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# STUDY ON BRAIN DIVERSITY OF SOME CATFISHES IN RELATION TO HABITAT

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**ABSTRACT**
Ecological parameters have great influence on the organization of central nervous system.The principal factor that brings about variations in the structure of the brain in fishes is widely regarded as their habitat. Fishes that utilizes the bottom habitat are possessed with highly developed hindbrain due to it's rely on some sensory mechanisms other than vision for food gathering. Most of the variability has been noticed in the hindbrain of teleosts with respect to habitats. It has usually been assumed that there is an interesting correlation between brain and habitat in fishes. The selected cat fishes were the representatives of bottom dwelling habitat namely: *Clarius batrachus*, *Heteropneustes fossilis, Mystus gulio* and *Mystus vittatus*. Within the fishes there shows a marked diversity in the hind brain lobes in response to habitat. The hind brain is equipped with well developed cerebellum, facial lobes, vagal lobes and somatic sensory lobes. Facial lobes showed great diversity in all fishes examined. Facial lobe is 8 lobed in *Mystus vittatus* followed by bilobed condition in *Heteropneustes fossilis, Clarius batrachus* and *Mystus gulio*. Facial lobe is generally associated with skin tasting nature. Vagal lobes are associated with mouth tasting and are equally well developed in all fishes. The somatic sensory lobes are well developed in all bottom feeders examined and its role is to perceive the movements of objects in water and accounts for the sense of taste and touch in abundant measures .Generally the hindbrain showed a high degree of structural diversity in different forms.

**KEYWORDS:** Hind brain, Clarius batrachus, Heteropneustes fossilis, Mystus gulio, *Mystus vittatus*.

## INTRODUCTION

Hindbrain in fishes shows a high degree of structural diversity in different forms has long been known to zoologists. Various sensory centres in the brain of fishes are developed more or less according to their habitat they occupy. The principal factor that brings about variations in the structure of the hindbrain is widely regarded as their feeding habit and habitat .Hindbrain consists of cerebellum, facial lobes, vagal lobes and somatic sensory lobes.The habitat reflects its brain structure. Ecological and social factors have an important role in the evolution of the shape of the brain. An animal's life style influences the structure of the central nervous system (Nieuwenhuys *et al.,* 1998). The life history of teleost fishes shifts its habitat during metamorphosis from larval to juvenile form. These shifts enable the fish to acquire new biota results in anatomical, physiological, behavioural and ecologic adaptation. The lobes of the medulla oblongata are the terminal centres for the nerve fibres of facial, vagal and somatic sensory lobes. The stimuli for feeding are perceived by senses like smell, taste, sight and lateral line system. The size of these lobes depends on the extent to which nerve fibres supply taste buds, eye, olfactory bulbs and lateral line system. Habitat and diet aspects are related to be teleostean brain which reflects the ecological base (Davis & Miller, 1967; Huber & Rylander, 1992; Kostrschal & Palzenberger, 1992). Turbidity and depth are closely associated with differences in eye size. Many authors have correlated the structure of brain with the feeding habits (Evans1931; Bhimachar 1935, 1937; Pavloski 1953; Khanna and Singh 1966; Saxena 1967; Sherly and Azis 1993; Butler and Hodos 1996). But studies confined to habitat and brain structure is limited.

Ecological factors influence brain evolution in diverse taxa was reported by various studies. *Gonzalez et al.* (2010) have analysed the brains in 43 cichlid species on their sex and ecology of sexual dimorphism. Earlier, studies on African cichlids on the influence of diet and habitats were made (Huber *et al.,* 1997; pollen *et al.,* 2007) and established a close relationship between the relative size of various brain structures varying in relation to habitat and prey.

Rebacca & Gabriella (2006) reported the brains in salmons which were reared among stones had significantly larger cerebella than genetically similar fish reared in conventional tanks. Gonda *et al.* (2011) established variation in brain size in nine spined stickleback from different habitats confirming earlier studies. Sreekala *et al.* (2011) established the correlation between medulla oblongata and feeding habits in two teleosts. Similarly Sherly (2012) reported the effects of habitats on the structure of the vagal lobe in two teleosts attributed to gustation in fishes. The present study has been undertaken for getting scientific information on the structural diversity of hindbrain in some Cat fishes:- *Clarius batrachus, Heteropneustes fossilis, Mystus gulio* and *Mystus vittatus.*

## MATERIALS & METHODS

The fishes for the present study include catfishes which were procured from natural habitats. These fishes were sacrificed and the brains were dissected out and fixed in neutral buffered formalin. The different parameters like length of brain, length of cerebellum, length of facial, vagal and somatic sensory lobes were measured to the nearest 0.01mm by the method of Hubbs & Lagler (1947).

## RESULTS

A significant phenotypic variation was noticed in the brain lobes of all the bottom habitat fishes. Hindbrain in all fishes was divided into metencephalon and myelencephalon. Metencephalon is represented by cerebellum and myelencephalon includes facial, vagal and somatic sensory lobes. As shown in (fig 1) the metencephalon in *Clarius batrachus* is represented by large elongated cerebellum (CLM). It occupies about 25% of the total brain length. It is responsible for the maintenance of body posture during swimming. The modification of brain in response to feeding habit in *Clarius batrachus* have been found in the myelencephalic part situated at the posterior region of the brain. It includes paired facial lobes (FL), Vagal lobes(VL) and somatic sensory lobes(SSL).The facial lobes constitutes 13.51%,vagal 10.41% and somatic sensory lobes are projecting sideways and includes 12.5% of the total brain length .The somatic sensory lobes accounts for chemosensory function.

The brain in *Heteropneustes fossilis* includes inwardly directed cerebellum with flat surfaces on both sides (Fig.2.) and measures 15% of the total brain length. The facial lobes are bilobed and occupy about 10%, paired vagals consist of 6.66% and paired somatic sensory lobes protrude sideways and constitute 36.6% of the total brain length. The somatic sensory lobes, vagal lobes and facial lobes accounts for the sense of taste and touch in abundant measures. It is one of the most active bottom habitat fish selected for the study.

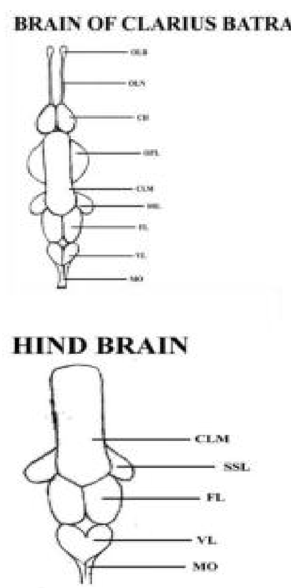


FIGURE: 1

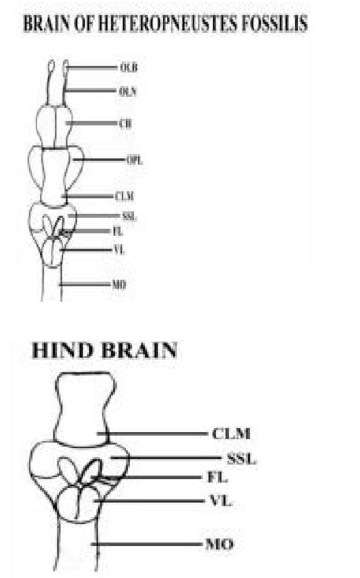


FIGURE: 2

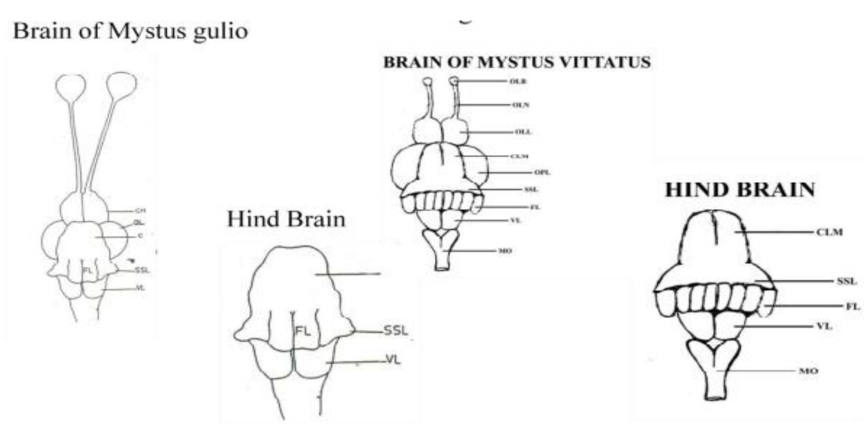


FIGURE: 3, 4

**PLATE 1**: *Brain of Fishes*

The cerebellum in *M. gulio* has a broad base steadily narrowing rostralwards (Fig. 3.) and. occupies 25% of the total brain length. The facial lobe occupies a position just below the cerebellum and almost rectangular in shape. Vagals are seen just below the facials.The somatic sensory lobes are projecting sideways. The length of the facial lobes is 10.64% that of the vagals is 9.24% and somatic sensory lobes is 12.45% of the total brain length. In *Mystus vittatus* the cerebellum is extremely larger and represents 28.57% of the total brain length (Fig 4). Unlike other fishes metencephalon is well developed with 8 lobed facial lobes,paired vagals and somatic sensory lobes. The facials accounts for 14.28%,vagals 7.14% and somatic sensory lobes 14.28% of the total brain length.

## DISCUSSION

The present study reveals a number of interesting adaptive features in the hindbrain of fishes. The marked distinctiveness of the brain diversity suggests the presence of different mechanisms based on diverse habitats. The environmental factors are all known to be important in shaping brain evolution (Gonda *et al*., 2011) agrees with the present study. Sato (1941) found highly developed facial lobes in mouth tasters and skin tasters. Facial lobes are enlarged in fishes possessing external taste buds (Miller and Evans, 1965). The multilobed facial lobes found in *Mystus vittatus* may partially be due to the division of the facial nerve the V11$^{th}$nerve into branches after entering the brain indicates its taste sense. The taste buds located on the barbels, lips or throughout the body may be responsible for it. Studies confined to this aspect are not yet worked out.

## CONCLUSION

Cerebellum volume among different species correlates strongly with habitat type, prey size and swimming ability (Huber *et al*., 1997). It is true in the case of *Mystus vittatus*. Swimming ability is high in this fish. Welldeveloped vagal lobes in *Clarius batrachus* reveal its gestation during feeding. In other fishes it is moderately developed. The somatic sensory lobes were correlated with aggressive feeding habit in *Mystus vittatus* than the other fishes. Bhimachar (1937) stated that the presence of an enlarged somatic sensory lobe is due to the more active habit of the fish. Some other mechanisms are also involved in the feeding mechanism.

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