Uttar Pradesh J. Zool. 15 (3) : 199-203, 1995 *ISSN 0256-971X*

CRANIAL NERVES OF *LABEO ROHITA* (HAM.)

K.C. PANDEY, H.S. SINGH AND YOUGESH KUMAR
DEPARTMENT OF ZOOLOGY, C.C.S. UNIVERSITY, MEERUT - 250 004, INDIA.

The present communication deals with the study of cranial nerves of *Labeo rohita* (Ham.). During this study stress has been paid to the nature of optic chiasma, trigeminofacial complex, hyoideus and vagus nerves, respectively. The organisation of different nerves and typical ten pairs of cranial nerves have been observed.

INTRODUCTION

Contributions on the cranial nerves of Indian freshwater teleostean fishes are inadequate, thus, with a view to provide suitable account the present investigations have been taken up. Present paper describes cranial nerves of *Labeo rohita* (Ham.), a herbivorous, mid surface water fish mainly feeding upon the microscopic plants, decaying higher plants, vegetable debris and filamentous algae found abundantly in freshwater bodies throughout north India.

MATERIALS AND TECHNIQUES

Specimens collected from local fish market of Meerut were fixed in 90% Alcohol. Abdomen of fish were cut open after making few bores in the head region, in order to allow better penetration of fixative. After the nerves were hardened they were traced very carefully as far as possible in the manner as suggested by Walker (1986).

OBSERVATIONS

Olfactory nerve takes its origin from olfactory lobes of brain from its anterior margin. It extends forward over parasphenoid and prevomer bones and reaches nasal capsule. After passing through lateral ethmoid bone it terminates in olfactory rosette. It is a special sensory nerve conveying smell impulses to brain.

Optic nerve originates from optic tectum of mid-brain from its ventral side. Nerve of each side cross each-other at front of diencephalon to form "optic chiasma". Nerve extends out of cranium through space between parasphenoid and pleurosphenoid bones. It descends forward intraorbitaliy between superior rectus and anterior rectus muscles and make supply to retina of eye. It carries visual impulses from retina to brain.

Oculomotor nerve originates form ventral side of mid-brain. It enters orbit through optic foramen. It is then distinguished into following branches namely-superior, middle and inferior branches. Superior branch make supply to superior rectus muscle. Middle branch after separating into two branches make supply to inferior rectus and anterior rectus muscles respectively. Inferior branch which is ventral in position make supply to inferior oblique muscle of eye-ball. Oculomotor nerve is a somatic motor nerve and innervates four out of six striated muscles of eye-ball. Trochlear nerve originates from dorso-lateral sides of brain between optic lobes and cerebellum. It extends out of cranium and enters orbit through a foramen in orbitosphenoid bone. It make supply to superior oblique muscle of eye-ball. Abducens nerve originates as a single root from ventral side of medulla oblongata, a little behind trigeminal nerve. It extend out of cranium and enter orbit through optic foramen. It makes supply to posterior rectus muscle of eye-ball.

Trigeminal and facial nerves have their independent origin from sides of medulla-oblongata but both nerves after travelling a short distance, joins each other to form "trigeminofacial complex". Complex divides into three trunks namely- supra-orbital, infra-orbital and hyomandibular trunks.

Supra-orbital trunk arises from trigeminofacial complex as a dorsal branch. It extends forward on lateral side of pleurosphenoid and orbitosphenoid bones. Trunk divides into two branches namely- ophthalmicus superficialis trigeminalis and ophthalmicus superficialis facialis. Ophthalmicus superficialis trigeminalis make supply to skin of snout and ophthalmicus superficialis facialis innervates supraorbital canal of lateral line system. Infra-orbital trunk arises from trigeminofacial complex as a ventral branch. It runs ventral to supra-orbital trunk. Trunk divides into three branches namely- maxillaris, buccalis and mandibularis trigeminalis. Maxillaris after its separation from infra-orbital trunk associates with buccalis branch for some distance and later it separates into two branches namely- superior and inferior branches. Superior branch extends forward and bifurcates distally to make supply to the upper lip and upper jaw by its two branches. Inferior branch pierces through the maxilla bone and make supply to upper jaw. Buccalis after its separation from trunk associates with maxillaris for some distance and then subsequently separates and extends forward below the process of maxilla, after passing under lateral ethmoid bone and on floor of nasal capsule, it reaches the upper lip and in its course make supply to the infra-orbital lateral line canal and taste buds of upper lip. Mandibularis trigeminalis after its separation from trunk extends along posterior border of eye and after reaching angle of mouth divides into two branches. One branch innervates the lower jaw. Other branch terminates in lower lip and mandibular teeth. A palatinus branch is also given off from infra-orbital trunk which make supply to the roof of the buccal cavity. Hyomandibular trunk comes out of cranium through the prootic bone and reaches over hyomandibula. It separates immediately on reaching over hyomandibula into mandibularis facialis and hyoideus. Mandibularis facialis extends forward, moving over quadrate bone and passing through it, branch extends forward upto tip of lower jaw and innervates mandibular lateral line canal. Hyoideus moves under opercle and after bifurcating into anterior and posterior branches terminates in anterior and posterior regions of branchiostegal membrane.

Auditory nerve originates from sides of medulla oblongata behind the facial nerve. Nerve divides into two branches namely- vestibular and saccular branches. Vestibular branch make supply to utriculus and ampullae of internal ear and sacculus branch make supply to sacculus and lagena.

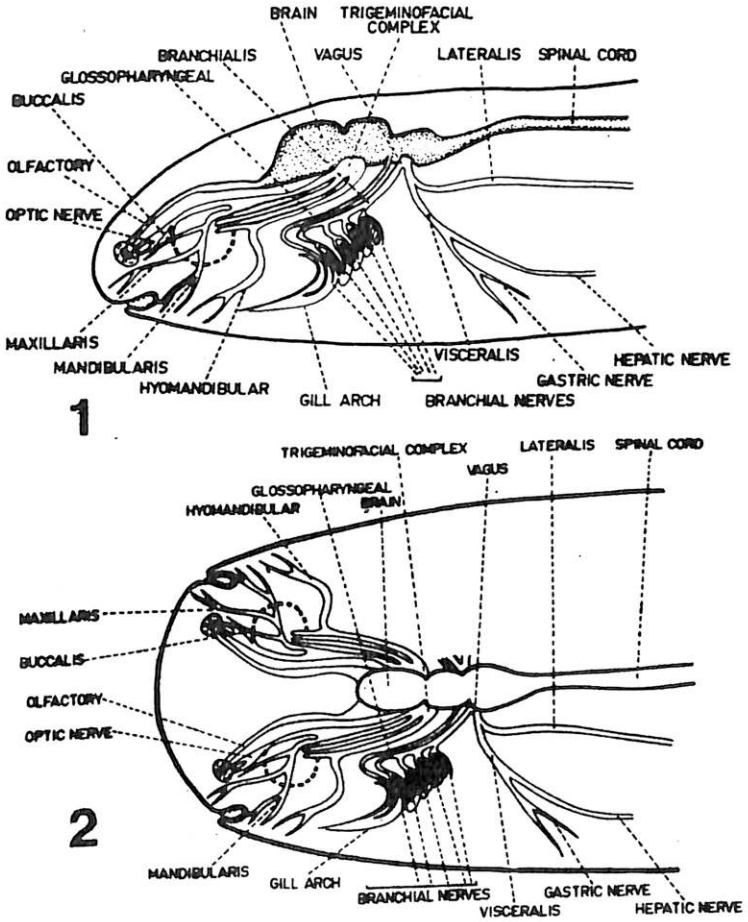
Glossopharyngeal nerve originates from ventro-lateral part of medulla-oblongata behind auditory nerve. It extends out of cranium through an opening in exoccipital bone. It enters first gill arch. It is a mixed nerve and supplies a part of lateral line system, taste buds of pharynx and muscles of first gill arch.

Vagus nerve originates through a pair of roots and emerges out of cranium through vagal foramen in exoccipital bone. It arises behind the glossopharyngeal nerve and has an extensive distribution. Out side the cranium, it form the vagal mass which separates into five trunks namely- first three trunks, forming first, second and third branchiales respectively, fourth trunk fourth branchialis and visceralis and fifth trunk lateralis. All branchiales separates into post and pre-trematic branches and makes supply to four gill arches respectively. Visceralis extends behind and before entering body cavity gives a branch to heart and pericardium. Main nerve then enters body cavity and after branching into several roots make supply to the different regions of gut and other organs. Lateralis is a stout nerve that runs upto the end of tail along lateral line canal and innervates it by several branches.

DISCUSSION

The discussion is curtailed to the analysis with the authors previous contribution (Pandey *et al.*, 1994), where a detailed discussion with other fishes in general has already been made.

Uberoi (1959) appears to be pioneer in making the study of cranial nerves of freshwater Indian fishes. He studied the nervous system of *Mystus seenghala.* A number of investigators form different corners of India like Workman (1900), Berkelbach & Sprenel (1915), Atoda (1936), Karandikar & Thakur (1951), Lal (1962), Mithel (1964a & b), Sinha (1964), Maheshwari (1965), Saxena (1966a & b, 67,69), Dalela & Jain (1968), Chandrashekhar (1971), Verma & Srivastava (1972) and Pandey



Figs. 1-2. 1. Showing side view of cranial nerves in *L. rohita* (Ham.); **2.** Showing dorsal view of cranial nerves in *L. rohita* (Ham.).

et al. (1994) have contributed to our knowledge of the cranial nerves of fishes like *Ameiurus, Silurus, Mormyrus, Parasilurus, C. batrachus, C. mrigala, Scianoides brunneus, M. armatus, M. seenghala, B. bagarius, A. cuchia, H. ilisha, N. nandus, X. cancila, W. attu* and *H. fossilis.* But, as far as authors are aware so far no attempt has been paid to study the cranial nerves of *Labeo rohita* (Ham.), despite of the fact that it is one of important freshwater carps in immense culture practice throughout the country.

Optic chiasma is intermingling of minute nerve fibres at site of contact of optic nerves of either side, Bone & Marshall (1982). Presence and absence of optic chiasma in piscine cranial nerves has also been marked by number of investigators earlier but none of them has assigned any practical reason for presence or absence of chiasma. Thus it is difficult for the authors to correlate their findings. However, in our opinion presence of optic chiasma might be an efficiency dependent change present in surface dwelling fishes which feed chiefly with the help of sight. Fact that optic chiasma is well formed in fishes feeding chiefly on surface water is also supported by the investigations followed by Saxena (1969) and Verma & Srivastava (1972) in fishes like *H. ilisha, N. nandus* and *X. cancila.* These workers observed formation of chiasma in these fishes, which are feeding chiefly on surface water.

Trigeminal and facial nerves arise in different manner in different fishes but the place of origin for both these nerves appears to be same *i.e.* medulla oblongata. In some fishes they arise from single root like *Mystus,* from two different roots as in case of *Wallago, Mastacembelus* and *Amphipnous cuchia,* four roots (two dorsal and two ventral) in case of *Bagarius.* Earlier workers like Atoda (1936), Mithel (1964), Sinha (1964), Maheshwari (1965), Saxena (1965, 67 & 69), Dalela & Jain (1968); Chandrashekhar (1971) and Verma & Srivastava (1972) have also noticed different and varied origin of these two nerves in different fishes. Two nerves, trigeminal and facial soon after their origin unite to form a complex called "trigeminofacial complex" and gives off following nerve trunks at different places. It gives off supra-orbital and infra-orbital trunks outside the cranium and hyomandibular trunk before coming out of cranium together with palatinus. These main trunks subsequently separate into ophthalmicus superficialis trigeminalis, ophthalmicus superficialis facialis, buccalis, maxillaris, mandibularis trigeminalis, mandibularis facialis, opercularis facialis, hyoideus and palatinus. Similar observation regarding main branches and their sub-branches have also been made by earlier investigators like Mithel (1964), Sinha (1964), Maheshwari (1965), Saxena (1965, 67 & 69), Dalela & Jain (1968), Chandrashekhar (1971) and Verma & Srivastava (1972) in the different fishes at their disposal. Hyoideus runs behind and downward at level of pre-opercular curves and finally terminate into fine branches which supply the membrane of branchio-stegal region. Presence of this nerve has also been noticed by author in fishes like *Catla catla, Labeo rohita* and *Wallago attu.* However, the other authors have over looked this small branch except Saxena (1969), who noticed it in *Hilsa ilisha* and *Cirrhina mrigala.*

Vagus nerve gives off three main branches in all namely- branchiales, visceralis and lateralis. Level of bifurcation of these three branches varies in different fishes, however, in most of the fishes separation of branchiales and visceralis takes place much before the lateralis. Sinha (1964), Mithel (1964), Maheshwari (1965) and Saxena (1965, 67 & 69) have also drawn similar conclusion. Besides this Sinha (1964) reported the independent origin of lateralis branch from brain in *Wallago* as cited by Dalela & Jain (1968) to which authors disagree. Author feels that they (Dalela & Jain, 1968) might have not consulted original paper of Sinha, because Sinha (1964) himself has mentioned that, two roots unite and the common trunk develops vagus ganglion, before the trunk issues out of cranium through its foramen at hind end of exoccipital. Lateralis trunk of vagus nerve separates first from nerve and then branchio-visceralis trunk issues out separately from cranium. To our surprise they (Dalela & Jain, 1968) have resembled fish, *Clarias* with the *Wallago attu* on this issue and mentioned that lateralis represents a branch of vagus nerve in the subsequent lines of their discussion. It is also very surprising that such a misleading observation has not been pointed out by any of subsequent workers since 1968 till date.

ACKNOWLEDGEMENTS

We are thankful to Prof. S.S. Lal, Head, Zoology Department, C.C.S. University, Meerut for extending laboratory facility.

REFERENCES

ATODA, K. 1936. The innervation of cranial nerves of catfish, *Parasilurus asotus. Sci. Rep. Tohoku* Univ. **11** : 91-115.

BERKELBACH, H. & SPRENEL, V.P. 1915. The cranial relation of the cranial nerves in *Silurus glanis* and *Mormyrus. J. Comp. Neur. Philadelphia.* **25** : 5-63.

BONE, Q & MARSHALL, N.B. 1982. *Biology of fishes,* Blackie and Sons, London.

CHANDRASEKHAR, K. 1971. Memoir on *Cirrhina mrigala. Ind. J. Zoot.* **12** : 57-59.

DALELA, R.C. & JAIN, D.N. 1968. Studies on cranial nerves of *Clarias batrachus. Agra Univ. J. Res. Sci.* **17** : 107-114.

KARANDIKAR, K.P. & THAKUR, T.P. 1951. Morphology of *Scianoides brunneus. Univ. Bombay Zool. Mem.* **3** : 71-80.

LAL, M.B. 1961. Morphology of *Tor putitora* (Ham.). *Agra Univ. J. Res.* (Sci.). **11** : 167-172.

MAHESHWARI, S.C. 1965. The cranial nerves of *Mastacembelus armatus* (Lacep.). *Jap. J. Ich.* **12** : 89-98.

MITHEL, M. 1964a. The cranial nerves of *Mystus seenghala* (Sykes.). *Agra Univ. J. Res* .(Sci.). **13** : 67-78.

1964 b. Cranial nerves of Cat fish-sisorid. *Bagarius bagarius. Copeia.* **4** : 673-678.

PANDEY, K.C., SINGH, H.S. & KUMAR, Y. 1994. Cranial nerves of *Heteropneustes fossilis* (Bloch) *Uttar Pradesh J. Zool.* **14 (2)** : 137-142.

SAXENA, P.K. 1966a. The cranial nerves of the common Cat-fish, *Clarias batrachus* (Linn.). *Jap. J. Ich.* **14** : 91-98.

1966b. Some salient features in the cranial nerves of certain Indian teleostean fishes. *Ibid.* **14** : 99-100.

1967. The cranial nerves of the mud-eel, *Amphipnous cuchia* (Ham.) *Acta anat.* 67 : 306-320.

1969. The cranial nerves of *Notopterus notopterus* (Palls.) *Anat. anz.* **124** : 198-209.

SINHA, B.M. 1964. Cranial nerves of *Wallago attu. Proc. Nat. Acad. Sci. India.* **34** : 42-48.

UBEROI, I.B.S. 1959. Nervous system of *Mystus seenghala. M.Sc. Thesis, Punjab University, Chandigarh.*

VERMA, H.S. & SRIVASTAVA, V.M.S. 1972. Cranial nerves of *Xenentodon cancila. Ind. J. Zoot.* **13** : 138-143.

WALKER, W.F. 1986. *Vertebrate Dissections.* Saunders College Publishing, Philadelphia, New York. pp. 391.

WORKMAN, I.S. 1900. The ophthalmic and eye muscle nerves of cat fish-*Ameiurus. J. Comp. Neurol.* **100** : 403-410.