REARING LARVAL TUNAS IN THE LABORATORY

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Despite the extensive high-seas fisheries for the several species of tunas, little is known about the early life of these fishes. One of the objectives of the Life History Studies Program at BCF's Tropical Atlantic Biological Laboratory (TABL) is to solve problems that biologists encounter in working with eggs and larvae of tunas. We hope to rear successfully tuna larvae from fertilized eggs--and to describe the egg and the development of the species from hatching to the juvenile stage. At present, tuna larvae caught at sea are difficult to identify with certainty because of the similarity in appearance among tuna species. We hope also to determine growth rates and mortality rates of tuna larvae reared in the laboratory and to investigate factors that may have an important influence on survival. If the effects on larval survival of physical and biological factors can be evaluated, then useful predictions of future recruitment to tuna stocks in the open sea may be possible--through the use of indices of larval abundance, and measurements of such environmental variables as temperature, salinity, and availability of potential food for tuna larvae.

Obtaining Eggs and Embryos

Tunas are seldom caught when they are ready to spawn. Attempts made by TABL biologists to artificially fertilize tuna eggs on research cruises have been unsuccessful. Kume (1962) has reported the only known successful fertilization of tuna eggs. Two larvae of the bigeye tuna, Thunnus obesus, hatched in his experiments--but survived less than one day. Because we could not obtain adult spawners at TABL, we collected planktonic fish eggs in the Straits of Florida hoping that some tuna eggs might be present and that they might then be hatched in the laboratory.

Eggs were collected from May through August 1969 in the western edge of the Gulf Stream near Miami, Florida (Fig. 1). A 1-m. plankton net was towed at the surface where the pelagic eggs of many species of fish drift until they hatch. Collections were brought to the laboratory and an attempt was made to sort the eggs by type. Then eggs were incubated and the larvae were reared. Examination of larvae that hatched from eggs collected in May 1969 showed that we had successfully hatched, and reared to 12 days past hatching, larvae that we identified later as those of the little tuna, Euthynnus alletteratus (Fig. 2). This was the first time tuna were reared past the yolk sac stage under laboratory conditions.

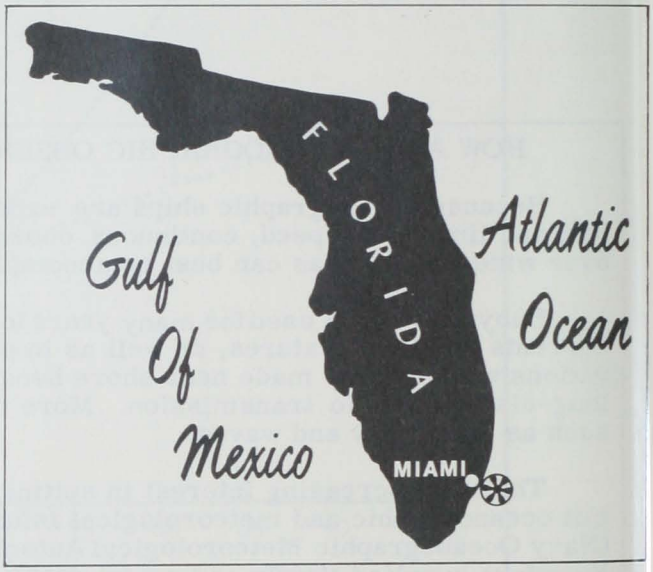

Fig. 1 - Area where eggs of the little tuna were collected. The eggs were hatched and reared in the TABL laboratory at Miami.

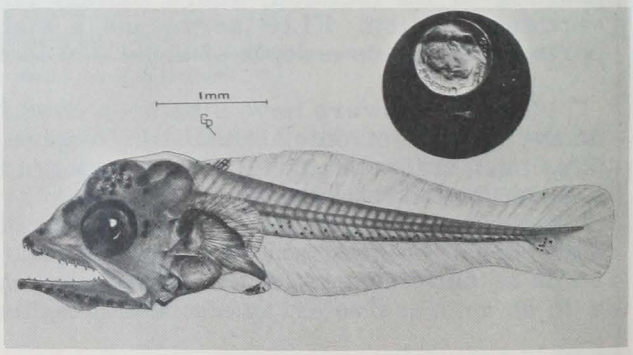

Fig. 2 - Twelve-day-old larva of the little tuna reared in laboratory.

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Note: See also "Larval Tuna Fish Reared for First Time," COMMERCIAL FISHERIES REVIEW 31(6):7(June 1969).

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Rearing Methods

Success in rearing tuna larvae beyond the yolk sac stage was achieved by using two slightly different methods. In the first, eggs were incubated in 20-gal. aquaria to which a dense culture of Chlorella was added to induce a "bloom" in the tank. We had known from previous experience that the likelihood of success in rearing pelagic fish larvae in small tanks increased by the Chlorella, but its role in promoting success is still unclear. In the second method, to vary the experiment, incubation and rearing were attempted in a 140-gal., round, fiberglass tank to which no Chlorella was added. Both tanks were aerated and circulated by compressed air provided through airstones. Water temperature was held at approximately 26° C. Lights were left on continuously in all tuna-rearing experiments.

Tuna larvae hatched within 12 hrs. of collection, probably within 24 hrs. after the eggs were spawned in the Gulf Stream. The larvae were slightly less than 3 mm. long at hatching and had a large yolk sac with a single, prominent oil globule. The eyes were unpigmented and no functional mouth or gut was present. Within 48 hrs. after hatching, the yolk was absorbed, larvae had developed pigmented eyes, and mouth and gut were functional. Food was added to the tanks at this time.

The food on which larvae of the little tuna began to feed was zooplankton collected in Biscayne Bay by a 35-micron mesh plankton net. For the first 3 days, only plankton less than 100 microns in body width was fed to the larvae, but larger organisms were offered to older larvae. Most of the food provided consisted of copepod nauplii and copepodites. Larvae in the 20-gal. aquaria and the 140-gal. tank accepted this food. Tuna larvae were very active in their search for food, and feeding rates were higher than those of many other fish larvae that we have reared.

The growth of larvae in our experiments probably was not as fast as in the natural environment. Though larvae fed well for about the first 10 days after hatching, the condition of most larvae then deteriorated. The growth in length for one rearing experiment is shown in Figure 3. Slow growth may have been due to a gradual increase in metabolites or bacterial contamination in the rearing tanks. We suspect that the behavior of larvae also may have been altered under tank conditions because most older larvae would not accept as food the larger zooplankton which has been observed in the guts of ocean-collected larvae. Twelve days after hatching, some larvae did accept brine shrimp (Artemia salina) nauplii, but the larvae would not eat large zooplankton or other larval fish.[1/]

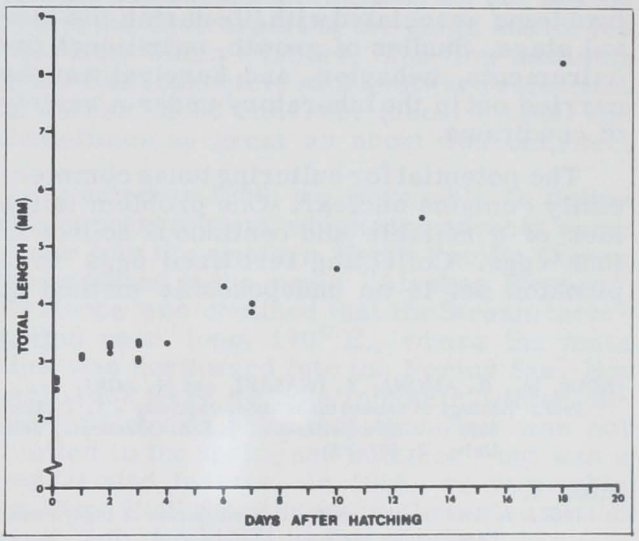

Fig. 3 - Growth in length of little tuna larvae reared in laboratory.

Larvae of the little tuna have not survived beyond 18 days after hatching in any of our experiments from May through July 1969. Causes for the complete mortalities are still unknown. About half our attempts failed because larvae did not initiate feeding and died shortly after absorption of the yolk. The percentage of successes was higher in the 140-gal. tank than in 20-gal. tanks; this suggests that the larger volume of water was beneficial to rearing. No rearing attempts were successful in 20-gal. tanks without a bloom of Chlorella, although larvae fed readily in the 140-gal. tank without Chlorella. One source of mortality undoubtedly was the presence of food at a density other than the optimum. Too little food could have caused starvation of the larvae, but too great an amount could have polluted the rearing tanks in a few days. The effects of food density and feeding rates on survival of tuna larvae are critical problems yet to be solved.

1/Charles Mayo, School of Marine and Atmospheric Sciences, University of Miami, recently succeeded in rearing the little tuna to more than 20 mm. long, and larvae of bullet mackerel (Auxis sp.) to about 12 mm. His larvae accepted larger food and growth was faster than in our experiments.

Potential for Rearing

Tunas probably can be reared beyond the larval stage in sufficient quantity for experimental purposes. Techniques still need to be improved. But the major obstacle in culturing pelagic larvae of marine fishes--failure of larvae to initiate feeding--does not seem as great a problem for tuna larvae (at least for the little tuna) as it is for larvae of many other fishes that we have attempted to rear. Experimental rearing of tunas offers an exciting opportunity to study many critical problems associated with life during the larval stage. Studies of growth, nutritional requirements, behavior, and survival can be carried out in the laboratory under a variety of conditions.

The potential for culturing tunas commercially remains unclear. One problem is the lack of a reliable and continuous source of tuna eggs. Collecting fertilized eggs in a plankton net is an undependable method of obtaining large numbers. Catches at sea of adult tunas ready to spawn are rare. This precludes the possibility of artificially fertilizing their eggs. Recent successes in maintaining adult tunas in captivity (Nakamura, 1962; Inoue et al, 1967) suggest that hormone injections might be used to stimulate these captive fish to spawn. Because adult tunas are among the most difficult of fishes to handle without causing mortality, however, the repeated handling now necessary when using hormone injections may be impossible for successful spawning of tunas and tunalike fishes.

Other problems to be solved include providing large quantities of animal food, and the large volume of good water required by fast-growing and active tunas. Some of our laboratory-rearing experiments may help to determine whether these problems can be overcome and, if so, whether tunas can be reared on a commercial scale.

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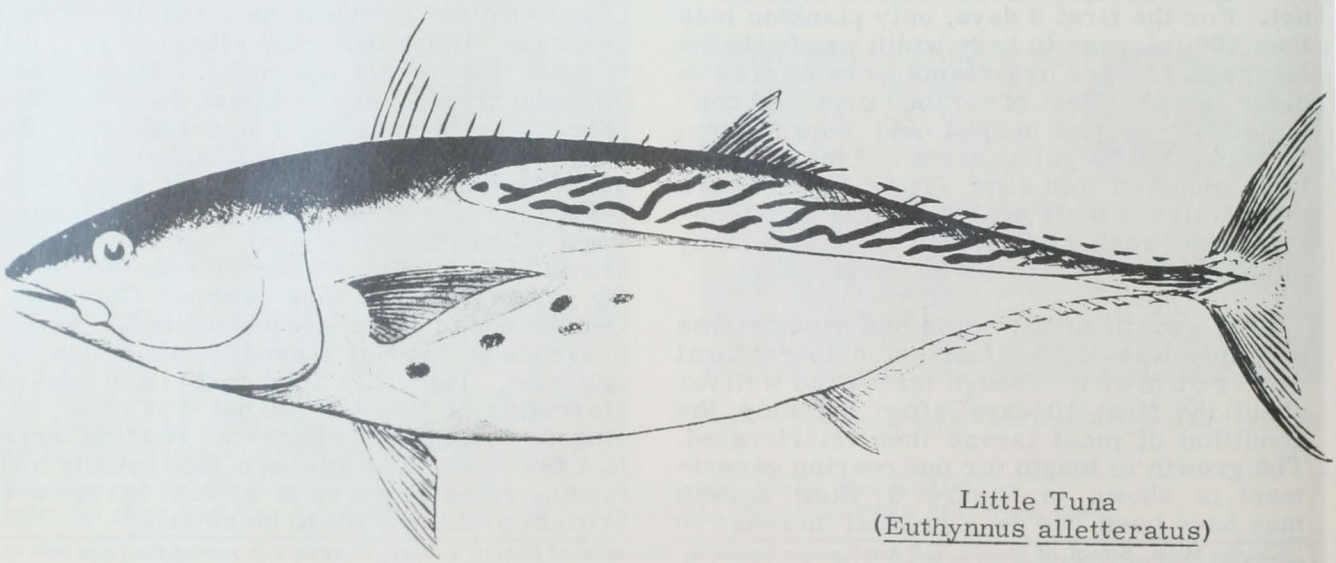

Little Tuna
(Euthynnus alletteratus)