# Genetic and Biotechnology in Aquaculture

#### Gametogenesis

- Gamelogene is is the creation of gametes.
- In males, it is
  Spermatogenesis, creation of sperm.
- In females, it is occenesis, creation of ova.



- Meiosis generates genetic diversity through:
- the exchange of genetic material between homologous chromosomes during Meiosis I
- the random alignment of maternal and paternal chromosomes in Meiosis I
- the random alignment of the sister chromatids at Meiosis II

### **Cytogeenetic and Kariology**

Cytogenetics: is a branch of genetics that is concerned with the study of the structure and function of the cell, especially the chromosomes.

An eukaryotic chromosome is a molecule of DNA together with associated proteins Carries part or all of a cell's genetic information

- Most fish are diploid (2N)
- Normal for most vertebrates ~50 chromosomes typical (range 16-446)
- Produce haploid (1N) gametes

ĨX	¥8 2	ăă	57	äX	<b>88</b>	88 7	<b>3</b> 3	XX °
<b>10</b>	<b>88</b> 11	12	<b>88</b> 13	14	<b>86</b> 15	<b>88</b> 16	<b>XX</b> 17	<b>8</b> 7
<b>87</b> 19	20	21	<b>X 3</b> 22	<b>XX</b> 23	24	<b>8 (1</b> 25	<b>X8</b> 26	<b>XX</b> 27
B 8 9 9 9 9 1	2	<b>X 8</b> 3	68	5	<b>1</b> 6	7 7	X	(j
10	<b>38</b> 11	12	<b>13</b>	<b>8</b> 3 14	15	<b>1</b> 6	<b>装置</b> 17	18
<b>19</b>	20	<b>21</b>	22	<b>XX</b> 23	24	25	26	<b>8</b> 27

- Normally, all the individuals of a species have the same number of chromosomes.
- Closely related species usually have similar chromosome numbers.
- Presence of a whole sets of chromosomes is called euploidy.
- It includes haploids, diploids, triploids, tetraploids etc.
- Gametes normally contain only one set of chromosome – this number is called Haploid
- Somatic cells usually contain two sets of chromosome - 2n : Diploid

- 3n triploid
- 4n tetraploid

The condition in which the chromosomes sets are present in a multiples of "n" is Polyploidy When a change in the chromosome number does not involve entire sets of chromosomes, but only a few of the chromosomes - is Aneuploidy.

- Monosomics (2n-1)
- Trisomics (2n+1)
- Nullisomics (2n-2)
- Tetrasomics (2n+2)

- Constant chromosome number usually characteristic of a species
- Some species may display variation
- Rainbow trout 58-64 chromosomes
- Variation results when chromosome arms rearrange



## **Types of Chromosomes**

#### Sex chromosomes

 In humans, the X and Y chromosomes that are involved in sex determination. These have different sizes and shapes

#### Autosomes

- Chromosomes other than the sex chromosomes
- In trout, chromosomes 1 to 29 are autosomes

#### Chromosomes

- A diploid cell has two sets of each of its chromosomes
- A trout has 60 chromosomes (2n = 60)
- In a cell in which DNA synthesis has occurred all the chromosomes are duplicated and thus each consists of two identical sister chromatids



# Homologues

- Homologous chromosomes:
  - Look the same
  - Control the same traits
  - May code for different forms of each trait
  - Independent origin each one was inherited from a different parent





### **Chromosome Shape**

- As chromosomes condense and become visible during cell division, certain structural features can be recognized
- 1) Chromomer

#### 2) Centromere

- A region of a chromosome to which microtubule fibers attach during cell division
- The location of a centromere gives a chromosome its characteristic shape

# **Centromere Location**

 Replicated chromosomes at metaphase consist of sister chromatids joined by a single centromere





- Chromosomes may differ in the position of the Centromere, the place on the chromosome where spindle fibers are attached during cell division.
- In general, if the centromere is near the middle, the chromosome is metacentric
- If the centromere is toward one end, the chromosome is acrocentric or submetacentric
- If the centromere is very near the end, the chromosome is telocentric.



#### 3) Kinetochore

- Within the centromere region, most species have several locations where spindle fibers attach, and these sites consist of DNA as well as protein.
- The actual location where the attachment occurs is called the kinetochore and is composed of both DNA and protein.
- The DNA sequence within these regions is called CEN DNA.

#### **Chromosome structure**

- The centromere is a constricted region of the chromosome containing a specific DNA sequence, to which is bound 2 discs of protein called kinetochores.
- Kinetochores serve as points of attachment for microtubules that move the chromosomes during cell division:



#### 4) Telomere

- The two ends of a chromosome are known as telomeres.
- It required for the replication and stability of the chromosome.
- When telomeres are damaged or removed due to chromosome breakage, the damaged chromosome ends can readily fuse or unite with broken ends of other chromosome.
- Thus it is generally accepted that structural integrity and individuality of chromosomes is maintained due to telomeres.

#### Telomere Repeat Sequences

until recently, little was known about molecular structure of telomeres. However, during the last few years, telomeres have been isolated and characterized from several sp.

TTAGGG



