UNIT 1

Introduction to Taxonomy, Ecology and Biology of Fish

Structure

1.0 Introduction to Taxonomy

Merely sorting out and naming a fish by group names is not sufficient to place them in an organized system. They have to be allotted a certain rank and status in the fish kingdom. For this purpose a system of hierarchy of names as Divisions, Orders, Families, Genera and Species are defined.

Thus so many divisions and subdivisions are present in every living organism. Similarly fishes and all animals are divided or classified and this is called Classification. The aim is to highlight or indicate their individuality and identity for easy recognition.

This system of classification in a graded fashion is broadly called the science of Taxonomy or Systematics.

1.1 Hierarchy

In every system there is a graded organization or every arrangement is organized in ranking manner such as best, better, good, poor etc.

This is evident that from the very beginning all living organisms have been divided as Animal and Plant Kingdom. In the Animal Kingdom a proper arrangement exists. Our ancient observes classified the animals as vertebrates and invertebrates. We now have the animals broadly grouped as Fishes, Ampphibions, Reptiles,Birds, Mammals as vertebrates and Cnidaria, Arthropoda,Molluskans,Echinodermatas etc. as invertebrates. This gradation is according to their status in the evolution ary ladder, mammals being the most highly evolved and Prorozoans the least. In a similar fashion in taxonomy also a system of hierarchy was developed based on their evolutionary history, non-varying and constant structural patterns and group characters. Animals are grouped under Phylum, Class, Orders, Families, Genera and Species. Subdivision of each one these is also known such as subphylum, subclass, suborder, subfamily, subgenera, subspecies etc. many more divisions like tribe are also known but it is sufficient to use the broadly accepted classification. These are called systematic categories or Taxon (Taxa plural). All groups of anyone kind are supposed to differ from its related group by a roughly equal and the same degree of difference. Closely related organisms have more features in common.

The various taxa are defined below.

Phylum : One of the major kinds of group used in classification of living organisms. Eg. Phylum Chordata indicating the vertebrates. This consists of one or more number of similar Classes.

Class. A : Sub-division of Phylum, this includes broadly the major animals each distinct from other by major characters both internal and external. Ex. Class Pisces (Fishes) different from Aves (Birds).

Order : Groups number of similar families; sometimes it may be even one family such as order Gonorhynchiforms with one family Chanidae. All fish orders end with the word 'formes' and mostly the prefixes are the most common fish generic name. ex Cypriniformes, Siluriformes(after genera Cyprinus, Silurus).

Family : This is a systematic category including one or more genera of common phylogenetic origin and separated from other families by a decided gap. This consists of a number of genera similar in most charecters . even a single genus may constitute a family because of its peculiarities. Ex. Horaichthyidae for the genus horaichthys Kulkarni. All family names end with the word 'idea'.

Genus: This is a systematic category or taxon, which includes one species or a group of species presumably of common phylogenetic origin which is separated from other similor units by a decided gap. Ex. Genus Puntius has an assemblage of 55 species (Jayaram, 1991) but Chanos has only one species (*Chanos chanos*).

Species : Species are actually (or potentially) interbreeding groups of populations which are reproductively isolated from similar such groups. For example Mystus cavasius can interbreed among themselves but cannot do so with any other species of Mystus. This is the normal pattern through hybrids are known and are cultured artificially now. The species is the keystone of any taxonomic study. This is because the species is the only one objective category which one can actually observe, collect, and test for any investigations.

Thus the hierarchy for a fish group is depicted as below:

Phylum Chordata

Class Pisces

Order Cypriniformes

Family Cyprinidae

Genus *Puntius*

Species *Puntius sophore* (Hamilton-Buchanan)

It will be seen that all categories above species have only a single word Species alone and always cited by two names followed by the name of the auther or scientist who first gave the specific name. there are several kinds of names used in taxonomy such as descriptive names, ecological names, geographical names, patronymic names and names without definite meaning. These are illustrated below:

(i) The specific name portrays mostly the characteristics or the common local name.

Exs. *Channa punctatus* a species of the genus *Channa* with punctuated marks on the body.

Salmostoma Iongicauda meaning long caudal fin.

(ii) Sometimes the locality name or the name of the collector or of an emi nent person is also adopted as the specific name.

Ex. (Geographical name). *Glyptothorax anamalaiensis Silas* after Anamalai hills, S.India.

(Patronymic name) *Euchiloglanis hodgarti* (Hora) after the name of the collector.

Hara horai Misra after the late Dr. K.S. Misra

(iii) Descriptive name describing some character of the species.

Ex. *Monopterus albus*(Zuiew) indicating white colour.

(iv) Ecological name. according to the habitat in which it lives.

Ex. *Osteochilichthys godavariensis Rao*

However no taxon should be named offending or in a seditious manner.

Gender matching : It has been stated that scientific names are derived from Latin or Greek words. Latin in the Code of International Code of Zoological Nomenclature(ICZN) includes ancient, mediaeval and modern names whereas Greek includes only ancient Greek words. Accordingly the specific and generic names should match gender wise.

If an adjectival name is used as the specific name it must agree grammatically with the generic name. even if the species is transferred to another genus its termination must also be changed if necessary to agree with the genus name.

albus=white is adjective

Mystus vittatus ending in –us is madculine.

Garra mullya ending in –a is feminine

Dicaeum album ending in –um is neuter.

Latin nouns ending in –es is usually feminine

Greek nouns ending in –es is on the other hand masculine. Generally the prefix sub is used with Latin words and Pseudo with Greek words.

Author names : These are names of persons or scientists who first proposed the taxa, be it a new species or genus. Names of genera and species and below must be cited with the name of the first author who proposed it, found or described it for the first time. For instance genus Rasbora Bleeker means that the genus was first proposed by the author Dr. P. Bleeker, though only his surname is cited and not the initials etc. only day for his taxa and not Francis Day. Exception is Hamilton Buchanan since this is the correct name and not Buchanan as often cited.In similar manner the author or the first proposed or founder of the specific name is mentioned immediately often the taxon name and not where else.

Ex. *Barilius bakeri Day* means that Day proposed the name bakeri for this species and described it under the genus Barilius of Bleeker.Author names in brackets. Sometimes some author names are placed in brackets.

Ex. *Puntius ticto* (Hamilton-Buchanan). This means that the name tictowas given by Hamilton-Buchanan, the original author, but he described it under a different genus and not under Puntius. In this case he described it under the genus *Cyprinus* of Linnaeus which later workers found to be incorrect and placed the species under the genus puntius. Hence the author names is within brackets.

Mostly only the specific names have this stricture and not genera.

1.2 Introduction to Ecology

Ecology is a branch of science, which deals with the study of organisms and their environment, which is as much as complex and dynamic, but also interdependent, mutually reactive and interrelated to various disciplines of science

The term 'ecology' was coind by Ernst Haeckle in 1869, which is the combination of two Greek words, Oikos meaning 'house, kitchen or dwelling place' and logos meaning the study of to denote the relationships between organisms and their environment. Thus, literally, ecology is the study of organisms 'at home'. Ecology has been defined in various ways by different authors. Warming (1895, 1905), who actually employed this science for the study plants, defined Oikologie as "the study of organisms in relation to their environment". Woodbury (1954) treated ecology as a science which investigates organisms in relation to their environment. Taylor (1936) defined ecology as "the science of all the relations of all organisms to all their environments"

1.3 Scope of Ecology

Tayler (1936) once described ecology as the science of all the relations of all the organisms to all their environments.

During the recent years, ecology has assumed greater importance due to its relation with mankind through environment. The various aspects of environment such as environmental pollution and its control, conservations of natural resources and proper monitoring on the consumers and decomposers have a direct influence on the betterment of the mankind.

In fact, there exists a balance in the nature between various biotie organisms with regard to the environmental factors and if by any natural or artificial means this balance is disturbed, it leads to the harmful results for mankind as a whole.

Ecological studies of the organisms are very useful in determining the heredity and evolutionary phenomena. In brief, the scope of ecological studies involves:

1. Determination of population of different niches.
2. Evolution and origin of species as a result of speciation and natural selection.
3. Study of the composition and ecological processes of habitats so as to determine their utility for the mankind.
4. Monitoring of environmental pollution by testing various ingradients of the biosphere, and
5. Proper maintenance of natural resources.

Basic concepts of Ecology

Like other sciences ecology too has its own principles and basic concepts, which are as follows:

All living organisms and their environment are naturally reactive, effectively each other in various ways. Animal population, flora and vegetatiation are inter dependent through the environment and are mutually reactive. Environment which is actually a complex of several interrelated function and is much dynamic,works as sieve to select organisms.

Sub Divisions

Being a vast and complex subject, the field of ecology can be sub divided in to various ways such as based on taxonomic affinities, habitat, levels of organization etc. However the important subdivisions based on levels of organisation are

1) Autecology
2) synecology

1. Autecology

This is also known as ecology of individuals where we study the relation of individual species to its environment. In autecology one studies the factors which influence the growth and life of a particular organisms. With an autecological approach, individual species are the units of study.

2. Synecology

Under natural conditions, however, organisms-plants, animals, microbes, ect, live together as a natural group affecting each other life in several ways.Thus

more complex situations exist. Such an approach where unitsof study are groups of organisms is called synecological approach. Dependingupon. the conditions syncology may deal with population, community ecology, biome ecology and ecosystem ecology.

Branches of Ecology

The specialized disciplines of ecology are as follows -

1. **Oceanograhy** - It is the study of marine habitat and organisms.
2. **Limnology** - It is the study of freshwater bodies like lakes, ponds and their organisms,
3. **Terrestrial ecology** - It is the study of biomes and the organisms distributed therein. It can further be differentiated into (I) forest ecology, (ii) cropland ecology and (iii) grassland ecology
4. **Pedology** - It deals with the study of soils, in particular their acidity, alkalinity, humus-content,mineral contents, soil types etc., and their influence on the plant and animals life.
5. **Community ecology** - It is the study of distribution of animals in various habitats.
6. **Population ecology** - It includes the study of population, its growth, competition, means of dispersal etc.
7. **Geographic ecology or Ecogeography** - It includes the study of geographical distribution of organisms.
8. **Ecosystem ecology** - It is the relation and interaction of both plant and animal communities of organisms.
9. **Animal ecology** - It is the interpretation of animal behaviour under natural conditions.
10. **Cytoecology** - It deals with the cytological details in a species in relation to populations in different enviromnental conditions.
11. **Palaeoecology** - It deals with the organisms and their environment in geoecological past.
12. **Insect ecology** - It is the ecology of insects.
13. **Mammalian ecology** - Ecology of mammals.
14. **Avian ecology** - Ecology of birds.

15. **Production ecology and Ecological energetics** - This branch of ecology deal with the mechanisms and quantity of energy conversion and energy flow through different trophic levels in a food chain and rate of increase in organic weight of the organisms in space and time.

16. **Applied ecology** - The wild life management, range management, forest conservation, biological control, animal husbandry, pollution control, are the various aspects dealt within the applied ecology.

17. **Radiation ecology**- It deals with the gross effect of radiation of radioactive substances over the environment and living organisms.

18. **Space ecoloy** - It is the modern subdivision of ecology. It is concerned with the development of those ecosystem which support life of man during space flight or during extended exploration of extraterrestrial environment.

1.4 Introduction to Fish Biology

Fish have great significance in the life of mankind, being an important natural source of protein and providing certain other useful products as well as economic sustenance to many nations. The gradual erosion of commercial fish stocks due to over -exploitation and alteration of the habitat is one reason why the science fish biology came into existence (Royce, 1972).

It is a well known fact that the knowledge on fish biology particularly on morphometry, length-weight relationship, condition factor, reproduction, food and feeding habit, etc. is of utmost important not only to fill up the lacuna of our present day academic knowledge but also in the utility of the knowledge in increasing the technological efficiencies of the fishery entrepreneurs for evolving judicious pisciculture management.For developing fishery, it is necessary to understand their population dynamics- how fast they grow and reproduce, the size and age at which they spawn; their mortality rates and its causes, on what they prey upon along with other biological processes.

There are many isolated disciplines in fish biology, of which the study of morphology is inseparably related to study of the mode of life of the organism. It fact, the size and shape are fundamental to the analysis of variation in living organisms (Grant and Spain, 1977) and morphological variations even in the same species most often related to the varied environmental factors.

Short Answer Type Questions

1. Define Taxonomy.

2. What are classification taxa or categories.

3. Define genus and species.
4. What is the need of classification.
5. Define term ‘ ECOLOGY’.
6. Who coined the term ecology and its meaning.
7. Define Autocology and synecology.
8. Name any two main branches of Ecology.
9. Define biology.
10. What is fish morphometry.
11. What is Pedology.
12. Define Limnology.

UNIT 10

Reproductive System and Endocrine System of Fish and Prawn

Structure

10.1. Reproductive System of Fish

Reproduction is the process by which animals increase their population to continue their races in the nature. There are four types of reproduction monosexuals — bisexual, Hermophrodites and parthenogenetic. Reproductive system mainly consists of reproductive organs known as gonads, (testes and ovary), the gamets (sperms, ova). Fishes reproduce by several methods and are generally bisexual. Some species are hermophrodite and even parthenogenetic reproduction occurs in a few cases. Some fishes are highly specialised for breeding and show interesting development of parental care comparable with higher animals. The sperms and the eggs develop in separate gonads except in some species of Sparidae and Serranidae, which are true hermophrodites and the eggs and sperms develop in the same gonad and self fertilisation takes place. However, hermophrodite gonads sometimes occur in other species also. Parthenogenetic development takes place in *Poeciliaformosa*, in which the sperms simply induce the egg to develop, but take no part in fertilization.

Sexual dimorphism

The characteristics of sexual difference or sexual dimorphism that enables identification of the sexes are classed as primary and secondary. Primary sexual characters are concerned with reproductive organs, the testes in males and overies in females. The primary sexual characters often require dissection for their discrement, which makes the secondary sexual characters often more useful, although sometimes not so possitive.

Some species show well marked sexual dimorphism, which may be of two kinds:

(i) Some species possess structural peculiarities directly related with fertilization of ova. These are in the form of copulatory organ in the male for introducing the milt into the body of the female, as the claspers in sharks.

(ii) Some species possess structural peculiarities that are not connected with sexual union or fertilization, but are related with courtship, or fight among rival males.

In most fishes excepting the elasmobranchs and a few teleosts, fertilization is external in water. In Chondrichthyes the eggs are fertilized within the the body of the female, and the males are provided with claspers or myxopterygia for transferring the sperms into the body of the female (fig. 10.2).

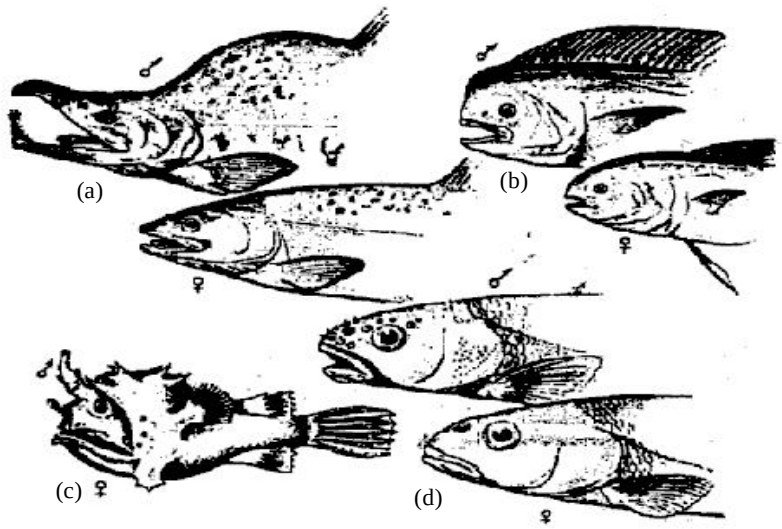


Fig 10.1 Sexual dimorphism in Fishes a. Pink salmon, b. Dolphin, c. Angler fish, D.Creak Chub

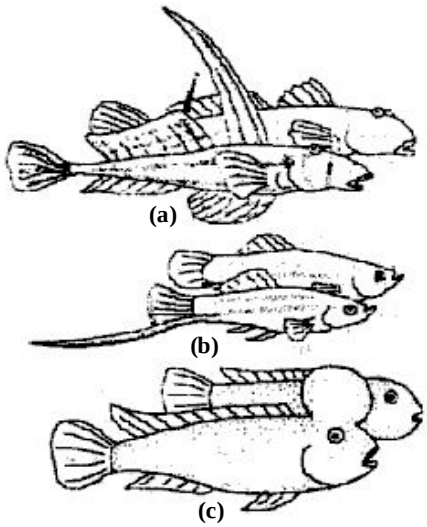


Fig 10.2 Sexual dimorphism in a. Drogonet b. Sword Fish c. Lion-head chichilid

Reproductive organs

The gonads develop from the coelomic epithelium. The ovaries may be naked as in the Elasmobranchs, Dipnoi, Chondrostei and Amia. This is called 'gymnovarian' condition and is primitive. Here, the ova are discharged into the coelomic cavity and pass out through the anteriorly placed oviducal funnel of the Mullerian duct. In Lepidosteus and teleosts. the ovaries become enclosed in coelomic sacs and the lumen of the ovary is continued into the oviduct.

This is called the 'cystovarian' condition, and is secondary. In a few teleosts belonging to the Salmonidae, Galaxidae. Hyodontidae, Notopteridae and Osteoglossidae the oviducts degenerate partly or completely and the ova are shed into the coelomic cavity and then pass out through pores or funnels. In the eels (Anguillidae) both male and female gonoducts degenerate losing all connection with the gonads.

Male reproductive organs

The male fish consist of a pair of testes which are elongated and flattened structures, situated on either side, ventral to the kidneys in the posterior region of the abdominal cavity. The testes remain attached to the body wall and the air bladder by means of mesorchia. They may or may not be equal in size The two sperm ducts join posteriorly to open into the urinogenital papilla. The testes may show indentations along their margin which become prominent during the breeding season.

In a few species, the anterior three-fourth part of each testis is functional and the pdosterior one-fourth is sterile as in *Mystus seengha/a* and Tor tor. The posterior region of the testis in these species is structurally and fiinctionally different from the anterior region. Various stages of germ cells are present in the anterior and middle part of the testis whose function is to produce sperms but the posterior region consists of sterile empty lamellae and probably serves for the storage of sperms during the breeding season. In some species, the entire testis is functional and serves to produce sperms. Paired glandular structures called the seminal vesicles are present as outgrowths of the hinder ends of the vasa deferentia in some teleosts as *Clarias batrachus, C. lazera, Hereropneustesfossilis.* However, in some other species *(Rita rita, Mystus vitattus)* the posterior part of the testis is glandular. The seminal vesicles are secretory in nature and show periodical changes in correlation with the testicular cycle. The function of the fluid secreted by the seminal vesicles is not known and it has been suggested that the fluid may serve to keep the sperms in an active but viable condition or it may help in nourishing the sperms.

Female reproductive organs

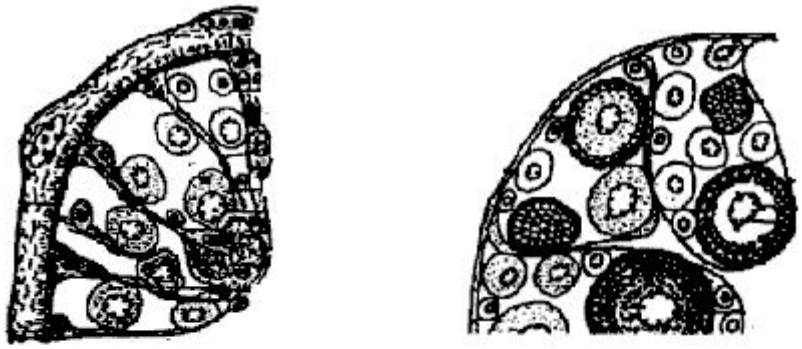
The ovaries are paired elongated sac-like structures lying in the abdominal cavity, ventral to the kidneys. They are attached to the body wall by means of the mesovarium. The anterior ends of the two ovaries are free but their caudal ends may become united into one. The hinder end of each ovary is continued posteriorly into a short oviduct. The two oviducts fuse and open to the exterior by a separate genital aperture or by a common urinogenital opening. Generally, both the ovaries are equal in size, but occasionally they are unequal also. They are thin, flaccid and traslucent when immature, but on maturity, they become enlarged and lobulated, while the ripe ova are seen bulging out. The wall of the ovary is fairly thick during the non-breeding season but becomes thin and highly vascular during the spawning period. It consists of three layers (i) an outer-most thin peritoneum, (ii) a thicker tunica albuginea made up of connective tissue, muscle fibres and blood capillaries, (iii) the innermost layer is the germinal epithelium which projects into the ovocoel in the form of lamellae. These ovigerous lamellae are the seat for the development of oocytes. which are visible in various stages of development. The germ cells or oogonia are found in clusters in the lamellae and probably originate from the germinal epithelium. An oogonium has a large nucleus, and a thin layer of ooplasm which is chromophobic. Each oogonium passes through a number of maturation stages to become a ripe ovum. Several of these stages may be present at the same time in the ovary. As the oogonium increases in size, there is increase in the quantity of ooplasm which is stained with basic dyes.

Oocyte stages

The developing egg is known as an occyte of which several stages can be recognised in the ovary. These are:

Oocyte I.

This is larger than the oogonium, spherical in shape and with a central nucleus, having 2 or 3 nucleoli. The cytoplasm is basophilic.



(a) (b)

Fig 10.3 T.S. of Ovary a. Immature stage b. Mature stage

Oocyte II

There is further increase in the size of the oocytes, number of nucleoli and basophilia of the cytoplasm. Several small nucleoli of various sizes are seen along the periphery of the nuclear membrane. Many oocytes at this stage, possess a yolk nucleus, lying close to the nuclear membrane in the cytoplasm. Later, the yolk nucleus moves away towards the periphery of the oocyte.

Oocyte III

This is still larger in size, and is distinguished by the appearance of a thin layer of folicular cells around the cytoplasm, a few nucleoli pass out of the nuclear membrane, and are seen in the cytoplasm of the oocyte.

Oocyte IV

There is further increase in the size of the oocyte and a large number of small, clear vacuoles called the yolk vesicles, appear in the periphery of the ooplasm. The vesicles appear empty in the early stage and are not stainable. Many oocytes show an undulated nuclear membrane, and the nucleoli enter into the pockets of the nuclear membrane, and pass out into the ooplasm.

Oocyte V

As the oocyte grows further, the yolk vesicles increase in number and fill the entire ooplasm. A vitelline membrane of zona radiata is also clearly visible, between the ooplasm and the follicular layer or the zona granulosa. Nucleolar extrusion continues at this stage.

Oocyte VI

This is characterised by the appearance of yolk in the form of minute granules in the extravesicular ooplasm. They appear first in the peripheral region and accumulate there in large numbers. The yolk granules then proceed centripetally, till the whole-ooplasm becomes impregnated with them. The yolk granules fuse to form larger globules, and the oocyte is of considerable size. A thin layer of fibroblasts, known as theca is also distinguishable outside the follicular layer.

Oocyte VII

There is heavy deposition of yolk globules which are fairly large in size. The yolk vesicles also fuse and become large. The nucleus migrates gradually towards the periphery. Some yolk vesicles are pushed towards the periphery of the egg and form cortical alveoli.

Ripe Egg

A ripe egg is largest in size, yellowish in colour and translucent. It is full of large amount of yolk globules and yolk vesicles may lie scattered in it. The nucleus is generally not visible in the ripe egg. An ovary contains several ripe eggs at a time during the spawning period. A mature egg is surrounded by an external layer of theca, followed by the follicular epithelium (zona granulosa), and the innermost, zona radiata. The zona granulosa is a syncytial layer having deeply staining nuclei. The theca is sometimes differentiable into theca externa and theca interna. The function of the follicular epithelium in fish oocyte, is controversial. The granulosa cells are believed to be responsible for the deposition of yolk in the developing ovum, and for its removal in ova which degenerate and become atretic. In addition to these, the granulosa cells may also be responsible for the secretion of ovarian hormones.

Maturation and spawning

Both male and female gonads undergo marked cyclic morphological and histological changes before reaching full maturity and becoming ripe. This is called maturation of the gonads. Most of the fishes exhibit seasonal cycle in the production of gametes. The expulsion of gametes from the body into the surrounding water is called ‘spawning resulting in fertilization. Fish spawns during

a specified period which depends upon several factors. The period during which the gonads attain full maturity and spawning takes place in the population is called the breeding season of the species. After spawning, a new crop of germ cell is formed, which gradually mature to become ready for the next season.

In the viviparous teleosts, fertilization generally takes place while egg is within the follicle. The egg may continue its development within the follicle (follicular gestation) or development takes place within the ovarian cavity (ovarian gestation).

Eggs

The number of eggs produced by a single female differs considerably and depends upon several factors like her age, size, condition and species. The egg is generally surrounded by a shell but when it leaves the ovary, it is enclosed in a vitelline membrane. Generally, the egg is spherical or oval in shape and has some amount of yolk in it. Eggs of bony fishes are of two main types.pelagic eggs are buoyant and provided with a thin, nonadhesive membrane, while demersal eggs are heavy and sink to the bottom, and are covered by a hard adhesive membrane. Sticky, demersal eggs become attached to the debris of the bottom and are prevented from being swept away along the current of water at the time of deposition. Marine fishes, produce either pelagic or demersal eggs, but the eggs of fresh water fishes are generally demersal. Pelagic eggs are of small size and single large oil globule may be present on the surface of its yolk. The eggs of some species (scomberisocidea, belonidae and exocoetide) have sticky threads for attachment with some object or with each other.

Development

The cleavage is incomplete and meroblastic, development is direct.

Cleavage and the formation of blastula

The development of an egg begins soon after it is fertilized by a sperm. The egg of bony fishes have a relatively large amount of yolk, which is segregated from the active, cytoplasm. Cleavage is confined to the superficial layer of the cytoplasm and is incomplete (meroblastic). In the earlier stages cleavage planes are all vertical so that all the blastomeres lie in one plane only. The blastomeres are separated from each other by furrows but lie over the yolk. In the later stages, cleavages occur in the horizontal plane also, so that the blastomeres become arranged in more than one row (fig. 10.4). The marginal cells are in contact with the yolk. The disc of cells thus formed on. the animal pole of the egg, is called the blastoderm. The central cells of the blastoderm divide to form a number of ‘free’ blastomeres which become arranged on the top of the yolk

so as to form a layer of cells called the periblast. The space between the blastoderm and periblast is the blastocoel and the embryo is in the blastula stage. The blastoderm gives rise to the embryo while the cells of the periblast probably serve to digest the yolk, and supply it to the developing embryo

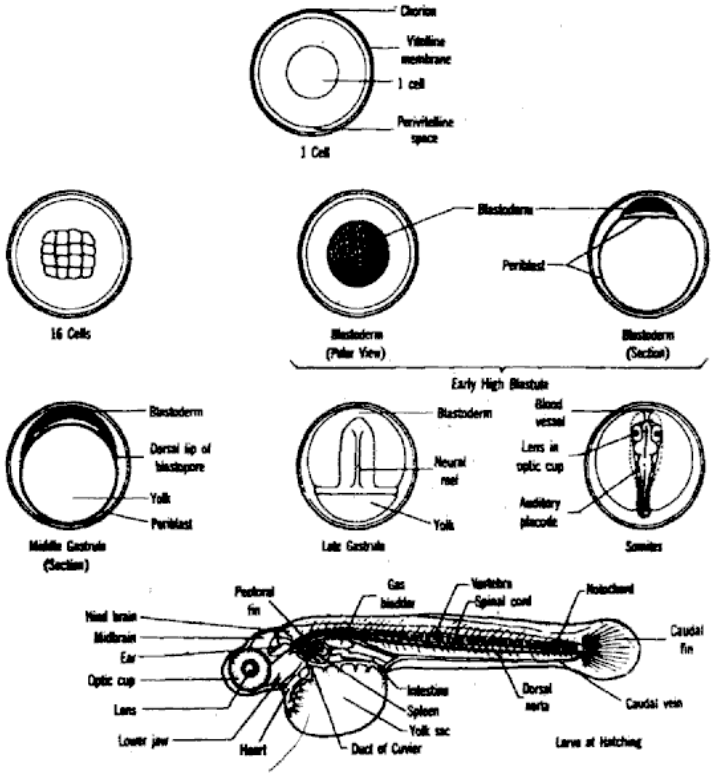


Fig 10.4 Development stages of a Bony Fish

Fate map of Blastula

It is possible to identify various regions of the blastula wall that are destined to give rise to specific organs in the embryo. Thus a fatemap of the teleostean blastula can be constructed showing the presumptive ectoderm, mesoderm, notochord, neural plate etc. In the fish blastula, the areas which are destined to give rise to the organs of the dorsal region of the animal, are concentrated towards one side of the blastodisc. This is the posterior end of the future embryo. At this end, along the margin of the blastoderm, lies the presumptive endoderm which is destined to form the gut. In front of this lies the presumptive notochord, and still further forwards, towards the centre of the blastoderm, lies the area of the nervous system. The presumptive mesoderm lies along the sides of the areas for endoderm, notochord and neural plate. The mesodermal area extends mainly along the margin of the blastoderm and in *Fundulus,* is not continuous at the

anterior end due to the presence of presumptive epidermis. But in Salmo the presumptive mesodermal area is present all round the margin of the blastoderm.

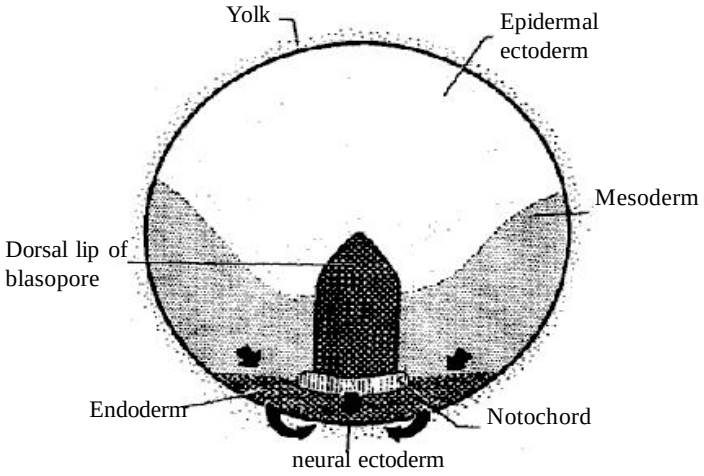


Fig. 10.5 Fate map of the blastoberm showing the presumptive areas

Gastrulation

Gastrulation in bony fishes is accomplished by two processes. invagination and epiboly. At the beginning of gastrulation, the presumptive endodermal and mesodermal cells at the posterior end of the blastoderm turn inward and migrate forwards under the blastoderm, so as to form the hypoblast. However there is no inpushing of the epithelial layer and no true archenteron is formed.

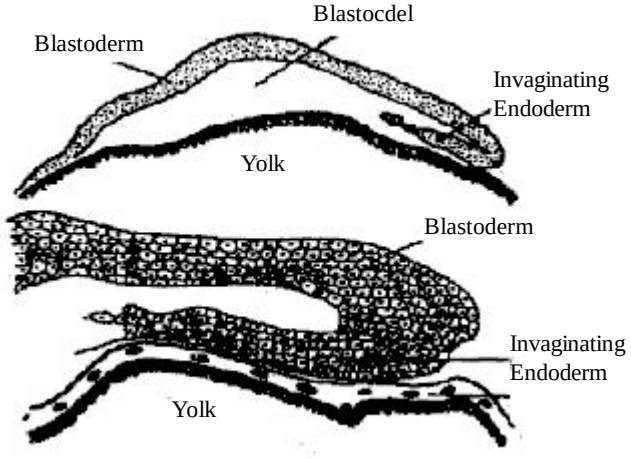


Fig.10.6. Early stages of gastrulation (A) Under low magnification (B) Posterior end under high magnification.

The presumptive endodermal cells lying along the posterior margin of the blastoderm , migrate inward along the surface of the yolk. As these cells move

inwards, they are concentrated towards the midline of the blastoderm. The presumptive mesoderm cells also invaginate in a similar way and roll over the edge of the blastoderm. Although no true archenteron is formed the edge of the blastoderm may be compared with the dorsal lip of the blastopore of amphibians. The mesodermal cells, after invagination, also converge towards the midline, where the axial organs of the embryo are formed.

Hatching and post-embryonic development

After the completion of gastrulation, various organs of the body are formed resulting in a small embryo with more or less cylindrical and bilaterally symmetrical body. The body is raised up from the surface of the yolk. so that the embryo proper becomes distinct from the yolk sac. In this condition, the head of the embryo projects anteriorly from the yolk sac, the trunk lies over the yolk and the tail projects behind.

The broad connection between the body and the yolk sac becomes constricted so as to form a stalk. Blood vessels develop in the wall of the yolk sac. Yolk is digested by the periblast and supplied to the body through blood vessels. The yolk sac is gradually reduced in size while the embryo grows. Finally, hatching takes place and the embryo becomes a free swimming larva.

Development of young ones

Young stages of fish, from the time of hatching till they become fully mature adult are known as hatching, and fry and fingerling. The period of larval development varies considerably in different fishes. A newly hatched fish with a yolk sac is known as a sac- fry or hatching and after the yolk sac disappears, it is known as the advanced fry or spawn.

In some species the advanced fry resembles closely the adults except in size. This is called direct development and is seen in and many fishes. On the other hand an indirect development takes place in eels, where the

larval form is leptocephalus or elever. In many fishes the fry undergoes metamorphosis during which the larval characters are lost and the adult features appear. A fry which loses the larval characters, is like a miniature adult and is called fingerling. This enters an active feeding stage which results in the growth of the body and maturation of gonads to give rise to the adult. The females ar usually larger in size than the males but the latter attain sexual maturity earlier.

The development of youngone of a cyprinid fish described in the following stages. Fig (10.11)

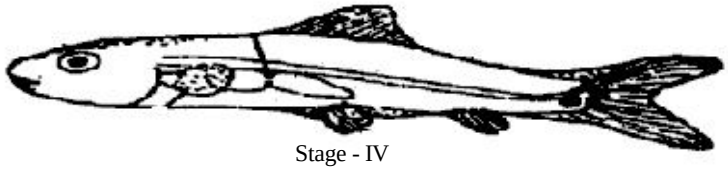
1. Stage I

This is called prolarva with fairly large sized yolk sac. The yolk sac is broad anteriorly, tapering towards the posterior end, and has a row of pigments on its upper part. It has a broad head, pigmented eyes, and a median continuous fold. The dorsal fin is demarcated but rays are not present in it. The caudal fin is truncate and 7-8 rudimentary rays are present in it. Anal fin is not demarcated and the pelvic fin is not yet formed. The pectoral fin is represented by a membranous flap without any rays.

Stage - I

Stage - II

Stage - III



Stage - IV

Stage - V

Fig.10.7 Development stages of Bony Fish

Stage II

Yolk sac is slightly reduced, and chromatophores are present on the head. Dorsal fin is further demarcated and 7-8 rudimentary rays can be seen in it. Caudal fin consists of 15-16 rays. The anal fin is slightly demarcated but rays are not seen in it. The pectoral fin does not contain rays and is still in the form of a membranous flap. The air bladder is now visible.