ON THE BURROWING HABITS OF A GOBIOID FISH OF THE GENUS *TAENIOIDES* IN THE ANDAMANS.[1]

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In the course of his recent studies on the ecology and bionomics of the Gobioid fishes of the Gangetic delta Hora [2] (1935, 1936) briefly dealt with the burrowing habits of certain species. While stationed in Port Blair, Andamans, during the years, 1932 to 1935, I had an opportunity of observing the burrowing habits of two species of Muraenid and Gobioid fishes living in the mud flats at the entrance to certain brackishwater creeks in the vicinity of Port Blair. My stray notes on this subject are offered in the present communication as a supplement to Hora's published observations.

While digging in the mud for worms and other organisms near the edge of a creek at South Corbyn's Cove, Port Blair, I found, in addition to several specimens of a Muraenid eel, a few examples of a Gobioid fish of the genus *Taenioides* not more than four inches in length. In life, they were of a pinkish brown ground colour with golden yellow blotches on the sides. As this Goby lived in fairly deep burrows and observation of living examples in their natural habitat was impossible, a few specimens were taken alive to the Fisheries Laboratory where they were kept in aquaria for further observation. Soft mud from the creek was placed at the bottom of a large aquarium jar and sea water was added to a height of about 6 inches above the surface of the mud. When the live specimens of *Taenioides* were dropped into the jar, they explored the bottom for 5–10 minutes, presumably, to find a suitable place for burrowing, and then shovelled up the mud with their head to make burrows. Where the mud was soft the process of burrowing was fairly quick, a burrow 6–8 inches long taking only 10–15 minutes to make. Where the mud was hard the fish actually bit off lumps of mud with their long sharp teeth and

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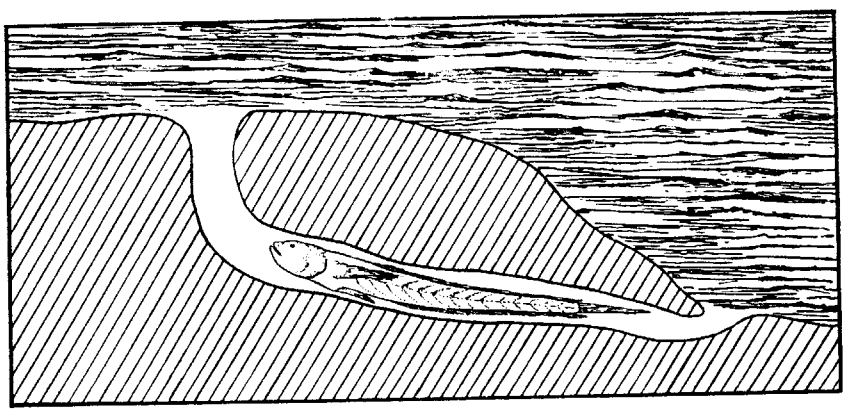
[1] The specimens of fish used in the experiments which form the subject matter of this note are immature forms and are consequently difficult to identify. In dentition they agree with the description of *Taenioides cirratus* (Blyth) but seem to differ from it in body proportions. It is likely that the specimens represent the young of *T. caeculus* (Bl. & Schn.), a species recorded by Day from the Andamans.

[2] Hora, S. L. *Trans. Nat. Inst. Sci. India*, I, p. 9, pl. i, fig. 2, (1935).
Compt. Rend. XII Congr. Internat. Zool. Lisbonne, 1935, pp. 854, 855, pl. xlvi, fig. 5, (1936).

ejected them rapidly through the opercular openings.[1] In this manner a burrow was completed in about 15 minutes. The loose mud that was falling from the sides in the process of burrowing was thrown out from the burrow by the vigorous motion of the operculum, the fins, and the posterior part of the body of the fish. The meandrine lamellar ridges on the dorsal surface of the head, on the cheek, and on the sides of the body up to the caudal fin presumably facilitate the process of burrowing by acting as effective shovels.

The burrow may be a simple tunnel of more or less uniform calibre running obliquely as in Text-fig. 1 and opening on the surface of the mud at the same

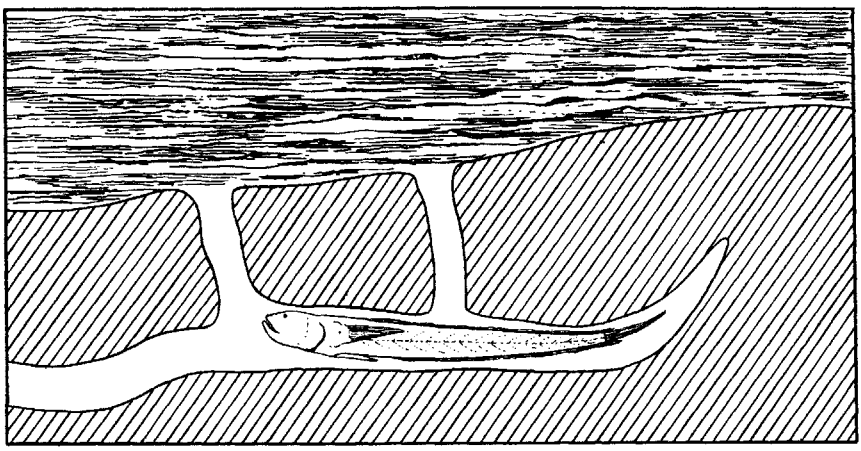


TEXT-FIG. 1.—A simple burrow of *Taenioides* with the two openings at different levels of the bottom.

or different levels by two rounded apertures. The fish takes up a position in the middle of the burrow where it is concealed from view. The burrow may end blindly at one end and lie horizontally some distance below the surface, and often in communication with the exterior by additional vertical tunnels as in Text-fig. 2. The egress and ingress of the fish is thus greatly facilitated. In this instance it is not known whether the inhabitant of the horizontal burrow has made the vertical tunnels or some other fish trying to burrow in the close vicinity has chanced to cut across the horizontal burrow. A slight variant of the type of burrow described above may be seen in Text-fig. 3 where the horizontal burrows are slightly curved communicating as usual with the exterior by vertical tunnels. Burrows of different calibres,

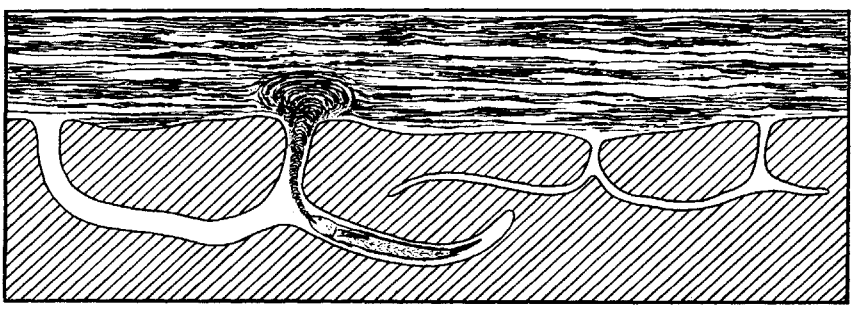
[1] Dr. Hora (1936) observed in *T. rubicundus* that when the mud provided was hard the fish had to bite off large lumps which they 'coughed' out by mouth. In the species observed by me of which I had only small specimens the particles of mud bitten off were ejected forcibly through the gill-openings which are large enough for the passage of the particles of mud. The gill-rakers in this process seem to be adpressed to the walls of the gill-chamber when expanded and thus facilitate the passage of the particles without hindering the function of the gills.

presumably belonging to two different sizes of fish may be seen in this figure. A complicately branched burrow as in Text-fig. 4 with vertical tunnels of



TEXT-FIG. 2.—A horizontal burrow of *Taenioides* ending blindly at one end, and with two vertical connecting burrows of narrower calibre leading to the outside.

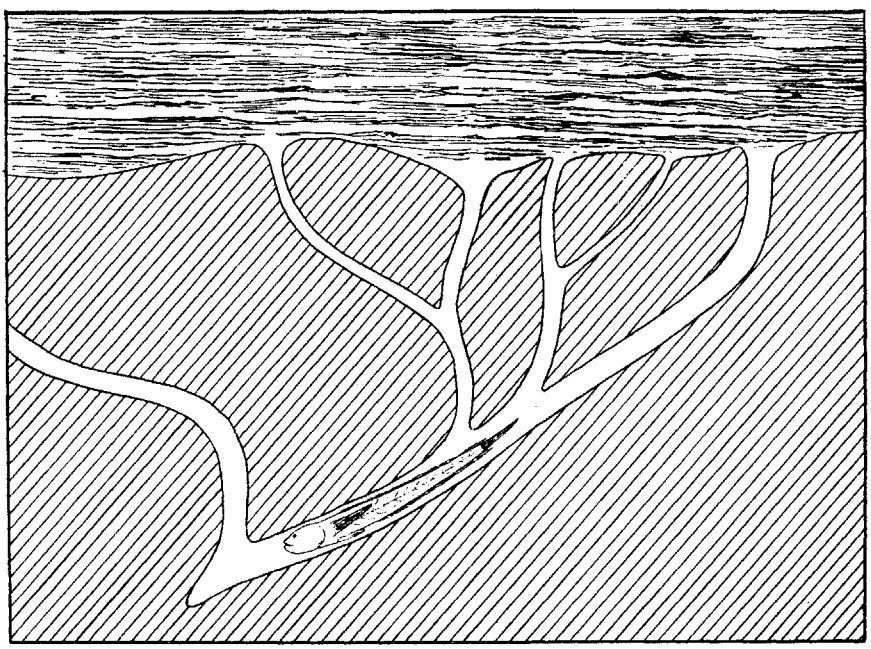
varying calibre has also been observed in the Laboratory. I have not observed more than one fish in these burrows and their connected tunnels, and am



TEXT-FIG. 3.—Burrows of *Taenioides* of narrow calibre communicating with the outside by means of short vertical shafts. The fish in one of the burrows is expelling a cloud of mud to keep the burrow open and clean.

consequently unable to say whether the burrows of different calibres are made by fish of different sizes. The occlusion of the vertical tunnels by falling particles of mud is fairly common, and I have observed fish repairing damage to their burrows by throwing out forcibly the particles of mud dropping into them in a cloud that may frequently be observed at the mouth of the burrows (Text-fig. 3).

The fish usually take up convenient positions in the horizontal portions of the burrows, and by vigorous movements of the gill-operculum and of the body maintain an inward respiratory current of water flowing through the tunnels and bringing with it minute particles of organic and inorganic matter. The respiratory movements of the gill-operculum are about sixty to the minute.



TEXT-FIG. 4.—A deeper and more complicated burrow of *Taenioides* communicating with the outside by subsidiary burrows of narrower calibre.

The fish, however, rest at short intervals stopping all movements. Occasionally, in the course of the day, but more often at night, the fish emerge from their burrows to the surface of the bottom mud, swim about a little in the upper layers of water and finally return to their burrows. The junction of the vertical and the horizontal portions of the burrows is often utilized by the fish to reverse the direction in which they lie in the burrows. The forcible ejection of water and solid particles by mouth assisted by the undulatory movements of the body in a postero-anterior direction referred to above is, however, an infrequent phenomenon, but the backward and forward movements of the fish in their burrows are more frequent and are suited to the needs of the fish. When the inward respiratory current is set up, the movements of the body of the fish are slow and rhythmical, and a gentle current of water enters the burrow by the opening nearest to the anterior end of the fish and leaves it at the other end of the burrow nearest to the tail-end of the fish.

The more violent expiratory currents are caused by the rapid undulatory movements of the body in a reverse direction and by the forcible expulsion of water through the mouth.

The capacity of the fish to burrow in pure sand or in a mixture of sand and mud was tested in another experiment. An aquarium jar was filled with sand to a fourth of its height and filled with sea water. Two specimens of the *Taenioides* were introduced into the jar. Failing in the repeated attempts to burrow in the sand at intervals of every few minutes, the fish kept on swimming along the sides of the jar, often sticking to the surface of the glass by the ventral fins, and finally settled down on the surface of the sand more or less exhausted. In a well-mixed mixture of equal parts of soft mud and sand, the fish were at first unsuccessful in making burrows, but several hours later they were found inside burrows in the sand and mud mixture.

The behaviour of the Muraenid eels captured in the same locality as *Taenioides* was, however, different in the aquarium. The moment they were introduced into the aquarium consisting of sand, mud, or a mixture of both, they took a straight plunge into the bottom disappearing into burrows made instantly with their sharp pointed snout in less than a minute. They, however, returned now and again to the mouth of the burrow keeping their head well above the surface of the substratum and continuing the respiratory movements of their operculum.

When the bottom mud in the aquarium was only just kept moist, the Muraenid eel often came to the mouth of the burrow, while *Taenioides* never once left the burrow.

Of the three specimens of *Taenioides* one lived in the Laboratory aquaria for 47 days, while the other two lived for 58 days.

I have to thank my friend, Dr. S. L. Hora, for suggestions in writing up this note.

Discussion.

On being invited by the President to make some remarks on Dr. H. S. Rao's illuminating paper, Dr. Hora referred to the observations made by him on the burrowing habits of the Gobioid fishes of the Gangetic Delta. Attention was particularly directed to the suitability of the soft and colloidal mud of the estuaries for making burrows. The various advantages derived by the fish by living in burrows were referred to, and mention was made of parallelism in form between the diverse types of burrowing animals, such as snakes, eels, gobies, etc.