

**FISHERIES PRODUCTION AND MANAGEMENT
(3 UNITS)**

**FIS 501
LECTURE GUIDE**

BY

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FIS501: FISHERIES PRODUCTION PRODUCTION AND MANAGEMENT (3 UNITS)

THE BIOLOGY OF HEREDITY

Transmission of biological characters from parents to offspring through genes is a kind of inheritance known as *heredity*. Living organisms have hereditary characters, as every individual is an offspring of other individual of a similar kind. In spite of this we have observed that variations exist between organisms even of the same species. The characters that can be transmitted are those that are controlled by the genes. As a discrete unit of inheritance, the gene controls the appearance of a character by directing the development of one or more proteins, which leads to the manifestation of the character.

All genes inherited by an offspring, constitute its genetic make-up or genotype. This is distinct from the phenotype, which is the outward or physical appearance of the inherited characters or traits in an individual. However a sudden change in the structure of genes may occur and this is referred to as mutation. A gene mutation can be transmitted from parent to offspring, if the mutation occurs in gametes, gamete – producing cells or on the zygote. Such a mutation is then inherited by subsequent generations of the off–spring. The body or somatic cells of animals and the sporophyte stages of plants have a characteristic number of chromosomes fixed for a particular species, they are referred to as the diploid or $2n$ number.

Growth is an irreversible or permanent increase in size of an organism as a result of formation of new cytoplasmic materials. Growth can be determined by increase in length, size or by dry weight of organisms. At cellular level, the growth process is usually an increase in cell number by mitotic division. Mitosis is a simple cell division whereby a cell passes a copy of its genetic materials to each of the daughter cells. Mitosis is responsible for the processes of growth and the repair of tissues. Mitosis occurs in stages namely; Prophase, Metaphase, Anaphase, and Telophase.

As each chromosome is made up of genes which are functional units of inheritance, chromosomes control the major features of heredity. Genes that occupy the same relative position or loci on the homologous chromosomes but separate during meiosis are referred to as alleles: the pair is known as allelic pair. Meiosis is a type of cell division in reproductive cells. This cell division gives rise to haploid gametes which have half the number of chromosomes that are found in parent cells. Meiosis occurs only in reproductive organs. When two gametes unite

through fertilization, there is fusion of gamete nuclei. It is important to note that the chromosome number in different organisms is constant.

Meiosis helps to maintain constancy in the chromosome number of a species. Meiotic division consists of two nuclear and cytoplasmic divisions, namely first and second divisions. The first meiotic division is reductive in nature while the second stage is mitotic. It is during meiosis that hereditary materials are interchanged between chromosomes resulting in variation within and between species.

From fertilization to hatching, embryogenesis proceeds from a single egg cell to the highly organized larvae. The eggs undergo cell division or cleavage. Cleavage is the division of cells early embryo.

Depending mostly on the amount of yolk in the egg, the cleavage can be holoblastic (total cleavage) or meroblastic (partial cleavage). The pole of the egg with the highest concentration of yolk is referred to the vegetal pole; while with low concentration is referred to the animal pole. Thus, one cell divides into two:

- (a) The daughter cells called blastomers, and then cleave into four cells;
- (b) These cleave into eight
- (c) And soon reached by vertical cleavage. The mass then resolves itself into a layer of cells forming a hollow sphere, the blastula.
- (d) The next stage is the formation of double-walled sac, the gastrula, the outer wall is called the endoderm and the inner wall is endoderm. The endoderm surrounds a new cavity known as the primitive gut. In some cases, these two layers are formed by delamination that is, pushing of a portion of the wall of the blastula. The endoderm produces specialized cells in the principal digestive glands and forms the lining of air passages and most of the alimentary canal. The mesoderm gives rise to blood and blood vessels, connective tissues, muscles, reproductive glands and the kidney.
- (e) The embryonic axis is formed with optic vesicles.
- (f) During the further development, the eye lens, optic vesicles, myomeres and brain appear.
- (g) The tail grows and lifts off the yolk, eyes became pigmented.
- (h) The embryo reaches the hatching stage.

The larvae phase begins with hatching and is a fundamental stage of early life history. The innate behavior of newly hatched larvae differs widely among species. Pike larvae, for example remain rather inactive during the yolk sac period, trait larvae after hatching show a positive geotaxis and a negative photo taxis.

Morphological characteristics may vary over a certain range at time of hatching because hatching is not correlated with a definite morphological stage; for example body length, yolk sac size and the differentiation of head and trunk are variable features among newly-hatched larvae. However, temperature during incubation influences the larva's morphological stage at hatching. Within certain limits, development from fertilization to hatching is prolonged by low temperatures and accelerated by high temperature. Temperature to be the most important external factor because it has a direct influence on the timing of ontogenetic events.

**Duration of egg Development from fertilization to Hatching
In some cultured freshwater species.**

S/N	Species	Hours	Temperature	Author
1	Heterobranchus bidorsalis	23	26°C	Agbebi et al 2005
2	Clarias gariepinus	21	26°C	Aluko et al 2001
3	Heterobranchus coryyfillis	23.1	25°C	Olufeagba 1999
4	Pseudoplatystoma coruscan	19	24°C	Cardoso et al 1995
5	Ictalurus punctatus	23	24°C	Makeeva and Emel'yanova 1993

EMBRYOGENESIS IN RELATION TO GENETIC IMPROVEMENT

The timing for the occurrence of morphological changes in the developing embryo revealed much about the life cycle of different fish. The accurate timing for the first cleavage opens the window into genetic improvement of the species. Most problems encountered such as un-hatched eggs even though fertilized, abnormality in embryo and the difficulties associated with hatchery management, embryogenesis has been able to give reasons for this occurrence.

Embryological studies provide some basic information of embryonic and larva development. It further provides a better understanding of early embryonic, larva stages and their behavior. Embryological stages helps in determining the species frequencies, the implication of chromosome engineering research and to know the various stages involves from fertilizer egg to hatching.

Embryology is a key factor in chromosome manipulation in that apart from the type of manipulation involved, the exact timing and duration of the shock relative to both meiosis (extrusion of the second polar body) and mitosis (first cleavage when zygote divides to become an x-called embryo determines the success of triploid production (chromosome manipulation).

TAXONOMIC CHARACTERS

Character is any attribute of any organism that we can detect and describe. A Taxonomic character must be easily observable and vary from one taxonomy to another. Therefore, good characters must be genetically, rather than environmentally determined. For instance, fish that live in impoverished waters may have relatively large heads and bodies because they are under-nourished. In this situation, one might mistake emaciated fish with big heads for a separate species simply because the fish were starving due to environmental conditions. Nonetheless, differences in head size and body shape are often determined genetically and as such can be used as good characters.

Most good characters used in fish taxonomy are morphological that is, they are attributes of body form and structures because such attributes are the easiest to observe. Morphological characters may be divided into those that are directly measurable and those that are not. Measurable or quantitative, characters include those like length of body parts which can be measured with a millimeter or centimeter scale (morphometric) and those like number of fin rays (menstic) which can be counted. Statistically, morphometric characters are continuous variables. This means that, theoretically, any number of values exists between one measurement of say head length and another depending on the degree of accuracy. Menstic characters are discontinuous or discrete variable. There might be 9 or 10 rays counted in a fin, but there will not be 9.5.

QUALITATIVE CHARACTERS

Values of qualitative characters are not easily expressed as numbers are. Such attributes as colour or shape are usually described in words such as red or fusiform. But with the technological advances, more and more qualitative characters have the potential to become quantitative. Photographic image analysis by computer can render differences in tints and outline in digital terms. More simply, qualitative characters can be scored subjectively. For example, body shape might be scored to 1 (slender) to 5 (robust) or body colour shade from 1 (light) to 5 (dark).

Non-morphological characters

Taxonomic characters need not always be morphological even though morphological characters are often easiest to observe and measure. Characters can also be functional (physiological), behavioural, distributional, cytological or bi-chemical.

Every kind of taxonomic character is potentially important and should be used if it proves valuable in identifying fish taxonomy and if the resources are available.

CHARACTER COMBINATION

If a single character does not efficiently separate individuals of two different populations or species, a group of characters whose values are combined mathematically into a discriminant function may do so. Thus, usually by computerized correlative procedure “virtual” characters are created as combinations of real (directly observable) characters.

SUGGESTED DATA SHEET FOR RECORDING

Your Name:

Species:

Specimen Number:

Counts

1. Dorsal fin spines
2. Dorsal soft rays
3. Anal spines
4. Anal soft rays
5. Total splanchnic rays
6. Scales along lateral line
7. Scales above lateral line
8. Scales below lateral line
9. Scales around caudal peduncle
10. Scales around caudal peduncle
11. Branchiostegal rays
12. Pyloric caeca
13. Total gill rakers on first arch
14. Total vertebrae

Measurements

1. Standard length
2. Body depth
3. Caudal peduncle depth
4. Caudal peduncle length
5. Pre-Dorsal length
6. Length of dorsal base
7. Length of anal base
8. Height of dorsal fin
9. Height of anal fin
10. Length of pectoral fin
11. Length of pelvic fin

12. Length of longest dorsal spine
13. Head length
14. Head width
15. Snout length
16. Suborbital width
17. Orbit to pre-opercle angle
18. Eye diameter
19. Upper-jaw length
20. Gape width