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DEVELOPMENT OF OOCYTES TO MATURITY AND SPAWNING

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Spawning in fishes is closely associated with the development of intra-ovarian eggs. Measurements of diameters of intra-ovarian eggs have been found to be an useful tool in studying the development of oocytes to maturity and spawning. An attempt to study the maturity by the measurements of ova was first made by Clark (1934) on the California sardine (Sardina caerulea). Her pioneering work was followed by those of Hickling and Rutenberg (1936) and De Jong (1939).

The method proposed by the above workers is essentially as follows: Ovaries are fixed in 5% formaldehyde and a small portion of the ovary is teased out on a slide in the same medium and measurements of all the ova in the field of the microscope are made, until about 500 ova are measured. In case the eggs appear asymmetrical due to preservation, the micrometer may be placed in horizontal position and the diameters are measured parallel to the graduations on the micrometer. Ovaries after fixing in Bouin's solution, may be cut in rotary microtome and the diameter of the oocytes in the sections could also be measured. Prabhu (1956) suggests that measurements of at least 1000 eggs from each ovary are necessary to mitigate the probable error in the representation of various groups of eggs in different stages of maturity and represented by various modes in the graphs. Normally the first batch of immature eggs are avoided in the measurements.

The intra-ovarian eggs vary not only in their size but also in their inclusions in ovaries which are fully
ripe or in the penultimate stage of ripeness. There are several batches of oocytes which take their origin from the germ cells of the ovigerous lamellae and, as the spawning process continues every season, these batches pass on from one stage to the other. An examination of the ovary in the penultimate stage of development shows chiefly the following four types of ova: Fig. 3.3.1.

(1) Immature ova: minute transparent ova, minute transparent ova possessing a nucleus and a protoplasmic layer.

(2) Maturing ova: small, opaque ova in which yolk formation has just commenced, but not completed.

(3) Mature ova: Opaque ova, fully yolked, but still contained within the follicle.

(4) Ripe ova: Large fully or partially transparent ova which have burst out from the follicles.

Ovarian maturity stages are determined based on the predominance of the above mentioned types of development.

Histologically, oocyte development could be broadly classified into a primary growth phase, a secondary growth phase and a final maturation to be followed by ovulation and spawning.

1. Primary growth phase: The immature oocytes, known as the oogonia, are seen multiplying by mitosis in the stroma of the ovigerous folds. The oogonia are transformed to the primary oocytes by arresting the chromosomes at the prophase of the first meiotic division; this process is known as oogenesis. In the oogonia, the nucleo-cytoplasmic ratio is high, but as the growth progresses, this ratio decreases. Highly spiralized lampbrush chromosomes are usually seen in the nucleus of the primary oocyte. Nucleoli multiply and arrange along the periphery of the nucleus, called peri-nucleolar stage. The follicular
Concomitant with maturation of the oocyte, various authors have classified the different maturity stages into 4 to 7 stages, calling them as "stage I, stage II, etc." and taking into account the different size of the oocyte.

In the present context, it is that oocyte maturation and development in some species may result in a 300-400% increase in oocyte volume. In some species, the germinal vesicle breaks down and the second metaphase is reached by a process of maturation of the germinal vesicle. The second meiotic division, resumption of meiosis, is considered a process of the chromosome activity that proceeds to the metaphase of the telophase of meiosis.

Primarily, oocyte maturation involves the final maturation of the oocyte, whereas the progression of the oocyte is divided into the advanced stages of the zygote's development. The primary growth phase, normally accompanied by a characteristic reaction of your body's immune system, is characterized by the appearance of different types of late-stage growth phase.

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Based on ova diameter measurements, four different types of spawning periodicities have been recognized in teleostean fishes:

**Type A:** Spawning taking place only once a year during a definite, short period. In this case, the eggs which are destined to be spawned are withdrawn from the immature stock in a single group, sharply distinguishable at least in the later stages of maturation from the stock of small eggs from which it was derived (Fig. 3.3.5). The oocyte development in this case is said to be synchronous, as in *Therapon jarbua*, *Macrones vittatus* and *Chirocentrus dorab*.

**Type B:** Spawning taking place only once a year, but with a longer duration. In species exhibiting this type of spawning, the range in size of the mature ova, irrespective of the number of modes representing them, have been found to be nearly half of the total range in size of the entire intra-ovarian eggs in the whole ovary (Fig. 3.3.4), as in *Pelates quadrilieatus* and *Cypselurus oligolepis*.

**Type C:** Spawning twice in a year. In the ovaries of fishes exhibiting this type of spawning, in addition to the batch of eggs in ripe condition, another batch of eggs in which yolk formation has already commenced could be seen (Fig. 3.3.4), as in *Psammoperca waigensis*, *Therapon puta* and *Selaroides leptolepis*.

In the B and C types of spawning, the oocyte development is described as group synchronous.

**Type D:** Spawning throughout the year, but intermittently. Withdrawal of eggs from the immature stock is a continuous process; and there will be no sharp separation between the general egg stock and the maturing eggs (Fig. 3.3.5). The pattern of oocyte development in this case is said to
Subjecting an enzyme from the sperm to break it down, the resulting microzyme can be caused by a substance peroxidatic the enzyme to form the reaction. It is not known whether the enzyme or the sperm enters at the time of fertilization. It is assumed that fertilization appears on the viscosity of the sperm when the egg becomes ripe, a small opening known as the micropyle.

Fertilization

Preceding season advances the number of eggs in the mating and mature groups as the season progresses; unspayed eggs and decreasing egg ratio of a few inseminated eggs on the eggs in the group appear to be successful groups of eggs. Occasional presence in the other hand, it moves toward the eggs in the mature group.

Clark (1934) points out that if only one batch of eggs is spawned, the ratio between the number of eggs in the mature group and the number of eggs in the group is constant, and only one batch of eggs should remain consistent on the other hand, it moves toward the eggs in the mature group.

Cutch at intervals over a relatively short period, mature ovulate, and spawn a part of a post-vitellogenesis batch at intervals over a relatively short period.

The term fertilization is generally applied to a species in which a female was more than once in a spawning season. Each female is fertilized by many males.

It may be mentioned here, that aprotic acid solution of sperms is observed in Stomatopods and Indo-

be, asyncronous, as observed in Stomatopods.
When the egg is laid free in the water, the outer covering (chorion) at once becomes hardened. The hardened chorion becomes thinner as development advances and the egg increases in size. This process called 'water hardening' is advantageous in that it offers protection to the eggs from predators. It is assumed that a part of the substance of the egg membranes is withdrawn and absorbed by the embryo and this seems to occur to a greater extent in the demersal eggs, where the embryo is more advanced on hatching, than in the pelagic eggs.

References


Fig. 3.3.1

NUCLEUS 

NECLEOLUS 

OIL 

DROPLETS 

IMMATURE OVA 

Ø 0.0167-0.217 mm 

VITELLINE MEMBRANE 

MATURING OVA 

Ø 0.233-0.4 mm 

ZONA RAD I ATA 

MATURE OVUM 

Ø 0.417-0.517 mm 

YOLK GRANULES 

RIPE OVUM 

Ø 0.533-0.783 mm 

ZONA RADIATA 

OIL GLOBULE
PRIMARY GROWTH PHASE

IMMATURE OVARY

NUCLEOLUS

NUCLEUS

PERINUCLEOLUS OOCYTE < 100

ZONA RADIATA

OIL DROPLETS

LAMP BRUSH

CROMOSOMES

NUCLEOLUS

VACUOLATED OOCYTE 100-150 \mu m
SECONDARY GROWTH PHASE AND FINAL MATURATION

PRIMARY YOLK GRANULE OOCYTE 150-200 μm

SECONDARY YOLK GRANULE OOCYTE 210-250 μm

TERTIARY YOLK GRANULE OOCYTE 240-270 μm

HYALINE OOCYTE 280-350 μm
Fig 3.3.5

MACRONES VITTATUS

IV 17.5 cms
II 16.8 cms
III 16.5 cms

NO. OF OVA FROM 6 FISHES
AVERAGE NO IN 1, II AND III

MICROMETER DIVISIONS

OVA DIAMETER POLYGON OF MACRONES VITTATUS

(AFTER PRABHU 1956)

STOLEPHORUS INDICUS

I 18.3 cms
II 17.7 cms
III 17.4 cms

NO. OF OVA FROM 8 DIFF. OVARIIES 6-2-7.5 cms

AVERAGE IN 1, II AND III

MICROMETER DIVISIONS

OVA DIAMETER POLYGON OF STOLEPHORUS INDICUS

(AFTER PRABHU 1956)