ISSN 1110-0354

Bull. Nat. Inst. Of Oceanogr. & Fish., A.R.E., 2003 Vol. (29): 267 - 279

STUDIES ON GROWTH AND PRODUCTION OF SEABREAM SPARUS AURATA IN BRACKISH WATER FISH FARMS

BY

ABDALLA, A. EL-SHEBLY& NAGAT A. SILIEM
National Institute of Oceanography and Fisheries, Alexandria, Egypt

ABSTRACT

The effect of two stocking densities (1500 and 3000 fry/feddan) on growth performance, survival rate and total fingerlings yield of sea bream, Sparus aurata, fry was investigated. The results indicated that, density effects growth in extremely dense sea bream monoculture in nursing earthen ponds. However, sea bream fry reared at high density tended to have more fingerlings production.

Monthly variations in growth rate of sea bream fingerlings during rearing period were studied during the present work. It was observed that growth almost ceased after November when water temperature dropped below 15°C, fishes growth rate decreased between January and April, then growth increased as dependant on water temperature.

The final production of sea bream (Sparus aurata) reared under semi-intensive conditions was 407.2 kg with a mortality rate of 7.7%.

INTRODUCTION

Gilthead sea bream (*Sparus aurata*) is one of the most commercially important species for aquaculture. It is a highly level protein species in Mediterranean countries and can be produced in hatcheries.

Little work was done on the biology and culture of Sparus aurata in Egypt. Wassef (1978) investigated the growth in length and weight of Sparus aurata in the Egyptian Mediterranean waters at Alexandria; Ben-Tuvia (1979) studied the population dynamics and fisheries of gilthead sea bream in Bardawil Lagoon, Ameran (1992) studied the fish production of Bardawil Lagoon with special references to some biological aspects of Sparus aurata, El-Gamal (1997) studied the reproduction of the gilthead bream Sparus aurata reared in fish farms and Tharwat et al. (1998) studied stock assessment of the gilthead sea bream Sparus aurata from Bardawil Lagoon. Many authors studied the biology, embryonic development, growth and population dynamics of Sparus aurata in other regions of the world, Paul (1976), Zohar et al. (1978), Kiriakos et al. (1993), Petridis and Rogdakis (1996), Goldan et al. (1997), Miro and Jakov (1997), Fernandez et al. (1998), Goldan et al. (1998), Bessonart et al. (1999), Nikos et al. (2000), Carrillo et al. (2001), Nikos et al. (2002) and Sanchez (2002).

In Egypt, during recent years attempts have been in progress to develop marine fish culture under pond farm management conditions. The main problems seemed to be a shortage of information on the scientific management of marine fish farm, adequate fish feed and technology as well as pollution (Siliem, 1998; Essa, 2000 and Helal, 2003).

With this view point in mind, the present study was initiated to check what the effect of stocking density may have on the performance and yield of gilthead sea bream, *Sparus aurata*, raised in monoculture during fry nursing period. The present study aimed also to throw the light on the monthly variations in growth rate of sea bream fingerlings during rearing period under pond farm management conditions.

MATERIALS AND METHODS

1-Place of study:

Experiments of the present study were carried out at private brackish water fish farms at Shata City, Dameitta Governorate.

2-Experiment No.1:

The effect of the different stocking density on growth performance, survival rate and total yield of gilthead sea bream, *Sparus aurata*, fry:

The source of the experimental sea bream fry was the estuary of the River Nile, Damietta. During nursing period (90 days), the fry with a mean length and weight of 1.72 cm and 0.16 g were reared in earthen ponds (one feddan each) at low (1500 fry/fed.) and high (3000 fry/fed.) densities. The commercial supplementary feed meal from Sherbin oil company (30.8 % protein) was provided to the fry at a rate of 10 % of the total body weight of fish per day for six days a week. Utilization of the natural food available in the nursing ponds by the application of organic fertilizers (cow manure) at a rate of 1.0 ton/fed / year was also employed.

3 -Experiment No.2:

Monthly variations in growth rate of sea bream, Sparus aurata, fingerlings during rearing period in earthen ponds were studied:

Gilthead sea bream fingerlings with an average length of 9.0 cm and weight of 8.13 g were stocked in July, 2001 in rearing earthen ponds (1-3 fed/each) at a rate of 1500 fish / feddan. Fish were supplied with fresh trash fish and shrimp at a rate of 3% of the live body weight, two times daily, six days a week.

At monthly intervals, 30 fish were taken randomly as sample. Total lengths to nearest 0.1 cm, body weights to nearest 0.1 gm for each fish samples were recorded to determining growth rate, condition factor and to readjust the amount of food requirements. At the end of the experiments (August 2002), the ponds were drained and fish were collected and weighed.

4-Analysis:

Monthly from each nursing and rearing ponds, mean weight and length for fish were recorded from random samples of at least 30 fish. Water temperature, dissolved oxygen, pH and salinity values were measured daily.

Analysis of variance, F-test and Duncan's multiple range test were employed in evaluating the experimental results according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1-Experiment No.1:

The effect of the different stocking density on growth performance, survival rate and total yield of gilthead sea bream, *Sparus aurata*, fry:

Initial and final means of standard length, body weight and condition factor of sea bream fry reared in monoculture at different densities are shown in Table (1). Sea bream stocked in low density (1500 fry/fed.) had the heaviest body weight, longest length and highest condition factor, comparing with those reared in high density (3000 fry/fed.). The differences in body weight between densities were significant ($P< 0.05$). But in case of body length and condition factor, the differences were insignificant. From Table (2) it is observed that, the use of high density resulted in increasing fingerlings production by 69% (60.68 Vs 102.53 kg /fed. fingerlings). In contrast, specific growth rate (SGR) was slightly decreased by using high stocking rate, but the differences were insignificant.

The present result showed also that the best survival percentage (65.20%) was observed in sea bream fry reared at low density (Table 2). A similar response was also observed on the basis of daily gain in standard length (Table2). The results of the present experiment may be attributed to:

1) When the stocking density is low or moderate, the natural and supplementary feeds are usually sufficient to the maximum fish growth and survival. This effect has been observed also for mullet, sea bass, tilapia and carps (Hepher and Pruginin, 1981; Essa *etal.*, 1989; Siliem, 1998 and Helal, 2003).

2) The high density ponds are more turbid and thereby affected negatively fish food intake and growth (Swift, 1955; and Siliem, 1998).

The above results showed that, density effects growth in extremely dense sea bream monoculture in earthen ponds. However, sea bream fry reared at high density tended to have more fingerlings production.

Table (1): Mean initial and final standard length (cm), body weight(g) and condition factor(k) of sea bream, *S. aurata*, fry reared at two densities during nursing period(90days).

Items	*1500 fry/fed.*	*3000 fry/fed.*
1- __At the beginning:__		
Av. Individual standard length	1.72	1.72
Av. Individual body weight	0.16	0.16
Av. Individual condition factor	3.14	3.14
__2-At the end:__		
Av. Final Individual length	15.00	14.50
Av. Final Individual body weight	62.05	55.30
Av. Final Individual condition factor	1.84	1.81

Table (2): the effect of stocking density on the growth rate, total fingerlings yield and survival rate (%) of sea bream fry reared in monoculture at two densities during nursing period (90 days).

Items	*Stocking data*		*Harvesting data*				
	Density/fed	Total biomass (kg/ fed)	No.of fingerlings harvested/fed	Total yield (kg/fed	Sur. rate%	S.G.R %/day	Ind. Daily length gain (cm/day
Low density	1500	0.24	978	60.68	65.2	5.54	0.147
High density	3000	0.28	1854	102.53	61.8	5.25	0.142

2- Experiment No.2:

Monthly variations in growth rate of sea bream fingerlings:

During the rearing period, water temperature varied from 14^{0}C during winter months to 28.5^{0}C during summer months.

The oxygen content was low during summer months and high in winter. Its values ranged from 5.0 mg/L in August to 10.5 mg/L in January with an average of 6.5 mg/L. pH was within the normal ranges advised for fish culture and its average value was 7.7. The salinity fluctuated between 15 gm/L in winter and 21 gm/L during summer with an average of 17.2 gm/L.

The average length, weight, daily gain in weight, monthly growth rates and condition factor of the cultured sea bream (*Sparus aurata*) during the rearing period are shown in Table (3) and Fig. (1). The mean final length, and weight, increment in weight, percentage gain in weight, daily gain in weight, mortality rate, total production and food conversion were 28.3 cm/fish, 294 gm/fish, 285.87 gm/fish, 3516.24, 0.73 gm/fish, 7.7 %, 395 kg and 1.58, respectively (Table 4).

Stocking was started with fingerlings to avoid the high mortality in case of fry stocking. The mortality rate in the present work was very low (7.7 %). Nikos et al. (2000) recorded mean survival of 48% (i.e. 52% mortality rate) for *Sparus aurata* larvae under intensive rearing conditions.

Ameran (1992) recorded 22.95 mean length for one-year age *Sparus aurata*. Also, Tharwat et al. (1998) recorded maximum length of 18 cm for *Sparus aurata* during the first year. The fish under investigation attained an average final length of 28.3 cm after one-year culture, which is higher than that recorded by the previous investigators.

Paul (1976) recorded that 200 gm is added per year for *Sparus aurata* inhabiting Houraki Gulf (Newzealand). Wassef (1978) recorded 79 gm increase per year for *Sparus aurata* from the Mediterranean waters. Ameran (1992) recorded maximum of 157 gm for one year *Sparus aurata* at Bardawil Lagoon, Egypt.

In the present results, the growth in weight of *Sparus aurata* under investigation was 294gm/ fish that was higher than that recorded by the previous investigators which indicate the effect of feeding on increasing growth.

The food conversion ratio was relatively low (1.58) where the farm is rich in natural food and there are small fry of different fishes entering normally with water through the inlet nets that are considered good food for *Sparus aurata*.

Ameran (1992) recorded an average condition factor (K) of 1.38 for Sparus aurata at Bardawil Lagoon. Also, Tharwat et al. (1998) calculated a condition factor fluctuating between 1.34 and 1.41 for *Sparus aurata* at Bardawil Lagoon. The condition factor which measure the degree of fatness and well-being of fish in the present study showed an average of 1.39 which is within that recorded by the previous investigators.

It was observed that growth ceased after November reaching its lowest value (4.3 gm/month) in January (Table 3) when the water temperature dropped reaching 14 ^{0}C while, the maximum growth (46.4 gm/month) was recorded in April (Fig. 2) which indicate the effect of temperature on growth.

The final net production indicates the importance of *Sparus aurata* culture and the high outcome. Although the returns are relatively high, the absence of capital investments is the major reason why *Sparus aurata* culture hasn't yet developed in Egypt. Semi-intensive and intensive *Sparus aurata* culture are advised to overcome the problems of decrease of animal protein and for a good use of land and water.

Table 3: Monthly variations in growth of sea bream (*Sparus aurata*) reared in brackish water

Months	Days After Stocking	Mean Total Length, Cm	Mean Total Weight, Gm	Increment In Weight, Gm	Daily Gain In Weight, Gm	Condition Factor (K)
July, 2001	0	9	8.13	-	-	1.12
Aug.	30	13.2	34.7	26.57	0.89	1.51
Sep.	60	15.8	64.9	30.20	1.01	1.65
Oct.	90	17.7	82.0	17.10	0.57	1.48
Nov.	120	18.3	100.1	18.10	0.60	1.63
Dec.	150	19.1	107.5	7.40	0.25	1.54
Jan. 2002	180	20.4	111.8	4.30	0.14	1.32
Feb.	210	21.7	126.0	14.20	0.47	1.23
Mar.	240	23.0	158.6	32.60	1.07	1.30
Apr.	270	24.8	205.0	46.40	1.55	1.34
May	300	26.2	241.8	36.00	1.20	1.34
June	330	27.1	264.3	23.00	0.77	1.33
July	360	27.8	281.4	17.00	0.57	1.31
Aug.	390	28.3	294.0	13.00	0.43	1.30
Average						1.39

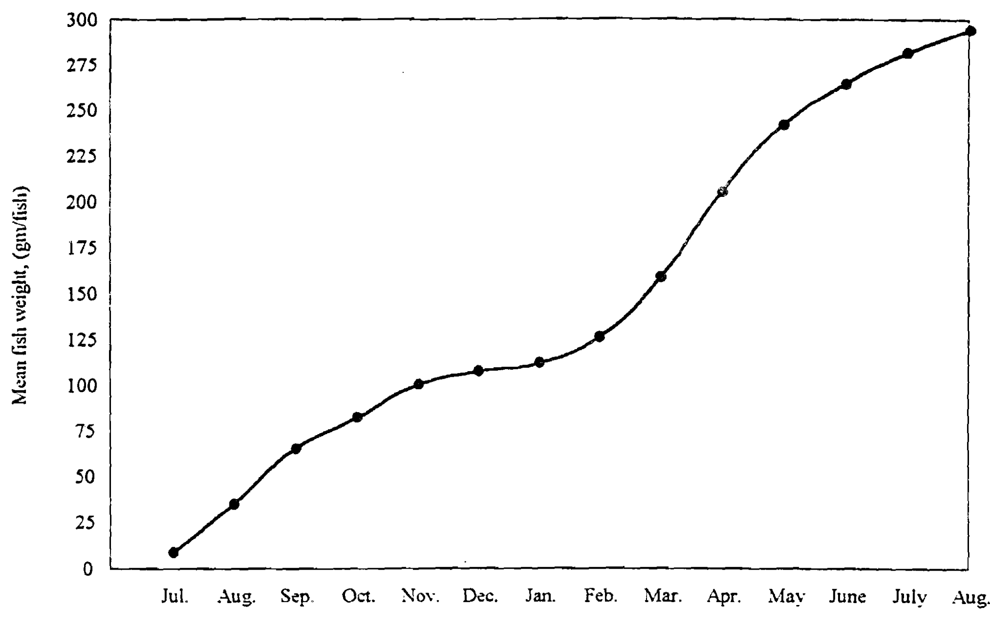

Fig. 1: Monthly growth in weight (gm/fish) of Sparus aurata

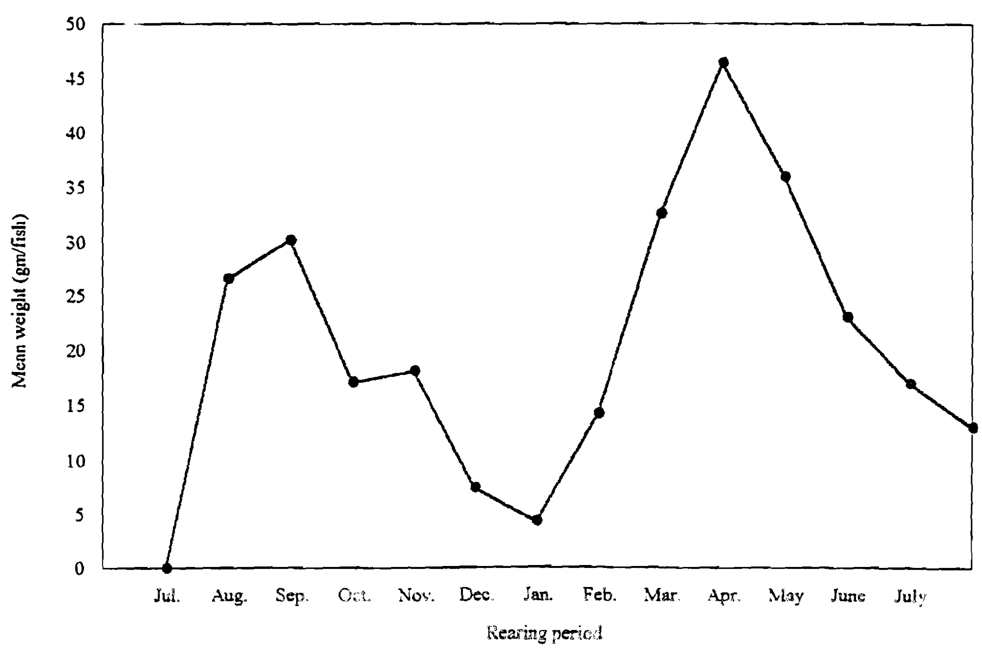

Fig. 2 Monthly increment in weight (gm/fish) of Sparus aurata

Table 4 : Evaluation of growth rate of *Sparus aurata* under semi-intensive rearing conditions

Items	Rate
Average initial weight (gm/fish)	8.13
Average final weight (gm/fish)	294
Increment in weight (gm/fish)	285.87
% increment in weight (gm/fish)	3516.24
Rearing period(day)	390
Daily gain in weight (gm/fish)	0.73
Stocking density	1500
Initial total weight (kg)	12.2
Final total production (kg)	407.2
Number of date fish	115
Mortality rate (%)	7.7
Total food consumed (kg)	625
Total net production(kg)	395
Food conversion ratio	1.58
Average initial length (cm/fish)	9.0
Average final length (cm/fish)	28.3
Average condition factor (k)	1.39

REFERENCES

Ameran, M. A. (1992): Studies on fish production of Bardawil Lagoon. M.Sc. Thesis, Suez Canal Univ. 158 pp.

Ben-Tuvia, A. (1979): Studies of the population and fisheries of *Sparus aurata* in the Bardawil Lag. n eastern Mediterranean. Invest. Pesq. Barc. 43 (1): 43 – 67.

Bessonart, M.; Izquierdo, M. S.; Salhi, M.; Hernandez, C. M.; Gonzalez, M. M. and Fernandez, H. (1991): Effect of dietary arachidonic acid levels on growth and survival of gilthead sea bream (*Sparus aurata*) larvae. Aquacult., 179 (1-4): 265 – 275.

Carrillo, J.; Koumoundouros, G.; Divanach, P. and Martinez, J. (2001): Morphological malformations of the lateral line in reared gilthead sea bream (*Sparus aurata L. 1758)*. Aquacult., 192 (2-4): 281 – 290.

El-Gamal, A. E. (1997): Biological studies on the reproduction of the gilthead bream *Sparus aurata* reared in fish farms. Ph.D. Thesis, Fac. of Sci., Mansoura Univ., 210 p.

Essa, M. A. (2000): Growth and production of marine fish, *Sparus aurata*, under different feeding and rearing conditions.J. Egypt. Ger. Soc.Zool., 31(B): 51-63.

Essa, M. A; El-Sherif, Z. M; Abu El-Ezz, S. M. and Abdel-Moati, A. R. (1989): Effect of water quality, food availability and crowding on rearing conditions and growth parameters of some economical fish species grown under polyculture systems. Bull. Nat. Inst. Oceanogr. Fish. A.R.E., 15(1): 125-134.

Fernandez, F.; Miguel, A. G.; Guinea, J. and Martinez, R. (1998): Digestion and digestibility in gilthead sea bream (*Sparus aurata*): the effect of diet composition and ration size. Aquacult. 166 (1-2): 67 – 84.

Goldan, O.; Popper, D. and Karplus, I. (1997): Management of size variation in juvenile gilthead sea bream (*Sparus aurata*), 1: particle size and frequency of feeding dry and life food. Oceanogr. Litera. Rev. 44 (11), 1345 p.

Goldan, O.; Popper, D.; Kolkovski, S. and Karplus, H. (1998): Management of size variation in juvenile gilthead sea bream (*Sparus aurata*) II: Dry food type and live/dry food ratio. Aquacultu. 165 (3-4): 313 – 320.

Helal, A. M. (2003): Studies on the production of sea bass, *Dicentraachus labrax*, under different rearing and feeding conditions. Ph.D. Thesis, Fac. Agric., Mansoura Univ., Egypt.

Hepher, B. and Pruginin, Y. (1981): Commercial fish farming with special referuces to fish culture in Israel. A wiley Intr. Science Publi., John Wiley & Sons, New York, 261p.

Kiriakos, Z; Koumoundouros, G; Kentouri, M. and Divanach, P. (1993): Embryonic development of sea bream *Sparus aurata* , [illegible] 1958). 15th Congress of the Hellenic Society of Biological Science. Florina – Kastoria, 122-124.

Miro, K. and Jakov. D. (1997): Age and growth of gilthead sea bream (*Sparus aurata* L.) in the Mirna Estuary, North Adriatic. Fish. Res., 31 (3): 249 – 255.

Nikos, P. Markakis, G.; Pascal, D. and Maroudio, K. (2000): Feeding requirements of sea bream (*Sparus aurata*) larvae under intensive rearing conditions. Aquacult., Engin. 21 (4): 285 – 299.

Nikos, P.; Pascal, D. and Maroudio, K. (2002): Enhanced biological performance of intensive sea bream *Sparus aurata* larviculture in the presence of phytoplankton with long photophase. Aquacult. 204 (1-2): 45 – 63.

Paul, L. G. (1976): A study on age, growth and population structure of the snapper *Sparus aurata* in the Hauraki Gulf, Newzealand. Fisher. Res. Bull. No. 13: 1 - 60.

Petridis, D. and Rogdakis, I. (1996): The development of growth and feeding for sea bream, *Sparus aurata* L., culture. Oceanogr. Litera. Rev., 43 (12): 1269 p.

Sanchez, A. (2002): Stock enhancement of gilthead sea bream (*Sparus aurata*, L.): assessment of season, fish size and place of release in SW Spanish coast. Aquacult., 210 (1-4): 187 – 202.

Siliem, N. A. (1998): Studies on the rearing of mullet, *Mugil cephalus*, and sea bream, *Sparus aurata*, in marine fish farms. Ph. D. Thesis, Fac. Agriculture, Cairo Univ., Cairo, Egypt.

Snedecor, G. A. and Cochran, W. G. (1967): Statistical methods. Iowa State Univ., Ames, 10, USA, 341pp.

Swift, D. R. (1955): Seasonal variations in growth rates, Thyroid gland activity and food conversion of brown trout, *Salmo Trouta*. J. Exp. Biol., 32:751pp.

Tharwat, A. A.; Emam, W. M. and Ameran, M. A. (1998): Stock assessment of the gilthead sea bream *Sparus aurata* from Bardawil Lagoon, North Sinai, Egypt. J. Aquat. Biol. and Fish., 2 (4): 483 – 504.

Wassef, E. (1978): Biological and physiological studies on marine and acclimatized fish *Sparus aurata* (L.). Ph.D. Thesis, Fac. of Sci., Cairo Univ. 225 p.

Zohar, Y.; M. Abraham and H. Gordin (1978): The gonadal cycle of the captivity – reared hermaphroditic telcost *Sparus aurata* during the first two years of life. Amn. Biol. Anim. Bioch. Biophys., 18 (4): 877 – 882.