# CHAPTER 9

## HISTOLOGICAL STUDIES OF THE CHANGES IN THE CORPUSCLES OF STANNIUS OF HILSA ILISHA AND HILSA TOLI

Corpuscles of Stannius are oval, often irregular bodies varying in number and size, embeded in the posterior kidney. Stannius (1839, c.f. Gorbman, 1959) was the first to describe the corpuscle of Stannius in the sturgeon and later in the teleosts. He also considered it to be a mammalian homologue. Their exact function still remains a subject of controversy. A number of studies have been reported on their possible functions which have been ably reviewed by Chester Jones (1957).

Many have failed to established a pituitary control over the corpuscles of Stannius (Pickford, 1953; Chavin, 1956; Rasquin and Rosenbloom, 1954; Hanke and Chester Jones, 1966).

Thyroid hormone has no effect on the corpuscles of Stannius (Nadkarni and Gorbman, 1966) but removal of the latter has been shown to stimulate the thyroid (Leloup and Leloup-Hatey, 1964).

Many could not find adrenocortical steroids in the corpuscles of Stannius (Ford, 1959; Phillips and Mulrow, 1959; Chester Jones et al., 1965; Hanke and Chester Jones, 1966). Aganist these observations, it has been suggested that the corpuscles secrete sodium-retaining steroid thus forming part of the adrenocortical system (Fontaine and Leloup-Hatey, 1959, c.f Ogawa, 1963). That mineral corticoids like deoxy-corticosterone

is produced by corpuscles of gold fish was suggested by Ogawa (1963).

A few workers have noticed hypertrophy of corpuscles in relation with change in media (c.f. Ogawa, 1963). Rasquin (1956) after studying the changes in the corpuscles of Stannius in relation to salinity of the medium, stated that it may play a role in osmoregulation.

Recent experiments have led to certain conclusions. Varghas and Concha (1957, c.f. Ogawa, 1963) noticed a marked edema, decrease in plasma Na and death in about seven days due to removal of corpuscles. Fontaine (1964) and Chester Jones et al. (1965) observed decrease in concentration of serum Na, rise in Ca and to some extent K also. These abnormalities can be corrected by extracts of corpuscles and by aldosterone with sodium chloride.

Chester Jones et al. (1966) Chester Jones and Henderson (1965) and Hanke and Chester Jones (1966) suggested the presence of a pressor substance in the corpuscles of Stannius which raises the blood pressure of the eel, Anguilla anguilla and the possible existance of a renin-angiotensin system analogus to the one existing in mammals.

Olivereau (1965) while conducting experiments on eels with metopirone for periods of 1-21 days, studied the histological alteration in the pituitary, kidney, thyroid, corpuscles of Stannius, interrenal glands etc and noted that adrenocortical tissues were stimulated whereas corpuscles of Stannius were slightly activated.

With the hope that a comparative histological study of the corpuscles of Stannius of migratory H. ilisha and non-migratory H. toli may help to shed some light on their function, the present investigation was undertaken. To study its possible role in osmoregulation, the corpuscles of H. toli drifted into the river were also studied as it may be considered an experimental situation similar to transfering sea water fish to hypotonic medium.

## MATERIALS AND METHODS

Living fishes were removed from the net and decapitated immediately. The posterior part of the kidney was quickly removed and fixed in Bouin's fluid. 5μ was sections were cut and stained with haematoxylin-eosin and Heidenhain azan stain.

## OBSERVATIONS

The corpuscles of Stannius of fingerling of H. ilisha captured from river:

The flat, oval corpuscles are situated on the dorsal side of the posterior kidney. It consists of a thick fibrous capsule which surrounds the cord of cells (Fig. 1).

The thick capsule consist of fibrous tissue which is more at both the ends (Fig. 2). Some empty spaces were discernible throughout the fibrous capsule. The nuclei of the capsule were elongated, fusiform. Many capillaries with blood cells were also seen in the capsule.

The cord of cells within the capsule were attached to

the capsule at both the ends. These cords were also united at both ends at the point of attachment to the capsule. The cords of cells ran more or less parallel to each other. At times they were found united to each other. The cells were small and roughly cuboidal. Their outline was rarely visible. Empty spaces between cords and also between cords and capsule were prominent. The blood vessels were observed at the beginning point of the cords where the latter were attached to the capsule. The nuclei of the cells forming the cords were round in shape and contained prominent nucleoli (Fig. 3). Very little, finely granular chromatin material was visible. Cells at the beginning may have elongated nuclei and two nucleoli. Very few granules were seen with haematoxylin-eosin staining. With azan staining, the granules were discernible clearly.

In the cells of the central region, nuclei were devoid of chromatin material and cytoplasm contained few granules. Some cells in the central zone were found lost also, leaving empty spaces behind. The presence of certain cells in which the nuclei were densely filled with chromatin material and the cytoplasm appearing to be lost completely were also noticed. Some cells also showed mitotic division.

Corpuscles of Stannius of mature H. ilisha captured from river:

The size of the corpuscle had increased. The extremely thick fibrous capsule was a remarkable feature. The capsule seemed to have undergone degenerative changes as many empty spaces were observed in it. The muscle fibres presented a wavy and coarse appearance. The elongated nuclei were devoid of

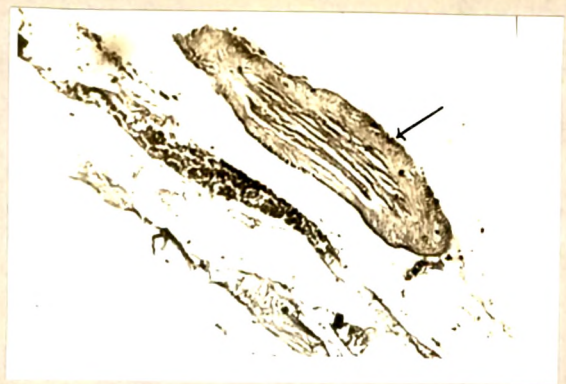

Fig. 1

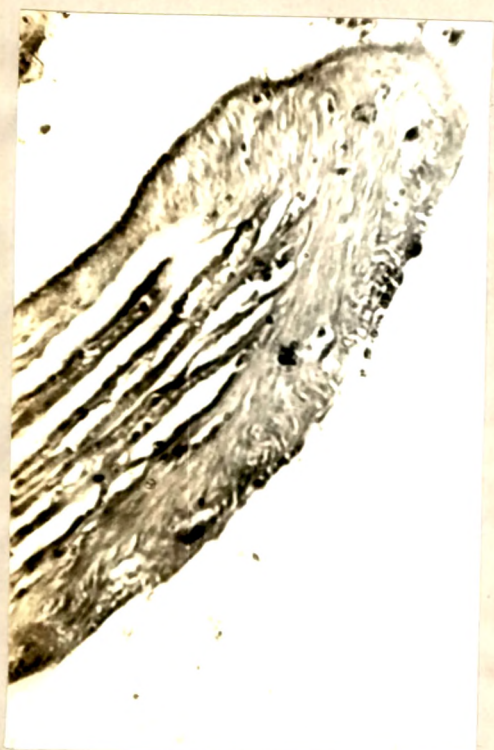

Fig. 2

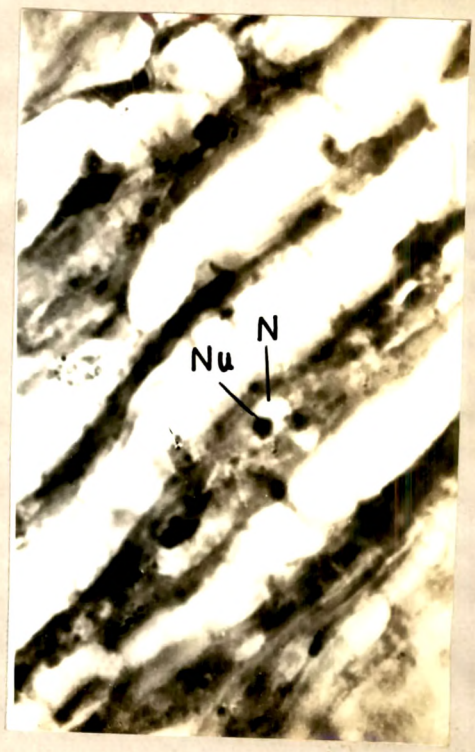


Fig. 3

Fig. 1. Corpuscle of Stannius of fingerling of H. ilisha (arrow). HE. X 63.
Fig. 2. Corpuscle of fingerling of H. ilisha showing thick capsule and cord of cells. H.E. X 400.
Fig. 3. Corpuscle of fingerling of H. ilisha showing cord cells with nucleus (N) and nucleolus (Nu). H.E. X 1000.

chromatin material and seemed empty. Many blood vessels had appeared in the fibres of the capsule. The length had increased tremendously whereas noticeable increase was observed in width too. The central area of the cords was destroyed leaving eosinophilic masses with interspersed empty spaces. It may be due to loss of nuclei and final dissolution of cells of the central cordzone. In the remaining regions also the uniformity of cords was not found. Instead of long, parallel cords of cells, loops or rows of cells were observed (Fig. 4). In some places of these loops eosinophilic masses were noticed. The cells of the apex were completely destroyed leaving behind granules, remnants of nuclei and cytoplasm. In nuclei of the intact cells of the cords were much enlarged and pycnotic. The nuclei of these cells were devoid of chromatin but the cytoplasm was full of granules (Fig. 5). Generally at both the ends of the capsule the cells of two- three cords were observed very close forming a compact mass. The outlines of the cell were not easily discernible. The nuclei were round, enlarged and pycnotic. Cytoplasm was full of granules. Some cells of this compact mass near both the ends were also destroyed leaving lightly staining eosinophilic mass. The cords were not found in contact with the capsule.

In some places a few cells showed nucleus filled with chromatin material. In a few cells the cell membrane was observed to be broken and the cell content extruding out.

Corpuscles of Stannius of spent H. ilisha captured from river:

The large corpuscles were with thick capsule showing

wavy fibres. There were many lacunae observed in the fibrous capsule. In the middle region of the capsule due to large, elongated lacunae the former appeared double layered. In the central region of the corpuscle the cords of cells exhibited most profound degenerative changes. Here eosinophilic amorphous mass was observed. A few wandering nuclei densely filled with chromatin material and also abnormally enlarged nuclei devoid of chromatin were observed (Fig. 6). At some places in the same region, the cells with nuclei were noticed clumped together without showing definite cell boundaries and in this mass many lacunae were also visible. The nuclei of such mass were of irregular shape and pycnotic.

As mentioned in the earlier case, the cords near either end come very close, forming group of cells.(Fig. 7). This group was seen detached from the capsule. These cells showed oval nuclei devoid of chromatin. The cell boundaries were not distinct. Blood vessels were observed in this region.

When stained with azan stain, the granules were visible with sharp contrast. They were distributed evenly in the cytoplasm of the intact cells.

Corpuscles of Stannius of immature H. ilisha captured from sea:

More than one small corpuscles were noticed. The fibrous capsule was thick and compact (Fig. 8). Both the ends were elongated than the central lumen. A few blood vessels were noticed in the thick capsular region. The nuclei of the fibrous capsule were normal.

Fig. 4

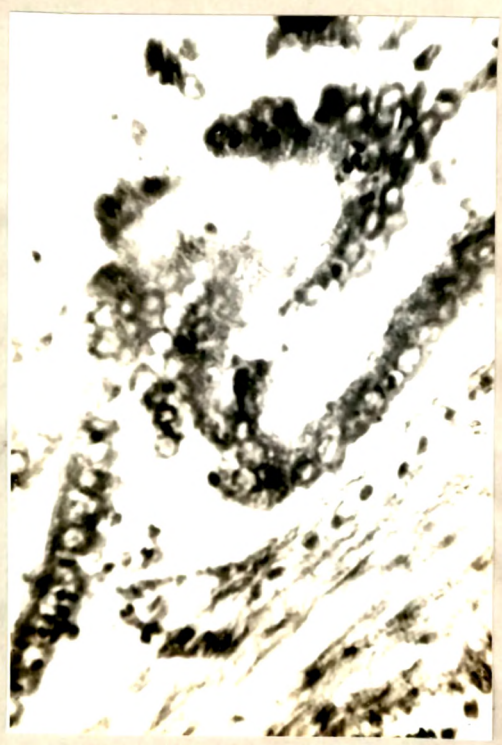

Fig. 5

Fig. 6

Fig. 4. Corpuscle of mature H. ilisha. Note wavy cords. H.E. X 63.
Fig. 5. Corpuscle of mature H. ilisha. Cord cells with empty nuclei and cytoplasm full of granules. H.E. X 630.
Fig. 6. Central region of corpuscle of spent H. ilisha showing degenerative changes. H.E. X 630.

The internal structure differed from the fingerling of H.ilisha. The cords of cells were not running parallel. At both the ends the cells of the cords were arranged in groups, from which cords separated running towards the lumen. The cells near the capsule showed nuclei devoid of chromatin material and cytoplasm full of granules whereas the nuclei of cells away from the capsule were full of chromatin material. The central region, at some places, showed amorphous eosinophilic mass. (Fig.9).

The corpuscle of stannius of immature H.toli showed the same characteristics as immature H. ilisha.

Corpuscle of Stannius of mature H.toli captured from sea:

Two to three elongated corpuscles were noted. (Fig. 10). In some specimens the muscle fibres of the capsules were found shrunk. A pronounced blood supply in loose, shrunk muscle at both the ends of capsule was observed. A few muscle fibres appeared wavy and distorted. Lacunae were also seen at several places in the capsule. Some nuclei were devoid of chromatin material whereas some were densely filled with chromatin. In a few nuclei nucleolus was also discernible. The cells of the cords forming compact mass near both ends of capsule were normal. The cytoplasm showed granules. Their nuclei were round and centrally placed. However, a few cells of the cell cord near the capsule showed the pycnotic, elongated nuclei placed towards the capsule side of the cell. In the central zone the distorted, broken cells formed a mass (Fig.11). Most of the cells of this group exhibited pycnotic nuclei whereas a few showed nuclei deeply stained with haematoxylin. (Fig.12).

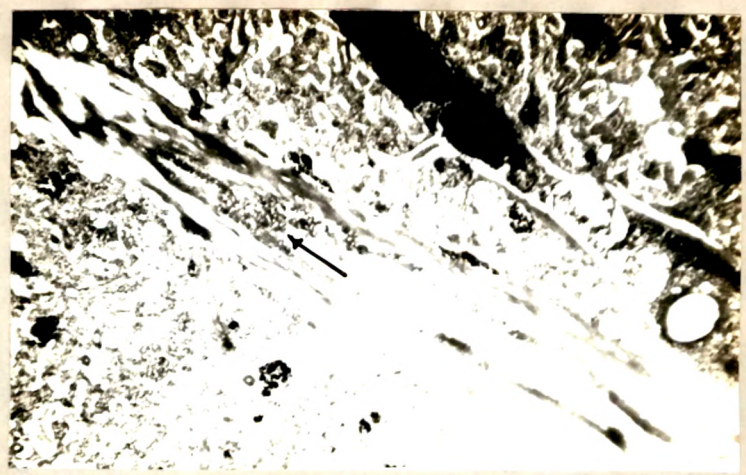

Fig. 7

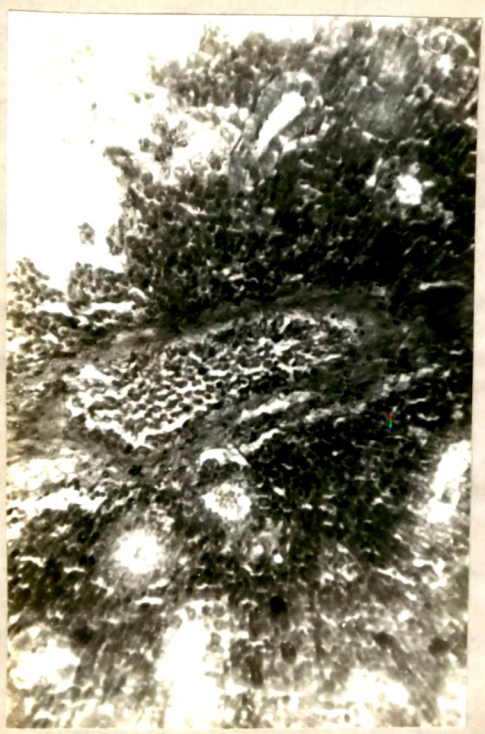

Fig. 8

Fig. 9

Fig. 7. Corpuscle of spent H. ilisha showing cord cells forming a mass (arrow) near the apex. H.E. X 63.
Fig. 8. Corpuscle of immature H. ilisha . H.E. X 250.
Fig. 9. Central region of corpuscle of immature H. ilisha showing eosinophilic mass (arrow). H.E. X 630.

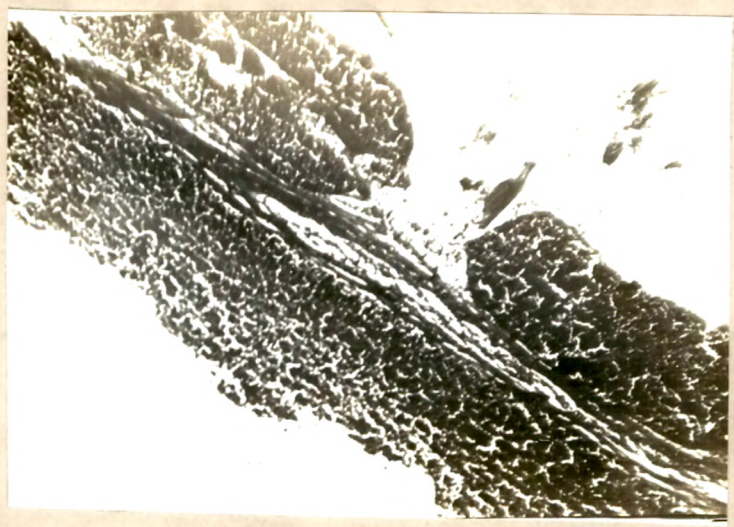

Fig. 10

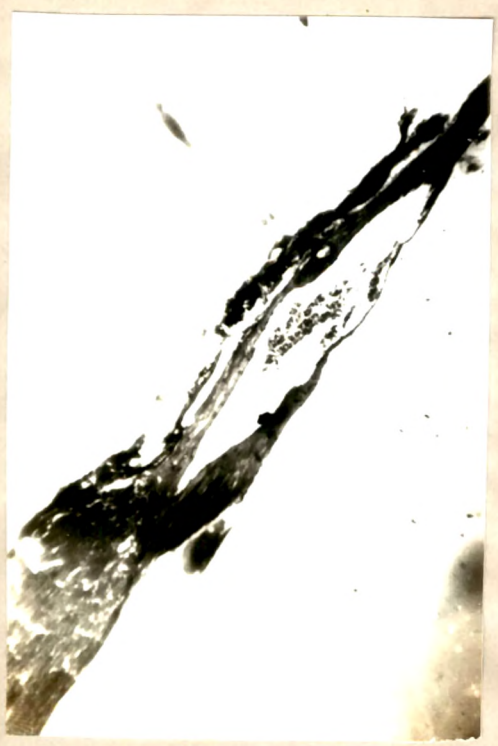

Fig. 11

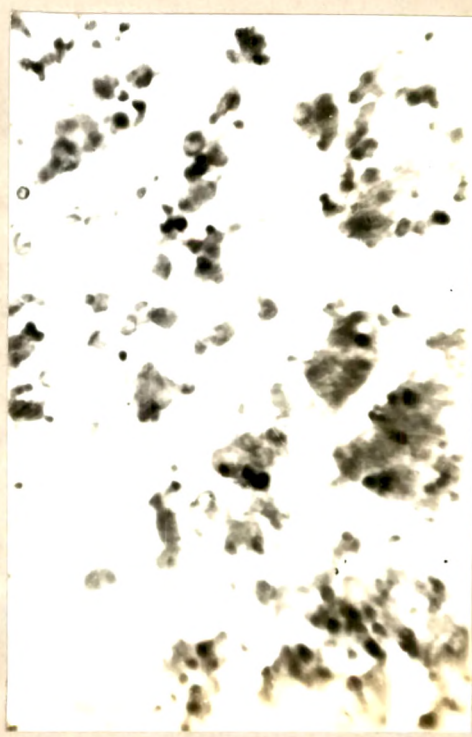

Fig. 12

Fig. 10. Elongated, thick walled corpuscle of mature H. toli. H. E. X 63.
Fig. 11. Corpuscle of mature H. toli showing cord cells forming a mass in the central region. H.E. X 63.
Fig. 12. Same as fig. 11. H.E. X 630.

Corpuscles of Stannius of mature H. toli captured from river:

The structure of the capsule was as noticed in the mature H. toli. In addition, it showed more wavy muscle fibres causing many more lacunae in the capsule. The muscle fibres were less eosinophilic. At such places nuclei were deviod of chromatin material, extremely enlarged and irregular in shape. The capsule appeared to have shrunk and in the central zone both the sides had come very close to each other (Fig. 13). Around the capsule many blood vessels were observed filled with red blood corpuscles. On both the ends of capsule many blood capillaries were present.

The cells in the from of broken cords at either end were very few, and were with oval nuclei containing fine chromatin and cytoplasmshowing many granules. The detached group of cell mass near either end showed varied conditions Cell masses with irregular nuclei, pycnotic nuclei, nuclei densely filled with chromatin, small nuclei without cell boundary and cytoplasm, clumps of destroyed cell mass were all grouped together (Fig. 14). The central zone was completely empty and devoid of any mass. This might be due to complete destruction of cord cells.

## DISCUSSION

Krishnamurthy (1964) in his studies on the changes in the corpuscles of Stannius of Colisa sp. reported three stages of activity. Similarly different stages of activity has been found in H. ilisha and H. toli of different stages of

Fig. 13

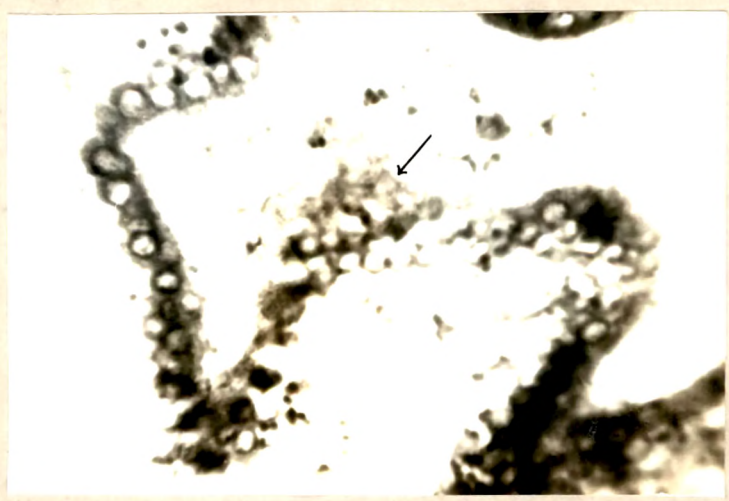

Fig. 14

Fig. 13. Corpuscle of drifted H. toli. H.E. X 63.

Fig. 14. Corpuscle of drifted H. toli showing degeneration. Note enlarged, pycnotic nuclei and eosinophilic (arrow) mass. H.E. X 630.

maturity.

The histological observations on the corpuscles of Stannius of fingerlings, immature, mature and spent migratory H. ilisha and immature, mature and spent non-migratory H. toli reveals that as maturity is attained the degenerative changes in the corpuscles of Stannius advances. These findings corroborates the observations of Nadkarni and Gorbman (1966) who have noted degeneration of the central part of the corpuscle of Stannius in some spawning salmon.

Several workers have proved the change in the blood electrolyte composition after removing the corpuscles of Stannius (Fontaine, 1964; Chester Jones et al., 1965; Varghas and Concha, 1957, cf. Ogawa, 1963) and that the electrolyte balance could be restored by extracts of corpuscles. This suggests the functional significance of corpuscles of Stannius in maintaining the electrolyte balance in the changed environment of different salinity. Thus the active corpuscles in the fingerlings of H. ilisha which is returning to sea from complete fresh water is highly significant. The increased activity of corpuscles in fingerling is evident by the mitotic division of the cells noticed.Thus it may be presumed that corpuscles of Stannius acts as an endocrine gland, forming part of a system controlling the electrolyte content of blood. The increased activity of the corpuscles in the fingerling also suggest that they probably help in the physiological preparation for migration, supporting the hypothesis advanced by Fontaine and Lopez (1965).

The degenerative changes viz. partial loss of central zone of cprpuscle cords, pycnotic nuclei of cells and empty cytoplasm of cells, in case of migrating H. ilisha indirectly supports that blood electrolyte composition may control the activity of corpuscle of Stannius as suggested by Hanke and Chester Jones (1966). Hanke and Chester Jones (1966) demonstrated significant histological changes in the eel by keeping the fishes in distilled water and seawater.

If Ogawa's (1963) views are considered, it can be stated that as more corticoids are essential, secretion is increased and hence hypertrophy of corpuscle cells noticed in mature fishes.

Drifting H. toli is suddenly transferred to unaccustomed hypotonic medium and the fish must maintain electrolyte balance i.e. prevent the outgoing ions of Na, K etc. In eel it has been observed by Chester Jones et al. (1965) that stress and struggling causes the loss of Na renally and extrarenally. Thus the problem of maintaining the electrolyte balance for H. toli drifting becomes manifold (because the drifting of H. toli accompanied by stress due to sudden change in environment). The destruction of corpuscles indicate the relative exhaustive secretion after an initial attempt of hyperactive secretion to retain outgoing Na, in response to the need to keep blood electrolyte level.