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Effects of different feed amounts on the growth performance of gilthead sea bream (*Sparusaurata*) in the Black Sea

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The aim of this study was to investigate the growth performanceof gilthead sea bream (*Sparusaurata*) fed by different feed amounts in the Black Sea. The gilthead sea bream with an average weight of 11.24±0.04 g was fed by restricted amounts of food (Group I) and *ad libitum* (Group II) for 127 days. At the end of the study, the average weight and feed conversion rates of Group I and Group II were 70.58±0.79 and 74.26±0.54 g and 1.68±0.07 and 2.19±0.15 g, respectively. Group II showed higher growth between III and VI periods where the water temperature was relatively high. The growth was limited in the periods between VII to IX under optimal temperature value. At the end of the study, growth differenceswere not significantly differed between the groups (p>0.05). While the final weight, relative growth rate, specific growth rate, feed efficiency and survival were not significantly different (p>0.05), there was a significant difference in feed conversion rate between the groups (p<0.05). At the end of the study, it could be concluded that water temperature is the most important factor in the growth rate of Gilthead Sea Bream in the Black Sea.

Keywords: Black sea, Gilthead sea bream (*Sparusaurata*), feeding, growth, feed efficiency, temperature.

INTRODUCTION

European finfish mariculture spans a broad latitude range, from the Mediterranean basin in the South, to the North Atlantic areas bordering the Arctic Circle. Marine fish cultivation is dominated by three species in this region: salmon (*Salmosalar*), European sea bass (*Dicentrarchus labrax*) and gilthead seabream (*Sparusaurata*). While farmed salmon production was 1,570,327 ton,the global production of farmed European sea bass and gilthead seabream were approximately 163,610 tonnes in 2011 (Anonymous, 2012). Although gilthead sea bream is scarcely found in the Black Sea (Banarescu, 1964; Svetovidov, 1964), it is very common in the other seas surrounding Turkey. Annual gilthead sea bream production in Turkey was 34 tonnes in 1986 and reached to 32,187 tonnes in 2011 (Anonymous, 2012).

The gilthead sea bream is the most common cultured fish species of the Mediterranean area and its production increased during the last decades. In the areas where

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Table 1. The recommended feed amount according to water temperature (%)

Weight (g)	Temperature (°C)			
	13-17	17-22	22-25	25-28
10-35	1.8	2.0	2.2	2.0
35-100	1.4	1.6	1.8	1.6

Table 2. Proximate composition (%) and energy content (Kcal g^{-1}) of the feeds according to the feed company.

Composition	Diet A (1-1.5 mm)	Diet B (3 mm)
Crude protein (%)	55	45
Crude fat (%)	16	20
NFE	9	13
Ash (%)	9.1	10
Cellulose	1.7	1.8
Moisture (%)	8.5	8.5
Vitamin A (IU kg^{-1})	16000	12500
Vitamin D3 (IU kg^{-1})	5000	3000
Vitamin E (mg kg^{-1})	600	300
Vitamin K3 (mg kg^{-1})	80	50
Vitamin C (mg kg^{-1})	1000	500
Gross energy (Kcal g^{-1})	5000	4800
Digestible Energy (Kcal g^{-1})	4300	4100
Metabolic Energy (Kcal g^{-1})	4000	3700

water temperature drops to 9°C, this species suffers from somedisease (Tortet al., 1998). Due to the decrease in the food intake at low water temperature levels, it is emphasized that the given amount of food should be determined in a sensitive manner (Temelli et al.,1991a).

Despite the many studies on feeding requirements, fresh and the pelleted food intake (Company et al., 1990; Goldan et al., 1997; Guinea and Fernandez, 1997), using feed stimulants (Chatzifotis et al., 2009) and alternative raw materials in food of juvenile gilthead sea bream (Emre et al., 2008; Emre et al., 2013), studies on the feed amount and rates of this species are very scarce.

The aim of the present study was to evaluatethe effects of different feed amounts on growth, feed efficiency and survival rate of juvenile gilthead sea bream in the Black Sea conditions.

MATERIALS AND METHODS

Fish stock, rearing condition and experimental design

Origin and maintenance of fish stock

Young gilthead sea bream were obtained from a commercial farm based in the Aegean Sea. The study was conducted between 24 June and 5 November for 127 days. The average weight of fish was 11.24±0.04 g and was transported to the Marine Fish Facilities of Aquaculture and Fisheries Faculty of Sinop University. Rectangular polypropylene tanks with a water volume of 55 L were used for the study. Each tank received running sea water (17-18‰) at 3 L/min.

Diet and experimental design

The study was designed astwo groups withthree replicates. A total of 120 fish (20 individuals for each tank) were used. Fish were weighted every 2 weeks throughout the study period(a total of 9 periods) of 127 days in order to adjust feed ration. Temperature was measured twice a day. The other water quality parameters (dissolved O_2, pH and salinity) were measured once a day during the study.

The feed obtained from a commercial fish feed company (Çamlı Yem Besicilik, İzmir-Turkey) was used for feeding the fish.Two feeding regimeswere used. The first group (Group I) was fed by restricted amounts of food according to the recommended table specification (based on the live weight percentage depending on water temperature) supplied by the company (Table 1). Known quantity of feed was prepared prior the study and the second group (Group II) was fed with the same feed to satiation.After fish cut the taking feed, the remaining feed was weighted to determine the feed consumption in Group II.

The specification of feed was given in Table 2. Since the mouth opening changed during the study, diet A was given until the IV. Period and diet B was given after that time.

Both groups were fed twice a day (in the morning and in the evening). Parameters were calculated according to the formulae given by Steffens (1989), Yiğit et al. (2002) and Yıldırım et al. (2009):

Table 3. The growth performance, food amount, feed conversion rate and survival rates of the experimental groups.

Parameter	Group I (% wet weight)	Group II (Satiation)
Initial total length (cm)	9.11±0.26[a]	9.14±0.23[a]
Initial weight (g)	11.22 ± 0.04[a]	11.25 ± 0.03[a]
Initial condition factor	1.49±0.13[a]	1.47±0.11[a]
Final total length (cm)	16.15±0.13[a]	16.21±0.06[a]
Final weight (g)	70.58 ± 0.79[a]	74.26 ± 0.54[a]
Final condition factor	1.68±0.05[a]	1.74±0.02[a]
Weight gain (fish/g)	59.36	63.01
Total weight gain (g)	1143.8	1266.6
Total feed intake (g)	1922	2127
Feed conversion rate	1.68±0.07[a]	2.19±0.15[b]
Survival (%)	95.00±1[a]	90.00±2[a]

[a,b]Means±SD followed by the same letter, within a row, are significantly different ($p<0.05$).

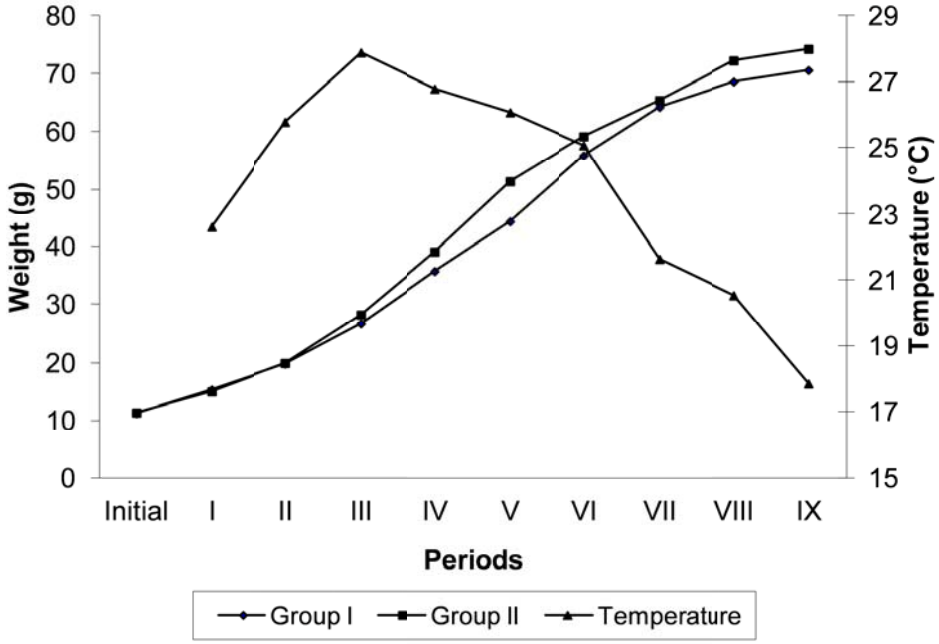

Figure 1. The mean wet weights and temperature during the study.

Condition factor; $W = aL^b$

Weight gain (fish/g): Final weight (g)-Initial weight (g); Feed conversion rate (%): FCR= Total feed intake (g) / wet weight gain (g); Survival (%)= Initial fish number/ Final fish number.

Statistical analysis

Statistical analysis included one-way analysis of variance (ANOVA) and Tukey's multiple significant difference tests using the software program (IBM SPSS 21). Survival rates data were transformed to arc-sin prior to statistical test.Differences were regarded as significant at $p<0.05$ level.

RESULTS AND DISCUSSION

At the end of the study period, except feed conversion rate, no statistically significant differenceswerefound between the two groupsfor severalgrowth performance parameters ($p>0.05$) (Table 3). A decrease in live weight percentage (%) was determined in both feed amount in accordance with the decreasing water temperature (Figure 1). While the highest feeding rate was determined in period IV at the average water temperature of 26.8±1.1°C, the lowest feeding rate was observed in period IX at the average water temperature of 17.9±0.9°C.

The best growing water temperature for gilthead sea bream was reported as 22-24°C (Benli and Uçal, 1990; Alpbaz, 2005). In this research, relative growth rates at the water temperature between 17-29°C were 23.26% in Group I and 24.20% in Group II. However, reduced growth rate was observed by decreasing temperature. Some studies showed that while growth rate was high in spring and summer months, it was low in fall and winter months and the fish got lost weight (Gjerdem and Gunnes, 1978; Okumuş et al.,1997). Şahin et al. (1999) stated thatgilthead sea bream loses weight because of low water temperature after November in Black sea.

Temelliet al. (1991b) reported that gilthead sea bream reached to 27g from 15.38 g and to144.5 g from 110.6 g by feeding 1.4-1.7 and 1-2% of body weight, respectively at 20-26°C after 3months. In the present study, total weight gains were 59.36 and 63.01 g in Groups I and II, respectively (Table 3).

The condition factor values of gilthead sea bream were 1.39-1.84 in the Aegean Sea at 14-18°C water temperature (Temelli et al., 1991b). Şahin et al. (1999) reported that the condition factor values changed between 1.4 and 1.8 in gilthead sea bream in winter months in the East Black Sea.At the end of this research, condition factors were 1.68 and 1.74 in group I and Group II, respectively which werein accordance withthe previously mentioned researches.

The specific growth rate of gilthead sea bream was 0.3 in ponds in the Aegean Sea (Gordin et al., 1987), 0.6 in net cages in the Mediterranean Sea (Bermüdez et al., 1989), 0.6 in net cages in the Aegean Sea (Alpbaz et al., 1991), 0.4 in tank media in the East Black Sea (Şahin et al., 1997),and between 1.1 and 1.3 in cages in the Black Sea (Çiftçi, 1997). It were 1.45 (Emre et al., 2008), 2.12 (Chatzifotis et al., 2009) and between 2.42 to 2.44 in tank media in the Mediterranean Sea (Emre et al., 2013), respectively. In this research, specific growth rates (1.36±0.01 in Group I and 1.40±0.02 in Group II) were higher than thatof the mentioned studies. The differences could be result from the food specifications, the fish size, the cultivation conditions and the seasonal differences.

Feed conversion ratewas 3 in cagesin the Mediterranean Sea (Bermüdez et al., 1989), between 2.3 and 2.4 in cages in the Aegean Sea (Tekin, 1996), between 1.1 and 2.2 in tanks in the Aegean Sea(Gençand Tekelioğlu, 1997), between 1 and 1.8at water temperature of 14.18°C cages in the Aegean Sea (Temelli et al., 1991b), between 1.1 and 1.48 in tanks recirculation water system (Kissil et al., 1997), between 2.1 and 2.2 in tanks in the East Black Sea (Şahin et al., 1999). It was 2.09 (Emre et al., 2008), 1.1 (Chatzifotis et al., 2009) and between 2.05 to 2.08 in tank media in the Mediterranean Sea (Emre et al., 2013), respectively. In our research, the feed conversion rates were 1.68±0.07 in Group I and 2.19±0.15 in Group II.

The growth performance of gilthead sea bream have been tried to be evaluated in the present study with two different feed amount. Group II showed higher growth between III and VIperiods where the water temperature was relatively higher (25.1-27.9°C). The growth was limited in the periods betweenVII-IX where the water temperature was under the optimal value.At the end of the study, growth difference was not significantly different between the groups ($p>0.05$).

While the feed conversion rate was high in Group II at optimum water temperature, same growth values were obtained with restricted feeding under optimum water temperature value. This situation showed that the feed given under optimum water temperature was not converted into the desired weight gain. Ultimately the feed amount rises, and this condition increased the production costs.

Therefore, feeding to satiation by taking into consideration temperature values or feeding regime according to the table values provide both reducing feed costs in production and release of less waste into water.

Conclusions

The present results reveal that temperature significantly affect the growth and feed utilization of gilthead sea bream in Black Sea ambient conditions. It can be concluded that gilthead sea bream juveniles can show optimum growth rate between June and November until the water temperature decrease to the below 17°C in Black Sea.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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