

Sea Water Fish, *Glossogobius giuris* at Last Lives in Fresh Water Now

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Fish being a major food source for many countries and for many millions of peoples, it is established that pesticide toxins and abnormal environmental conditions are lethal to fish population and its survival. In these contest tissues of fish, *Glossogobius Giuris* was studied and explained the consequence and impacts of Toxins on Fish Endocrinology and Physiology and Reproduction.

The hypothalamo – hypophyseal – ovarian system of gobiid fish, *Glossogobius Giuris*, exhibited seasonal changes. It has been established that in vertebrates the neurosecretory system serves as a functional and morphological link between the hypothalamus and the hypophysis. Based on the histological studies two neuroendocrine system had been recognized, viz., the preopticohypophysial system and the system of nucleus lateralis tuberis (NLT). The nucleus preopticus (NPO) is generally divided into pars parvocellularis (Ppc) and pars magnocellularis (Pmc). This has been confirmed in *G. giuris*. The neurons of the NPO are known to be chromalium haematoxylin phloxin (CAHP) or paraldehyde thionine and paraldehyde fuchsine positive. The NPO neurons of *G. giuris* contain CAHP and AF positive granules and their axons are heavily loaded with neurosecretory material.

The neurons of NLT contain varying quantities of AF and CAHP granules in their cytoplasm. The cell size, shape and quantity of the secretory granules in the cytoplasm vary greatly according to the stage of sexual maturity and phase of the reproductive cycle. The morphology and anatomy of the pituitary have been documented as eight distinct types of hormone cells in the adenohypophysis based on their difference in size, staining intensity and their stage of secretory activity. These results show a correlation between the changes in the ovaries and in pituitary. Simultaneous changes in the basophils of PPD and acidophils of RPD, and ovary during various phases of reproductive cycle were observed.

Hypothalamic neurons of both the NPO and NLT showed seasonal variations in their size and secretory activity which coincided with different phases of reproductive cycle, and the external factors like photoperiod and temperature.

During the preparatory period (March), the pars magnocellularis (Pmc) and the pars parvocellularis (Ppc) of NPO and NLT indicated an accumulation of NSM in the neurons. This phenomenon has been earlier observed in *Heteropneustes fossilis* by Vishwanathan and Sundararaj. During prespawning period the Pmc and Ppc neurons of NPO showed considerable increase in their nuclear diameter and granular cytoplasm. In the NLT there was only a slight increase in the nuclear diameter and granulated cytoplasm. The meso – adenohypophysis of the pituitary contains basophils in various stages of degranulation.

The ovaries during this period showed maximum growth and maturation packed with yolky oocytes. Stage II primary oocytes showed the onset of vitellogenesis with a simultaneous increase in stage III primary oocytes.

During the spawning period (September to December) the process of degranulation continued further in PPD region. Consequently, vacuoles appeared in the basophils. Thus the processes of granulations and degranulations in the basophils coincided with the process of oogenesis, and the periodicity of spawning in *G. giuris*, it has been observed that the rapid release of hormones from the degranulated basophils was associated with the maturation of gonads and spawning behaviour of the fish. Similar reports have been given by Raizada in *Rasbora daniconius*. Cold water stimulated the NLT to activate

the gonadotrophs and gonadotrophic hormones which stimulate spermatogenesis and androgen production. In the present investigation it was found that the ovaries were maximally enlarged during the spawning period. The proportion of stage III, IV and V oocytes was significantly higher.

During the post-spawning period (January to February) the GTH cells exhibited maximum vacuolization. This coincided with increase in the number of atretic follicles and oogonial proliferations in the ovary. This phenomenon suggests that a lower content of gonadotropin in the basophils, with a simultaneous increase in the circulation is responsible for the development of oocytes. At the same time, the NLT neurons further decreased in their nuclear size and showed accumulation of secretory materials in the cell bodies, with a slight increase in temperature and photoperiodicity. The Pmc and Ppc of the NPO showed a slight increase in their neurosecretory material in the early post-spawning period, and thereafter the NSM accumulated in the perikarya of the neurons in *G. giuris*. Hence, it is concluded that during the monsoon season the hypothalamic nuclei are activated rapidly to release gonadotropin from the hypophysis for the purpose of spawning.

Intrinsic control is brought through hypothalamo-hypophyseal-gonadal axis, which is under the influence of ecological (extrinsic) factors which included light, temperature and some other physico – chemical factors. Hypothalamo-hypophyseal complex plays a major role in the regression of reproductive cycles in fishes as in other vertebrates and exhibits marked histological changes when exposed to various percentages of salinity (10, 20 and 30%). On the other hand the prolactin cells of *G. giuris* treated in different percentages of salinity (10, 20 and 30%), exhibited characteristic signs of involution with reduction in nuclear size, staining intensity and extensive degranulation. This phenomenon suggests a reduction in secretory activity in hyper saline medium. In the present study it is observed that the fish transferred from freshwater to dilute saline water showed a rapid shift in the size and distribution of granules in the eta cells of RPD. These changes may be the result of an altered or impaired synthesis of prolactin in response to the saline environment. The gonadotrophs are also essential for the normal gonadal development cycle in fishes. GTH have been studied in response to various percentages of salinity. Changes in some basophils of the pituitary gland after exposure to saline medium. In saline exposed *G. giuris*, the basophils showed hypertrophy and vacuolization, and most of them became degranulated. Most of these vacuolated basophils contained secretory vesicular substances which stained deeply with aniline blue. Others showed dense granulation and stained deeply with Herlant's tetrachrome and Cleveland Wolf's trichrome.

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This is evidenced by gradual increase in the average diameter of ova and gonosomatic index. At the same time NLT cells showed marked depletion of NSM, when compared to NPO cell. Hence it can be said that NLT was more active in saline medium. It is known as neurosecretory activity in the hypothalamus changes in response to gonadal activity. During the spawning period in the PPD of the pituitary of *G. giuris* exposed to 30% salinity, the granulated basophils were distributed uniformly with a simultaneous increase in the number of degranulated basophils. This suggests that the gonadotrophic hormones are released for further growth of oocytes.

Pesticides are toxic and induce variety of changes in freshwater fishes. Cytomorphological changes in the hypophyseal cells viz., prolactin cells and gonadotrophs of the pituitary of teleostean after the exposure to malathion during the preparatory period, the prolactin cells in the RPD of *G. giuris* (maintained in freshwater) showed spherical shape and contained a mass of homogenous secretory material in the cytoplasm. Prolactin cells in *G. giuris* exposed to different concentrations of malathion (0.05 to 0.5 ppm) for an interval of 24, 48, 72 and 96 hrs showed marked cytological changes. In 24-96 hrs treatment showed degranulation and vacuolization in the cytoplasm and conspicuous intercellular spaces. These cellular disturbances in the RPD may be directly related to the increase in concentration of malathion. This suggests an acute stress response during spawning phase malathion exposure resulted in a significant reduction in the content of gonadotropin in PPD. The short term effects of malathion in *G. giuris* during spawning phase was similar to those observed in the spawning female of *H. fossilis*. These changes may be the result of an altered or impaired synthesis of gonadotropin in response to the malathion. Thus in *G. giuris*, exposed to malathion for 24 to 96 hrs, inhibition of ovarian growth and comparable changes in the pituitary gonadotrophs were noticed indicating a possible impairment of pituitary gonadal axis. Malathion can deplete NSM in the neurons of NLT suggesting that they retard the synthesis/release of NSM, reduces the NSM in both the NPO and NLT. Depletion was found to be more marked in NLT than in NPO. However this depletion of NSM in the neurons is associated both with concomitant reduction in the number of granulated basophils in the hypophysis and with ovarian regressions which implies the inhibition of gonadotropin hormones. Further, in the degranulated NLT cells a few vacuoles also appeared when the fish was maintained in higher concentration of malathion (0.5 ppm). Cassano et al. and Nordberg and Sarenius have opined that mercury affects the hypothalamic nuclei which is responsible for the synthesis of gonadotropin releasing hormone. Its involvement in inhibiting gonadal growth through hypothalamo-hypophyseal-ovarian axis is also suggested by Lamperti and Niuwenhuis. In *G. giuris* the photoperiod plays a major role in the regulation of reproductive cycles and exhibits marked histological changes in the hypothalamo-hypophyseal complex. In the present investigation, it was observed that the hypothalamic neurons of both the NPO and NLT, the pituitary-basophil (GTH), acidophils (eta cells) and ovary showed histological changes when exposed to various photoperiodic regimes and salinity percentages.

In *G. giuris*, during preparatory period (March to May) the activity of hypothalamic nuclei (both NPO and NLT) neurons showed a reduction in the nuclear diameter and an increase in the neurosecretory material. This was probably due to the gradual increase in photoperiod. Exposure of the fish to long (12L + 12D) and short (8L + 16D and OL + 24D)

photoperiod altered the functional activity of the hypothalamic nuclei, PAS positive basophils (GTH) and prolactin in the adenohypophysis and developing oocytes in the ovary. The structural differences were also observed between groups of fishes exposed for 7 and 14 days to either a long or short photoperiod. In most of the fishes from Indian sub-tropical regions long photoperiod (14L + 10D) stimulated gonadal maturation, long photoperiod initiated the vitellogenesis in freshwater exposed fish. This is evidenced by gradual increase in the average diameter of ova and gonosomatic index. This was found to be more marked in 10% saline exposed fish than freshwater and control ones.

In short photoperiod experiments (8L + 16D) on *G. giuris* for 7 days the PAS positive basophils showed degranulation in the cytoplasm. Few vacuoles appeared in these degranulated cells when the fish was maintained in saline media. At the same time, NLT cells showed marked depletion of NSM when compared to NPO cells, indicating the release of NSM which in turn stimulates the GTH hormones for further growth of oocytes. Hence it can be said that NLT was more active in saline treated fish for 7 days. In contrast, however, total darkness (OL + 24D) induced a retardation of ovarian recrudescence. After 7 days of exposure to total darkness atretic oocytes were observed in the ovaries of freshwater exposed fish. The rate of degeneration of oocytes in the ovary was more in saline treated ones for 7 to 4 days. Urasaki has reported a similar phenomenon in *Oryzias latipes*. *G. giuris* exposed to total darkness (OL + 24D) brought about the ovarian regression by inhibition vitellogenesis and by causing atresia of all yolky oocytes to total darkness for 7 to 14 days resulted in the inhibition of ovarian growth with comparable changes in the pituitary gonadotrophs. These studies also indicated an accumulation of NSM in the neurons of NLT. Such accumulation of NSM was associated with an increase in the number of granulated basophils in the hypophysis and formation of many atretic oocytes in the ovaries. On the other hand, the short photoperiod and hypersaline media although regressed the ovarian weight, a distinct ovigerous lamellae with large number of primary oocytes are found. This phenomenon suggests that fishes exposed for short photoperiod in hypersaline media initiated the ovary for further development of oocytes as found in *G. giuris*.

In the light of the above findings, it is evident that Ovarian recrudescence appears to be directly related to the increased photoperiod and higher temperature. Spawning occurs during a period when there is a decrease in photoperiod and fall in temperature and Photoperiod is an important factor with regard to reproductive cycle. Hypersaline condition stimulates a faster gonadal development during the preparatory period, and for further development during spawning period.