BIOLOGY

Sexual Dimorphism in *Tilapia*

OBSERVATIONS have shown that the growth rate of males in the *Tilapia* genus is faster than that of the females.

Tilapia aurea (formerly known as *Tilapia nilotica* L.) and *Tilapia galilaea* usually reproduce during the second year of life. Cultivation of *Tilapia aurea* in its second year of life and *Cyprinus carpio* produced low yields of harvestable *Tilapia*, due to the spawning of *Tilapia*.

Mono-sex culture of male *Tilapia aurea* was successful and yielded large fish. Yashouv and Hefetz[1] showed that sex can be differentiated by differences of the openings in the genital papilla. The males have two openings and the females three. Pruginin and Shell[2] sexed *Tilapia aurea* with a mechanical grader.

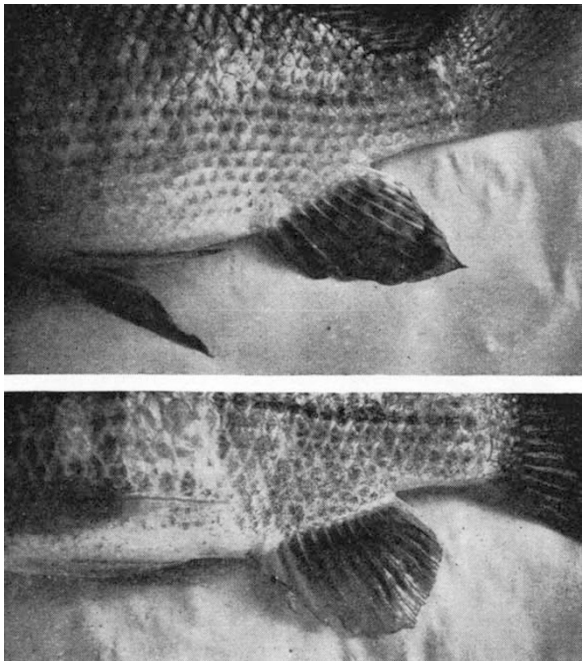

Fig. 1. The anal fin in *Tilapia aurea*. Upper, male; lower, female

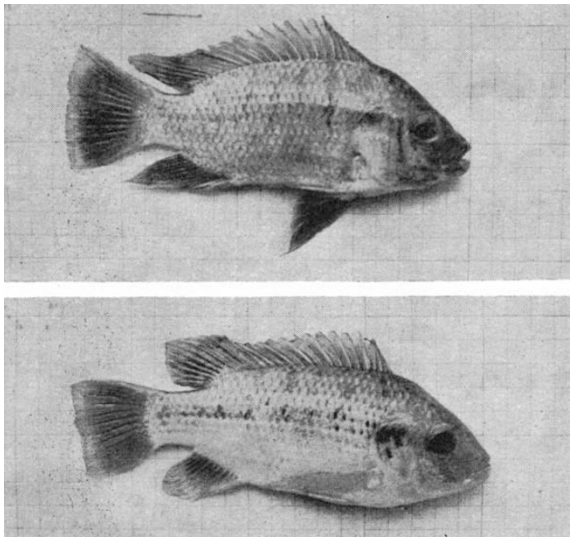

Fig. 2. The anal and dorsal fins in *Tilapia galilaea*. Upper, male; lower, female

While working with *Tilapia aurea* and *Tilapia galilaea* it was noticed that sexing can be accomplished either according to the genital papilla, or according to the shape of the dorsal and anal fin (Figs. 1, 2).

In males above 60 g the dorsal and anal fins are pointed, while in the females the dorsal and anal fins are rounded and more expanded. In bigger fish these differences are more distinct. These secondary sexual characteristics may be helpful in sexing *Tilapia aurea* and *Tilapia galilaea*.

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[1] Yashouv, A., and Hefetz, A., *Bamidgeh*, **11**, 36 (1959).
[2] Pruginin, Y., and Shell, E. W., *Prog. Fish-cult.*, **24**, 37 (1962).

Presumed Sensory Cells in Fish Epidermis

METHYLENE blue, injected subcutaneously, will stain particular elongated cells, spindle-shaped or flask-shaped, in the epidermis of various teleost fish. Such cells were found by Whitear[1] in the minnow (*Phoxinus laevis*), and afterwards in several other species, both fresh-water and marine; that paper should be consulted for references to the scanty earlier literature on the subject. It was suggested that these cells are receptors for the common chemical sense, but as it seems preferable to describe them by a term not indicative of a supposed function, they will be called 'spindle cells' here. For technical reasons, the exact relationship of the spindle cells to the surface of the skin, and to nerve fibres, could not be ascertained by means of the light microscope.

Epidermal spindle cells have now been identified in sections of minnow skin, examined by electron microscopy. Skin from the operculum of *Phoxinus laevis* was fixed in buffered osmium tetroxide, stained in bulk with alcoholic phosphotungstic acid, and embedded in 'Araldite'.

Examination of electronmicrographs has confirmed that the spindle cells do constitute a distinct cell type, which cannot be confused with general epithelial cells, mucous (goblet) cells, or with other secretory cells present in the epidermis. They have been found in sections of skin taken from both inner and outer surfaces of the operculum: methylene blue staining showed them to be present on the chest and gular region. Their distribution is not entirely even, as they tend to occur in groups of three or four, although the spindle cells are not usually contiguous. The adjacent epithelial cells are unmodified, which is one of the characters distinguishing a group of spindle cells from a taste-bud.

Fig. 1 shows the appearance of a spindle cell in *Phoxinus*, as seen in electronmicrographs. The nucleus usually lies at the level of the second or third layer of epidermal cells from the outside, and a neck-like process extends to the surface. Sometimes a pointed process extends inwards also. Usually the outer end of the distal process is slightly bulbous, and it is invariably outlined by a zonula occludens[2] 0·5–0·75μ deep. A single microvillus, with no definite internal structure, projects from the spindle cell beyond the level of the skin surface, but it is not clear whether it is always present. Nor is it certain what relationship the microvillus has to the thin cuticle which covers the surface of the skin, but which is easily detached during preparation.

The spindle cells can be recognized in ultra-thin sections, even if the distal process is not included, by the numerous rounded bodies, 0·075–0·1μ in diameter, which pack the cytoplasm. In phosphotungstic acid stained material, most of these bodies are electron-dense, but some are paler and have the appearance of vesicles. They resemble the inclusions described by Trujillo-Cenóz[3] in the sensory cells of fish taste-buds, and their distribution within the cell is also similar. They are most abundant immediately distal to the nucleus, least so proximal to it. Similar bodies do occur in ordinary epithelial cells of the