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The Study on the Technology of Producing Sea Bream (*Sparus aurata* L., 1758) Larvae in Marine Fish Hatcheries in Turkey

*Şahin Saka, Deniz Çoban, Kürşat Fırat

Ege University, Fisheries Faculty, Aquaculture Department, 35440, Urla, Izmir, Turkey
**E mail: saka@sufak.ege.edu.tr*

Özet: ***Türkiye'deki deniz balıkları kuluçkahanelerinde kullanılan çipura (*Sparus aurata *L., 1758) larva üretim teknikleri üzerine çalışmalar.*** Türkiye'de ki deniz balıkları kuluçkahanelerinde kullanılan çipura larva üretim teknikleri araştırılmıştır. Tam sayım metodu kullanılmış ve çipura üretimi yapan 7 adet kuluçka tesisi ile görüşülmüştür. Çipura larvası üretimi yapan işletmeler yeşil su tekniğinin etkisi altındadır. Türkiye'de uygulanan teknikler mümkün olan en gelişmiş yöntemler olmakla birlikte, bazı mühendislik bilgilerinin tamamı kullanılmamaktadır.

Anahtar Kelimeler: Deniz balıkları kuluçkahanesi, çipura, larva üretim teknolojisi

Abstract: It has been examined the sea bream (*Sparus aurata* L., 1758) larvae production techniques of marine hatcheries in Turkey. Full counting method was used and seven hatcheries produced sea bream larvae were interviewed. Cultivation of sea bream larvae systems in hatcheries in Turkey has been affected by green water technique. It has been established that the hatcheries in Turkey apply the improving technique as much as possible, but they do not use some of the engineering knowledge completely.

Key Words: Marine fish hatcheries, sea bream, larval rearing technology

Introduction

Even though the species *Sparus aurata* (L., 1758) is widely known in the Mediterranean region as a valuable fishery product with very good market price, the knowledge of it's special characteristics is incomplete while most information from experiments (mainly rearing data) are reserved and patented from big hatcheries and farms (Tandler and Helps, 1985; Conides, 1992). Marine fish cultivation within the Turkish mariculture industry has shown a rapid improvement for the last 15 years. The number of hatcheries dealing with larval production has increased up to 19 and the number of enterprises dealing with cultivation up to 243. In these hatcheries production of sea bass (*Dicentrarchus labrax*) and sea bream (*S. aurata*) is being periodically continued apart from the pre-studies of other species such as red sea bream (*Pagrus major*), common dentex (*Dentex dentex*), sharp-snout bream (*Puntazzo puntazzo*), striped bream (*Lithognathus mormyrus*) and turbot (*Psetta maxima*). The finfish mariculture industry comprises approximately 490 production units operating in about 11 countries of the Mediterranean basin. Particular reference is made to sea bream and sea bass culture (Stephanis, 1995).

Hamza (1989) studied mariculture in Egypt in three categorise such as fisheries, pond systems and integrated fish farms. He explained that besides sea bream, sea bass and grey mullet, other species resistant to salinity like tilapia and dover sole are cultivated in that region. The same researcher, in his studies in 1996, emphasized that hatcheries and sea bass and sea bream cultivation in off-shore cages were highly valued and the species were classified as sea bream, sea bass, rabbitfish, snapper, grouper, sole, bivalve, molluscs and marine shrimp. Garvey and Bennett (1991), in their studies dealing with fish cultivation and the legal improvements in Western Ireland, emphasized that aquaculture could be seen as an important potential source for the development of the country and could be considered as a strong development factor in local, regional, national and even EU standards. In Israel, marine culture has shown an improvement in cultivation of sea bream and sea bass in intensive pond culture and cage rearing for the last ten years although the studies on other species are in different stages of their improvement (Kissil, 1996). In this study we examined the sea bream (*S. aurata* larvae production techniques of marine hatcheries in Turkey.

Material and Methods

Hatcheries for marine fish in Turkey have been chosen as research subject. In 2001, the number of hatcheries rearing sea bream is seven. Seven hatcheries were interviewed. Four of these seven hatcheries interviewed are in the province of Izmir country, two in the province of Muğla country; one is in the province of Adana country. On their request, the names of the firms were kept hidden. A survey was conducted among all active businesses to determine the systems on sea bream larvae rearing, and the questions prepared for the inquire were answered by the authorities of the firms themselves. Then, after gathering the necessary data, and collecting later data, we evaluated data by comparing this information with international studies.

Results

In hatcheries concerned with the prelarval stage, it has been calculated that stocking densities were 100-150 larvae.l-1 (Figure 1.4). Larvae are kept in tanks that were 5% hourly water exchange (Figure 1.2) with a temperature of 16-17°C in the light (Figure 1.1; 1.3). In 62% of hatcheries concerned with the postlarval stage, stock density was 50-100 larvae.l^{-1} (Figure 1.5) and, in general, hourly water exchange was 5% at the beginning of that stage (Figure 1.6) and 40-50% at the end of that stage (at end of the metamorphosis) (Figure 1.7). A seawater inlet was applied from the bottom (Figure 1.9) with saturation colon (Figure 1.8). For the 24h illumination of larvae tanks artificial light is used (Figure 2.1) and intensity of light is adjusted by a rheostat (Figure 2.2). All hatcheries concerned with the larval stage used small sized rotifer (*Brachionus* sp.) (Figure 2.4) for the first feeding, and 13% of them did not know the origin of the rotifer they use (Figure 2.3). In general, all of the hatcheries use algae (*Tetraselmis* sp. etc.) and Selco in rotifer enrichment (Figure 2.5).

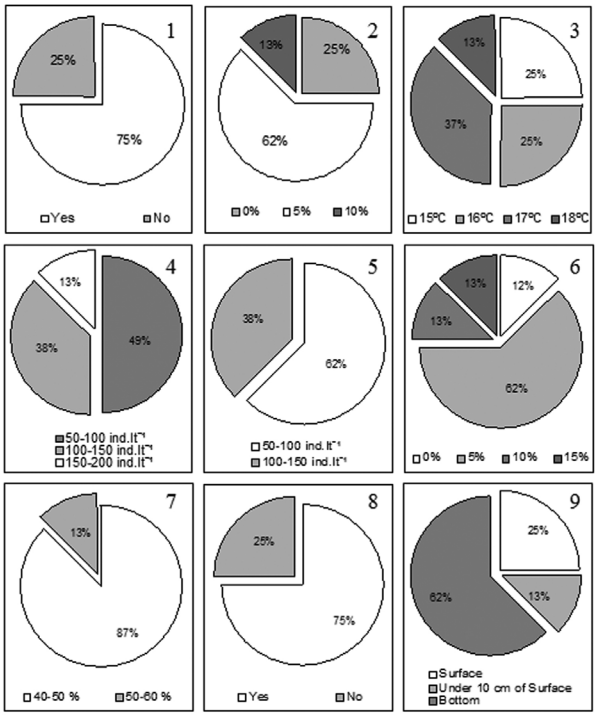

Figure 1. Light application (1), the amount of flow at the beginning of cultivation (2), temperature values (3) in prelarval period. The amount of stock in prelarval period (4). The amount of stock in postlarval period (5). The amount of flow at the beginning of cultivation in postlarval period (6). The amount of flow at the end of postlarva production (7). The use of saturation colon by hatcheries (8), position of sea water inlet (9).

In all hatcheries observed, it was noticed that INVE-originated *Artemia* were used (Figure 2.6) and the size of the first *Artemia* given were between 400 and 450µm (Figure 2.7). 87% of the hatcheries use INVE-originated microparticulate food with *Artemia* (Figure 2.8). It has been reported that in 73% of the hatcheries, digestive tract fullness rate of larvae was checked and found to be 60% and above (Figure 2.9). All hatcheries involved in this study classified larvae performance through growth measurement via a measuring box at least two times during production (Figure 3.1; 3.2). 50% of hatcheries faced the problem of air swallowing (Figure 3.3) and 75% of them applied the darkness method as treatment (Figure 3.4). 87% of the hatcheries involved in this study sorted the larvae with swimbladders from those without (Figure 3.5) and 43% used the method of density (by increasing salinity) (Figure 3.6). 43% of the hatcheries performed this sorting process during days 50-60 (Figure 3.7), and most of them eliminate the fish without swimbladders (Figure 3.8). Although 87% of the hatcheries observed swimbladder hypertrophy (Figure 3.9), 71% face hypertrophy in each cultivation period (Figure 4.1). All of the hatcheries declared swimbladder hypertrophy rate below 20%, and 57% use high illumination application when they face hypertrophy (Figure 4.2), 86% use high illumination to treat it, when faced with a swimbladder hypertrophy rate of 10-20% (Figure 4.3).

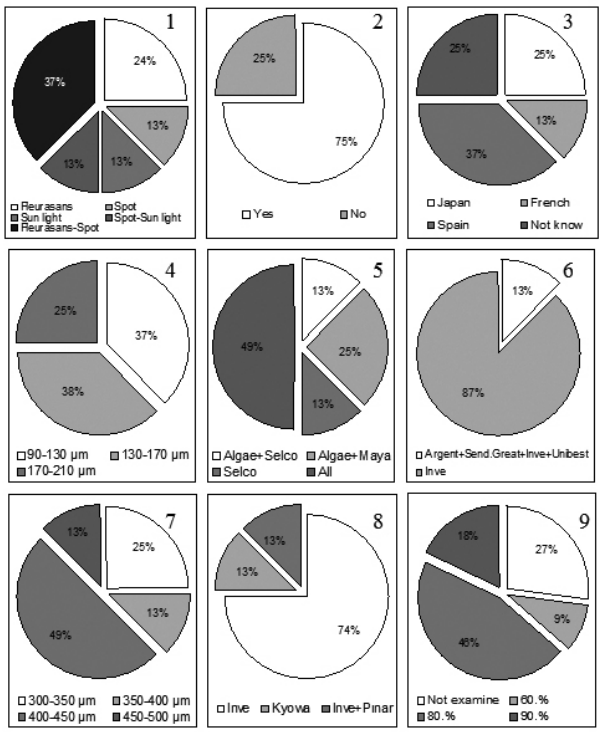

Figure 2. Source of light (1), usage of rheostat (2) in culture condition. Origin of rotifer used in feeding larvae (3). Sizes (4) and enrichment types (5) of rotifer used by hatcheries. Origin (6) and size (7) of artemia used by hatcheries. Microcapsulated food types in weaning stage (8), digestive tract fullness rate of larvae (9).

Discussion

During larval production period, seawater flow should be 0-30% during 1-30 days, 30-50% during 30-50 days (Alessio, 1976; Bromage and Roberts, 1995; Parra and Yufera, 2000). 62% of the hatcheries, in prelarval stage, and in the beginning

of postlarval stage, use 5% seawater flow; however, 87% of them, at the end of postlarval stage use 40-50% seawater flow. The results we have obtained from hatcheries showed parallelism with the results of the above studies.

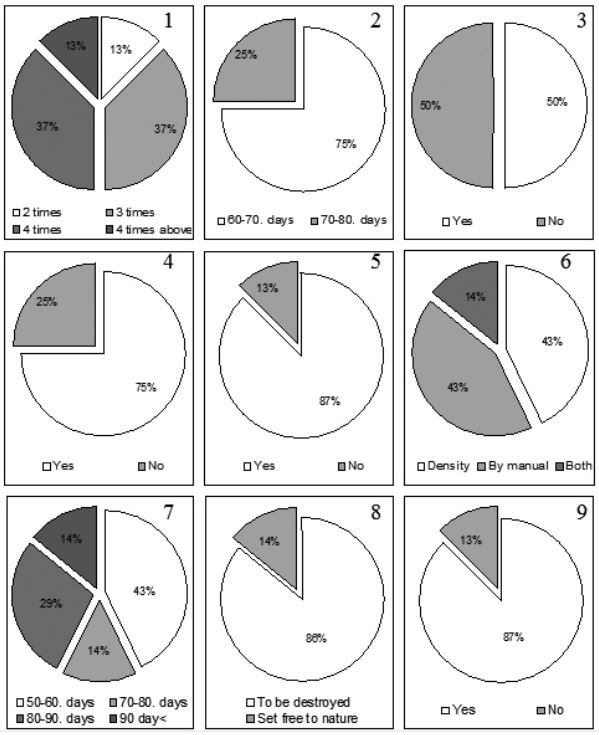

Figure 3. Number of growth measurement classification during larval production (1), first measurement time (2), rate of air swallowing in larvae according to hatcheries (3). Application of darkness method as a precaution taken when faced with air swallowing (4). Application for swimbladder (5), methods applied in sorting swimbladder (6), with or without swimbladder sorting time (7), position of chosen fish without swimbladder (8), observation of hypertrophy in firms (9).

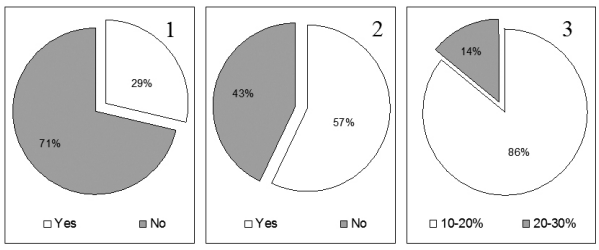

Figure 4. Rate of observation (1), application of high illumination to prevent hypertrophy (2), hypertrophy faced in each cultivation period (3).

Optimal temperature range for optimum feeding and growth (best food conversion rates) is between 18 and 22ºC for the species (Korringa, 1976; Conides, 1992). 16-22°C may be considered as the optimal temperature range for larval rearing *S. aurata* during embryonic development. Within this range, larvae at the stage of mouth opening showed the highest survival as well as the greatest length (Polo *et al*., 1991). In 80% of hatcheries, temperature limits show parallelism with the above mentioned limits and are between 14ºC-16ºC. In larval stage, the number of stock, as 50-100 individual per litre, plays a positive role on larvae improvement (Blancheton and Canaguier, 1995; Maurizi *et al*., 2000; Parra and Yufera, 2000). The results we obtained are the same with the number of stock mentioned above. Illuminating period, luminous intensity and the type of illumination are directly effective factors on the life of larvae and their improvements (Corneille *et al*., 1989; Cerqueria and Chatain, 1991). Generally, upper intensity light levels are required for growth optimisation (Boeuf and Le Bail, 1999). 63% of the hatcheries which took part in this study used spotlight first; however, they used a rheostat in order to prevent a sudden increase in luminous intensity. All hatcheries used 24 h illumination period.

Microalgae affect the microbiology (Nicolas *et al*., 1989), nutrition (Howell, 1979; Scott and Middleton, 1979), feeding (Reitan *et al*., 1993) and behaviour (Naas *et al*., 1992) of larvae. The addition of microalgae to the tanks during early rearing of the larvae may affect rearing performance (Planos and Cunha, 1999). All hatcheries were used green water techniques. It has been reported that the use of small sized rotifers significantly improves the initial feeding performance of turbot and specially sea bream larvae (Polo *et al*., 1992; Cunha and Planas, 1995) at the earlier development stages. The effect on feeding of using small sized rotifers is mainly due to an increase in feeding incidence rather than in ingestion rates (Cunha, 1996). *Rotifers* enriched by algae increased the number of alive larvae (Gatesoupe and Robin, 1982; Corneille et al., 1989). All hatcheries were used small sized rotifer (*Brachionus* sp.) enriched by algae for the first feeding.

Either enriched or not, giving artemia to bream larvae an important source of alive food for cultivating this species (Barnabe and Guissi, 1993). 87% of hatcheries used artemia produced by only Inve, the other firms used the other products of artemia as well. Artemia enriched with unsaturated fatty acids (20:5n3-22:6n3) increase the improvement and survival rate of larvae (Ballear *et al*., 1985). All of the hatcheries participated in this study use Selco products as artemia enricher. Artificial food given in the stage of changing from alive food to powdered food must be decided according to the feeding needs of larvae (Barnabe and Guissi, 1993). In artificial food highly digestive contents and useful formulations are needed (Bromage and Roberts, 1995). Although the artificial food products given show a large variety among firms, 87% of them use Inve products.

During larval stage and weaning stage, digestive tract fullness rates of larvae should be checked and evaluated daily. 73% of the hatcheries reported that they checked the digestive tract fullness rates but it is not understandable why the rest didn't. Sizing must be performed in order to prevent cannibalism in larval stage and to have them make optimum use of food (Bromage and Roberts, 1995). All the hatcheries do sizing in larval stage at least twice and 4 times at the most. When faced with air swallowing in larval stage, it must be provided that the fish should retire to mid-water level by

turning off the lights (Katavic, 1986; Chatain, 1987; Chatain and Ounais-Guschemann, 1990). In 40% of hatcheries air swallowing can be observed and half of them apply darkness method. 43% hatcheries that took part in this study do swim bladder sorting and use eye method to do the sorting. 43% of the hatcheries make this sorting on the 50-90 days and 14% of the hatcheries, leaving the fish without swim bladder into the nature, cause a negative effect on natural population. Deformities in biotic and abiotic factors cause extreme inflation of swim bladder in larval stage and directly effects living percentage of larvae (Chatain, 1989; Chatain and Carrae, 1992). It is known that increasing light intensity and illumination period up to 24 hours when faced with swim bladder hypertrophy has positive effects on larvae developed hypertrophy (Johnson and Katavic, 1984; Coves, 1987). 90% of the hatcheries reported that they met swimbladder hypertrophy and we have established in our study that 57% of them applied high light intensity as a treatment.

As a result, cultivation of sea bream larvae systems in hatcheries in our country has been affected by green water techniques. It has also been found that hatcheries did not perform any microscopic studies at a point when cultivation was critical. For instance, factors -like many firms do not check the digestive tract fullness rate of larvae at the first feeding or weaning stage- are quite important for not being able to solve the problems faced during cultivation. Apart from this, although the studies performed for the formation of swimbladder, either in the country or abroad, show parallelism, because the eye method used to do the sorting is not productive, fish without swimbladders can cause a lot of economical loss for the hatcheries. The fact that nearly 100% of artemia or microparticle food used by hatcheries in our country is provided by Inve is important from this point of market share of that company is in Turkey. In the light of these data, it has been established that the hatcheries in our country apply the improving technique as much as possible, but as it has been mentioned above, they do not use some of the engineering knowledge completely. We believe that it will be useful for cultivation of other species to make a study on the technology of producing sea bream larvae by some researchers in the future as it has been this study.

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