The anatomy based ultrastructural studies on the olfactory apparatus of a potamodromous fish [*Mastacembelus armatus* (Lacepède, 1800)] of South East Asia belonging to the Order: Synbranchiformes; Family: Mastacembelidae has been performed to explore the microscopical details on olfactory neuroepithelial system in lieu of neurogenesis and neural degeneration respectively. *M. armatus* has been categorized as 'Least Concern' in IUCN Red List Category [Version 3.1]. Macroanatomy of the olfactory apparatus has been performed using stereo zoom light microscope [ZEISS STEMI 508 DOC.], microanatomy through semithin and cryo sections, surface topography mapping by scanning electron microscopy [JEOL JBM-7500F], organelle based subcellular characterization under transmission electron microscope [TEM:TECNAI] have been employed. Apart from that qualitative chromatin structure analysis under fluorescence microscope [CARL ZEISS, AXIO SCOPE A1] in the lineage of neurogenesis and neural degeneration were also focused. The bioaccumulation of heavy metals in various subcellular compartments and its possible role in neural degeneration was analysed under transmission electron microscope with energy dispersive X ray microanalyser system [JEM – 2100 HRTEM, JEOL, JAPAN]. Anatomically the olfactory apparatus is present at the ethmoid region of snout and is comprises of olfactory chambers, olfactory rosette, accessory nasal sacs, olfactory nerve tracts, olfactory bulbs and brain. Olfactory rosette present at the dorso-lateral side of the fish snout, anterior to the eye and made up of multiple folding of olfactory epithelium in the floor of olfactory chamber. Extensions from the olfactory chamber form an accessory nasal sac. The olfactory neuroepithelium is comprises of sensory receptor cells, supporting cells, basal cells, goblet cells, *etc*. and a distinct zone of connective tissue region named as lamina propia. Sensory receptor cells are bipolar in nature extend their long axonal processes that travel through the epithelium towards the lamina propia and their short nerve fibres are acts as responsing projection for receiving sensing substances which may be either air borne or water soluble. Knob of the sensory receptor cell bears 5-6 numbers of cilia. Water borne odorants are sensed by the fish's olfactory sensory receptor cell. Odorant molecules are binds to the receptor proteins of the ciliary plasma memebrane, enabling them to activate a G protein. Activated G protein then activates adenyl cyclase, resulting an increase in second messenger concentration Entire process opens the ion channels in the membrane or translocates ions directly causing membrane depolarization. This event eventually leads to the generation of impulses by which the sensory informations are transmitted to the olfactory bulb. From scanning electron microscopical studies it has been revealed that within the neuroepithelium both ciliated and non ciliated zones are exits but no clear demarcations have been evolved either that cilia are sensory or non sensory in nature. Therefore distinct clarifications are required to isolate their nature. By using the transmission electron microscopy a distinct boundary line has been found out within the neuroepithelium of *M. armatus* that clearly separate the neuroepithelium into two regions as sensory zone and non sensory zone respectively. Towards the basal lamina at the upper face of lamina propia part, basal cells are arranged serially and are continuously replaced throughout their lifespan *i.e.*, a lineage of basal cell populations has been observed. Basal cells are polygonal in nature and their nuclei are oval shaped in structure. The differentiation of basal cell populations leading to gradual chromatin condensation and it ultimately leads to development of variable sensory neuronal cells. These basal cells are important for their replacing characters of the degenerative sensory neuronal cells and maintain the total thickness as well as functional acuity of the olfactory neuroepithelium. Bioaccumulation of variable heavy metals act as leading factors that causes degenerations of sensory neuronal cell of the olfactory neuroepithelium. From transmission electron microscopy attached with elemental analytical study it has been revealed that heavy metals are accumulated at specific cellular compartments *i.e.*, cytoskeletal region (especially microtubules) of sensory neuronal cell of the fish neuroepithelium. The dilated rough endoplasmic reticulum (rER), lysosomal diversity (primary lysosome, secondary lysosome, autophagosome, *etc*.), fragmented microtubules as well as neurofilaments with vesicular crowding and docking, *etc*. are marked when Cadmium (Cd) level is 10.93% within the microtubular region of ciliated sensory receptor neuron in compared to Below Detection Level (BDL) or minimal range of 0.06% - 0.09%. Up to a certain phase, the neurodegeneration of sensory neuronal cell evoke another important phenomenon *viz*., neurogenesis within the neuroepithelium to recover the sensory cell population but, if the excess heavy metals bioaccumulation process would continue within sensory cell compartments of neuroepithelium, the neurogenesis events failed to regenerate the new sensory cell population and it leads to olfactory dysfunction. Therefore, the olfactory dysfunction ultimately affects on the basic functional biological requirements of the fishes *viz*., prey detection, food collection, mate selection, avoidance of predators, orientation in migration, *etc*.