Salinity & temperature effects on seabream (Sparus aurata)

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Introduction

This section reports on the effects of salinity and temperature, during larval rearing, on the incidence of deformities in juvenile gilthead seabream (Sparus aurata). The experiments described were on specimens reared in the Red Sea (Israel).

It is well documented that providing the correct nutrition and environment improves growth and survival during the larval rearing of commercial teleost fish , factors which ultimately determine both production levels and quality.

However, environmental factors such as temperature and salinity can also have far reaching effects on the quality of juveniles produced, in terms of skeletal and cranial deformities. In fact, morpho-anatomical abnormalities can reach 90% of hatchery production, which can impact profoundly on the quality of marketed fish.

A study was made on gilthead seabream so as to determine the effect of larval rearing temperature protocols, at two different salinities (25 and 40 ‰), on the incidence of skeletal deformities that were screened at a later time in juvenile development.

Methods and Materials

The temperature protocols were employed throughout larval rearing and consisted of (1) constant 19 °C, (2) the NCM standard, which is an incremental increase from 19-24 °C ,and (3) constant 22 °C.

Each of the 6 larval rearing protocols (3 temperatures at 2 salinities) was replicated in 6 tanks.(Figure 1).

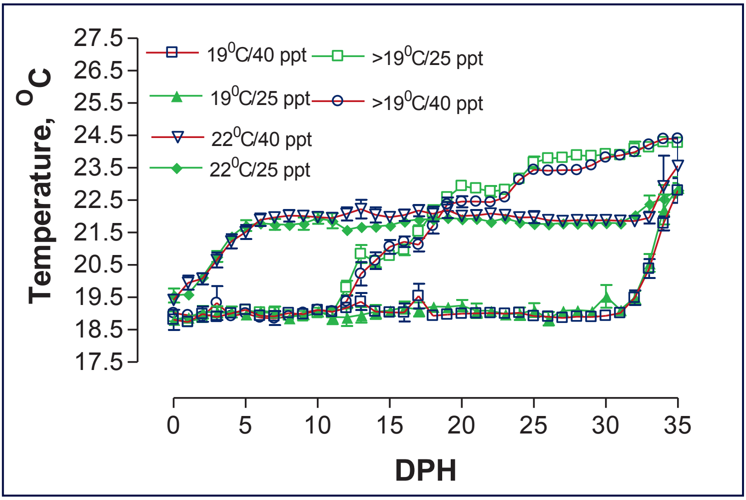

Figure 1: The experimental temperature/salinity (green always depicts the 25 ppt treatments) regime to which seabream larvae were exposed to measure its effect on deformities

Since rearing larvae at different temperature regimes would also mean different developmental rates, the end of larval rearing was determined at 1060 degree days.

At this stage samples were taken to determine swim bladder inflation, wet weight and length. The fish skeleton was not dense enough to be X-rayed so samples were stained with Alcian blue/Alizarin red in order to look at anomalies in bone and cartilage development. This procedure gives a very detailed and impressive result but, when fish are over 20 mm long, this approach demands much larger quantities of stain and fixing the tissues can take considerable periods of time.

After larval rearing, the fish were maintained in their separate treatments in the nursery but all were fed the same food until about 6 months after hatching. Once the fish were over 45 mm, they were X-rayed for skeletal deformities.

Results and discussion

The treatments had no significant effect on notochord length or biomass gain at the end of larval rearing (1060 degree days). However, larvae reared at the higher salinity (40 ‰) showed markedly poorer swim bladder inflation that their cohorts at 25 ‰ in all three temperature regimes (Figure 2).

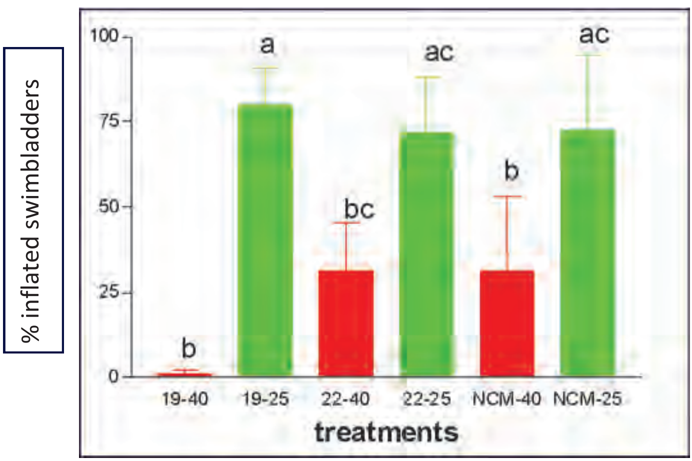

Figure 2: The effect of temperature (19, 22, NCM) and salinity (25, 40 ‰) rearing protocol on swim bladder inflation. Percent values having different letters were significantly ($P<0.05$) different (green always depicts the 25 ppt treatments).

There was also a tendency for better survival in the lower salinity treatments, which was significant in fish reared at 22 °C. In fact, juvenile fish from the 40 ‰ salinity treatments exhibited the highest incidence of skeletal malformation (mainly lordosis, kyphosis and vertebral compression) but no clear effect on cranial deformities when compared to fish reared at 25 ‰ at the end of the study (Figure 3).

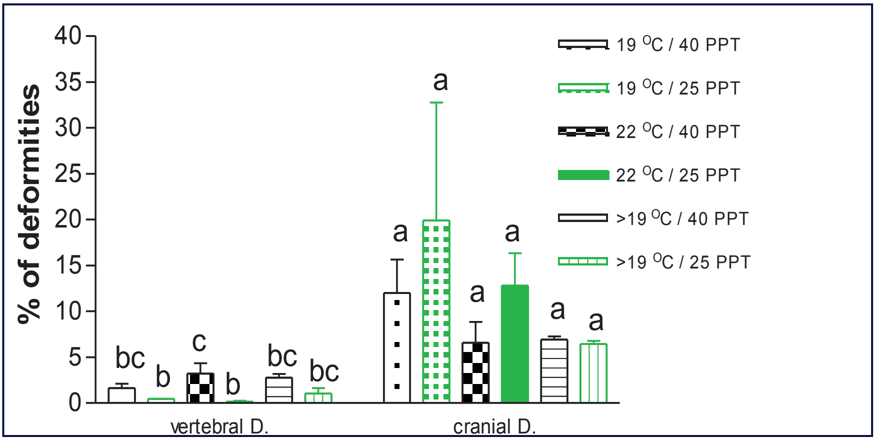

Figure 3: The combined effect of temperature/salinity regime (green always depicts the 25 ppt treatments) on the percentage of seabream having vertebral or cranial deformities

It is interesting to note that among fish lacking a swimbladder (Figure 4) the incidence of vertebral deformities was very high in all treatment combination except for the 22ºC/25 ppt. Furthermore, pug headedness was minimized at a salinity of 25 ppt, independently of the temperature regime.

Regime / Deformity	19-40	19-25	22-40	22-25	NCM-40	NCM-25
Vertebral	**70.2**	**75.0**	**75**	**0**	**96.3**	**43.3**
Pug head	**27**	**0**	**27.6**	**5.1**	**23.3**	**0**

Figure 4: Percent of deformity type found in fish lacking swim bladders

This difference was particularly conspicuous in the constant 22°C temperature rearing regime. Fish that are lacking a swim bladder must expend considerably more energy by excessive swimming in order to maintain their position in the water column.

This increases the stress load in the tail region which causes the vertebrae to respond by increasing bone volume, flattening dorsal zygapophyses and growing extra lateral ridges which decrease the strain from the faster tail beating but frequently results in haemal lordosis.

However, this study did not show a significant effect of larval rearing temperature on skeletal deformity. This observation is at odds with studies in other species, such as the European sea bass (*Dicentrarchus labrax*), which showed a very clear effect of early developmental temperature on the incidence of lordosis. Moreover, this deformity increased in severity if coupled with increasing critical swimming speed.

In fact, the overall incidence of skeletal deformity in fish from our study was conspicuously low (1.7%) when compared to gilthead seabream culture in Europe.

This observation may be tied to broodstock selection from the warmer seawater of this region (Red Sea). Conceivably, this results in the progeny exhibiting lower levels of abnormality when challenged with higher temperature rearing conditions.

Taken together, this suggests that genetics is also an important factor, apart from environmental influences, in explaining varying levels of deformity among different geographical populations of gilthead sea bream.

Recommendations (for gilthead seabream)

1. **For better seabream larval survival, it is recommended to rear at lower salinities (tested salinity was 25 ppt)**

2. **In order to minimize vertebral deformities (1.7%), perform your larval rearing at a salinity of 25 ppt**
   The incidence of skeletal deformities was independent of the rearing temperature within the range of 19-25ºC

3. **For best rearing results, in terms of malformation and growth, rear at 22ºC and 25 ppt for the entire larval period of 35 DPH (770 degree days)**

References

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