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Role of air breathing organs in Indian gobies of estuarine habitat

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Abstract- *Brachygobius xanthozonus* is an eel goby that inhabits in estuarine water. They usually reside in brackish water where plenty of plants and rocks are present which provides them with ample places for hiding, unlike the sympatric amphibious mudskippers it does not emerge but hides in rocks. Although they do well in a community setting, they will thrive the best in the company of only their own species. Even though they live in the brackish water, the addition of freshwater will induce spawning. The female will lay the eggs in the substrate beneath a root or rock where the male will fertilize them. After fertilization, the male will guard the eggs for approximately four days until the fry become waterborne. The Bumblebee Goby requires a diet rich in small, live foods such as tubifex worms, bloodworms, brine shrimp and daphnia.

Keywords: *Brachygobius xanthozonus*, goby, tubifex, teleosts

INTRODUCTION

Gobies are fishes of the Gobiidae family, inhabiting saltwater, brackish water, and freshwater of tropical and subtropical ocean. The family of gobies comprises 1875 species in 212 genera in which 36 gobies are amphibious and are referred to as mudskippers.¹ Usually gobies lives in water and like other teleosts they also rely on gills for gas exchange, some of them are capable of air breathing (air breathers) and are generally found coexisting with the amphibious mudskippers. In tidal ponds the occurrence of air-breathers are usually limited. The gill of teleost fishes is well suited for water breathing, but upon air exposure the lamellae coalesce, greatly reducing the functional exchange surface.^{2,3}

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Some fishes have the ability to breathe air effectively. Air breathing among fishes is associated with modification of the gill and the development of accessory breathing organs (ABO).⁴ Air-breathing fish can exchange respiratory gases using an air-breathing organ (ABO), such as the oral cavity of the integument, during environmental hypoxia. The gill and integument surface area, diffusion capacity, and their diffusion barrier thickness were measured. Our results show that although gill surface area is smaller than observed in other facultative air-breathing fish, but it has all features necessary to perform aquatic gas exchange. Additionally the integument of the palate has a short diffusion barrier thickness and a large calculated O₂ diffusion capacity suggesting that it functions as the ABO. Air-breathing fishes continue to attract the attention of biologists because of their illustrative value as models for understanding the evolution of vertebrate air breathing and the transition from water to land.⁵ Estuarine and marine

air-breathing fishes, in general, are dominated by highly derived groups of amphibious species (e.g. mudskippers and rockskippers), which routinely emerge during low tide⁶. The main purpose of the present study was to determine if the eel goby, *Brachygobius xanthozonus*, breathes air under natural conditions in the mudflat burrows. We also investigated the air-breathing behavior in order to obtain insights into the aerial respiratory performance of the fish.

MATERIALS AND METHODS

Two specimens of *Brachygobius xanthozonus* (Bleeker, 1849) were collected from the local water bodies of Madhepura. The capture location was in Madhepura (25.9240° N, 86.7946° E). Samples were collected by a drift gill net operated from traditional fishing craft. The specimens were preserved in 5% formalin and brought to the laboratory for a detailed examination.

OBSERVATION

Air-breathing behavior was observed in a fish chamber. The length (40 cm) and diameter (5.2 cm) of the horizontal bottom section provided enough space for the fish to move freely inside the chamber. The vertical section (length, 25 cm) had a tapered opening (diameter, 3.6 cm) at the top where fish could access air. Two cameras were mounted on the top and side of the chamber for video observation and recording.

Air breathing in the burrow

Seven out of the 15 burrows contained *Brachygobius xanthozonus* (Bleeker, 1849) but in only five burrows did fish perform air breathing. In the other two burrows with fish, water level intermittently moved up and down, suggesting activity inside. It is possible that the fish were breathing in other openings of the burrow. Air breathing was characterized by rapid inspiration followed by variable periods of breath holding either in the water or at the surface before expiration

Air-breathing capability

The present study demonstrated the capability of *Brachygobius xanthozonus* (Bleeker, 1849) to directly utilize atmospheric air for respiration. After inspiration,

some individuals immediately retreat into the water whereas others retreat into the water and return or remain at the surface until expiration. During breath holding, the fish stays motionless with its head floating at the surface. Three types of air-breathing behavior were similarly observed in the field burrows.

Like most brackish water and marine air-breathing fishes *Brachygobius xanthozonus* (Bleeker, 1849) does not possess any special organ for aerial gas exchange. The gills therefore can be inferred as the potential sites of O₂ absorption, as similarly suggested in more than 30 species of gobies fishes.

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