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FIRST FEEDING OF ATLANTIC BLUEFIN TUNA (*THUNNUS THYNNUS*) WITH COPEPODS (*ACARTIA TONSA*) OR ROTIFERS/*ARTEMIA* – LARVAL PREY SIZE PREFERENCES, GROWTH, AND DEVELOPMENT

J.O. Evjemo[1], E. Kjørsvik[2], N.D. Xuan[2], P. Arvenne[2], Y. Attramadal[1], G. Øie[1], T. Bardal[2], O.A. Garcia[3], and F.D.L. Gandara[3]

[1] SINTEF Fisheries & Aquaculture AS, SINTEF Sealab, Brattørkaia 17C, N-7010 Trondheim, Norway
[2] Norwegian University of Science and technology (NTNU), Dept. of Biology, Center for Fisheries and Aquaculture, N7491 Trondheim, Norway
[3] Instituto Espanol De Oceanografia (IEO), Centro Oceanografico de Murcia, 30860, Puerto de Mazarron, Spain

Juvenile production of Atlantic Bluefin tuna (*Thunnus thynnus*) is characterized by high mortalities and low growth rates during the larval stage. Startfeeding of Bluefin tuna larvae in hatcheries depends on the traditional food organisms rotifers and *Artemia* nauplii, and skeletal malformations have been observed in 70% of larvae and juveniles. When copepods are used as live food, the results are generally improved compared to the use of traditional live feed organisms, with higher survival, increased growth, normal development, earlier onset of ossification and less skeletal anomalies compared to larvae fed rotifers and *Artemia*. The aims of this study was to describe prey size preferences during larval development, and evaluate the effects rotifers/*Artemia* versus cultivated copepods had on growth, development and skeletal deformities on the Atlantic Bluefin tuna from hatching and through the first feeding period up to day 20 post hatch.

Atlantic Bluefin tuna eggs were supplied by Fortuna Mare SL in Spain, and two larval startfeeding experiments were performed. The first was carried out in SINTEF Fisheries and Aquaculture's laboratories, where cultivated copepods (*Acartia tonsa*) of progressing stages were used as live feed from 3 days post hatch (dph), in a 3000-l tank (23-25°C, 35ppt, 24h light). The second experiment was performed by Fortuna Mare SL at the Instituto Espanol De Oceanografi (IEO) in Spain, where larvae were fed either enriched rotifers or *Artemia* in commercial larval rearing tanks. Larval development and skeletal ossification were studied from larvae sampled through the experiments, fixed in 4% formaldehyde in phosphate buffered saline (pH 7.4), 0-20dph in experiment 1 (n=5-10 per day) and 8-23dph in experiment 2. In the second experiment, larvae between 18-23dph were analyzed for bone anomalies (n=33-39 larvae per group). Anal-

yses of larval bone development were performed at NTNU Centre of Fisheries and Aquaculture, by staining with Alizarine Red.

Nauplii stages accounted for the highest fraction of ingested copepods in tuna larvae during the experiment. There were 100%, 95%, and close to 70% nauplii stages among the ingested copepods found in larvae 3-8dph, 9-14dph, and 15-20dph, respectively. The size of the copepods in the tuna larvae guts increased with larval age as well as larval standard length. From day 9dph the larvae gradually started to feed more on the copepodid and adult stages and less on the smaller nauplii stages.

The individual dry weight of newly hatched tuna larvae was 96±13µg. The larvae did not ingest food before 3dph and the dry weigh was reduced to 87±14µg. There was a significant rise in dry weight of larvae to 147±40µg in next three days and from day 6, the growth increased more rapidly and reached an individual dry weight of 1386±205µg at 14dph. At day 18, the individual dry weight had reached 2065±361µg, which means that the dry weight had increased more than 20 from day 3 until 18dph. In experiment 1, feeding with copepods resulted in growth rates of 39%.day^{-1} between 7dph and day 10dph, decreasing to 30 and 15% at 12 and 16dph, respectively.

Atlantic Bluefin tuna larval skeletal development first started with the ossification of the feeding apparatus (mouthparts and teeth, from 7dph), followed by the swimming structures (caudal fin, dorsal fins, from 10dph), then cranium, vertebral column (from 13dph), other fin rays (anal fin, pectoral fins, pelvic fins), and finally the pterygiophores. Ossification of the neural arches in the anterior part of vertebral column was first observed by 10dph, and all 39-40 vertebrae were ossified by 23dph. The tuna fed rotifers/*Artemia* had a significantly higher incident of skeletal anomalies than the copepod fed group, and a significantly higher number of larvae were affected (6.5 vs. 92%), observed at 18-23dph.

Although the number of larvae analyzed for skeletal anomalies in both experiments was low (n=23-31, for 18-23dph), the larvae from experiment 1 (feeding on copepods) had a relatively low incidence of skeletal anomalies (6.5 %), compared to experiment 2 (92%), and other studies 60% and 61.5% (Pacific Bluefin tuna) all feeding on rotifers/*Artemia*.

The increase of dry weight, standard length and low incidence of skeletal anomalies clearly show that *A. tonsa* represents an optimal live food organism for tuna larvae.

Feeding tuna larvae with the copepod *A. tonsa* showed that the fish ingested different nauplii, copepodid, and adult stages. The larvae actively selected the size of the live prey organism.