

Structure of Respiratory Organs of *Esomus dandricus* (Ham.)

Haimanti Bhattacharya and Bharat Raj Subba

Department of Zoology, P. G. Campus, Biratnagar

Abstract

In *Esomus dandricus* (Ham.), 4 pairs of gills are present with secondary lamellae having a thin lamellar epithelium. The space, which is present in between the proximal margin of gill filaments and branchial septum, forms the so-called water channels to distribute water along the length of the gill filaments. Number of mucous glands and taste buds are present on the gill-rakers and gill head region. The gill filaments of the two-hemi branches are long and alternately arranged to each other, unequal in length and are separated by a comparatively long interbranchial septum (covering about 42% of the total length of the filaments). Tertiary lamellae are absent.

Keywords: Fish, *Esomus dandricus*, Respiratory organs,

Introduction

Animals need to extract oxygen from two main respiratory media viz. air and water for their metabolic demands. The oxygen capacitance in water is 21 times less than in air, whereas the CO₂ capacitance in pure water and air is the same (Dejours 1976). Further water is more dense and viscous than air, so the water breathers have to face more workload than air breathers for the extraction of oxygen from water. Fishes have developed an efficient organ for extraction of oxygen through gills than mammals can do it from air, in spite of their small respiratory area as compared to mammals (Hughes 1965, Hughes 1967, Dejours 1975).

Earlier studies have clearly indicated that there exists a close relationship between the structures of gills with their function. (Gray 1954, Hughes and Morgan 1973, Laurent and Dunel 1976, Hughes 1980). The relationship exists at various levels of the gill sieve system. Different workers in the fishes from different habitats have observed modification in the architectural plan of the gills.

Literature on fish gill morphology has been provided by Moon (1995), Fernandez

and Perna (1995), Laurent *et al.* (1996), Munshi (1996), Subba (1999). The present work is an attempt to describe the respiratory organs of the most commonly found fresh water fish in Nepal, the "Flying Barb", *Esomus dandricus* (Ham.).

Materials and Methods

Adults, live specimen of *Esomus dandricus* (Ham.) was collected from the ditches, ponds, and canals of Biratnagar. The fishes were anaesthetized with Tricaine methanesulphonate (Ms₂₂₂) and their gills were removed carefully and washed with saline water, then fixed with freshly prepared Bouin's fluid for 24 hours. They were then transferred to 70% alcohol. From all the four-gill arches, pieces were made. The pieces of gills were decalcified in decalcifying agent (5% HNO₃ and 70% ethanol) for 24 hours. Three changes of fixative were made in 24 hours after each 8 hours. Paraffin blocks were prepared following the routine methods. Section of gill

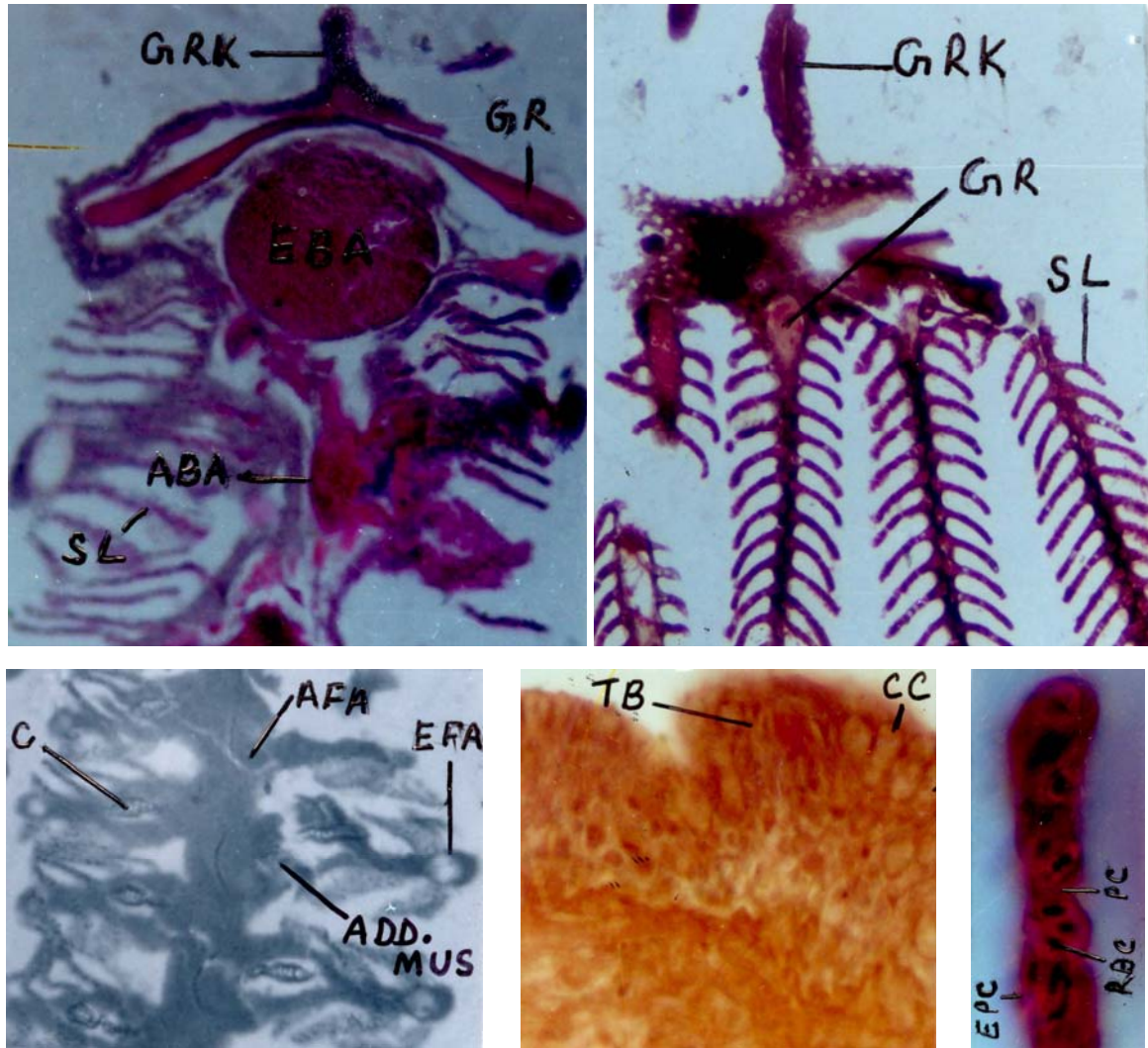


Figure 1.

GRK- gill raker; GR-gill; EBA- efferent branchial artery; ABA- afferent branchial artery; SL- secondary lamellae; PC- pillar cells; RBC-red blood cells; EPC- epithelial cells; CC-club cells; TB- taste buds; C-Cartilage; ADD.MUS- adductor muscle

filaments was cut in three planes- horizontal, transverse and longitudinal at 5 to 6 μ . For histological studies, double staining of sections was done using haematoxin and eosin.

Results and Discussion

The branchial apparatus of *Esomus dandricus* (Ham.) comprises of four pairs of gill arches. The gills remain covered with operculum. Each gill consists of two parts a) The gill head region b) The gill filament region.

Gill head region

The histological section of the gill head region is internally provided with a branchial arch for support of afferent and efferent blood vessels, nerves and abductor muscles. The triangular shaped bony structure of the branchial arch, the gill bar appears to have shrunken inwardly in the form of an inverted "V" to lodge the said blood vessels and nerves. Each branchial arch has one afferent and one efferent branchial artery. Slightly above the efferent branchial vessel are located two nerves, called pretrematic and posttrematic nerves respectively (Figure 1). A thick layer of epithelium covers each gill head region, which thins out at the sides. Below the epithelium lies a thick layer of club cells. The light microscopic study of epithelium reveals the presence of mucous glands, taste buds and small-undifferentiated cells. Gill-rakers are usually situated in the gill head region. They are well-developed filliform structures. The epithelium, which covers the gill-rakers, contains a large numbers of mucous glands and taste buds. In *Esomus dandricus* (Ham.), all four-gill arches were slightly different from the rest of the gill arches, as each gill raker has a broad base and a clearly visible epithelium.

Gill filament region

The epi- and ceratobranchial regions give rise to two rows of gill filaments (primary lamellae). The interbranchial septum in case of *Esomus dandricus* (Ham.) extends a little beyond half way down the primary lamellae. The filament of the opposite hemibranch is alternately arranged to each other. The distal ends of hemibranchs are free from each other. The secondary lamellae are well-developed, leaf-like structures. They are arranged parallel to each other on both sides of the filament. The two rows of lamellae of a filament alternate each other. The secondary lamellae appear to be fused at the distal end of the primary lamellae, so the tip of the filaments look blunt. Each secondary lamella consists of an outer epithelium (E), a middle basement membrane (B) and an inner core of blood channels (BC) separated by a series of pillar cell (PC). The total number of gill filaments on the first, second, third and fourth gill arches were 73, 87, 91 and 77 respectively. Distance between primary and secondary lamellae was 5-6 μ and the distance between secondary lamellae (interlamellar space) was 1.5 μ . The general pattern of the gills of *Esomus dandricus* (Ham.) was similar to other teleost fishes. The gill-rakers are long and filiform. The gill-rakers of the third gill arch show prominent respiratory epithelium towards the base. The number of gill-rakers on the dorsal region is more than that of ventral region. This type of gill-rakers is more common in omnivorous fishes feeding on both plant and animal matter. In histology they show more numerous taste buds and mucous glands on the epithelial surface. Club cells, taste buds and mucous glands are also present. (Plate I). They differ from obligatory air breathers where third and fourth gill arches are considerably reduced (Olson *et al.* 1986, 1994). The histology of gills of *Esomus dandricus* (Ham.) showed essentially the same