned or oblique. 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; those 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. Teeth may be pointed and with a varying number of cusps, according to which they are termed unicuspid, bicuspid, etc or they are said to be granular when they are numerous and flat, forming a rough surface like sandpaper. In fish such as Tetraodon and Protopterus, the teeth are coalesced into beak-like structures or massive ridges and these are usually used for crushing shells or seeds. The terms used to describe positions of teeth are: premaxillary, when teeth are situated in the front margin of the upper jaw, maxillary when on the sides of the upper jaw on a separate bone; mandibular, when on the margin of the lower jaw; vomerine, when 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. Nostrils can also be situated at the end of nasal tentacles, as in Channa. Fish nostrils are usually connected to olfactory organs and have no respiratory functions.

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. Gills usually consist of a series of bony hoops, to the posterior edge of which are attached numerous fine gill filaments, usually bright red because of the abundance of blood they contain. Water enters through the mouth, passes through the gill chamber and over the filaments, and is expelled through openings on each side of the head. 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. Clarias are an example of local fish which possess unusual accessory breathing organs which enable them to extract oxygen directly from the air, thus allowing them to survive for long periods out of water or in swamps and pools which become polluted when they almost disappear during the dry seasons. Gill rakers, rather like combs in appearance are found on the inside of the gill archers. They vary in number and size in different species and are sometimes an important aid to identification. Gill rakers serve both as a sieve, preventing large particles, from reaching and perhaps damaging the delicate gill filaments and also at times as a filter to collect minute food part6icles from the water as it passes through them. It therefore generally follows that species having numerous and fine gill rakers are microphages or plankton feeders, while those with heavier and fewer gill rakers feed chiefly on larger objects. The freshness of a fish can be determined by examining its gills. Recently caught specimens have blood-red gills, but bacterial action soon causes them to become white and sticky and they begin to give off an offensive odour before the flesh of the fish does

Lateral Line
The visible part of the extraordinary sensory system of fishes, known as the 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. Heterotis niloticus provide a striking example of a conspicuous lateral line. Some fish have a discontinuous lateral line, the anterior part often being higher on the body and more conspicuous. A few fishes have no lateral line. These external pores are connected through special sensory organs to nerves running to the brain and by means of these sense organs fishes are able to detect movements and vibrations which are far beyond their range of vision.

Scales
Most fish have their bodies and also sometimes part for their heads, fins and tail, covered by a layer of scales which are embedded below the skin. Besides this protective coat of flexible armour, fish are usually covered by a thin layer of mucous slime which helps to protect the skin from bacterial infection and lubricates the body to ease its passage through the water. The different types of scales possessed by various fish are important for identification purposes. Polypterus 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. Most fish have cycloid scales; that is, with the exposed margin evenly rounded, giving the skin a smooth surface. Figure 2 shows the different types of scales. For correct identification of a fish, it is sometimes necessary to count the number of scales in a horizontal line from the rear edge of the operculum to the end of the caudal

peduncle. A vertical count of the number of rows is also sometimes necessary, and figures are given for above and below the lateral line. The number of rows of scales around the caudal peduncle may occasionally be the most reliable guide to the determination of a species. The number of scales remains the same as a fish grows, but each scale increases in size. An abundance of food at certain seasons might speed up the growth rate of a fish; or perhaps growth is retarded as a result of gonad development and spawning or other factors. This stop-go pattern of growth leaves marks on the scales which are sometimes useful in determining the age of a fish. Unfortunately, these rings are more difficult to interpret and less reliable with tropical fish than they are with those from temperate waters where the seasons are more marked.

Colour

When colours are stated in the description of a fish, these refer to the colours of either a live or recently dead specimen. Identification on the basis of colour can however be quite misleading as these often differ strikingly according to the habitat, sex, breeding activity or other factors. Many members of the cichlid family rival chameleons in their 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 patehes. Colours of many fishes change after death and sometimes again after being preserved, so a museum specimen may, at first glance, appear very different from another member of the same species kept alive in an aquarium.

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. In some genera – Clarias is an example – only the males possess an external genital papilla. Extreme sexual dimorphism is also evident in the cyprinodont family, where males usually have larger fins and are more colourful than females of the same species.

Ancient Fishes

Three genera of fishes which live in West African freshwaters deserve the name ancient fishes. The term ancient means only that they closely resemble fish which lived thousands of years ago and do not show the characteristics of more modern, bony fish. That they have survived means that they are no less well adapted than more recently evolved groups of fish living under today's conditions.

Lepidosirenidae

The sub-order to which the family Lepidosirenidae belongs can be traced back to the Devonian period, some 300 million years ago. Only one species occurs in West Africa. *Protopterus annectens* the lungfish or mudfish. It is very easy to recognize because both the pectoral and pelvic fins are reduced to thread-like filaments and the dorsal, caudal and anal fins are continuous. The eyes are small and so are the scales, which are cycloid and embedded in the skin. The teeth are fused into sharp tooth-plates and the largest specimens can give a nasty bite. The most peculiar feature of this fish is that it has a pair of lungs which enable it to breathe air. This ability allows it to do something which no other species of fish can do aestivate it normally lives on flood plains and when these dry up, during the dry season it secretes a thin slime around itself which dries into a fragile cocoon. It can exist in this state for over a year, although normally it hibernates only from the end of one wet season to the start of the next. Even when the rains come and it takes to a normal life, it still

continues to breathe air. This means that it can survive in swamps which are normally badly oxygenated.

Polypteridae
Polypterus is another living representative of a group of fishes which can be traced back to the Devonian period. Its thick, ganoid scales, which are rhomboid in shape and barely overlap, give the genus a primitive, armoured appearance.

CLASSIFICATION
A system of classification provides the means for resolving the problem of the origin and evolution of life. Classification involves scientific philosophy that uses inductive procedures.

Primary function of classification is to create order out of chaos by leading to accurate identification of individuals and to their ranking or arrangement into various taxa since it is impossible to discuss or think about organisms. The modern systematist utilizes information from a great variety of disciplines – genetics, ecology, paleontology, comparative physiology, animal behavior, cytology, zoogeography, biochemistry, biometrics and related fields. Background information from such discipline is essential for the solution of many taxonomic problems. Systematics has become the focal point of many fields of biology since it deals with organic diversity, a major integral branch of biology.

To know the correct name of a fish is of great importance if one is to take advantage of the work already done by others and thus save a lot of unnecessary expense and effort. Only the use of the scientific names of fish will permit this, they are the same in all languages, whether Japanese, Arabic or English.

Any group of fish, or of any other animal for that members are similar in structure and appearance and are capable of breeding among themselves, are said to belong to the same specie. The singular is usually abbreviated sp. and the plural spp. If specimens form a certain locality show minor differences from others found elsewhere, they are refereed to as a sub-species or variety.

A group of species which closely resemble one another in structure but which do not interbreed, are said to constitute a *genus* (plural genera). For the correct name of a fish, both the generic and specific names must be given, and sub-specific or variety names are added if they exits. The generic name should always begin with a capital letter and the others with lower case letters. The names are usually printed in Italics, or in typing they are underlined.

Despise this, confusion sometimes arises as a result of different authors mistakenly using

different names for the same species. Thus it is customary in more detailed work to add the

name of the person who first described the species, and sometimes also the date that his

description was first published. Thus " Clarotes macrocephalus Daget 1954" indicates that

this species was first described by Daget in his publication of that year and such name should

be used only for the species intended by the author. Bracket around the author's name

indicates that, although the original description is still accepted as correct, for some technical reason the name fist given by the author is no longer valid and has been changed. Thus" Hepsetus odoe (Bloch)' means that this species, first described by Bloch as Sarcodaces odoe, was in fact a member of the genus Hepsetus.

Genera in turn fall into larger groups known as families, and these into sub-order and so on. But for general fisheries work it is sufficient to trace the fish back only as far as its family. **When writing about fish it is customary to put the families into ascending order, according to their place in the evolutionary ladder. This is determined on the basis of knowledge gained from studying fossil and the degree of advancement of structure in modern fish. Thus Protopterus and Polypterrus, belonging as they do to separate sub-classes which evolved long before other fishes, take precedence over Pellonula (a clupeid), or the slightly more advanced osteoglossid, heterotis, and so on until one comes to the Cichilds and Cyprinodonts which are reckoned to be more recently evolved and advance in structure.**

To track down the correct name of a fish by examining their visible eternal features, but this is not always so and exact identification sometimes requires a detailed examination of such parts as gill rakers, air-bladder or the skeleton.

REASONS FOR CLASSIFICATION

1. To create order out of confusion by making accurate identification of every organism.
2. To serve as guide on relationship between organisms.
3. To identify the differences out of different organisms. Since the categories in classification are based on the degree of similarities so that the more closely related organism or group of organism are, the more on factors or characteristics they shared together.
4. Because of varying shapes, sizes, physical and physiological diversities fishes possess, there is reason that fishes must be classified and identified.

MEHODS OF STUDYING TAXONOMY OF FISHES

1. MERISTIC CHARACTERS: there are feature on fish which can be counted e.g. spines and rays of a particular fin. In many fish, some of the rays, especially of the dorsal fin, are replaced by strong and sharp spines; these are counted separately when describing a fish. Roman numerals are customarily used for spine counts.
   In *Tilapia zilli*, DXIV- XVI, 11-13; A111, 7-10, are fin counts. These indicate that *T .zilli* has from 14-16 spines and 11-13 rays on the dorsal fin; 3 spines and 7-10 rays on the anal fin.

2. 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.

$$\frac{BD}{TL} \quad 0.4 - 0.6$$

There is disadvantage in using the total length (TL) because caudal fins may be damage before measuring it. Hence, it may give inaccurate measurement and may even be difficult to measure.

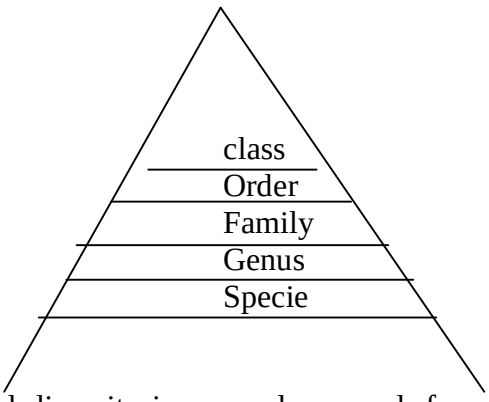
3. ELECTROPHORETIC METHOD: This involves the analysis of component proteins in the blood or tissue in identifying fish. A jot of the fish blood or extract from the ground muscle is taken and chromatographed. In the process, component protein in the extract travel at different velocity hence separated apart. The distance at which the proteins are after settlement to each other is relevant and peculiar to that specie of 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. The past for this study is the salinity and temperature which affect the features seen in fishes even though they are the same specie.

METHODS OF CLASSFICATION

Generally, seven standard categories forms the internationally accepted groups of classification for all living organisms. These standard categories are:

i. Kingdom
ii. Phylum (phyla)
iii. Class
iv. Order
v. Family
vi. Genus (Genera)
vii. Species (species)



The complexity and diversity increase downward; from kingdom to specie. Therefore, we find fish names existing in the genera and species levels. 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. and of recent, varieties have just being recognized in the taxonomic hierarchy just after specie level.

RULE OF CLASSFICATION

i. Internationally, consensus has been reached that in biological classification Latin scientific names should be used any where in the world. Reason being that vernacular names tend to be different even within thesame locality.

ii. 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"

iii. the generic and specific name must always be underlined e.g. *Clarias gariepinus*, *Oreoochrosiis niloticus or* italiased

iv. The followings have been internationally agreed upon is ending for their corresponding groups.

Group	**ending**	**examples**
- Orders	*iformes*	*clupeiformes*
- sub orders	*oidos*	*clupeoiddei*
-families	*idea*	*clupeidae*
- sub families	*inae*	*clupeinae*

The naming system comprising of specific and generic name is called *BINOMIAL SYSTEM OF CLASSIFICATION.*

CHARACTERTISTICS OF CHORDATES

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

CHARACTERTISTICS OF VERTEBRATES

i. They possess some form of cranium.
ii. They possess some trace of vertebral
iii. The front end of the nervous system is differentiated into an elaborate brain, associated with special receptors like eyes, nose etc.
iv. The meter organisation of the body allows the performance of delicate movements to suit the situations that the receptors reveal.
v. Presence of heart, at least 3 chambers, assisting in circulation of blood.
vi. The presence of haemoglobin in the red corpuscles as an act of carrying oxygen in the blood.
vii. The excretory system consists of meso-dermal funnel (kidney) which functions as osmo-regulator.

CHARACTERISTICS OF ELASMOBRANCHII

i. They are cartilaginous.
ii. They possess 5-7 gill slits
iii. They have spiracles.
iv. When scales are present, they are the placoid type.
v. They also have cloaca (unrinogenital) which has intermittent organ called clasper.

CHARACTERISTICS OF CHONDRICHTHYES

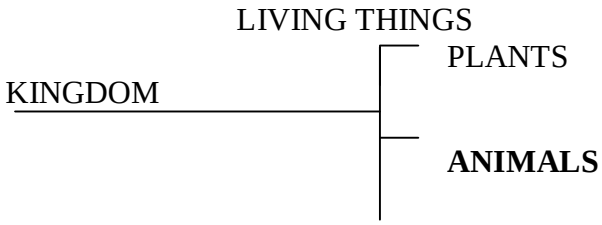
i. They possess constricted notochord
ii. They all have jaws
iii. The skeletons are cartilaginous
iv. They have the paired and unpaired fins
v. Nostrils are in pairs
vi. They have three semi-circular canals in the ear

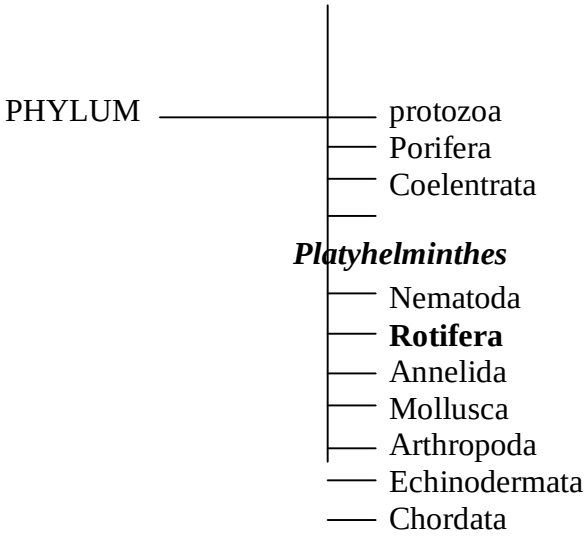
vii. The cranium is not totally fussed to the arch (not joined by connective tissues).
viii. They possess placoid scales
ix. Mouths are inferior

CHARACTERISTICS OF OSTEICHTHYES

i. They have bony jaws, skull and skeleton
ii. Gills are usually 4 pairs, in number
iii. They possess operculum
iv. The scales are bony either cycloid ctenoid or ganoid
v. Most are oviparous (egg layers) with external fertilization and high fecundity
vi. Most of them posses air bladder
vii. Respiration is by pumping by buccal/opercular opperture.

TAXONOMIC HIERACHY





SUBPHYLUM **Urochordata**

Hemichordata

Cephalo chordata

Vertebrata = craniata

(E.g. pieces, mammalia,)
(aves, Reptilia, Amphibia)

PISCES

SUPER CLASS — Agnatha (jawless fishes e.g. Haga fishes and lamp rays).

Gnathostomata
(Jawed fishes).

Gnathostomata

Class — Chondirichthyes (cartilagenous fishes

Sub CLASS — Holophali

Elasmobranchii

Order — Squareformes
(Sharks)

Rajiformes
(Rays & Skates)

Osteichthyes (modern bony fishes of Telcosts)

SUB CLASS — *idynoi* (e.g lung- fishes –extinct)

Crossopterygii (lobe fins- extinct)

Antinopterygii (Rayed- fin fishes)

ORDER — *Perciformes*

Cyriniformmes

Osteoglossiformes

Mugilliformes

—— *Clupeiformis*
—— Etc.

The external features of a scaleless fish.

1. Operculum
2. Cephalo- muchal shield
3 Dorsal spine
4. Dorsal filament
5. Dorsal fin
6. Adipose fin
7. Caudal pedunle
8. Caudal fin
9. Anal fin
10. Lateral line
11. Pelvic fin
12. Pectoral spine
13 pectoral fin
14 Humeral process
15 maxillary barbel
16 Outer mandibular barbel
17 Inner mandibular barbel

The external feature of a scaly fish.

1. Dorsal fin
2. Adipose fin
3. Dorsal spine
4. Caudal peduncle
5. Anal fin
6. Lateral line
7. Pelvic fin
8.Pectorial fin
9.Operculum

THE FISHES AND THEIR ENVIRONMENT

Every fish culturist should know the main characteristics of fish and their way of life. The knowledge enables to understand the relations existing between the fish and the environment and the way they can reap advantage from it. The fish will be first studied and then its environment will be described.

THE FISH

First anatomy, i.e. the main parts of its body, and fish biology, i.e. the way it is living, will be successively studied.

FISH ANATOMY - The Basic Structure of a Fish

Like most animals, the fish has a body which includes the head, the trunk and the limbs. The body has generally an elongated shape. The head, the 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 skin itself is covered by a layer of mucus which forms a protective sheath. If a fish is caught and handled with dry hands or roughly, mucus is removed and the skin remains exposed and may be injured by parasites, always numerous in the water. Fish, therefore should always be handled gently, with care and as little as possible. Most fish, except for instance catfish (Siluriformes), have scales under their skin, which cover each other like the tiles on a roof. The number of the scales covering the body of a fish varies only a little and can be used for identifying the different species. Running along the

side of the body, it a line of scales which have little pits in them; this line is called the lateral line. The pits are sensory organs and are responsive to changes in pressure in the surrounding water. In some fish there is a continuous line from the gill cover to the tail, in others it is interrupted. Others, again (Cichlid fish) have two lines running along each side of the body: an upper line going backward from the gill cover to about three quarters of the way, and a lower line running forward for a quarter from the center of the tail. The body of a fish is supported by a skeleton which is a bony frame. The skeleton keeps up the shape of the fish, acts as a muscle-holder and protects the internal organs. It is made of the skull bones which keep up the head, the backbone which keeps up the body and the tail, the fin-bones and the arch-shaped bones carrying the gills.

The Head

In the front part of the head is the mouth, of which the shape and features differ according to the feeding habits of the fish. Some fish have large mouths with sharp teeth for seizing prey: insects of fishes, while others have small mouths on the under surface of the head, suitable for scrapping up algae from the bottom. The shape of the teeth depends also on the feeding habits of the fish. Predatory 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). On the snout, above the mouth, are the nostrils. The nostrils are not used for breathing but only for smelling. Some fish have filaments along the side of their mouth which can be longer, than the head itself (catfish) and which are called barbels. Their number can vary within the range of 2 to 8. They are sensory organs which help the fish to find its food. At the hind end of the head are two bony flaps called opercula or gills covers, which can be lifted; underneath are the 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, the gill rakers are used as a strainer to sieve out food particles from the water (fig. 3).

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 a fish, the fins are the first things, which should be examined. The number of fins, their types, sizes, situtation 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. The rays can be either spiny or soft, ramified into a paint-brush and are then called soft rays. Fins can be paired or unpaired. The paired fins correspond to the fore and hind legs of the land vertebrates. There are four of them generally: two pectoral fins, one on each side of the body, behind the gill covers, and two pelvic fins which are on the ventral part of the body

either near the front, under the pectoral fins, or at the back. The unpaired fins are the dorsal fin on the upper part of the body, the caudal fin at the hind of the tail and the anal fin just behind the anus. In some fish, several fins can be missing while in others two dorsal fins, one at the back of the other, can be found. To move through the water, the fish uses mainly its caudal fin as a paddle. The other fins enable the fish to keep its balance.

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. I.e. having the appearance of being cut off squarely at the end. The number of spines and/or rays in the dorsal and anal fins is generally the consistent character in a species and is seldom the same in two different species; hence these fins are very important for purpose of identification. Each fin is made up of a number of rays, which are usually bony and flexible and are either simple or branched; i.e. they divide or subdivide part of the way along the ray. The number of simple and branched rays are given separately in a description. In many fish, some or all of the rays, especially of the dorsal fin are replaced.

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. The size and shape of this fin is often as a clue to the identity of a specie.

FORM

Commonly, the fish body is torpedo-shaped (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 (the entering wedge) and the contours sweep back gently in the tail race. Many fishes depart moderately to completely from the foregoing generalized shape. These departures range from globe shapes (globiform – e.g. puffers, tetraodontidae) through serpentine (a guilliform – e.g. eels, *anguillidae*), to threadlike in outline (filiform e.g. snipe eels, Nemichthyidae). Some are strongly flattened from side to side (compressed – butterfly fishes, chaetodontidae) and flounders, pleuronectidae) others, flattened but greatly elongated (trachipteriform, ribbonfishes, Trachipteridae) and still others, flattened from top to bottom (depressed – the skates, rajidae, and the batfishes, ogcocephalidae).

The ground plan of body organization in all fishes is bilateral symmetry i.e. the left and night halves of the body are basically mirror images of one another.

FISH ADAPTATION TO AQUATIC LIFE.

Shape - streamlined, fusiform

(a) rounding edge of such shapes reduces resistance
(b) tapering of posterior part minimizes drag
(c) mucus cover further reduce drag, smoothens
(d) Laterally compressed body prevails in quiet water body of relatively dense cover.
(e) Depressed body prevail among bottom dwellers
(f) Dorso-ventral flattening 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

- use as gliding organ in some flying fishes
- use for terrestrial locomotion in some catfishes
- as crawling organisation use of some modified fins e.g. paired like pectoral, pelvic fins

FISH DIVERSITY OF NIGERIA

Nigeria has diversity of fin and shell fish fauna consisting of over 250 species in Inland waters with about 101 species (22 families) in Kainji lake alone (Ita 1993) 86 of them in lake Chad (Hopson 1967), 25 species (10 families) in Tiga lake (Ita 1985) 21 species (10 families in Bakolori (Ita 1993) and 32 species (11 families in Oyan lake (Ikenweiwe 2005) and 199 species from 78 families in the brackish and marine waters (Tobor and Ajayi 1978). The predominant fin and shell fish families with their species are presented in Tables 1 and 2.

Table 1. Commercially and scientifically important fresh water fishes of Nigeria.

Family	**Common Name**	**Species**
Anabantidae	Climbing perch	Ctenopoma kings leyae Gunther, 1896
	Catfish	*Auchenoglanis biscutatus*
		(Geoffroy Saint-Hilaire 1827)
		A. occidentialis (Cuvier et Valenciences 1840
Bagridae	Silver catfish	Bagrus bayad macropterus
Pfatt, 1933		
		B. docmac niger n. ssp
		B. filamentous Pellegrin 1924
	Catfishes	*Chrysiothys auratus* longfilis
		(Pfaff 1933)
		C. Furcatus Gunter 1984
		C. nigrodigitatus (Lacepede 18030
		Clarotes laticeps (Ruppel 1829)
Centropomidae	Nile perch	*Lates niloticus* (Linne 1762)
Characidae	Silver fish	*Alestes baremose* (Joannis 1835)
		A. *dentex sethente* (C & V. 1849)
		A. *macrolepidotus* (C & V. 1869)
		A. nurse (Rupell 1832)
	Tiger Fish	Hydrocynus brevis Gunther 1864
		H. forskali Cuvier 1819
		H. Lineatus Bleeker 1862

		Micralestes acutiden Peters 1968)
Cichlidae	Jewel	Hemichromis fascialis (Peters 1957)
		Oreochromis niloticus
	Tilapia	Tilapia melanopleuris Dumeril 1859
Citharinidaae	Moon fish	Citharinus citharus (Geoffrey Saint Hilaire 1809)
		B. distichodoides Pelegrin 1919
		C. latus Mulleret Treschel 1845
	Grass eater	Distichodus brevipinnis Gunther 1864
		D. engycephalus Gunther 1864
		E. rostratus Gunther 1864
Claridae	Mud fish	Clarias gariepinus
	Cat fish	Heterobranchus bidorsalis
		Geoffroy Saint – Hilare 1809
		H. longifil C & V 1840
Clupeidae	Herrings	Cynothrisea mento
		Pellonula afzeliusi
Cyprinidae	Barbels	Barbus occidentalis
		Boulenger 1911
	African carps	Labeo coubie Ruppel 1832
		L. pseudcoubie
		L. senegalensis C & V 1842
Gymnarchidae	Trunk fish	Gymnarchus niloticum
		Cuvier 1829
Hepsetidae	African pike	Hepsetus odoe (Blochi 1794
Lepidosirenidae	African longfish	
Cyprinidae	Barbels	Barbus occidentalis
		Boulenger 1911
	African carps	Labeo coubie Ruppel 1832
		L. pseudcoubic
		L. senegalensis C & V 1842
Gymnarchidae	Trunk fish	Gymnarchus nilotica
		Cuvier 1829

Hepsetidea	African pike	Hepsetus odoe (Bloch 1794)
Lepidosirenidae	African Longfish	Protopterus annectes (Owen 1939)
Malapteruridae	Electric catfish	Malapterurus electicus (Gmelin 1789)
Mochocidae	Catfish	Mochocus niloticus Synodontis batensod Ruppell 1832 S. Schall Bloch Schruder 1801 S. clarias Linne 1761 S. filamentous Bountger 1901 S. membraneous (Geoffery Saint Hilaire 1809
Mormyridae	Trunk Fish	Gnathonemus tamasdua (Gunter 1862) G. senegalensis elongates (Praff 1933) Hyperopisus bebe occidentalis (Gunter 1866) Mormyrus deliciosus (Leach 1818 M. macrophthalmus Gunter 1866
Notopteridae	Trunk Fish	M. rume C & V. 1846
Ophiocephalidae	Snake head	Paraphiocephalus obscures Gunter 1861
Osteoglossidae		Heterotis niloticus (Cuvier 1829)
Polypteridae	Sail fish Sail fish of Birchirs	Calamichthys calabaricus Polypterus ansorgei Boulenger 1910 P. bichir lapradei

		(Steindachner 1869) P. endlicheri endlicheri (heckle 1849) P. senegalus segalus (cuvier 1929)
Schilbeidae	Butter fish	Eutropius nitoticus (Ruppell 1829)
	Glass Catfish	Physailia pellucida Boulenger 1901
	Catfish	Schilbe mystus (L. 1762) Siluranodon auritus (Geoffrey Saint – Hailarie 1827).
Tetraodontidae	Butter fish	Tetraodon fahaka strigosus Bennet 1834).

TABLE 2 IMPORTANT MARINE AND BRACKISH WATER FISHES OF NIGERIA CARTILAGINOUS FISHES

Family	Common Name	Scientific Name
Alopidae	Big eye Thresher	Alopias supercilliosus (Lorme 1939)
	Thresher Shark	A. vulpinus (Bonnaterre 1788)
Carcharhinidae	Bull shark	Carcharhinus leucas (Valenciennes and Henle, 1839)
	Black tip shark	C. limatus (Valenciennes in Muller & Henle 1839)
	Atlantic weasel	Paragaelus pectoralis (= grueli) (German 1906)
	Mill shark	Rhizoprionodon acutus Ruppell, 1837) (scoliodon terranovae (Richardson 1836).
Hexanchidae	Six gill shark	Hexanchus griseus
Laminidae	Great white shark	Carcharodon carcharias (L. 1758).
Odontaspididae	Sand tiger shark	Eugomphodus Taurus
Pseudocarchariidae	Crocodile sharks	Pseudocarcharias Kamoharai
Sphyrinidae	Smooth hammer	Sphyrna zygaena

	Head	(L. 1758)
Sphyrnidae	White fin hammer	Sphyrna couardi Cadenat 1950 S. Leurini (Griffith and Smith, 1834) (= S. diplana Springer 1941)
Triakidae	Tope shark	Galeorhinus galeus (L. 1758) Mustelus mustelus (L. 1758)
Pristidae	Large toothe	Pristis microdon Latham 1794 (=Pristis perotteti Muller & Henle
	Smasll tooth	P. Pectinata Latham 1794
	Common sawfish	P. Pristis (L. 1758)
Dasyatidae	Rough tail sting ray	Dasyatis centroura (Mitchill, 1851)
	Daisy sting ray	D. margarita (Gunther, 1870)
	Common sting ray	D. pastinaca (L. 1758) (=Trygon pastinaca (L. 1758)
	Round string ray	Taeniura grabata (. Geoffery Saint Hilaire 1817)
Mobulidae	Giant Atlantic	Mmanta birostris (Donnderff, 1798
	Manta	Mobula rochebrunei (Vaillant, 1879
Moliobatidae	Common eagle ray	Myliobatis aquila (L. 1758) (= M. cervus Smith 1934)
	Bullray	Pteromylaeus bovines (E. Geofrey St. Hilaire 1817)

BONY FISHES

Acanthuridae	Monrovia doctor Fish	Acathurus monroviae Steindachner 1876
Abulidae	Bone fish	Albula vulpes (L. 1758)
	Longfin bonefish	Pterothrissus belloci Cadenat, 1937.
Ariidae	Rough head sea Catfish	Arius gambiensis, Cadenat, 1950 (= A. latiscutatus) Gunther 1864
	Giant catfish	A. gigas Boulenger 1911
	Smooth mouth sea Catfish	A. heudeloti Valenciennes, 1840 A. Sp. Nov. A. Sp. Var
Ariommatidae	Silver rag drift fish	Ariomma bondi Fowler, 1930 (= Paracubiceps multisquamis Marchal 1961)
	Brown drift fish	A. melanum (Ginsburg 1954) (= Paracubiceps multisquamis Marchal 1961)
Balistidae	Grey trigger fish	Balistes capriscus Gmelin 1788 B. Punctatus Gmelin 1788
Batrachoididae	Hairy toad fish	Batrachoides liberiensis (Steindachner 1867)
Bothidae	Cape scald fish	Arnog lossus capensis Boulenger 1898 A. imperialis (Rafinesque 1810) Bothus podas africanus Nielsen, 1961. Sycium micrurum

		Ranzani, 1840
Carangidae	Alexandria	Alectis alexandrinus
	Pompano	(Geoffroy St. Hilaire 1817)
		(= Scyris alexandrinus)
		9= hynnis goreesic C. 1833)
	Blue runner	Caranx crysos (Mitchell 1815)
	Crevalle jack	C. hippose (L. 1766)
		B. senegallus Cuvier 1833
		(= C. africanus, steindachner 1833)
	Atlantic bumper	Chloroscombrus chrysurus
		(L. 1776).
	Roundscad	Decapterus punctatus
		(Cuvier 1829)
	Rainbow runner	Elegatis bipinnulata
		(Quoy & Gaimard 1825)
	Two-colour jack	Hemicaranx bicolor
		(Gunther 1860)
	African moonfish	Selene dorsalis (Gill, 1863)
		(=Vomer gibbiceps)
	Greater amberjack	Seriola dumerili (Risso, 1810)
	Long fin pompano	Trachinotus goreensis
		(Cuvier, 1832)
		Trachurus trachurus (L> 1758
		(= T. capensis
		T. trecae Cadnat, 1949
Chlorophthalmidae	Atlantic greeneye	Chloropthalmus atlanticus
		Poll 1953

Citharidae	Spotted flounder	citharus veingulata (L. 1758)
Clupeidae	Bonga shad	Ethmalosa dorsalis
		(Valenciennes 1847)
	West African	Ilisha africana (Bloch 1795)
	Ilisha	
		Sardinella aurita
		Valenciennes, 1847
		S maderensis (Lowe, 1839)
Corphaenidae	Pompano dolphin	Coryphaena equiselis (L. 1758)
	Little tunny	Euthynnus ailetteratus
		(Rafinesque 1810)
	skipjack tuna	katsuwonus pelamis (L. 1758)
	Atlantic bonito	Sarda sarda (Bloch 1973)
	Albacore	Thunnus alalunga
		(Bonnaterre 1788
	Yellow tuna	Thunnus albacares (Bonnaterre,
		(1788)

	Big eye tuna	Thunnus obesus (Lowe 1839).
Serranidae	White grouper	Epinephelus aeneus
		Geoffroy St. Hilaire 1809)
	Dungat grouper	E. goreenss (Valenciennes 1830)
	Dusky grouper	E. gigas (Brunnich, 1968)
	Esonue grouper	E. itajara (Lichtenstein 1822)
		(= Promicrops ditobo
		Roux & Collignon 1954.
	Ghanean comber	Serranus accraensis (Norman, 1931)
		(= Neathias accreansis)
Soleidae	Four eyed sole	Microchirus ocellatus (L. 1758)
Sparidae	Bogue	Boops boops (L. 1758)
	Angola dentex	Dentex angolensis Poll and
		Maul, 1953
	Canary dentex	D. Canariensis Steindachner
		1881
	Congo dentex	D. congoensis Poll 1954

	Large eye dentex	D. macropthalmus (Bloch, 1791)
	Senegal sea bream	Diplodus bellottii (Steindachner 1882
	Red Pandora	Pagellus bellotti (Steindachner, 1882)
	Red banded sea	Pagrus auriga
	Bream	Valenciennes, 1843
Sphyraenidae	Great barracuda	Sphyraena barracuda
		(Walbaum, 1972).
	Guachanche	S. guachancho (Cuvier, 1829)
	Barrcuda	
Stromateidae	Butterfish	Stromateus fictola L. 1758
Synodontidae	Brazillian lézard	Saurida brasiliensis
	Fish	Norman, 1935
		(=S. parri)
Trichiuridae	Large head hair	Trichiurus lepturus
	Tail	L. 1758

Xiphiidae	Swordfish	xiphias gladius L.1758
Zeidae	John dory	Zeus faber L. 1758
CRUSTRACEA		
Geryonidae	West African	Geryon maritae
	Geryon	Manning & Holthius 1981
		(= Geryon quiquedens
Palaemonidae	Congo river	Macrobrachium dux
	Prawn	Lenz, 1910
	Niger river prawn	M. felicinum Holthuis 1949
	Brackish water	M. macrobrachion
	Prawn	Herklots, 1851
	African river	M. vollenhovenii
	Prawn	Herklots 1857
	Estuarine prawn	Nematopalaemon hastatus
	Creek shrimp	Palaemonetes Africans
		Balss 1916
Penaeidae	Guinea shrimp	Parapenaeopsis atlantica

		Balss 1916
	Deep water rose shrimp	Parapenaens longirostris (Lucas 1846)
	Caramote prawn	Penaeus Kerathurus (Lucas 1846) P. notialis Perez-Fanfante 1967
MOLUSCS		
Bivalves Arcidae	Senegal ark	Anadara senegalensis (Gmelin 1791)
Cardiidae	Costate cockle	Cardium costatum Linnaeus, 1758
	Gaping cockle	C. ringens Bruguiere 1789
CEPHALOPODS		
Loliginidae	European squid	Loligo vulgaris Lamarck, 1798
Octopodidae	Common octopus	Octopus vulgaris Cuvier 1797
Sepiidae	Common cuttle fish	Sepia officinalis nierredda Rong 1837.

	Ghanian tongue sole	C. cadenati Chabanaud 1947
	Canary tongue Sole	C. canariensis Steindachner 1882
	Ghanian tongue Sole	C. monody Chabanaud 1949
	Senegalese tongue Sole	C. senegalensis (Kamp, 1858)
	Elongate tongue Sole	Symphurus ligulatus (Cocco, 1844)
Dactylopteridae	Flying furnard	Dactylopterus volitans (1758)
Drepanidae	African sickle fish	Drepane africana Osorio, 1892
Elopidae	West African Lady fish	Elops lacerta valenciennes, 1846
Engraulididae	European anchovy	Engraulis encrasicolus (L. 1758)

Ephippididae	African spade fish	Chaetodipterus goreensis (Cuvier 1831)
	West African Spage fish	C. lippie Steindachner, 1895
Fistulariidae	Blue spotted Cornet fish	Fistularia tabacaria L. 1758
Gerreidae	Flagfin mojarra	Eucinostomus Melanopterus (Bleeker 1863) (= Gerres melano pterus (Bleeker 1863)
	Guinea stripped Mojarra	Gerres nigri Gunther 1859
Grammistidae	Greater soapfish	Rypticus saponaceus (Bloch & Schneider 1801)
Pomadasyidae)	Big eye grunt	Haemulidae Brachydeuterus auritus (Valenciennes 1831)

	sompat grunt	Pomadasys jubelini
		(Cuvier 1830).
	Pigsnout grunt	P. rogerii (Cuvier 1830)
		(= P. suillus)
Hemiranpinidae	Balihoo halfbeak	Hemramphus brasiliensis
Lutjanidae	African red	Lutjanus agennes
	Snapper	Bleeker 1863
	African brown	L dentatus (Dumeril
	Snapper	1860)
	Gorean snapper	L. goreensis (Valencinnes, 1830
Megalopidae	Atlantic tarpon	Megalops atlanticus
		(Valencinnes 1846)
Mugilidae	Sickle fin mullet	Liza facipinnis
		(Valencinnes 1836)
	Large scaled mullet	L. grandisquamis
		(Valencinnes 1836
	Flat head grey	Mugil cephalus (. 1758)

OPPORTUNITIES IN ICHTHYOLOGY

Opportunities to study fish are limitless; they exist for everyone whether or not they are professional Ichthyogists. Research opportunities are boundless in all of the aspects of ichthoyology; much more is unknown than is known. There is teaching position, which is not yet occupied. As at present, fewest are those in which the primary responsibility is to study and to teach ichthyology. There are curatorial opportunities of developing, canning and studying of collections in museums. About 20 museums in North Africa need ichthyologists amounting to between 35 and 50 curatorial jobs. Duties include development care and study of old and new collections, supervision of public exhibitions, answering of questions and correspondence from the public and the preparation for publication of scientific research. Many curators (all those at museums associated with educational institutions) are graduate straining programmes and other forms of teaching. There is often keen competition for these positions, which typically require a Ph D degree. In recent years, however, a technical position titled collection manager requires far less formal training.

The great commercial fisheries – e.g. professional fisheries, farm management aquaculture, sales of fish products as in cold rooms, fish game, ornamental fish production bait fishes are available for people who have training on ichthyology. Trained personnel are needed in managing the fisheries of marine and inland waters and also those of reservoirs and hatcheries – fingerling production.

The expanding nature of the fisheries field affords many opportunities for employment in areas not previously investigated. Opportunities are also opened in area of environmental impact assessment, hobbies of recreational fishing and aquarium care. Other job opportunities include direct fishing (as a fisherman), fishing gear making selling or repair, boat making or repair, fresh fish selling, sale of processed/preserved fish, canned fish selling, shrimp selling, ice block making, making of different types of fish processing machines, ovens, fish pond construction and a host of others.

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