S. S. College, Jehanabad

Department: Zoology

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Subject: Zoology

Topic: Reproduction in fishes

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(9(4)) Reproduction and Development of Fishes.

→ Introduction:→

The ability to produce new individuals is one of the fundamental characteristics of living organisms. All multicellular organisms including fishes have a limited life span and survival of the species therefore, implies a mechanism for the production of new generations of that species, that is the ability of reproduction. All vertebrates produce bisexually, with a male and female sex, each producing specialized sex cells, the gametes. The gametes are produced in gonads or primary sex organs, which are testes in males and ovaries in females. The male gametes are called spermatozoa and the female gametes are called egg cells or the oocytes - In fertilization an oocyte unites with a spermatozoon to ~~from~~ form a single new cell, the zygote.

The Knowledge of gonadal cycles and their functional mecanism is of prime importance for the successful management of fishes in fisheries. The determination of spawning season is essential prerequisite in assessing the reproductive potential of fish population.

Male Reproductive organ:→

Male reproductive organs ~~comp~~ comprise a pair of elongated and flattened testes located ventral to the kidneys

on either side 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 of equal size. From the lower end of each testis there arises a sperm duct. The two sperm ducts join posteriorly and open into the urinogenital papilla.

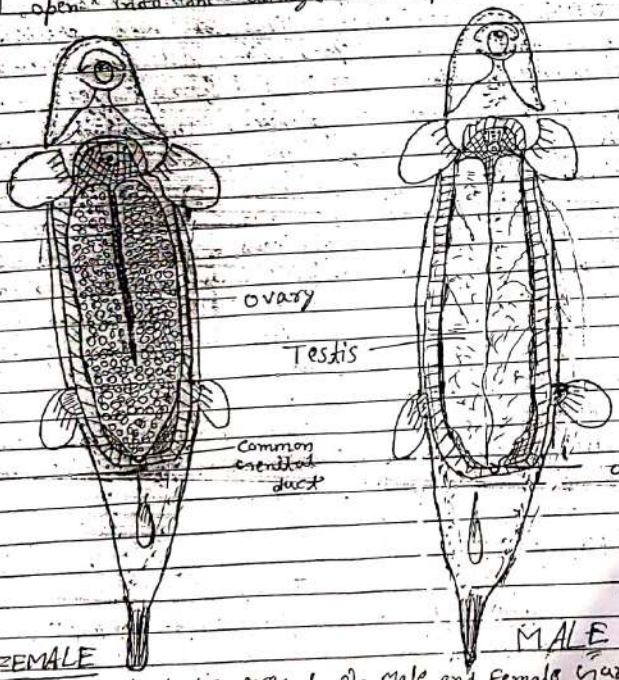

Fig of Reproductive organs of male and female Clarias batrachus

Testicular cycle:→

Morpho-histological changes are observed in teleostean fishes during different periods of testicular cycle. The testicular cycle is divided into the following phases.

(I) Resting Phase:→

During this period of testicular cycle the testes are thin, slender, translucent and pale in colour. This Phase extends from August to December every year. Histologically small-sized seminiferous tubules are predominant by occupied mitotic spermatogonia. The number of spermatocytes steadily increases with time, but spermatids and spermatozoa are absent. This period was marked by low serum testosterone level.

(II) Maturing Phase:→

This phase extends from January to early March. Morphologically the testes are similar in those of early immature Phase. except its greater weight and volume. Histologically the spermatogonial cells start dividing mitotically, cells at all stages of spermatogenesis are present. The number of spermatocytes and spermatids continue to increase, concominant with a reduction in the number of spermatogonia.

(III) Mature Phase:→

This Phase extends from late March to late ~~ma~~ May. Morphologically the testes show a marked increase in their weight and ~~volum~~ volume. cells at all stages of spermatogenesis are present. Testes contain large number of spermatozoa, but no spermatozoa are present in

the sperm duct.

In the latter part of mature Phase the lumen of seminiferous tubules and sperm ducts are fully filled with spermatozoa, and other gametic states are present in small number. Small amount of viscous milt can be obtained. Serum testosterone level shows increased trend during this Phase followed by an apparent increase in spermatogenesis stages.

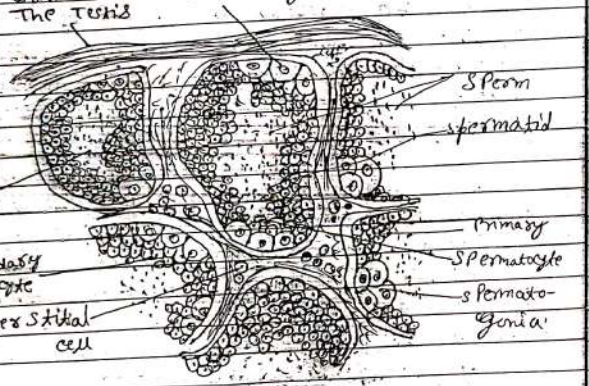

Fig. T.S = Mature testis

During late period of mature Phase of testicular development the lumen of seminiferous tubules and sperm ducts are fully filled with spermatozoa. By the end of this stage, spermatocytes and spermatids are replaced by spermatozoa. By the end of this stage, spermatocytes and spermatids are replaced by spermatozoa. Fully flowing milt (spermatic fluid) can be obtained by exerting the abdomen of the male fish. Highest level of serum testosterone is reported during this Phase of spermatic cycle.

(iv) Post-spawning (spent phase) :→

This Phase extends from early June to July. During this stage the testes become flaccid due to excessive discharge of sperms. The weight and volume are considerably reduced and the testes again do become thin, slender and translucent. Histologically, empty and collapsing seminiferous tubules are seen, some of which contain residual or unexpelled sperms. During this Period the serum testosterone level touches its low level.

After a brief period of rest, the testes start the cycle again. The spermatogonia are the only germ cells during resting phase, but are present throughout the year although their number is reduced during spawning period.

The interstitial or leding cells are the source of male hormones.

Female Reproductive Organs :→

The female reproductive organs consist of Paired elongated sac-like ovaries located ventral to kidney in the abdominal cavity. They are attached to the body wall by means of mesovarium. The anterior ends of the

two ovaries are free but their posterior ends are united into one. The hinder end of each ovary is continued posteriorly into a short oviduct. wall of the ovary

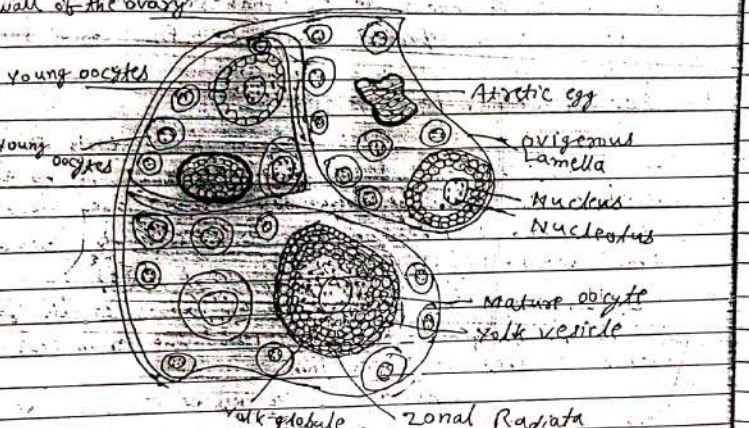

Fig. T.S. Mature ovary.

The two oviducts fuse and open to the exterior by a separate genital aperture. During non-breeding season the immature ovaries are thin, flaccid and translucent. However, on maturity they become enlarged and lobulated and the ripe ova are seen bulging out.

The wall of ovary is thick during non-breeding season but becomes thin and highly vascular during spawning period. It comprises an outer thin peritoneume a middle vascularized tunica albuginea made up of connective tissue and muscle fibres and the inner germinal epithelium. The germinal epithelium is the seat for the development of oocytes. The oogonial cells originate from the germinal epithelium. Each oogonium has a large nucleus and a thin chromophobic cytoplasm. The developing eggs are called oocytes. The oocytes are found in the following stages of development.

Oocyte I :→ such type of oocytes are larger than the oogonial cells. They are spherical in shape with a central nucleus with nucleoli and basophilic cytoplasm.

Oocyte II :→ They show increased volume number of nucleoli and basophilic character of the cytoplasm. The nucleoli are arranged along the periphery of the nuclear membrane. They possess a yolk nucleus in their cytoplasm close to nuclear membrane.

Oocyte III :→ They are larger than the oocyte II and are distinguished by the appearance of a thin layer of follicular cells around cytoplasm. Few nucleoli move to the cytoplasm through nuclear membrane.

Oocyte IV :→ They further show increase in their volume and yolk vesicles. such vesicles are arranged towards the periphery of the cytoplasm, increase number of nucleoli are observed in the cytoplasm.

Oocyte V :→ such types of oocytes are characterized by the appearance of yolk droplets in the cytoplasm. A thin layer of theca is also observed outside the follicular layer.

Oocyte VI :⇒ Such types of oocytes are characterized by the appearance of yolk droplets in the cytoplasm. A thin layer

Oocyte V :⇒ Such types of oocytes are recognized by their large size. The cytoplasm (ooplasm) is full of yolk vesicles. A vitelline membrane or zona radiata is also visible between the ooplasm and the zona granulosa. Nucleolar extrusion continues at this stage.

Oocyte VI :⇒ Such types of oocytes are characterized by the appearance of yolk droplets in the cytoplasm. A thin layer of theca is also observed outside the follicular layer.

Oocyte VII :⇒ Such oocytes show heavy deposition of large yolk globules. The nucleus moves towards the periphery. Few yolk vesicles are fused to form the central alveoli.

Ripe eggs :⇒ The ripe eggs are the largest in size and full of yolk globules and yolk vesicles. A mature egg is surrounded by an external layer of theca followed by the follicular epithelium (zona granulosa) and the innermost zona radiata.

Ovarian cycle :⇒

On the basis of microanatomy (histology) the ovarian cycle of a fish (Channa lamta) is divided into the following phases.

Resting

Resting Phase :⇒ This Phase extends from August to January every year during this Phase the ovaries are small, filamentous structure of white colour. The Primary oocytes of different dimensions are arranged along the periphery of the nuclear membrane.

Maturing Phase :⇒ This Phase extends from February to early April. The oocytes of various dimensions are seen with the start of yolk deposition on the inner periphery of the nuclear membrane. the nucleoli can be seen.

Mature Phase :⇒ This Phase extends from late April to early June. The oocytes of this stage are full of yolk glad globules. The nuclear membrane is not clear. Few small oocytes are also seen in the section.

After their release. Few immature oocytes are also seen in the histological sections.

Gonadosomatic index (GSI) :⇒

The gonads were dissected out and weighed and the GSI was calculated as Follows GSI = GW × 100/BW. where GW and BW are gonad weight and body wight respectively. Peaks of GSI of male and Female fishes were recorded during may which can coincide with the maturing Phase as indicated in histological sections.

Fecundity →

It can be defined at the total number of eggs produced by a gravid female during breeding season. For the calculation of ~~fe~~ fecundity ten ripe ovaries from five gravid females are dissected out and fixed in 5% formalin ~~of~~ for a week. After a week the ovaries are taken out from the preservative and are divided into ten samples. Each ~~samp~~ sample is weighed and heated in a test ~~with~~ tube with water and a pellet of KOH for ten minutes to release the ova from the ovarian tissues. Number of eggs of each sample was counted separately. The total number of eggs (fecundity) was calculated by the following formula.

$$\text{Fecundity} = \frac{W \times (n_1 + n_2 + n_3 + \cdots\cdots n_n)}{(w_1 + w_2 + w_3 - \cdots w_k)}$$

where, W = Total weight of the two ovaries.

w = weight of samples of ovaries.

n = number of ova in each sample of ovaries