Chemoreception is a multimodal neurophysiological process through which organism can detect and discriminate different chemical cues from their respective environment (Hara, 1971). This physiological process is classified into the following categories noted as the olfaction or sense of smell, gustation or taste and common general chemical senses respectively. The olfaction or sense of smell helps to distinguish chemical cues at a distance from external chemical environment (Doty, 2003). This process is recognized as a primitive sense in respect to ontogeny (Kotrschal *et al*., 1997). In lower vertebrates the existence of chemosensory structure is evident and it shows primitiveness regarding their structural peculiarity and functional existence (Hyman, 1940; Bergman and Moore, 2005) but in vertebrates a well organized olfactory system is evident (Freitag *et al.*, 1999). The anatomical detailing of fish olfactory system has been first described by Burne (1909). In fish the paired olfactory organs, present at anterior portion of head although an wide range of variations are exists within teleosts concerning the shape, size and number of variable structural components of the olfactory apparatus (Kleerekoper, 1969). Comparing with the invertebrates, the chemosensory structures of vertebrate are quite different in respect to their origin, anatomical complexity; location and acuteness of sensitivity (Kaupp, 2010).The preliminary morphoanatomical works on olfactory apparatus of variable fish groups are hardly characterized by scientists (Datta *et al*., 1976, 1982 and Sarkar *et al*., 2014). Maximum works on olfactory biology have been performed on anatomy based histology of the

teleosts belonging to order – Cypriniformes and order – Siluriformes. In vertebrate system the paired placodes of embryonic ectoderm are acts as developing precursors of olfactory system (von Kupffer, 1894). In the early stage of development, the placodes are originate from pre-placodal ectoderm and is positioned in the head region of the embryo (Knouff, 1935). The time dependent variations are evident for the formation of olfactory apparatus along with its different neuroepithelial components from preplacodal cell. (Zeiske *et al.,* 2003; Whitlock, 2004; Sarkar *et al*., 2014) and these variation are very much dependent on variable physical factors *viz*., temperature, pH, humidity, *etc*. (Herzig and Winkler, 1986; Morehead and Hart, 2003). Fully developed olfactory epithelium is made up of three distinct types of cells *viz.*, sensory receptor cell, supporting cell and basal cell. The sensory cellular components are greatly varies on the basis of their seasonal occurrences and functional preferences within the olfactory neuroepithelium of most of the teleosts (Hamdani *et al*., 2008) but how the basal cell elements are gradually modified into mature sensory components within the neuroepithelium are hardly characterized.

It was supposed that new nerve cell formation *i.e.,* neurogenesis was only restricted in early postnatal stages of invertebrates and in vertebrates (Cayre *et al*., 2002; Brann and Firestein, 2014). Later it proved that this process is continues at some distinct region of embryonic development at a considerable

rate up to the adulthood (Graziadei, 1979a, 1979b). The stem cells that are restricted in the olfactory epithelia are engaged to develop sensory neurons throughout the life of the animal (Brann and Firestein, 2010). The events of neurogenesis observed within the olfactory neuroepithelium are due to turnover of the immature sensory neuron population rather than due to replenishment of mature sensory neuron and it acts as basic mechanism that governs the aging process within the neuroepithelium. Neurogenesis and neural degeneration are two common events in neural cell biology. These turnover events are either in response to injury or due to physiological condition (Farbman *et al*. 2000). The life spans of these sensory components are time specific (Graziadei and Monti Graziadei, 1979a). The cell survivability, the level of cell proliferation and differentiation of these sensory components into mature neuronal cells are also fluctuates depending on affects of various metallic compounds of the aquatic external environment *viz*., lead, cadmium, copper, zinc sulphate, *etc.* (Eng Strom *et al*., 2015; Hentig and Byrd-Jacobs, 2016). Different level of chemical exposure and their time limits also leads to severe degeneration within the neuroepithelium. The roles of specific heavy metals for olfactory neural degeneration within variable subcellular components of sensory neuronal structures are so far not well established in fish biology.

Mastacembelus armatus (Lacepède, 1800) is common mud dwelling spiny eel of South East Asia belonging to the Order- Synbranchiformes; Family-

Mastacembelidae. They prefer to live at clear fresh water bodies as well as the marshy pocket. This species is usually nocturnal in their habit and appears at surface water body at night but during the day time they prefer to goes to underside of any obstacles. *M. armatus* is a potamodromous fish that entirely enjoyed their life within the fresh water. For interaction in chemical aquatic environment, like other teleost *M. armatus* also depend on their olfactory sensory organ. The olfactory organ of fish acts to perform their live activities *viz*., prey detection, food collection, mate selection, avoidance of predators, orientation in migration, *etc*.

This research contribution focused on the anatomy based ultrastructural study of olfactory system in *M. armatus* to explore the macroanatomy and microanatomy of the olfactory components, 3D topography mapping of variable sensory and nonsensory neuroepithelial components, elemental analysis of variable metallic components within the sensory neurons of the olfactory neuroepithelium through TEM based energy dispersive X-ray microanalysis (EDX) respectively. Apart from that the question of neural dysfunction in *M. armatus* is also addressed. The ultimate objective of the present study is to characterize different subcellular elements of ciliated sensory receptor neuron in relation to neurogenesis and neural degeneration within the olfactory neuroepithelium of *M. armatus.*