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3- SEA BASS, *Dicentrarchus labrax*, FARMING IN SEMI-OFFSHORE CONDITIONS ALONG THE EGYPTIAN WESTERN MEDITERRANEAN COAST.

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ABSTRACT

Sea bass, *Dicentrarchus labrax*, fingerlings (1.11 g) were stocked in 240 m^3 cages (4 x 3x 2.5 m each, equal 30 m^3) placed in West-Northern Shore of Mediterranean, West Lagoon, Matrouh Governorate, Egypt, to assess the responses of sea bass to rear in intensive (50 fish/m^3) or semi-intensive monoculture (35.8 fish/m^3) or polyculture with golden grey mullet, *Liza aurata*, or sea bream, *Sparus aurata* (715 sea bass+360 mullet or sea bream/cage, 30 m^3). The fish were handly fed on artificial diet (34.6 % protein) in wet form at a rate of 3-5% of the live body weight, two times daily, in addition to 1 % trash fish one time daily, for 323 days. Growth, survival, feed utilization and net production were depressed with increasing density. Final weight recorded were 172.29 g and 128.91g at a density 35.8 and 50 fish /m^3, respectively. The best fish performance and economic were achieved in sea bass semi-intensive monoculture and polyculture with mullet. The total fish production were varied between 4.77-5.40 Kg/m^3 and the payback period between 0.74-1.01 years.
Keywords: Sea bass, Cages, Growth performance, Production, Economic feasibility.

INTRODUCTION

Mediterranean offshore mariculture is seen as a way to increase fish production in areas where it would otherwise not be possible, and fulfill the lack between the demands and the production of fish in Egypt. The increased demands, concomitant with a shortage in sea bass, *Dicentrarchus labrax*, commercial production has resulted in a sharp increase in their market prices (El-sayed and El-Ghobashy, 1997; Megapesca, 2001). The culture of sea bass has been extensively practiced in many European and Mediterranean coasts (Tsevis *et al.*, 1992; Barnabe and Guissi, 1993; Blakstad *et al.*, 1996; Landoli, 2000; Deni *et al.*, 2000 and Stephanou, 2000 as well as Essa, 2001).

Essa (2000) and El-Gharabawy (2002) reported, marine fin fish, sea bass and sea bream (*Sparus aurata*) represents the most important species in mariculture programs in Egypt. However, only started to culture recently due to lack of reliable technology for rearing and feeding suitable for Egyptian conditions as well as lack of policy advise and training.

Therefore, the present work was conducted to study the effects of stocking densities and culture methods on growth performance, survival rate, feed utilization parameters and economic analysis of cultivation sea bass fingerlings in floating net cages placed in the Mediterranean offshore, West lagoon, Matrouh Governorate, Egypt.

MATERIALS AND METHODS

1- Fish and culture facility:

Fingerlings of sea bass, *Dicentrarchus labrax*, of about 0.8-1.2 g and sea bream, *Sparus aurata*, of range 7-8 g used in this study were collected from the Mediterranean coastal waters near Domitta branch of the River Nile during the month of April, 2000. While the fingerlings of mullet, *Liza aurata*, of about 3.2-3.7 g were collected from West lagoon, Mersi Matrouh City, during April 2000.

Sea bass fingerlings of approximately similar weight were stocked in April 18, 2000 into eight floating net cages of equal dimensions (4 m x 3m x 2.5m depth, equal 30 m^3) to assess the responses of sea bass to rear in intensive (50 fish/m^3, about 1500 per cage) or semi-intensive (35.8 fish/m^3, about 1075 per cage). Also to assess the responses of sea bass to rear in semi-intensive monoculture or polyculture with golden grey mullet or sea bream (715 sea bass +360 mullet or sea bream), two cages per treatment. The cages were placed in West Lagoon, Mersi Matrouh City. Each cage had a frame made of 2 inch aluminum pipe, with nylon netting bag of 6 mm mesh size and blocks of styrofoam were attached along two sides of the metal cage as floats. The fish were acclimated in the cages for 2 weeks to adapt them to culture conditions and feeding regime in captivity. At the end of conditioning period, about 50 fish were netted from each cage weighed to the nearest 0.1 g and their average initial weight and length were recorded.

During the growing period (May 2, 2000 to March 28, 2001, about 323 days), the fish were hand fed on standard diet in wet form at a rate of 5% of the live body weight from beginning until the end of July 2000, then reduced to 4 % until the end of Sept.,2000, after that to 3 % until the end of the experiment , March 2001,two times daily for six days a week. Formulations (%) and chemical analysis of standard diet are presented in Table (1). Fish were fed also on fresh trash fish at a rate 1% of the live body weight, one time daily for six days a week. The trash fish consisted mainly of sardine, shrimp and rabbit fish.

A monthly sample of about 50 fish was netted from each cage and weighed to the nearest g, and the daily ration was readjusted accordingly. Mortality rate was also monthly recorded for each cage throughout the study period.

2- Water quality criteria:

Regular water samples were collected monthly from the cage area (West Lagoon) for water quality analysis over a one-year period. Water salinity (ppt), pH, oxygen content (mg/l), alkalinity (mg/l), ammonia (mg/l), nitrite, nitrate, phosphate (mg/l), biological oxygen demand (BOD, mg/l), chemical oxygen demand (COD, mg/l) and some heavy metals (mg/l) were analyzed according to APHA (1989). A mercury thermometer used to measure the surface water temperature at 10 hr. While transparency (cm) was recorded by Secchi-disc.

Table (1): Composition and proximate analysis of the artificial diet and trash fish used during the course of present study, expressed as % of dry weight.

Ingredient Artificial diet (AD)	(%) (AD)	 (Trash fish (TF)
Fish meal	20	
Soybean meal	21	
Liver of cartilages	20	
wheat milling by- products	19	
Corn	10	
Cod oil	5	
Vitamin premix	2	
Mineral premix	3	
Proximate analysis		
Dry matter(DM)	73.04	23.47
Crude protein(CP)	34.58	62.69
Ether extract(EE)	6.5	21.00
Crude fiber(CF)	6.66	-
Ash	7.92	16.31
Nitrogen free extract (NFE)	43.34	-
Calculated gross energy Kcal (GE/100g DM)	443.03	551.81
P/ E ratio	7.78	

3- Growth performance:

At the end of experiment, several measurements namely growth rates and feed utilization parameters were calculated as mentioned in Ballestrazzi *et al.*, (1994) as follows:

3.1. Daily weight gain = Final body weight (g)- Initial body weight (g)/ Days

3.2. Condition factor (K) = Weight (g)/ (Total length)^3 (cm) x100

3.3. Specific growth rate (SGR) = (Ln W_2 - Ln W_1) x 100/ T

Where: W_2 = Weight at the end of the experiment.

W_1 = Weight at the beginning of the experiment.

T = Time (days).

3.4. Survival rate = No. of fish harvested / No. of fish stocked x 100

3.5. Feed conversion ratio (FCR) = Feed intake (g)/ Weight gain (g)

3.6. Protein efficiency ratio (PER) = Weight gain (g)/ Protein intake (g)

3.6. Protein productive value (PPV%) = Protein increment (g) / Protein intake (g) x100

Protein increment is the protein content in fish carcass (at the end - at start of the experiment).

4. Economical Evaluation:

The economical evaluation was estimated during the present experiment regarding the feed costs in nursing period. The following proposed equations were used in such evaluations (Hassanen, 1997):

Costs of 1 Kg (LE) = ? of each Kg ingredients x % of each ingredients in diets.

Feed costs per Kg fresh fissile (LE) = Costs per Kg diet (LE) x Feed conversion ratio.

To achieve a comparative economic analysis on sea bass (*Dicentrarchus labrax*) intensive or semi-intensive culture in floating net cages, the following parameters as described by El-Hennawy (1980) were employed: fixed costs, variable costs, total return, total income, operating ratio, return on sales, return on costs and payback period, as the following:

Operating ratio = Total costs/ Return.

Return on sales = Net income / Return.

Return on costs = Return / Total income.

Payback period(years) = Investment / Total income.

5. Statistical Analysis:

Statistical Analysis were performed by using a computer software program Graph PAD instate (Version 2.01) copyright © 1990-1993 Steve Whetzel, Park- Davis 930762 A. Graph PAD software.

RESULTS AND DISCUSSION

1-Water quality criteria in West Lagoon, Mersi Matrouh City:

The analysis of West Lagoon Water during experimental period are shown in Table (2). Water temperature varied between 15-28^{0}C, the average dissolved oxygen levels not less than 6.88 mg/l and pH values were always on the alkaline side (7.35-8.10), while water salinity ranged from 32.18-36.25 ppt. These values were beneficial to marine fish growing (Peres and Oliva-Teles, 2001; Erez *et al.*, 1990; Sayer *et al.*, 1993; Via *et al.*, 1998).

The results of ammonia, nitrite, nitrate and phosphate concentrations in the cages area (Table 2) almost laid in desirable range for fish growth and survival. Tudor *et al.*, (1994); Chakraborti and Jana (1991) found that, concentrations of ammonia, organic nitrogen and phosphorus are usually well below 1 mg/l in unpolluted water.

2- Stocking density:

The effects of stocking density of sea bass, *Dicentrarchus labrax*, on fish performance in the present study are shown in Tables (3 and 4). The results demonstrated that, fish growth rates, condition factor, survival rate, feed utilization parameters and total fish production were inversely correlated ($P<0.05$) with stocking density. At the moderate density, L35.8 (35.8 fish/m^3) the average final weight was 172.29 g, while the fish reached only 128.91 g at the highest density, H50 (50 fish/m^3), after 323 days rearing period. The same trend was observed for weight gain (% / day), average daily weight gain, survival rate and total production. Thereby, L35.8 fish group had higher condition factor values than H50 fish group (2.13 vs 1.96). It has been reported that *Dicentrarchus labrax* reared in floating cages in temperate areas at densities below 20Kg/m^3 take about two years to reach a marketable size of about 250 g (Pillay, 1990). Decreased growth rate with increasing density can be explained by reduced feed efficiency(Essa,1996) as well as protein and energy table (4). Table (4) showed that , increase sea bass density from 35.8 to 50 fish/m^3, significantly decreased FCR, PPV, PER and EU by 50 %, 53.3%, 31.9% and 42.3%, respectively. At higher densities, the stress caused by crowding and extremely low or high water temperatures may have increased mortality rates. Pillay (1990) reported, the optimum temperature for sea bass was 22-25^{0}C. Cannibalism was also another important factor that may have affected the survival of sea bass in the present study. Similar observation have been reported for sea bass stocked into 5120 m^3 floating cages placed in Shatta brackish water canal near Domietta (El-Sayed and El-Ghobashy, 1997).

Table (3): Performance of sea bass *D. labrax*, fingerlings reared in floating cages at two densities.*

Items	Density (fish/m^3)	
	35.8	50.0
-Av. Initial weight (g)	1.11 ± 0.22	1.11 ± 0.22
-Av. Initial total length (cm)	5.04 ± 0.37	5.04 ± 0.37
-Av. Final weight (g)	172.29 ± 19.00^a	128.91 ±14.48^b
-Av. Final total length (cm)	19.70 ± 0.57^a	18.73 ± 0.68^b
-Av. Daily weight gain (g/fish/day)	0.53^a	0.39^b
Specific growth weight(%/day)	5.11^a	4.82^b
-Av. condition factor (k) at Expt. final	2.13 ± 0.05^a	1.96 ± 0.04^b
Survival rate (%)	86.33 ±5.60^a	74.20 ± 7.13^b
Total weight gain (kg fish/m^3)	5.40^a	4.78^b
Total fish production (kg fish/cage30 m^3)	162.00^a	143.48^b

*Figures in the same row with different superscripts are significantly different ($p<0.05$).

3- Culture methods:

The present trial was also undertaken to assess the response of sea bass fingerlings to rear in mono or polyculture with golden grey mullet, *Liza aurata* or sea bream, *Sparus aurata*, in cages at West Lagoon, Mersi Matrouh City.

It is clear from Table (5) that, sea bass fingerlings indicate a slightly higher growth in weight (0.53 g/day), specific growth rate (5.12%/day) and survival rate (88.11%) in polyculture conditions with mullet than in monoculture (0.530 g/day, 5.11%/day and 86.33%, respectively). This mean that golden grey mullet not caused decline in sea bass performance but even stimulate it. This result was expected since the golden grey mullet were utilizing some of the natural food, especially algae and phytoplankton, that involved in the net cage which otherwise could not utilize artificial diet efficiently like sea bass, thus not competing with sea bass (Reinertsen *et al.*, 1993 and Siliem, 1998).The results of feed utilization parameters during the present study (Table 6) confirm these findings. The differences in FCR, PPV, PER and EU between sea bass monoculture and polyculture with mullet were not significant. But due to the low survival rate of mullet (74.4%), the polycul;ture conditions of sea bass and mullet came second in the total fish production after the sea bass monoculture (4.77 vs 5.40 kg/m^3).

On the other hand, sea bream, Sparus aurata, was apparently unable to rear jointly with sea bass in semi-intensive cage culture conditions. This may be related to the feed competition between sea bass and sea bream, carnivorous fishes (Métailler *et al.*, 1981; Kissil and Gropp, 1984; Izquierdo and Fernandez-Palacios, 1997). Thereby, sea bass possessed lowest results of growth performance, survival rate, feed utilization parameters and production, comparing with those recorded for sea bass monoculture or polyculture with mullet (Table 5 and 6). Cannibalism was the main cause of death in the polyculture of sea bass and bream.

5-Comparative economic analysis:

Table (7) demonstrated the economic performance of different sea bass marine cage culture conditions in West Lagoon, Matrouh Governorate. The results showed that, the intensive monoculture of sea bass or semi-intensive polyculture of sea bass and sea bream has to meet highest variable costs because of high fish fingerlings and feed requirements, thereby, did not achieves economic returns. In contrast, the annual capital costs of investing in semi-intensive sea bass monculture or polyculture with mullet are relatively low. This is due to the lower fish fingerlings and feed requirements in addition to their higher fish production and of course their total returns (2715 and 1980 LE/cage (30m^3,/ 323 days, respectively).

The results of economical profitability parameters for different sea bass marine cage culture conditions are summarized in Table (8). These results were supported the results of economic performances in Table (7). Semi-intensive sea bass monoculture or polyculture with mullet possessed the best operating ratio (65.5% and 71.9%, respectively), return on sales (34.4 and 24.0, respectively) and return on costs (152.6% and 138.9%, respectively). While intensive sea bass monoculture and semi-intensive polyculture of sea bass and bream conditions show a loss in these values. This indicates that these conditions or systems give low yield at high cost and require effective management.

The present results are encouraging because the bayback period from the successful systems varied between 0.74 to 1.01 years (Table 8). Through proper management, it should be possible to reduce the cost of the main inputs of artificial feed, which constitute about 57% from the total variable costs. .

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REFERENCES

APHA (American Public Health Association (1989). Standard methods for the examination of water and waste water (17 th edition). New York, 1268 pp.

Ballestrazzi, R.; D. Lanari; E. D'Agaro; A. Mion (1994). The effect of dietary protein level and source on growth, body composition, total ammonia and reactive phosphate excretion of growing sea bass (*Dicentrarchus labrax*). Aquaculture, 127: 197-206.

Barnabe, G. and A. Guissi (1993). Combined effects of diet and salinity on European sea bass larvae, Dicentrarchus labrax. J. World Aquaculture Soc., 24 (4): 339-350.

Blakstad, F.; A.F. Fagerholt and D.Lisac (1996). Cost of bass and bream production: comparison between land based and cage facilities. In: Sea Bass and Sea Bream Culture: Problems and Prospects. Handbook of contributions and short communications of the EAS Workshop held in Verona (Italy), 16-18 Oct., 1996, PP.245-248.

Chakrabarti, R. and B.B. Jana (1991). Plankton intake as a function of body weight by common carp fry in different feeding conditions. Aquaculture, 93:21-34.

Deni, H.; A.Y. Karkut and N. Tekelioglu (2000). Development in the Turkish marine aquaculture sector. P.71-78 In: Mediterranean Offshore Mariculture, Zaragoza:CIHEAM, 2000,215 pp., Serie B, No. 30 Options, Spain.

El-Gharabawy, M.M. (2002). Intensive and semi-intensive fish culture in west-Northern Shore of the Mediterranean Sea Fifth and Final Report, Academy of Scientific Research and Technology, Cario, Egypt.

El-Hennawy, M. (1980). Project Feasibility Study Indicator for Evaluation New Business.First Edition, El-Dar Al-Misria El-Haditha, Alexandria (in Arabic).

El-Sayed, A.F.M. and A. El-Ghobashy (1997). Effect of stocking density on growth rate, feed utilization and profatibilty of European sea bass, *Dicentrarchus labrax*, reared in floating cages. Bull. Nat. Inst. Of Oceanogra. And Fish., A.R. E., (23).449-458.

Erez, J.M.;D.Krom and T. Newwirth (1990). Daily oxygen variations in marine fish ponds, Elat, Israel. Aquaculture, 84:289-305.

Essa, M.A. (1996). The effect of fish density and feeding frequency on both Oreochromis niloticus and Mugil cephalus fish reared as mixed culture in floating cages. Bull. Nat. Inst. Oceanogr. & Fish., A.R.E., 22:181-197.

Essa, M.A. (2000). Growth and production of marine fish ,*Sparus aurata,* under different feeding and rearing condition .J. Egyptian - German Society of Zoology, 31 (B):51-63

Essa, M.A. (2001). Role of fish culture in natural fishery resources development. Symp. Nat. Fisheries, 4-6 Sept., Fac. Fisheries, Mostafa Kamel Univ., Hatay, Turkey.

Hassanen, G.D.I.; A.M. Abou-Ashour; H. Abdel-Rahman; S.H. Abd El-Rahman and A.K.I. El-Hammady (1997). Effect of dietary composition on some performance and hematological aspects of sea bass, *Dicentrarchus labrax*. Egypt J. Aquatic Biology and fisheries, 1(2): 109-130.

Izquierdo, M. and H. Fernandz-Palacios (1997): Nutritional requirements of marine fish larvae and broad stock. P.243-264.In: Feeding Tomorrow's Fish. Proc. CIHEAM, FAO and IEO, Mazarron (Spain), 24-26. June 1996(A.Tacon and B.Basurce,eds).

Kissil, G.W. and J. Gropp (1984). Optimal protein and energy ratios in gilthed sea bream (*Sparus aurata*) feeds. In:European Mariculture Society.Proc. of the II Seminar of German-Israel Cooperation in Aquaculture Research, Hamburg, pp.99-102.

Landoli, C. (2000). Marine fish farming in Italy. P.33-44. In: Mediterranean offshore Mariculture (J.Muir and B. Basurco, eds.), Zaragoza:CIHEAM, 2000, 215 pp., Serie B, No. 30 Options Mediterranean, spain.

Megapesca (2001). Marine aquaculture in Egypt. www.megapesca.com Megapesca Ldt., Portugal ,November2001, 30pp.

Métailler, R.; J.F. Aldrin; J.L. Messager; G. Mevel; G. Stephan (1981) Feeding of European sea bass (*Dicentrarchus labrax*): role of protein level and energy source. J. World Maricult. Soc., 12: 117-118.

Peres, H. and A. Oliva-Teles (2001). Influence of tempertaure on protein utilization in juvenile European sea bass (*Dicentrarchus labrax*). Aquaculture, 202(3-4): 289-302.

Pillay, T.V.R. (1990). Sea bass and sea breams. In: Aquaculture principles and practices. Fishing News Books, Oxford, 575 pp.

Reinertsen, H.; A. Jensen; A.Langiland and S.Olsen (1993). Algal competition for phosphorus: The influence of zooplankton and fish . Can. J. Aqua., 43 : 1135-1141.

Sayer, M.D.; J.P. Reader and T.R.K. Doziel (1993). Fresh water and acidification effects on fish. Fish Biol. and Fisheries, 3: 95-132.

Siliem, N.A.A. (1998). Studies on the rearing of Mullet, *Mugil Cephalus*, and sea bream, *Sparus aurata*, in marine fish farms. Ph.D. Thesis, Fac.Agriculture, Cario University, Cario, Egypt.

Stephanou, D. (2000). Experience of offshore fish farming in Cyprus. P.57-64. In: Mediterranean offshore Mariculture, Zaragoza:CIHEAM, 2000,215 pp., Serie B, No. 30 Options, Spain.

Tudor, M.; I. Katavi and J. Mari-Lui (1994). Acute toxicity of ammonia to juvenile sea bass (*Dicentrarchus labrax*) at different aeration levels. Aquaculture, 128(1-2): 89-95.

Tsevis, N. S. Kolaoudatos and A. Conides (1992). Food conversion budget in sea bass, *Dicentrarchus labrax*, fingerlings under two different feeding frequency patterns. Aquaculture, 101:293-304.

Via, J.D.; P. Villani; E. Gasteiger and H. Niedeerstatter (1998). Oxygen consumption in sea bass fingerlings (*Dicentrarchus labrax*) exposed to acute salinity and temperature changes: metabolic basis for maximum stocking density estimations. Aquaculture, 169(3-4): 303-313.

٣- استزراع أسماك القاروص فى الساحل الشمالى الغربى للبحر الأبيض المتوسط

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استهدفت الدراسة الحالية تربية أسماك القاروص البحرية فى أقفاص شبكية عائمة (٣٠م^{٣} للوحدة) باللاجون الغربى بمحافظة مطروح لدراسة إمكانية استزراع القاروص بالنظام المكثف(٥٠/م^{٣})أو بالنظام شبه المكثف المنفرد (٣٥,٨ سمكة/م^{٣}) أو بالنظام المتعدد الأنواع بالاشتراك مع أحد أسماك العائلة البورية (أسماك الدهبانة) أو الدنيس (٧١٥ قاروص + ٣٦٠ أسماك الدهبانة أو الدنيس / قفص) . و لقد غذيت الأسماك على عليقة متزنة محتواها البروتينى ٣٤,٦ % بمعدل ٥ % فى البداية و تناقصت إلى ٣ % فى النهاية و ذلك من الوزن الكلى للأسماك يوميا على وجبتين بالإضافة إلى وجبة ثالثة عبارة عن مفروم أسماك طازجة بمعدل ١ % من الوزن الكلى للأسماك يوميا لمدة ٣٢٣ يوما . ولقد أظهرت النتائج أنه بزيادة معدل التخزين من ٣٥,٨ إلى ٥٠ سمكة /م^{٣} تناقصت معدلات النمو و الإعاشة و الاستفادة الغذائية للقاروص المربى منفردا و كان نتيجة ذلك أن حققت أسماك القاروص المرباة بالنظام شبه المكثف ٥,٤٠ كجم /م^{٣} و فى النظام المكثف ٤,٧٨ كجم /م^{٣} كما حققت أسماك القاروص المرباة بالنظام المتعدد الأنواع مع أسماك الدهبانة أفضل معايير للنمو و الإنتاج و العائد الاقتصادى بالمقارنة بنظيرها المربى مع الدنيس (٤,٧٧ كجم/م^{٣} مقابل ٢,١٩ كجم^{٣} على التوالى) حيث كانت فترة استرداد للقاروص فى النظام شبه المكثف منفرداً حوالى ٠,٧٤ سنة فى النظام شبه المكثف مع اسماك الدهبانة حوالى ١,٠١ سنة. و قد اتضح من النتائج أهمية استزراع أسماك القاروص فى النظام الشبه مكثف سواء بالنظام المنفرد أو المتعدد مع بعض أسماك العائلة البورية (الدهبانة).