

LABORATORY REARED EGGS AND LARVAE AND
SUBSEQUENT STAGES FROM PLANKTON OF
VELLAR ESTUARY, PORTO NOVO. I.
THE ENGRAULID FISH, *THRYSSA*
MYSTAX (SCHNEIDER)

By

M. THANGARAJA*

*Centre of Advanced study in Marine Biology,
Annamalai University, Parangipettai 608 502,
Tamil Nadu.*

INTRODUCTION

Literature pertaining to the eggs and larvae of *Thryssa mystax* is very meagre, despite a number of contribution on the early life history of other species of *Thryssa*. Delsman (1929, 1931), Chacko (1950), John (1951), Nair (1952) and Bapat (1955) have described the eggs of *Thryssa* spp. Early larval forms of *Engraulis* sp (= *Thryssa* sp) were first described from the Java sea by Delsman (1929). Panikkar and Aiyar (1937) and Gopinath (1946) recored the postlarvae of the same from Madras and Trivandrum Coasts respectively. Vijayaragavan (1957) dealt with the early life history of *Engraulis gravi* (= *T. grayi*). Basheerudin and Nayar (1962) studied the larval distribution of *T. mystax* in the Mahanadi estuary. Although there are some reports on the distribution of the larvae and juveniles of *T. mytax*, there is no description yet on its egg and larval development. The present work deals with the developing eggs and larvae of *T. mystax* reared in the laboratory upto 112 hours (5.1 mm) and also the postlarvae (7.4 mm) to juvenile (34 mm) stages collected from the plankton.

*Present Address**

MARINE SCIENCE AND FISHERIES CENTRE
MINISTRY OF AGRICULTURE AND FISHERIES
P. O. BOX 467, MUSCAT
SULTANATE OF OMAN

MATERIAL AND METHODS

Eggs and larvae were collected with a plankton net (bolting silk cloth, No. 10, 158 μ m) from the Vellar estuary (lat. 11° 29' N ; long. 79° 49' E), Bay of Bengal by the mechanised boat 'Medusa'. Surface water salinity and temperature were also recorded. Eggs were sorted from the plankton samples and kept in culture troughs containing filtered and well aerated estuarine water collected from the collection site. The postlarvae and juveniles from plankton were preserved in 5% neutralised formalin immediately after collection. Stages of development are shown in Fig. 1 : A to O. Eggs and larvae were measured by an ocular micrometer. Drawings were made by using prism type camera lucida. The terminology and other laboratory rearing techniques followed by Thangaraja (1982) were adopted for the present study. The morphometric data of the larvae are presented in table 1.

LABORATORY REARING TECHNIQUES

The eggs and larvae of fishes are easily susceptible to infection by ciliates. The ciliates flourish on dead eggs and cast off membranes, and under laboratory conditions, they multiply very rapidly. In order to prevent this, the eggs and larvae were reared in estuarine water filtered several times, and also through frequent changes of water which was kept aerated constantly by means of an aerator. This method has been found very useful in keeping the larvae moving about and preventing them from resting at the bottom where ciliates and bacteria may be teeming (Cunningham, 1981). Drastic increase in the temperature of the water was controlled by keeping the culture tanks in a water bath filled with circulating water.

The larvae fed with the nauplii of brine shrimp, *Artemia salina*, cultured in the laboratory since they are considered to be the best larval food. They were also fed with such phytoplankton as *Coscinodiscus* sp, *Skeletonema* sp, *Thalassiothrix* sp. etc., and nauplii of copepods and gastropod veligers according to their food preference.

Table 1. Morphometric data for *Thryssa mystax* larvae, Ranging from 3.50 mm to 34.00 mm Total length.
(Values are given in mm.)

| Morphometric Characters | Total length of the larvae (in mm) | | | | | | | | | | | |
|--------------------------|------------------------------------|------|------|------|------|----------------------|------|------|--------------------------|-------|-------|-------|
| | 3.50 | 4.20 | 4.89 | 5.10 | 5.00 | 5.50 | 5.50 | 5.10 | 7.40 | 16.00 | 20.20 | 34.00 |
| Standard length | 3.40 | 4.03 | 4.74 | 4.97 | 4.82 | 5.32 | 5.29 | 4.87 | 6.94 | 14.31 | 18.35 | 28.09 |
| Yolk sac length | 1.97 | 1.56 | 1.42 | 1.31 | 1.01 | Yolk fully absorbed. | | | | | | |
| width | 0.74 | 0.42 | 0.41 | 0.40 | 0.40 | | | | | | | |
| Preanal distance | 2.64 | 2.97 | 3.50 | 3.51 | 3.46 | 3.74 | 3.65 | 3.03 | 4.97 | 11.74 | 12.87 | 15.70 |
| Postanal distance | 0.86 | 1.23 | 1.39 | 1.59 | 1.54 | 1.76 | 1.85 | 2.07 | 2.43 | 4.26 | 7.33 | 18.05 |
| Eye diameter | 0.25 | 0.27 | 0.27 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.39 | 0.53 | 0.92 | 1.54 |
| Auditory sac diameter | 0.09 | 0.09 | 0.12 | 0.20 | 0.23 | 0.23 | 0.28 | 0.31 | (Not visible externally) | | | |
| Head length | | | | | | 0.83 | 0.66 | 0.71 | 1.21 | 1.81 | 3.69 | 6.88 |
| Head depth | | | | | | 0.57 | 0.47 | 0.57 | 1.10 | 1.23 | 2.54 | 6.88 |
| Snout length | Not measurable | | | | | 0.10 | 0.11 | 0.11 | 0.35 | 0.58 | 0.92 | 1.30 |
| Maximum body depth | | | | | | 0.77 | 0.51 | 0.62 | 0.75 | 1.58 | 2.14 | 6.72 |
| Head to dorsal origin | Dorsal not yet formed | | | | | | | | 4.22 | 8.41 | 10.50 | 12.85 |
| Head to pelvic origin | Pelvic not yet formed | | | | | | | | | | 8.02 | 11.17 |
| Head to anal origin | Anal not yet formed | | | | | | | | 5.09 | 11.80 | 12.99 | 15.87 |
| Depth at caudal peduncle | Not measurable | | | | | | | | | 0.75 | 1.15 | 3.48 |

Even though intensive care was taken during the laboratory rearing of larvae, most of them were found to perish immediately after the absorption of yolk sac. This phase is considered to be the 'critical period' in the larval growth. The term 'Critical period' was first applied to early development of fish by two early French fish culturists, Fabre-Domergue and Bietrix (1897). They used this term to describe the time of complete yolk absorption when normally high mortality is met with among marine fish larvae in laboratory rearing attempts. Therefore it is no wonder that successful rearing of fish larvae to adult stages has remained an elusive problem to ichthyobiologists and aquaculturists, and still continues to be a major hurdle in fish seed production programme. Until such time when laboratory rearing techniques attain perfection to effectively deal with the critical phase in larval growth and facilitate progressive development from egg to juvenile stages without any break, we will have to continue to depend on both laboratory reared stages and natural collections in order to present the whole range of development sequences.

RESULTS

Developing egg : Egg is pelagic, spherical and colourless with a very narrow perivitelline space. It ranges from 0.921 to 1.012 mm in diameter with an average of 0.966 mm. Yolk is segmented, and there is no oil globule.

Stage I (Fig. 1 A) : The eggs were collected at 3.30-4.00 a.m. and stage I shows the developing eggs as observed at 5 a.m. Cell division is at an advanced stage and the eggs is in morula stage.

Stage II (Fig 1 B) : This stage indicates further development as observed at 11 a.m. Developing embryo has 16 prominent somites, but the head or tail is not yet distinct. The eggs remain floating in the mid column of the water in the trough.

Stage III (Fig 1 C) : This stage reveals the growth at 4.10 p.m., 5 hrs after stage II. The formation of unpigmented eyes, heart and auditory vesicles is seen on the embryo.

Newly hatched prolarva (Fig. 1 D) : The eggs hatched around 8.15 p.m. 4 hrs after stage III described above. Prolarva is 4.52 mm in average length. There are 28 preanal

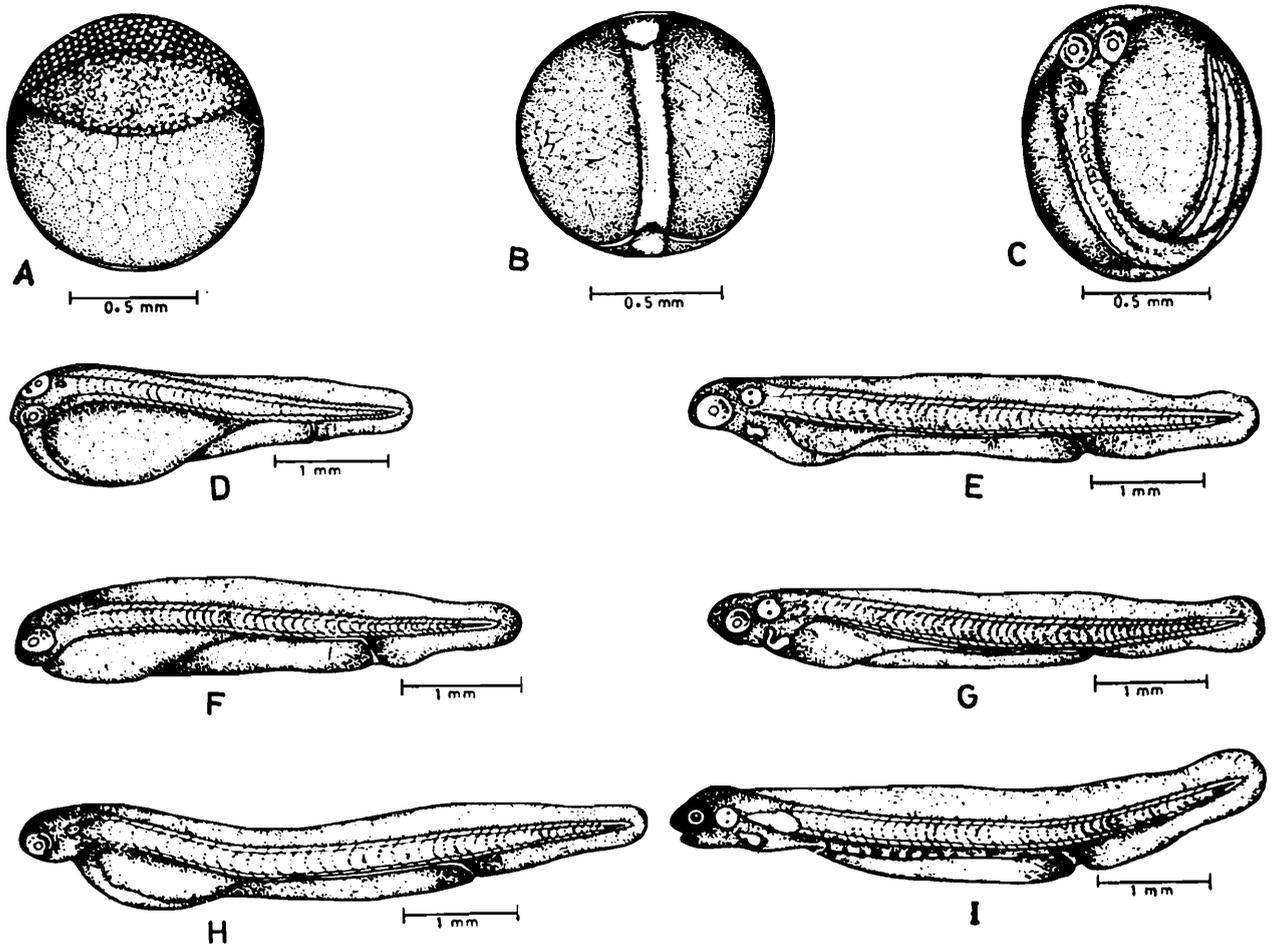


Fig. 1 (A—I). Eggs and larval stages of *Thryssa mystax* : A. Stage I—developing egg ; B. Stage II—developing egg ; C. Stage III—developing egg ; D. Newly hatched prolarva ; E. 16 hr prolarva ; F. 24 hr prolarva ; G. 40 hr prolarva ; H. 46 hr prolarva ; I. 64 hr postlarva

and 16 postanal myotomes. Yolk is heavy, and hence the larva tends to settle on the bottom of the troughs, but frequently moves about using its caudal fold. The caudal has not yet developed any ray. Tubular heart and the eyes are more prominent.

Prolarva—16 hr (Fig. 1 E) : The prolarva has grown to a length of 4.2 mm. Yolk sac is slightly diminished in size. There is no pigmentation on the body or the eye. Myotomes are constant at 28+16. The locomotory behaviour of the larva is the same as in the previous stage.

Prolarva—24 hr (Fig. 1 F) : The larva is 4.89 mm in

length. Yolk sac is further reduced in sizes. Myotomes remain at $28+16$. The caudal develops minute rays.

Prolarva—40 hr (Fig. 1 G) : Total length of the larva is 5.1 mm. Eyes are still unpigmented. Yolk is not fully absorbed. Heart is somewhat sac-like. The larva is very active, swimming constantly in a perpendicular manner from the bottom to the surface and *vice versa*, with occasional rest at the bottom. Myotomes are still constant at $28+16$.

Prolarva—46 hr (Fig. 1 H) : A slight reduction is noticed in the total length (5.0 mm). Yolk is still present. Myotomes have increased to $27+18$.

Postlarva-88 hr (Fig. 1 J) : The larva has not increased in length from that of the previous stage. The eyes are now movable as in the adult. The myotomes are $27+18$. Two

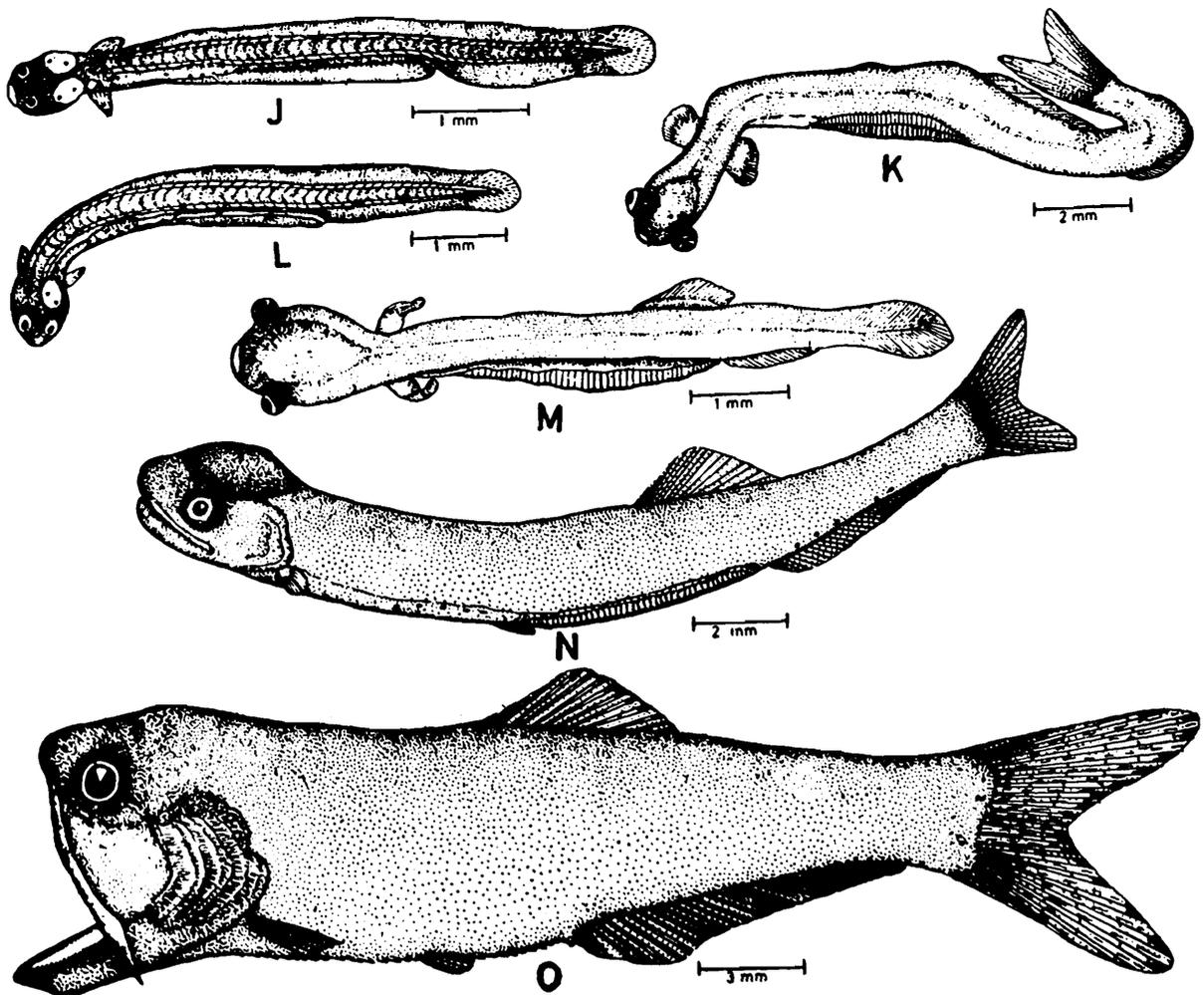


Fig. 1 (J—O). J. 88 hr postlarva ; K. 112 hr postlarva ; L. 7.4 mm postlarva ; M. 16.0 mm postlarva ; N. 20.2 mm postlarva ; O. 34.0 mm juvenile

new pigment spots are present just behind the heart. Caudal rays have increased in number and are very prominent.

Prolarva—64 hr (Fig. 1 I) : Total length has increased to 5.5 mm. with the complete absorption of yolk and the opening of the mouth and anus, the transformation into the postlarval phase has taken place. The eyes and optic vesicles are developed. The heart is sac-like. The pectoral fins develop as mere flaps. The lower jaw is smaller than the upper one. Melanophores are developed for the first time along the abdominal wall : 10 punctate pigments anteriorly and a single row of 10 stellate pigments posteroventrally. Caudal rays have further increased in number. The postlarvae-keep swimming in the subsurface water column.

Postlarva-112 hr (Fig. 1 K) : The larva has reduced to a length of 5.1 mm. Rays have developed in pectoral fins. The caudal rays are very minute, numerous and straight. The chromatophores are not as prominent as in the previous stage, but the pigments near the cardiac region are still present. Two of the 10 pigments spots at the anterior of the abdomen have disappeared. At the posterior of the abdomen there are 2 vertical bands and near the anus there is a stellate pigment. In the postanal region, there are 3 groups of chromarophores arranged in the ventrolateral side. There is no change in the myotomic number.

Postlarva of 7.4 mm length (Fig. 1 L) : The dorsal and anal fins have developed from the larval finfold, but the rays are not yet discernible clearly. All the pigments has disappeared. Anus is located below the level of the last ray of the dorsal, just anterior to the origin of the anal fin. The myotomes are 27+18 as in the previous stage. The notochord is still straight. Alimentary canal appears segmented as in *Stolephorus* spp (Thangaraja, 1982).

Postlarva of 16.0 mm length (Fig. 1 M) : The body is soft and elongate but coiled after preservation. Myotomes are not clear. The tip of the notochord is upturned. There are a few minute punctate pigments at the base of the eyes. The dorsal, anal and caudal rays are clear.

Postlarva of 20.0 mm length (Fig. 1 N) : The pigments have reappeared. There are about 5 punctate pigments along the base of the abdomen, but in front of the pelvic ; 2 punctate pigments on the isthums ; and, 8 punctate pigments between the anus and the caudal peduncle. The pelvic fins has developed. The extension of the maxillary bone is clear. There are 13 dorsal rays, 41 anal rays and 7 pelvic rays. Pectoral rays are minute and difficult to count. Preanal myotomes remain at 27.

Juvenile of 34.0 mm length (Fig. 1 O) : The juvenile is easy to identify. The base of the anal is pigmented. The dorsal side of the head has group of minute punctate pigments. There are minute pigments along the dorsolateral region from the head to the caudal peduncle. Pigments are also seen on the caudal rays. Minute teeth have appeared on the jaws. Gill rays and gill rakers are well developed. There are 15-18 prepelvic and 10-12 postpelvic ventral scutes, which are very prominent. The fin formula is D III, 11-12 ; A III, 32-39 ; P I, 12.

DISCUSSION

Clupeids are generally characterised by the segmentation of the yolk at the fertilised egg stage and the vertical arrangement of the muscles in the myotomes of the larvae. Delsman (1929, 1931) considers that the elongate eggs found in the Indian waters belong to *Anchoviella* while the irregular spherical eggs are those of *Engraulis*. He described two types of *Engraulis* egg, a larger type where the diameter is 1.0-1.1 mm and a smaller type with a diameter of 0.8-0.9 mm and concluded that the former belonged to *Engraulis gravi* and later to *Engraulis* (= *Thryssa*) *mystax*. The eggs described here resemble *T. mystax* in having an average diameter of about 0.96 mm.

According to Delsman (1929) and Vijayaraghavan (1929) the first day larva of *E. gravi* (= *T. hameltoni*) has 29 and 30 preanal myotomes respectively but in the present case the newly hatched prolarva is found to have only 28 preanal

myotomes. The 46 hr to 112 hr old larva has 27 preanal and 18 postanal myotomes (total 45). The number of larval myotomes (45) corresponds to the vertebral count of the adult ($21+24=45$). Interestingly enough, the preanal myotomes remained at 27 even in the 20.2 mm larva owing to the very slow forward shifting of the anus. However, the anus comes to occupy its adult position (below the 21st myotome), only when the larva grows to 34 mm in total length.

Rao (1964) collected the postlarva (5.5 to 25 mm) of *T. mystax* in all the zones of the Mahanadhi estuary, excluding the freshwater zone, and concluded that *T. mystax* is a purely brackishwater fish. In the present study also, the eggs, postlarvae, juveniles and adult were observed in the strictly estuarine zones of the Vellar estuary with a salinity range of 19.37 to 35.78‰. Both these observations indicate that spawning of *T. mystax* takes place in the estuaries and backwaters.

T. mystax resembles *T. Vitrirostris* in many external characteristics including the meristic counts (Whitehead, 1972). However, *T. mystax* has less number of gill rakers ($14-18+9-12$) than the latter ($21-23+14-17$). The serrae on the upper surface of the gill rakers are very few, comparatively short, and rather blunt in *T. mystax* (Thangaraja and Ramaiyan, 1983-1984).

The size of the developing eggs, the number of myotomes in the prolarvae and postlarvae, the number of ventral scutes and finrays in the juvenile and the nature of the gill raker serrae provide sufficient evidence to the identity of the present material as of *T. mystax*. The occurrence of mature adults of *T. mystax* in the localities where from the eggs and larvae described here were collected may be taken to be additional evidence to the above inference.

SUMMARY

Eggs and larvae of *Thryssa mystax* were collected from Vellar estuary and reared the developing eggs upto 112-hr stage in the laboratory. The postlarvae from 7.4 mm to

34 mm juvenile were studied from the plankton collections. Eggs, postlarvae, juveniles and adult were collected from the Vellar estuary with a salinity range of 19.37 to 35.78‰.

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