

REPRODUCTIVE *BIOLOGY IN FISHES*



INTRODUCTION

- Among the 21723 living species of fishes existing in the world at present , a wide variety of patterns of reproduction Such as – unisexuality , bisexuality , hermaphroditism and parthenogenesis are observed.
- Like other vertebrates , the fishes usually reproduce sexually and in a quite large number of them , spermatozoa and eggs are formed in separate individuals and the gametes are expelled in the surrounding water where fertilization take place ; soon.

In order to evolve and standardize an efficient hatchery system for producing the young fish of good quality insufficient numbers of a given species, it is essential to know the details of its natural breeding . it involves the study of -

- ✓ Sexuality of a given fish
- ✓ Sexual dimorphism
- ✓ Reproductive cycle
- ✓ Time/season/place of reproduction
- ✓ Fecundity
- ✓ Courtship behavior and spawning pattern
- ✓ Parental care
- ✓ Larval life history

Factors affecting reproduction

- **Environmental factors** – light, temperature , water quality parameters etc .
- **Intrinsic physiological factors** – hormonal , neurohormonal .
- **Nutritional requirements of fish** – natural food ,feeding pattern , balanced diet required for optimum gonadal growth.

SEXUALITY IN FISHES

- Unisexual fishes
- Bisexual fishes
- Hermaphroditism

UNISEXUAL FISHES

- Unisexual fishes are those that produce offsprings of one sex only. It is a rare phenomenon among fishes.
- Hubbs and hubbs (1932,1946) were the first to report all female population of the fish, Poecilia formosa.
- The female of P. formosa mates with males of other species of Poecilia sps. .

BISEXUAL FISHES

In most of the fishes sexes are separate i.e. there are male and female fishes. Such fishes are called gonochoristic fishes.

Gonochoristic fishes have been classified into 2 categories based on their embryonic development such as –

1. Undifferentiated gonochoristic fishes
2. Differentiated gonochoristic fishes

- UNDIFFERENTIATED GONOCHORISTS FISHES –

During initial stage of development ,gonadal tissue remain in the different stage , then develops into ovary and then into either testes or ovary.

- DIFFERENTIATED GONOCHORISTS FISHES –

Indifferent gonad directly develops into either ovary or testes .

HERMAPHRODITISM

- A hermaphrodite is one in which both male and female sex organs are present in same individual .
- Two type of hermaphroditism have been distinguished –
 1. Synchronous hermaphroditism
 2. Metagonous hermaphroditism

- **SYNCHRONOUS HERMAPHRODITISM –**

The gonad of these fishes is divided into ovarian and testicular areas , the ovary developing oocytes and testes developing spermatozoa.

- **METAGONOUS HERMAPHRODITISM –**

In metagonous hermaphrodites , the juvenile gonad is usually ambisexual ovarian and testicular rudiments are present in same fish.

SEXUAL DIMORPHISM

- Most of fishes exhibit sexual dimorphism or secondary sexual characters by which sexes can be distinguished from each other .
- In a few fishes secondary sexual characters are discernible throughout the life span where as in some other they are discernible only during the breeding season .

Some character of sexual dimorphism

are -

- Size of fish
- Length /shape/texture of fins
- Coloration
- Genital papilla
- Ovipositor
- Shape of head

- Size of the fish -

Some species of fishes exhibit size difference between sexes . For example, in Tilapia; males grow faster than female , but in major carps the females grow faster than male.



- Length/shape/
texture of fins-

In several species of fishes, sexual differences are found in the shape/size of the fins . In Labeo dero dorsal fin of male is different from that of female – anterior part of the dorsal fin is elongated in the form of a lobe in male which is not found in female.



- Colouration –

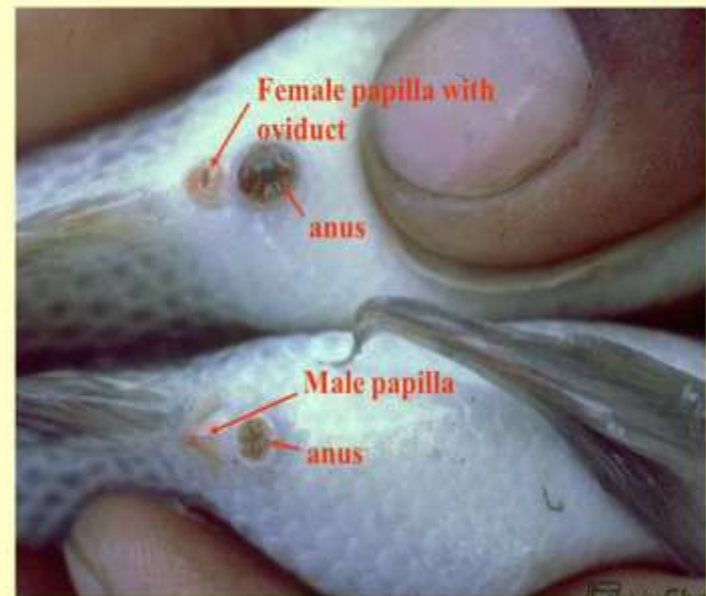
some species of fishes exhibit sexual dichromatism i.e. different color patterns in different sexes. During breeding season male develops bright coloration in fishes such as salmonids .



- **Genital papilla** –

In few fishes like Clarias , Heteropneustes etc . Male have prominent genital papilla, particularly during breeding season which are elongated and cylindrical in male but small, button shape in females.

Visual Selection of the Genital Papilla



• Ovipositor –

In a few fishes like bitterlings the ready to spawn females develop long, pink tubes from genital aperture region which is used for laying eggs into the mantle cavity through the inhalent siphon of freshwater mussel.



- Shape of head –

A few species exhibit sexual differences in the shape of head . In male salmon , the snout develops like a hook whereas in females the same are not noticed.

MALE



FEMALE



REPRODUCTIVE CYCLE

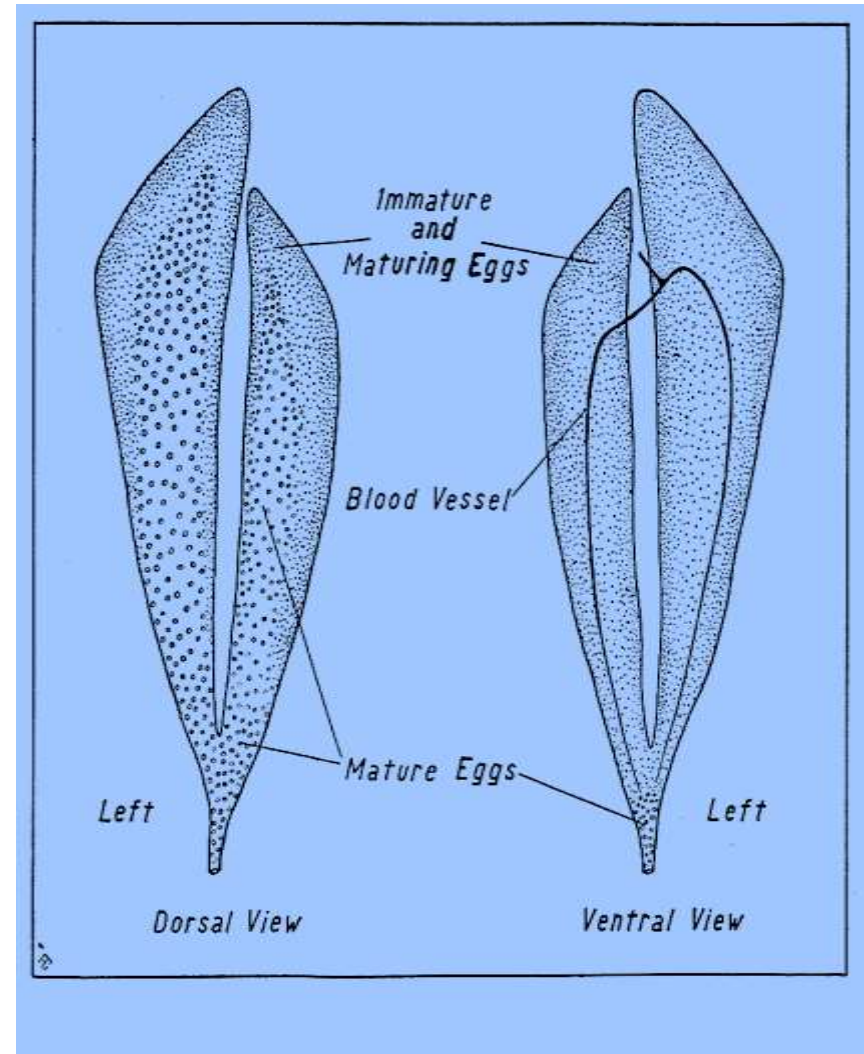
- A few fishes breed only once in their long life span eg. Pacific salmon . The fresh water eel breeds only once in 10-14 years . Most of the fishes breed in one season every year , they are called **seasonal breeders** , but some breed in all seasons, through out the year , and they are called **year round spawners** .
- Seasonal breeders exhibit rhythmic changes in the structure and physiology of ovary and testes in different seasons. These changes are demarcated into five phases –
 1. Resting phase (December - January)
 2. Preparatory phase(February – April)
 3. Maturing phase (may – June)
 4. Spawning phase (July - September)
 5. Post spawning phase(October - November)

GONADOSOMATIC INDEX (GSI)

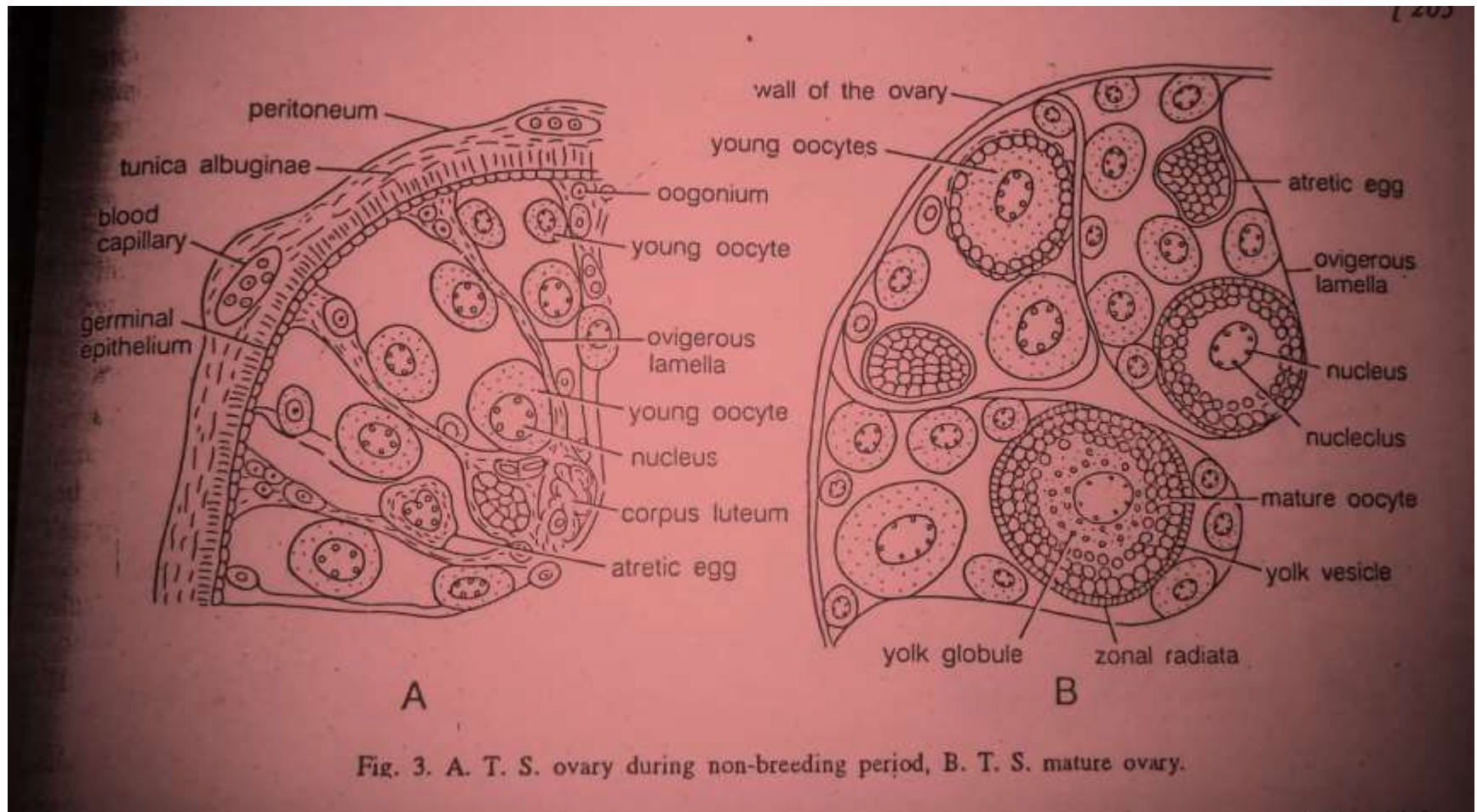
- It is a ratio between body weight and the weight of gonad showing the status of ovary and testis in terms of maturity and denotes the phase of the reproductive cycle-
- $$\text{GSI} = \frac{\text{Weight of the gonad}}{\text{Weight of fish-weight of the gonad}} \times 100$$
- GSI of fish increases with the maturation of the fish i.e. lowest during post spawning phase and highest at the peak of maturity i.e. spawning phase.

FEMALE REPRODUCTIVE ORGAN

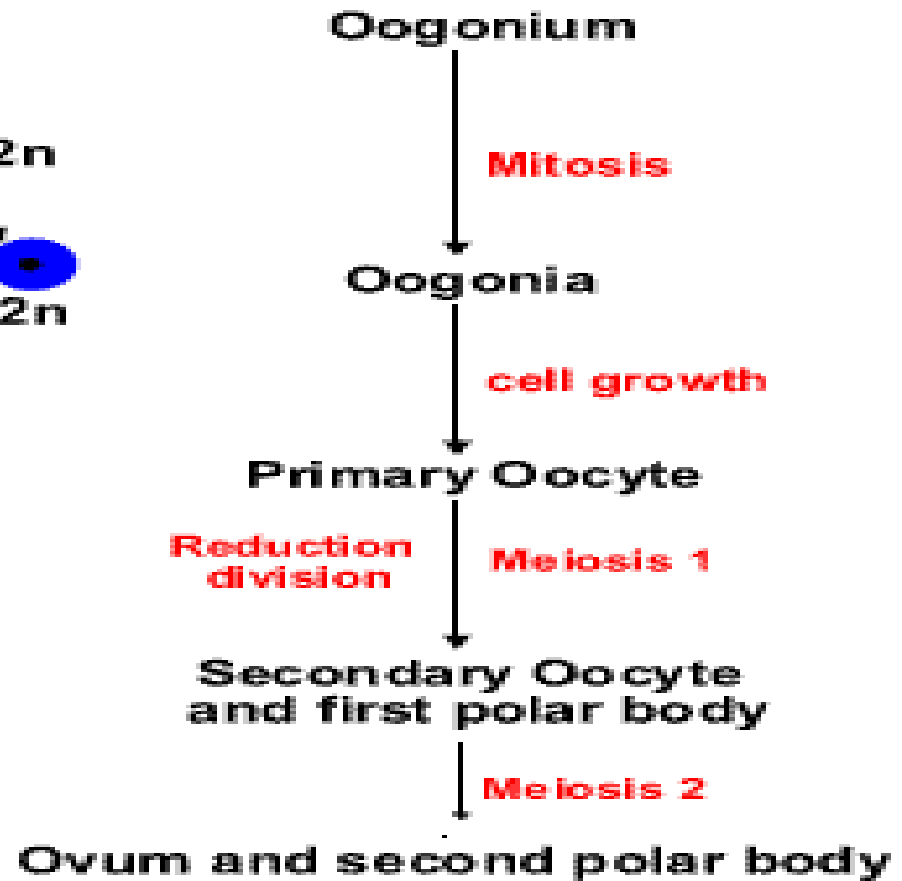
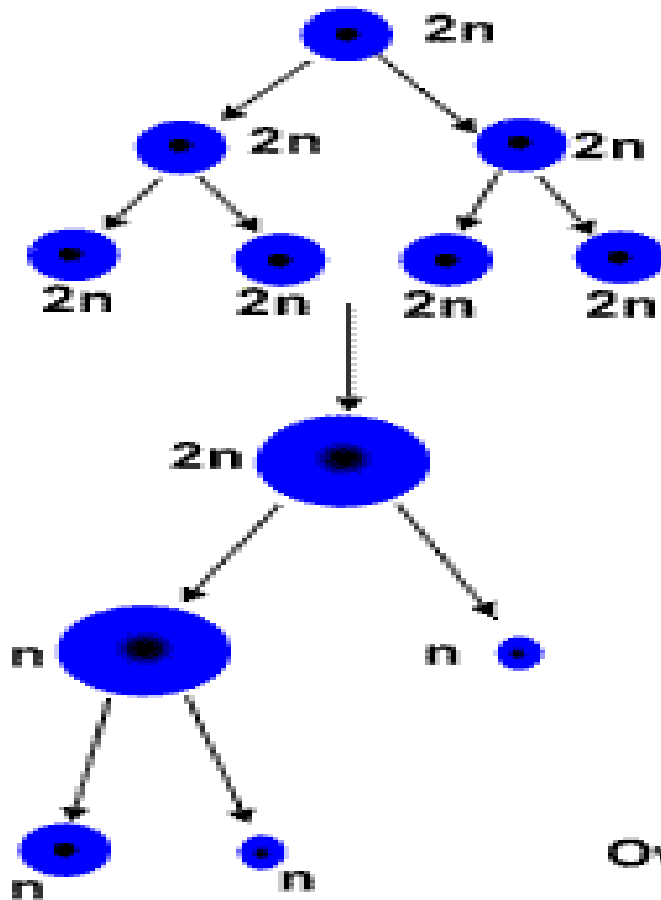
- Unlike mammals , the female reproductive system of teleosts is highly variable with a wide range of reproductive patterns including viviparity. The teleostean ovary in general is a hollow paired organ . There may be hundreds or even millions of fertile eggs present in the ovary of a fish at any given time.



T.S. OF MATURE OVARY



O O G E N E S I S

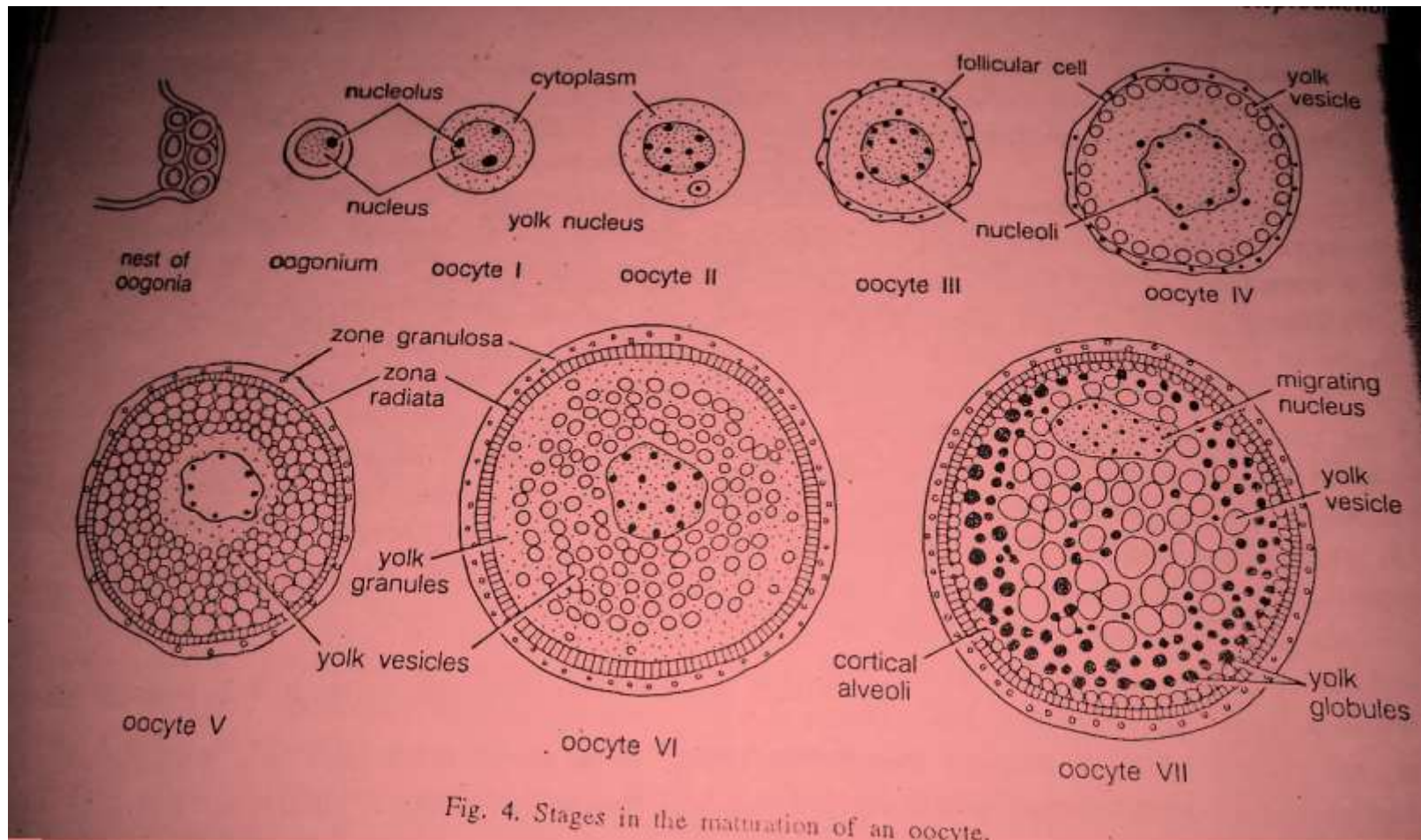


OVARIAN CYCLE

In the female fishes development of ovary taking place ,it is also called ovarian cycle . In this cycle several phages takes place –

- Resting phase- oocytes in the stage I and II
- Preparatory phase- stage III and IV
- Maturing phase or prespawning phase- stage V and VI
- Spawning phase- stage VII
- Post spawning phase- stage I and II

Stages of maturing of an oocytes



RESTING PHASE

- Normally it commences between August to September . The ovary looks small, thin, thread like , translucent, pale or dirty white in color with inconspicuous vascularization .

PREPARATORY PHASE

- During October to December the ovaries become slightly larger , thicker, opaque and yellowish in color .there is an increase in the weight of ovary .

MATURING PHASE

- Generally it commences between January to March. There is a gradual increase in the volume and weight of the ovaries and occupy about $\frac{2}{3}$ to $\frac{3}{4}$ th of body cavity.

SPAWING PHASE

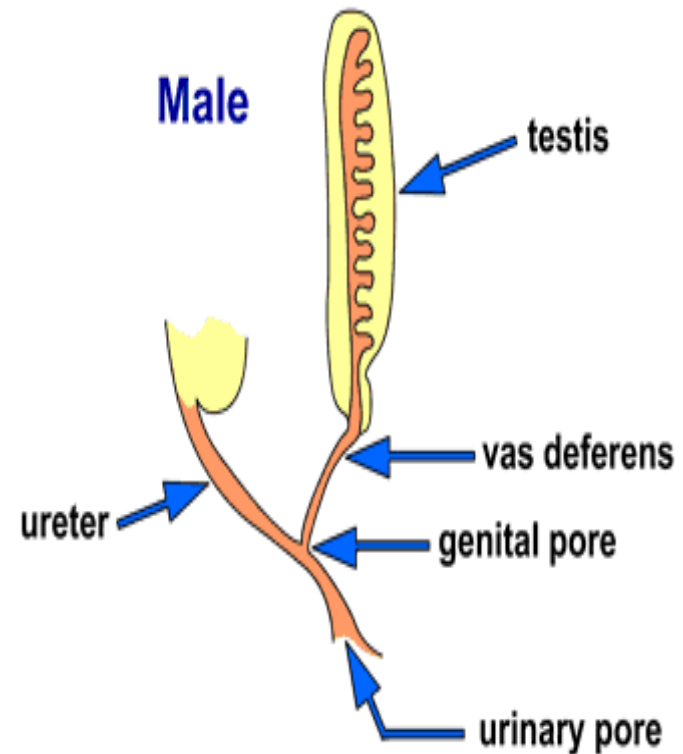
- Spawning phase usually commences between April to June. During this phase, the ovaries show a well marked increase in their volume and weight. They are turgid and yellow in colour with a large number of translucent eggs. Ovarian wall is almost transparent. Ova may be extruded by applying a gentle pressure on the abdomen.

POST-SPAWNING PHASE

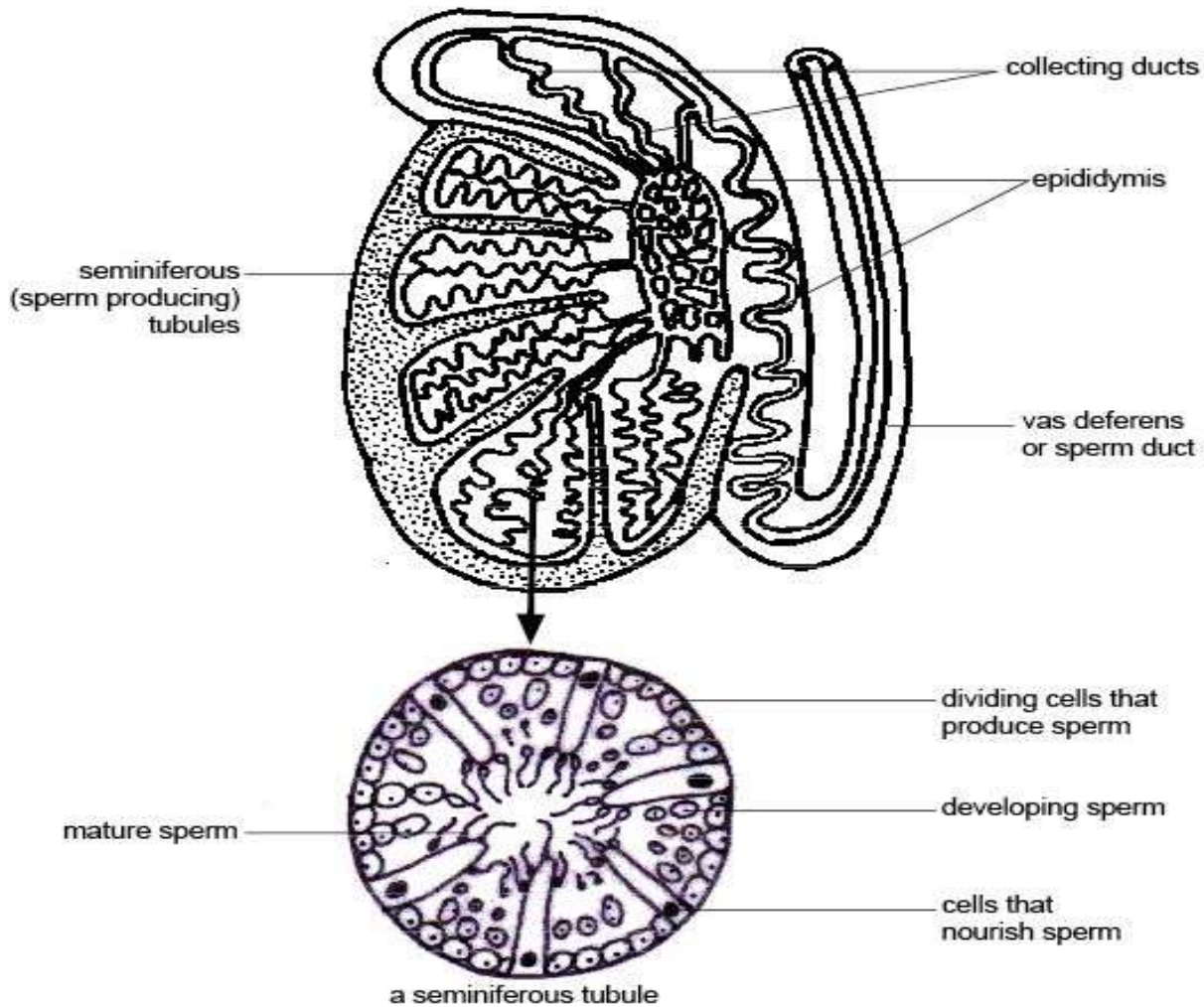
- It is also called as spent phase . Normally it runs between July and early August . The ovaries are flacid , shrunk and sac-like , reduce in volume with dull colour . The vascular supply highly reduce.

MALE REPRODUCTIVE ORGAN

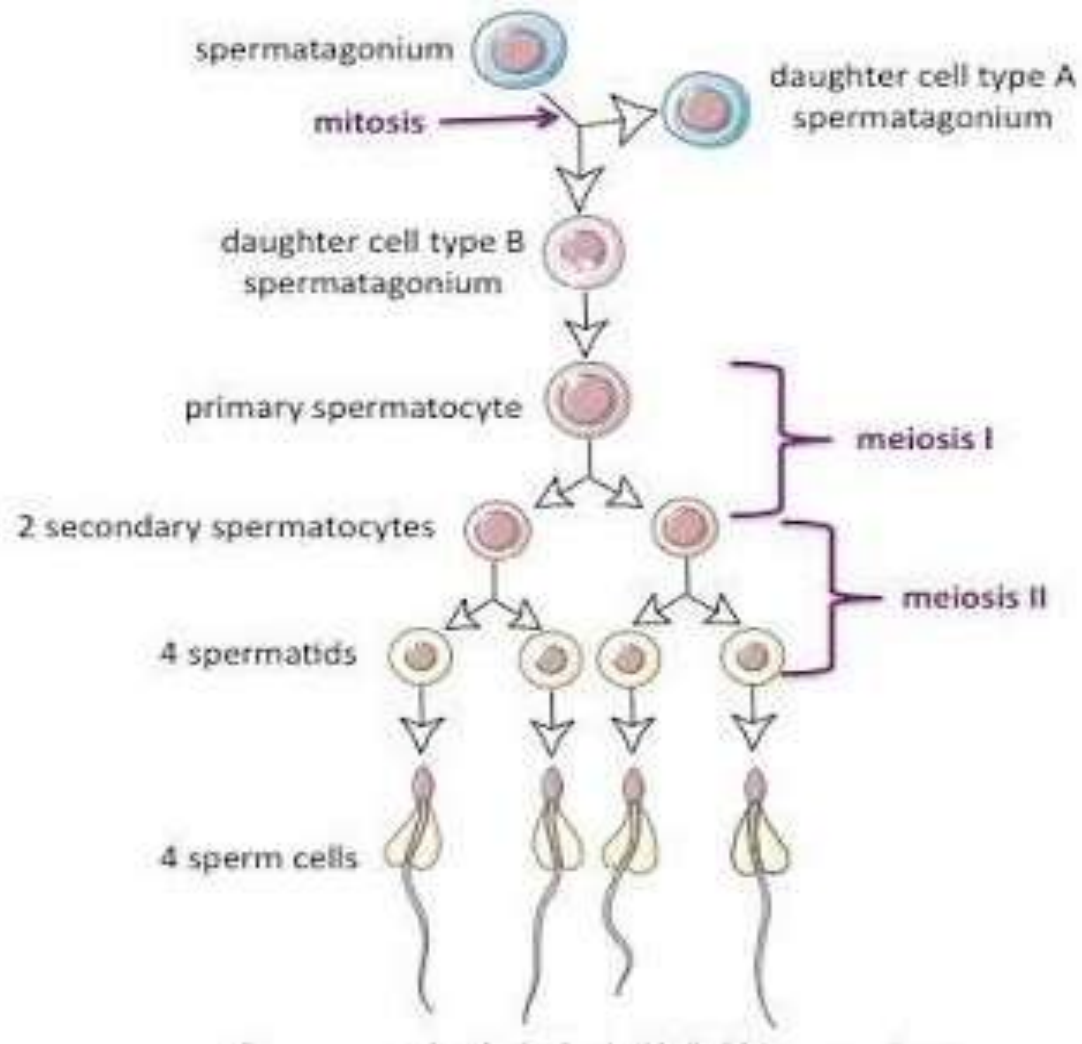
Reproductive organs of the male fish consist of testes which are elongated paired structures attached to the dorsal body wall. From the posterior mesodermal surface of each testis, the main sperm duct (vas deferens) arises and lead to the urinogenital papilla situated between the rectum and urinary bladder.



T.S. OF MATURE TESTIS



SPERMATOGENESIS



Testicular cycle

Parallel to the ovarian cyclic change taking place in female, the primary reproductive organ of male i.e. testes also undergoes rhythmic changes which are summarised below –

1. Resting phase
2. Preparatory phase
3. Mature phase
4. Spermiation phase
5. Post spermiation phase

RESTING PHASE

- During resting phase the testis remain in an immature state, GSI being the lowest at this stage. Seminiferous tubules are solid being filled with spermatogonial cells. Such tubules are called spermatic cords.

PREPARATORY PHASE

- During this stage , further step in spermatogenesis can be noticed . As a result primary spermatocytes and secondary spermatocytes and spermatids are produced. Spermatids possess haploid number of chromosomes.

MATURE PHASE

- During this phase spermatids undergo further development into mature spermatozoa . The process of development of spermatozoa from spermatid is called spermateleosis or spermiogenesis.

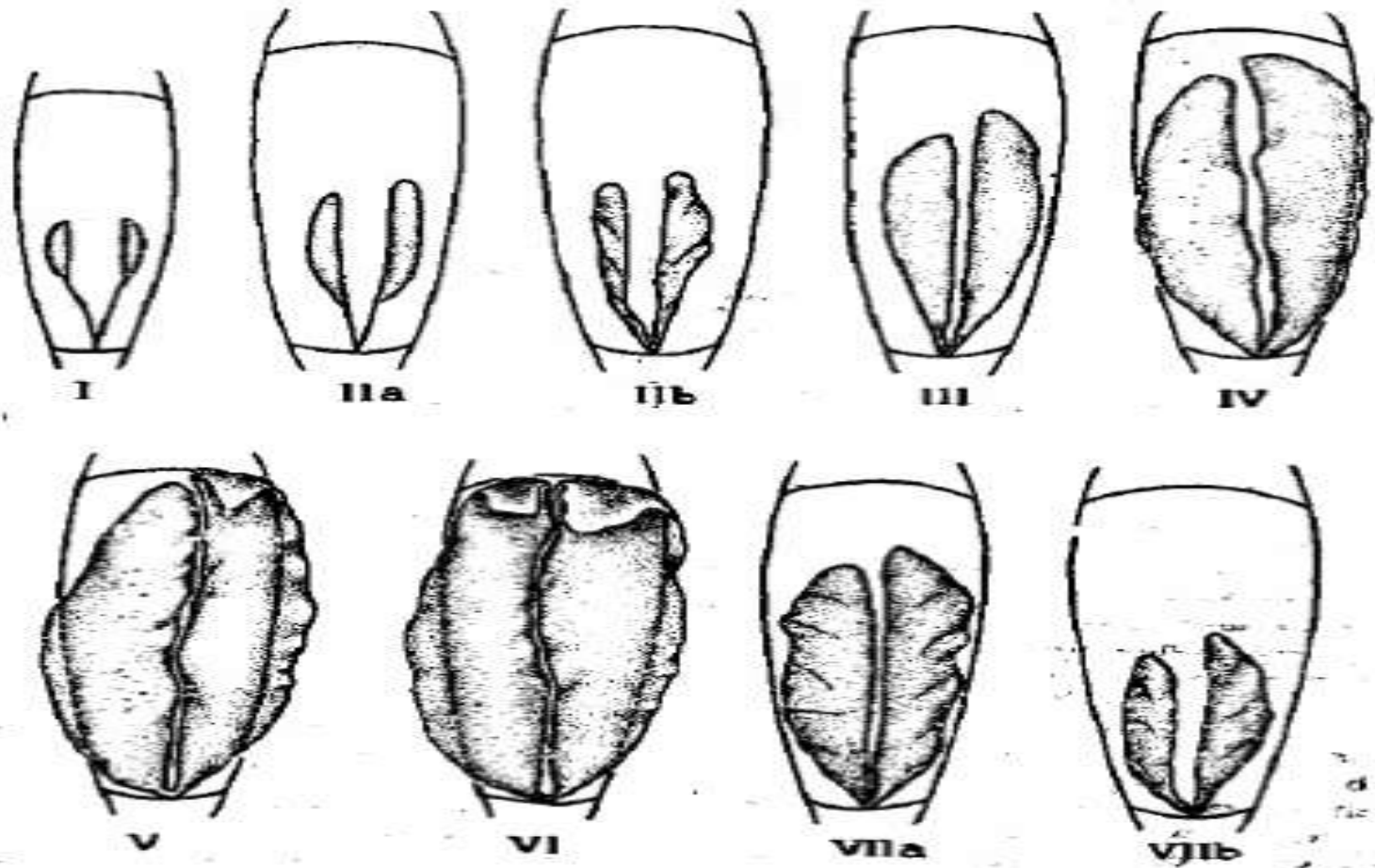
SPERMATION PHASE

- During the courtship and mating process, the male ejects the milt out of its body through the genital aperture to fertilize the eggs released by female . In most of fishes except live bearers fertilization is external , taking place in water . A male fish that yields milt is called milter.

POST SPERMATION PHASE

- During this phase, the testis is characterized by the presence of evacuated seminiferous tubules.

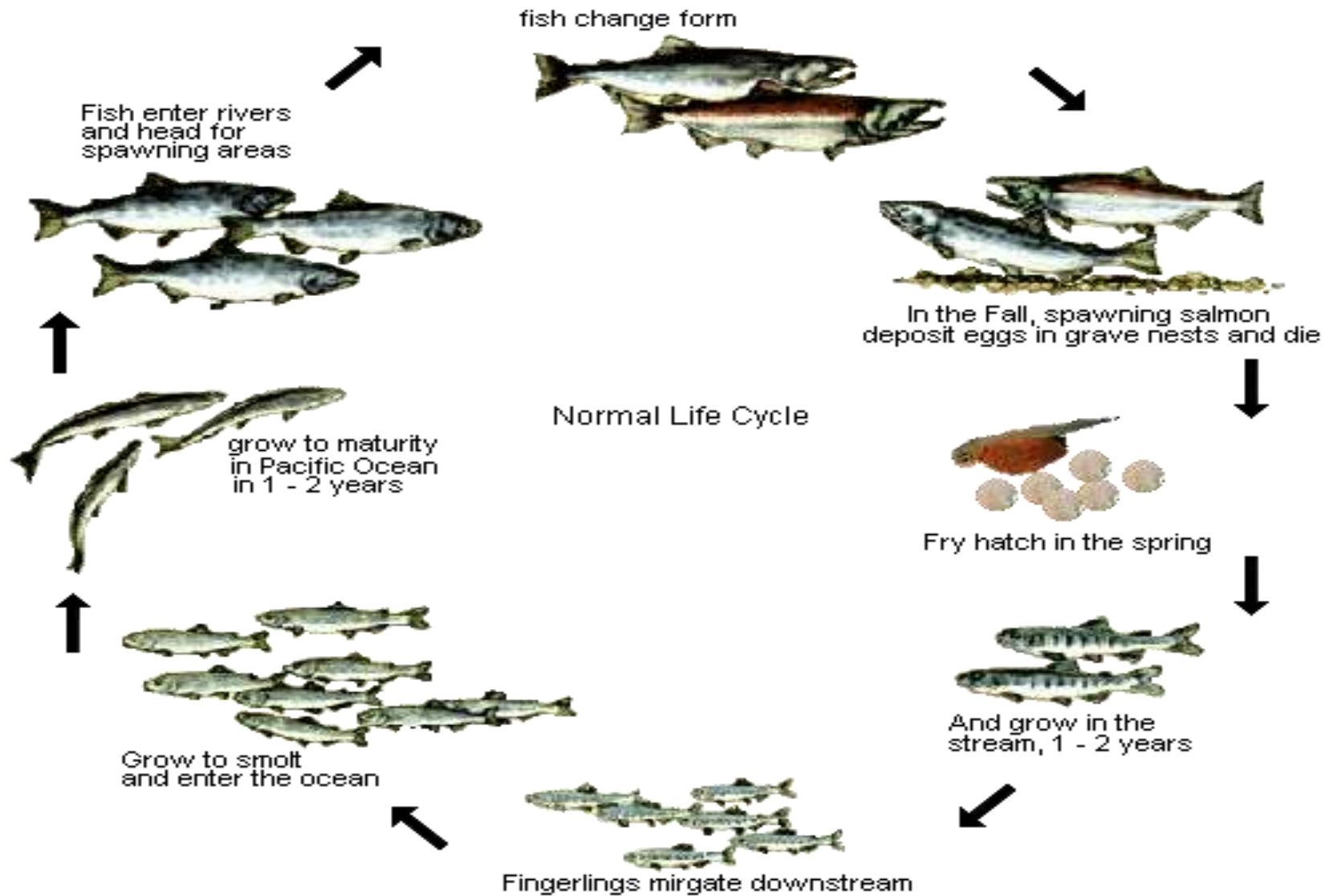
Development stages of gonads



HORMONAL REGULATION OF FISH

REPRODUCTION

It is well established that in all vertebrates the pituitary gonadotropins and gonadal steroids are the hormones most directly involved in the regulation of reproductive behavior. In fishes too, there are a number of ways in which the CNS-pituitary-gonad axis may regulate reproductive behavior; pituitary hormones may act directly on behavioral control mechanisms; pituitary hormones may stimulate the secretion of gonadal hormones which in turn regulate reproductive behavior of fish.



REFERENCE

- Breeding and seed production of fin fish and shell fish – Thomas Rath Mohapatra.
- Fish and fisheries – Prof. Kamleshwar Pandey.

Thank you

