Egypt. J. Aquat. Biol. & Fish., Vol. 11, No.2: 119 -143(2007) ISSN 1110 – 6131

THE BIOLOGICAL LOAD OF SILVER CARP CAGES IN THE RIVER NILE AND THEIR EFFECTS ON WATER QUALITY AND GROWTH PERFORMANCE

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Key words: Cages, intensive, River Nile, growth performance, water quality, biological load, Silver carp.

ABSTRACT

Silver carp fingerlings were stocked in cages at three different densities. Four replicates cages 6x9x4m were cultured for 150 days during two seasons from February to December 2004. These stocking densities of silver carp (initial weight 5-10g) were tested in three locations; El-Mahmoudia (8, 10 and 12 fish/m^3); Fazara (6, 8 and 10 fish/m^3) and Edfina (4, 6 and 8 fish/m^3) in cages suspended in the River Nile at each location in two seasons. The impacts of cages on water quality were investigated. Results obtained are summarized as follows:

1- Water temperature ranged from 26.5 to 27.4°C in all cages at all locations.

2- Values of pH, DO, NH_4, NH_3, NO_2, TP, OP and *chlorophyll a* increased significantly down stream after passing the cages.

3- SD decreased sharply after the site of cages at all locations.

4- Survival rate was affected by location

5- Location released affects on cage production.

The maximum production rate achieved was 19.87 kg/m^3 in first season with initial weight of 10g fish/m^3 at El-Mahmoudia. The results of this study suggest that cages in the River Nile and stocking density are more than load on water.

We can suggest that necessary codification the use of water in the River Nile in cages culture, also, transferring these cages in lakes.

INTRODUCTION

Cage fish culture is a viable alternative to traditional techniques of rearing, due to its practicability and, mainly, low costs Beveridge (1996).

In recent decades, net-cage aquaculture has become one of the main patterns of the intensive fish-culture in the lakes, reservoirs and even rivers in China.

Freshwater aquaculture is of great importance in commercial fisheries in China, thus it supplies more than one third of the total freshwater fishery production of the world (Longgen Guo and Zhongjie Li , 2003).

Cage aquaculture is one of the main freshwater intensive culture patterns in Egypt, due to its benefits in terms of increased fish production and its feasible profit. During the fish cage culture, a large amount of waste materials was brought into the water directly (Longgen Guo and Zhongjie Li , 2003).

Site selection is a key factor in any aquaculture operation, affecting both success and sustainability of the culture activity. The correct choice of the site in any aquatic farming operation is vitally important since it can greatly influence economic viability by determining capital outlay, and, by affecting running costs, rates of productions and mortality factors. It is impractical to try control water quality parameters in cage culture systems, therefore culture of any species must be established in geographical regions having adequate water quality and exchange (Pérez *et al.*, 2003).

Cage culture, as with any aquaculture venture, requires good water quality, thus water properties strongly affect the choice of an aquaculture site. Hence, cages should be located in uncontaminated areas by industrial, municipal and agricultural pollutants. Other water quality parameters, such as temperature, pH, presence of nitrogenous compounds, dissolved oxygen, etc., should be within the ranges that provide life support and growth for the cultured species. The correct choice of sites is vitally important since it influences the economic viability of the facility (Lawson,1995). However, the availability of suitable areas for aquaculture is diminishing because of water quality degradation. Therefore, the first prerequisite for sustainable aquaculture is an adequate aquaculture resource allocation system.

Stocking density is one of the most important variables in aquaculture because it directly influences survival, growth, behavior, health, water quality, feeding and production. In cage culture, optimum stocking densities and carrying capacities vary with species, size of fish, size of cages, rate of water exchange, and size of ponds and length of growing season (Kilambi *et al.*, 1977; Chua and Teng, 1979; Coche, 1982; McGinty, 1991; Duarte *et al.*, 1994; Beveridge, 2002; Chua and Tech, 2002; Masser, 2004). Production strategies often involve the manipulation of densities by harvesting, grading and transferring fish to larger-mesh cages during the culture period (Campbell, 1985; Schwedler *et al.*, 1989; Beveridge, 1996, 2002; Lazur, 1996; Ahmad *et al.*, 1999; Liao *et al.*, 2004). Consequently, optimum stocking densities need to be determined for each species and production phase to enable efficient management and to maximize production and profitability. Therefore, the objectives of the present study are to evaluate of these cages in the River Nile and to determine the impacts of these cages and stocking density on water quality and biological load.

MATERIALS AND METHODS

The present study was carried out in the River Nile branch Rasheed, Egypt, at three locations; El-Mahmoudia, Fazara and Edfina. The experimental work was conducted in floating cages. Experimental cages were fixed on the water stream at the main water inlet to the Mediterranean Sea, where Rasheed branch minded. At each location three stocking densities were tested (8, 10 and 12 fish/m^3) for El-Mahmoudia; (6, 8 and 10 fish/m^3) for Fazara and (4, 6 and 8 fish/m^3) for Idfina. Moreover, two initial weights; 5 and 10g/fish were investigated. Each stocking density was performed in four replicates. The study was performed in two successive rearing seasons where fish initial weights were 5 and 10g/ fish for two seasons. The experimental cages were of diameters 6 ×9× 4 m/cage with a total water volume of 216m^3/cage. The first season expanded from15th February 2004 to 15th July of the same year and the second season started in 15th July and lasted in 25th December of the same year. In both seasons the experiments lasted in 150 days. During the first month fish were reared in cages with nets of a very low diameter (80 mesh), then fish were transferred to cages with nets of (10 mesh) until the harvest. Cages were covered with nets of the same diameter during all experimental period. During both seasons a total of 24 cages were used at each location; three locations, within each three stocking densities in four replicates each.

Sampling:

Water samples from the cages were collected monthly, for physico-chemical analysis (temperature °C, dissolved oxygen DO as mg/l and saturation of oxygen as percentage, using YSI 6600 CID (yellow spring Instruments, Ohio, USA).In each cage SD, NH_4 (total ammonia),

NO_2 (Nitrite) and NO_3 Nitrate were measured by Hack apparatus according to APHA (2000), NH_3 was calculated by conversion Tables for pH and temperature (Boyd, 1990). Total phosphorus (TP), Orthophosphate (OP) and *chlorophyll "a"* were measured according to APHA (2000). Qualitative and quantitative estimates of phytoplankton and zooplankton were also recorded monthly according to APHA (2000). At the end of the experiment, fish were harvested, counted and weighed. The growth parameters were calculated as follows:

Daily gain (DG) = $(Wt_2 - Wt_1)/ T$;

Specific growth rate (SGR) = $(\text{Ln } Wt_2 - Wt_1) \times 100/ T$; where Wt_1 is the initial weight in grams, Wt_2 is the second weight in grams, and T is the period in days

Condition factor (K) = Body weight / Total length^3 x 100.

Statistical analysis was performed using the analysis of variance (ANOVA). Duncan's Multiple Range Test Duncan (1955) was used to determine the significant differences between means at $P<0.05$. Standard errors of treatment means were also estimated. All statistical evaluations were carried out using Statistical Analysis Systems (SAS) program (SAS, 2000).

RESULTS AND DISCUSSION

Data of tables (1-4), show the water quality parameters. The average values of water temperature ranged between 27 to 27.4°C during experimental period at all locations during both tested seasons. These results clear that the water temperature did not differ significantly the among all cages in all locations. The pH values ranged between 7.6-7.98; 8.1-8.5 and 8.5-9.13 in El-Mahmoudia; Fazara and Idfina respectively. These results show that the pH values increased with down stream, i.e, the pH values was significantly higher in Idfina than other locations, also, pH values in Idfina > Fazara > El-Mahmoudia, which may be due to the increase of phytoplankton and increase photosynthetic uptake CO_2 and of substituted hydroxyl ions. These results are in good agreement with those obtained by Masser (2004); Shaker (2006) and Rowland *et al.*(2006). The same trend was observed in DO and saturation percentage of DO. Secchi disc visibility (SD) is the first important parameter as an indicator of phytoplankton production in water. The increase in SD reading indicated the clear of water, while the reading decrease indicated the bloom of water. From the results in tables (1-4), it is clear that the SD decreased water down stream. These results are in good agreement with those obtained by shaker *et al.*(2002) ,Nagler *et al.* (2003) and Shaker Abdel–

Aal (2006) who found that the increase of organic and mineral fertilization increased phytoplankton and decreased SD. Secchi disc visibilities were significantly low the down stream water due to the accumulation of organic compounds , macronutrients and then transfer by water to these locations. These results clear that the highly intensive of cages and highly intensive of fish in cages in all locations led to increase of biological lood in water. The same trend was observed in NH_4, NH_3, NH_2 and NO_3 (nitrogen compound). These results indicated that the silver carp cages deteriorate water quality in River Nile by increasing organic and inorganic compounds. These results may be due to the intensive of cages at low area and intensive of silver carp in cages. These results are in agreement with these data obtained by *chlorophyll ' a'* analyses in water, indicating high correlation between organic compound, and *chlorophyll 'a'* in water. *The chlorophyll 'a'* increased down stream; so the trend was Idfina >Fazara > El-Mahmoudia . These results are in agreement with those obtained by Shaker (2006), who reported that the increase of organic, inorganic compound and macronutrient increased *chlorophyll 'a'*, phytoplankton and zooplankton. The average concentration of total phosphorus (TP) and orthophosphate (OP) were significantly decreased in El-Mahmoudia than Fazara and Idfina. These results may be due to the leaching of these compound and transfer with down stream. Chlorophyll 'a', phytoplankton and zooplankton were significantly increased at Idfina than other locations. These results are in agreement with that obtained by Shaker and Abdel–Aal (2006). As presented in tables (5-9) and Fig (1), the average density of phytoplankton, and zooplankton increased with down stream water . These results indicated that the average numbers of phytoplankton and zooplankton were higher significantly ($p<0.05$) in Idfina than that of Fazara and El-Mahmoudia. These results clear that the mass production of phytoplankton and zooplankton depend on organic lood in water.

The average annual number of total phytoplankton were 1518.92, 2701.67 and 6648.25 org/l for El-Mahmoudia, Fazara and Idfina respectively. Zooplankton were 361.17, 934.58 and 1397.92 org/l for the same location respectively, (Table 9) and Fig (1). These results clear that there is a highly significant difference among the three locations for phytoplankton and zooplankton. Fish production; growth performance and fish carcass are illustrated in Tables (10-14).The final weight of individual fish were 1295, 1415, 1517, 1175, 1173 and 1033 g at El-Mahmoudia, with initial weight 5 g per fish at stocking 8, 10, 12 in season

1 and 2, while, at 10 g per fish were 1842, 1887, 1816, 1559, 1420 and 1391 for the same stocking and seasons 1 and 2 . These results show the significantly effect of initial weight on final weight, net gain and daily gain of fish in all cages. Generally, the final weight, net gain, daily gain increased significantly with the increasing initial weight of fish in each location. These results are in agreement with these obtained by Shaker *et al.* (2002), Shaker and Abdel Aal ,(2006) and Macleod *et al.* (2006) who found a positive correlation between initial weight and growth performance of fish.

Generally, the highest final weight, net gain and daily gain were recorded in El-Mahmoudia then Fazara and Idfina. The survival rate did not differ significantly by stocking density or season in the same location. While, the survival rate decreased significantly with down stream water . The highest survival rate was recorded in El-Mahmoudia than Fazara and Idfina.

The positive correlation was found between final weight and muscle; head skeleton and stomach in fish at each location. The stocking density did not effect on carcass test. A muscles percentage ranged from 46 to 52%, the highest percentage recorded in El-Mahmoudia location.

The average final weight of fish at the three locations, El-Mahmoudia, Idfina and Fazara at stocking density 8 fish /m were 1295,910 and 600, 1175, 854 and 450 g respectively, when initial weight 5 g/fish. While at 10g was 1842, 1370, and 760 and 1559, 1179 and 550g. These results clear that the final weight did not significantly differ by stocking density, while affected by location i.e the effect of water quality on final weight of fish in cages at each location with different stocking density and different initial weight.

From the data presented in Table (13) about growth performance and carcass compositions of silver carp in cages under different initial weight, season and location regardless stocking density it is clear that the growth performance of fish increased with increasing initial weight in all locations.

From the above results we can conclude that the cage culture in Egypt need to rationing along the River Nile, also, the stocking density in cages should be low to keep good water quality of the River Nile .

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Table (1): Water quality parameters in silver carp cages as affected with stocking density, season and initial weight at El-Mahamodia "Rasheed branch of River Nile ".

Size g	season	Density / M^3	Temp. °C	pH	DO mg/l	Saturation %	SD cm	NH_4 mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	T.P mg/l	O.P mg/l	Chlorophyll a mg/l
5	First	8	27.3	7.6	4.1	46.1	134	1.01	0.135	0.022	0.1	0.36	0.16	31.14
		10	27.1	7.7	3.9	41.5	136	1.07	0.09	0.02	0.1	0.36	0.16	31.38
		12	27.0	7.8	3.7	39.6	137	1.1	0.14	0.02	0.1	0.36	0.14	34.98
	Second	8	27.4	7.7	4.0	43.2	131	1.3	0.1	0.023	0.126	0.41	0.11	39.0
		10	27.1	7.8	3.8	40.1	134	1.18	0.11	0.022	0.12	0.35	0.11	35.7
		12	27.1	7.6	3.5	37.6	142	1.1	0.10	0.04	0.15	0.39	0.14	34.9
10	First	8	27.3	7.7	3.6	39.2	125	1.21	0.16	0.04	0.12	0.4	0.18	30.06
		10	27.0	7.8	3.4	37.0	137	1.23	0.1	0.022	0.14	0.38	0.18	31.74
		12	27.1	7.9	3.1	32.5	135	1.22	0.16	0.02	0.1	0.35	0.15	33.3
	Second	8	27.0	7.98	3.5	36.7	118	1.51	0.16	0.04	0.16	0.4	0.16	35.1
		10	27.0	7.8	3.5	37.1	133	1.17	0.11	0.02	0.14	0.38	0.16	34.0
		12	27.1	7.94	3.2	30.2	138	1.16	0.11	0.02	0.17	0.38	0.15	31.4

Table (2): Water quality parameters in silver carp cages as affected with stocking density, season and initial weight at Fazara "Rasheed branch of River Nile ".

Size g	season	Density / M^3	Temp. °C	pH	DO mg/l	Saturation %	SD cm	NH_4 mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	T.P mg/l	O.P mg/l	Chlorophyll a mg/l
5	First	6	27.1	8.2	7.2	85.2	70	2.1	0.61	0.14	0.27	1.02	0.46	61.96
		8	27.0	8.2	6.9	80.1	84	1.3	0.4	0.18	0.21	0.79	0.24	46.59
		10	27.2	8.1	6.3	73.2	95	1.2	0.38	0.28	0.16	0.76	0.27	30.13
	Second	6	27.1	8.2	7.3	83.5	72	1.8	0.50	0.2	0.27	0.99	0.39	69.26
		8	27.1	8.3	6.9	80.5	81	1.6	0.58	0.23	0.22	0.78	0.25	33.48
		10	27.1	8.2	6.5	75.7	97	1.4	0.50	0.29	0.14	0.84	0.17	30.45
10	First	6	27.1	8.3	7.1	80.6	70	1.9	0.45	0.21	0.28	1.01	0.42	66.1
		8	27.1	8.2	6.7	77.0	80	1.6	0.52	0.26	0.2	0.79	0.25	39.86
		10	27.1	8.4	6.0	72.2	84	1.28	0.59	0.34	0.15	0.79	0.21	32.75
	Second	6	27.0	8.3	7.0	77.5	70	1.4	0.5	0.21	0.31	0.95	0.39	69.14
		8	27.0	8.4	6.6	75.1	84	1.3	0.56	0.25	0.24	0.75	0.28	31.96
		10	27.1	8.5	5.9	74.2	99	1.6	0.62	0.26	0.16	0.79	0.26	31.14

Table (3): Water quality parameters in silver carp cages as affected with stocking density, season and initial weight at Idfina "Rasheed branch of River Nile ".

Size g	season	Density/ M^3	Temp. °C	pH	DO mg/l	Saturation %	SD cm	NH_4 mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	T.P mg/l	O.P mg/l	Chlorophyll a mg/l
5	First	4	27.0	9.13	10.48	117	12.5	2.2	1.4	0.35	0.57	1.38	0.45	102.84
		6	27.0	8.89	10.1	95	29	2.0	1.48	0.3	0.59	1.53	0.49	86.36
		8	27.0	8.6	5.3	68.5	54.3	1.71	1.2	0.22	0.26	1.25	0.46	67.39
	Second	4	27.0	9.08	10.6	111	13	2.4	1.47	0.35	0.71	1.75	0.59	106.21
		6	27.0	8.72	9.46	97.6	37	1.98	1.38	0.28	0.59	1.46	0.44	76.32
		8	27.0	8.5	5.46	70.5	55	1.88	1.2	0.23	0.25	1.26	0.45	68.89
10	First	4	27.0	9.11	10.6	117	13	2.6	1.35	0.36	0.65	1.68	0.54	100.11
		6	27.0	8.75	10.1	103	33.6	1.99	1.52	0.29	0.66	1.46	0.43	78.63
		8	27.0	8.57	5.35	70.6	53.5	1.82	1.2	0.23	0.26	1.24	0.45	65.22
	Second	4	27.0	9.08	10.5	115	13	2.38	1.49	0.36	0.71	1.89	0.63	109.85
		6	27.0	8.82	9.6	96	34	1.93	1.26	0.28	0.57	1.48	0.43	75.57
		8	27.0	8.5	5.42	70.2	54	1.9	1.2	0.22	0.24	1.25	0.42	67.99

Table (4) : Average water quality in sliver carp cages as affected with initial weight and season in different locations regardless stocking density at Rasheed branch of River Nile".

Size g	season	Location	Temp. °C	pH	DO mg/l	Saturation %	SD cm	NH_4 mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	T.P mg/l	O.P mg/l	Chlorophyll a mg/l
5	1	El-Mahmoudia	27.1 ±.5a	7.7 ±.4c	3.9 ±1.5c	43.7 ±6.5c	136 ±5a	1.09	0.12 ±0c	0.02 ±0c	0.1± .02c	0.36 ±.1c	0.15 ±.01c	32.5 ±1.5c
		Fazara	27.1 ±1a	8.2 ±.4b	6.8 ±1.2b	79.5 ±6.5b	83 ±3b	1.5	0.46 ±.1b	0.2 ±0.0b2	0.4 ±.1b	0.86 ±.2b	0.42 ±.04b	74.7 ±4.56b
		Idfina	27.0 ±.4a	8.8 ±.2a	9.5 ±2.2a	105 ±12.8a	32 ±3c	2.05	1.3 ±.3a	0.5 ±0.1a	1.0 ±.2a	1.39 ±.4a	0.77 ±.1a	126.5 ±9.12a
	2	El-Mahmoudia	27.2 ±.6a	7.7 ±.5c	3.8 ±.8c	42.4 ±8.4c	136 ±7a	1.19	0.1 ±0c	0.02 ±0c	0.13 ±.01c	0.38 ±.1c	0.12 ±.01c	36.5 ±2.56c
		Fazara	27.1 ±1a	8.2 ±.4b	6.9 ±1.4b	79.9 ±10.2b	83 ±5b	1.6	0.52 ±.1b	0.24 ±0.02b	0.44 ±.13b	0.87 ±.2b	0.39 ±.02b	79.1 ±9.2b
		Idfina	27.0 ±1a	8.8 ±.2a	9.6 ±1.4a	106 ±14.5a	35 ±3c	2.12	1.4 ±.3a	0.46 ±0.05a	1.06 ±0.24a	1.49 ±.3a	0.7 ±.12a	132.1 ±7.2a
10	1	El-Mahmoudia	27.1 ±.4a	7.8 ±.2c	3.4 ±1.1c	39.9 ±4.5c	132 ±9a	1.22	0.14 ±0c	0.02 ±0c	0.12 ±.03c	0.38 ±.1c	0.17 ±.01c	31.7 ±2.3c
		Fazara	27.1 ±.5a	8.3 ±.4b	6.6 ±1.6b	76.6 ±7.6b	78 ±6b	1.59	0.52 ±.1b	0.27 ±0.03b	0.39 ±.04b	0.86 ±.2b	0.51 ±.02b	70.9 ±5.5b
		Idfina	27.0 ±.5a	8.9 ±.6a	9.6 ±1.8a	105.5 ±12a	33 ±2c	2.32	1.32 ±.3a	0.56 ±0.12a	0.92 ±.12a	1.46 ±.3a	0.8 ±.12a	117.5 ±11.2a
	2	El-Mahmoudia	27.0 ±1a	7.9 ±.5c	3.4 ±.8c	40.5 ±3.2c	130 ±5a	1.28	0.13 ±.0c	0.02 ±0c	0.16 ±.04c	0.39 ±.1c	0.16 ±.01c	33.5 ±4.2c
		Fazara	27.0 ±1a	8.4 ±.4b	6.5 ±.8b	75.6 ±6.8b	84 ±5b	1.43	0.56 ±.2b	0.24 ±0.02b	0.46 ±.1b	0.83 ±.2b	0.48 ±.013 b	73.5 ±9.4b
		Idfina	27.0 ±1a	9.0 ±.3a	9.8 ±1.2a	103.8 ±8.4a	34 ±4c	2.09	1.34 ±.1a	0.57 ±0.13a	1.12 ±.22a	1.54 ±.3a	0.74 ±.14a	120.2 ±9.9a

Means in the column followed by different letters are significantly different (Duncan s Multiple Range Test P<0.05).

Table (5): Average numbers of phytoplankton and zooplankton taxa sliver carp cages as affected with initial weight and stocking density in different season at El Mahmoudia Rasheed branch of River Nile".

Size	Season	Density / M^3	Phytoplankton (org./1)					Zooplankton (org./1)				
			Chlorophyta	Bacillagphyta	Cyanophyta	Euglena	Total phyto	Cladocera	Rotifea	Copepoda	Ostracoda	Total zoo
5	1	8	1084	515.5	241.5	136.5	1977.5	130	103	60.5	31	324.5
		10	925	453	225	94	1697	107	83	58	19	267
		12	752	372	186	54	1364	156	148	75	15	394
	2	8	1162	548	159	146	2015	184	93.5	86.5	28	392
		10	1003	577	169	94	1843	122	94	60	18	294
		12	856	496	132	76	1560	157	195	82	17	451
10	1	8	1083	459	100	97	1739	133	79	66	41	319
		10	830	294	107	101	1332	102	81	59	24	266
		12	534	154	109	70	867	164	191	79	14	448
	2	8	1082	409	137	121	1749	178	101	69	28	376
		10	708	316	104.5	92	1220.5	145	96	68	14.5	323.5
		12	472	220	101	70	863	203	183	80	13	479

Table (6): Average numbers of phytoplankton and zooplankton taxa in sliver carp cages as affected with initial weight and stocking density in different season at Fazara Rasheed branch of River Nile".

Size	Season	Density / M^3	Phytoplankton org./l					Zooplankton org./l				
			Chlorophyta	Bacillaphyta	Cyanophyta	Euglena	Total phyto	Cladocera	Rotifea	Copepoda	Ostracoda	Total zoo
5	1	6	1850	1114	392	457	3813	476	450	195	85	1206
		8	1568	925	381	447	3321	400	407	181	32	1020
		10	1153	544	241	327	2265	327	294	122	21	764
	2	6	1693	1138	357	452	3640	410	439	171	63	1083
		8	1491	728	380	423	3022	393	413	132	20	958
		10	1008	496	220	304	2028	297	273	108	16	694
10	1	6	1554	1005	358	326	3243	424	438	162	74	1098
		8	1132	869	281	303	2585	397	412	161	33	1003
		10	806	483	188	126	1603	317	317	134	15	783
	2	6	1466	960	356	341	3123	448	434	196	50	1128
		8	1078	652	268	306	2304	405	371	150	23	949
		10	756	442	156	119	1473	225	205	86	13	529

Table (7): Average numbers of phytoplankton and zooplankton taxa in s River carp cages as affected with initial weight and stocking in different season at Idfina Rasheed branch of River Nile".

Size	Season	Density / M^3	Phytoplankton org /l					Zooplankton org /l				
			Chlorophyta	Bacillagphyta	Cyanophyta	Euglena	Total phyto	Cladocera	Rotifea	Copepoda	Ostracoda	Total zoo
5	1	4	4043	2624	713	839	8219	608	554	489	121	1772
		6	3493	2266	715	788	7262	599	492	203	63	1357
		8	2273	1387	503	515	4678	514	451	152	55	1172
	2	4	4124	2655	725	808	8312	649	568	454	108	2079
		6	3274	2098	694	675	6741	466	401	377	147	1391
		8	2337	1410	489	529	4765	519	502	116	39	1176
10	1	4	3998	2529	695	790	8012	579	503	418	97	1597
		6	3335	2193	709	719	6956	543	440	182	51	1216
		8	2303	1408	485	537	4733	515	405	135	47	1102
	2	4	4277	2721	768	877	8643	616	513	353	114	1596
		6	3250	2295	718	534	6797	571	416	148	92	1227
		8	2324	1456	452	429	4661	472	428	146	44	1090

Table (8): Average numbers of phytoplankton and zooplankton taxa in sliver carp cages as affected with initial weight and season regardless stocking density in different locations at Rasheed branch of River Nile ".

Size	Season	locations	Phytoplankton Org /1					Zooplankton Org /1				
			Chlorophyta	Bacillagphyta	Cyanophyta	Euglena	Total phyto	Cladocera	Rotifea	Copepoda	Ostracoda	Total zoo
5	1	El-Mahmoudia	920± 78bc	447± 73c	218± 44c	95± 11c	1680± 288c	122± 11c	111± 10c	65± 8c	22± 3c	320± 23c
		Fazara	1524± 230b	861± 109b	338± 79b	410± 46b	3133± 354b	401± 26b	384± 16b	166± 12b	46± 5b	997± 42b
		Idfina	3270± 576a	2092± 282a	644± 119a	714± 102a	6720± 388a	574± 43a	499± 25a	281± 19a	80± 9a	1434± 58a
	2	El-Mahmoudia	1007± 276b	540± 122c	153÷ 32c	105± 24c	1805± 92	154± 13c	128± 9c	76± 7c	21± 3c	379± 21c
		Fazara	1397± 312b	787± 176b	319± 56b	393± 79b	2896± 142c	367± 21b	375± 12b	137± 12b	33± 5b	912± 50b
		Idfina	3245± 422a	2054± 458a	636± 128a	671± 132a	6606± 274b	545± 32a	490± 22a	316± 20a	98± 7a	1449± 72a
10	1	El-Mahmoudia	816± 72c	302± 49c	105± 28c	89± 11c	1312± 102a	133± 11c	117± 11c	68± 9c	26± 2c	344± 27c
		Fazara	1164± 172b	786± 98b	276± 48b	252± 41b	2478± 188c	379± 19b	389± 16ba	152± 12b	41± 4b	961± 39b
		Idfina	3212± 426a	2043± 248a	630± 72a	682± 66a	6567± 312a	546± 26a	449± 24	245± 19a	65± 7a	1305± 51a
	2	El-Mahmoudia	754± 56c	315± 81c	114± 23cb	94± 12c	1277± 71c	175± 14c	127± 12c	72± 7c	19± 3c	393± 19c
		Fazara	1100± 138b	685± 138b	260± 46b	255± 33b	2300± 122b	359± 21b	337± 28b	144± 11b	29± 3b	869± 29b
		Idfina	3292± 626a	2157± 452a	646± 72a	613± 58a	6708± 288a	553± 33a	452± 43a	216± 16a	83± 5a	1304± 41a

Means in the column followed by different letters are significantly different (Duncan s Multiple Range Test P<0.05).

Table (9): Average numbers of phytoplankton and zooplankton taxa in sliver carp cages as affected with initial weight and season regardless stocking density in different locations at Rasheed branch of River Nile ".

locations	Phytoplankton Org/L					Zooplankton Org/L				
	Chlorophyta	Bacillagphyta	Cyanophyta	Euglena	Total phyto	Cladocera	Rotifea	Copepoda	Ostracoda	Total zoo
El-Mahmoud. ia	874.75 ± 112c	401 ± 66c	147.5 ± 22c	95.75 ± 11c	1519 ± 172c	146 ± 11c	120.75 ± 11c	70.25 ± 7c	22 ± 3c	359 ± 61c
Fazara	1296.25 ± 178b	779.75 ± 92b	298.25 ± 33b	327.5 ± 36b	2701.75 ± 132b	376.5 ± 33b	371.25 ± 36b	149.75 ± 16b	37.25 ± 5b	934.75 ± 91b
Idfina	3254.75 ± 324a	2086.5 ± 211a	639 ± 92a	670 ± 79a	6650.25 ± 346a	554.5 ± 41a	472.5 ± 61a	264.5 ± 46a	61.5 ± 6a	1353 ± 111a

Means in the column followed by different letters are significantly different (Duncan s Multiple Range Test P<0.05).

Table (10): Growth performance and carcass composition of sliver carp cultivated in cages as affected with stocking density: initial weight and season at El Mahmoudia "Rasheed branch of River Nile ".

Size g	season	Density / M^3	Final weight g	Net gain g	Daily gain g	Survival %	SGR	K	Length cm	Muscles g	Head g	Skeleton g	Stomach g
5	First	8	1295	1290	8.6	95.7	3.7	1.16	48	665	275	140	215
		10	1415	1410	9.4	96	3.76	1.07	49	730	300	157	228
		12	1517	1512	10.08	93.6	3.8	1.19	50	790	315	154	258
	Second	8	1175	1170	7.8	96.6	3.58	1.25	46	606	254	135	180
		10	1173	1168	7.79	94	3.64	1.18	46	606	250	134	183
		12	1033	1028	6.85	90	3.55	1.25	44	527	217	117	172
10	First	8	1842	1832	12.2	94.5	3.47	1.17	53	920	375	188	359
		10	1887	1877	12.5	95.1	3.49	1.16	54	982	384	199.5	321.5
		12	1816	1806	12.04	91.2	3.47	1.15	53	922	366	186	342
	Second	8	1559	1549	10.33	93.1	3.37	1.17	51	814	305	164.5	275.5
		10	1420	1410	9.4	93.2	3.22	1.17	50	732	288	161	259
		12	1391	1381	9.21	89.8	3.28	1.15	50	728	284	158	[illegible]

Table (11): Growth performance and carcass composition of sliver carp cultivated in cages as affected with stocking density; initial weight and season at Fazare "Rasheed branch of River Nile".

Size	season	Density / M^3	Final weight g	Net gain g	Daily gain g	Survival %	SGR	K	Length cm	Muscles g	Head g	Skeleton g	Stomach g
5	First	6	910	905	6.03	83.3	3.46	1.28	41	435	188	95.5	191.5
		8	1062	1057	7.63	85.5	3.57	1.27	44	535	220	115	192
		10	1108	1103	7.35	88.0	3.59	1.23	45	540	226.5	124	217.5
	Second	6	854	849	5.66	82	3.42	1.27	41	424	175	90	165
		8	958	953	6.53	82	3.49	1.27	43	468	199	97	194
		10	1004	999	6.66	87	3.53	1.27	44	496	197	112	194
10	First	6	1140	1130	7.53	82.0	3.15	1.19	46	580	231	122.5	196.5
		8	1370	1360	9.1	83.7	3.28	1.17	49	714	293	156	197
		10	1375	1365	9.1	87	3.28	1.18	49	725	293	157	200
	Second	6	1020	1010	6.73	80	3.16	1.24	43	520	215	115	170
		8	1179	1169	7.79	81	3.18	1.16	47	615	240	135	189
		10	1250	1240	8.27	85	3.22	1.16	47	610	265	138	20.7

Table (12): Growth performance and carcass composition of sliver carp cultivated in cages as affected with stocking density; initial weight and season at Idfina "Rasheed branch of River Nile ".

Size g	season	Density / M^3	Final weight g	Net gain g	Daily gain g	Survival %	SGR	K	Length cm	Muscles g	Head g	Skeleton g	Stomach g
5	First	4	600	595	3.97	63.1	3.18	1.26	36	264.5	138	68.5	129
		6	600	595	3.97	63.5	2.96	1.3	36	275	135	65.5	124.5
		8	600	595	9.97	62.2	3.06	1.27	36	271	138	67.5	123.5
	Second	4	500	495	3.3	61.3	2.78	1.28	34	227.5	112	65.5	104
		6	450	445	2.97	64.0	3.18	1.28	32	205.5	102	50.5	92
		8	450	445	2.97	62.0	2.96	1.3	32	187.5	99.5	50.5	112.5
10	First	4	850	845	5.63	60.0	2.99	1.33	41	403.5	180.5	89	177
		6	850	845	5.63	62.0	2.73	1.28	41	400.5	182.5	90.5	176.5
		8	760	755	5.03	70.0	3.19	1.27	40	355	173	88	144
	Second	4	650	645	4.3	70.0	2.46	1.29	37	296	151	74	129
		6	600	595	3.97	74.0	2.99	1.31	36	265.5	137	66.5	131
		8	550	545	3.63	80.0	2.67	1.28	35	251.5	126.5	64.5	107.5

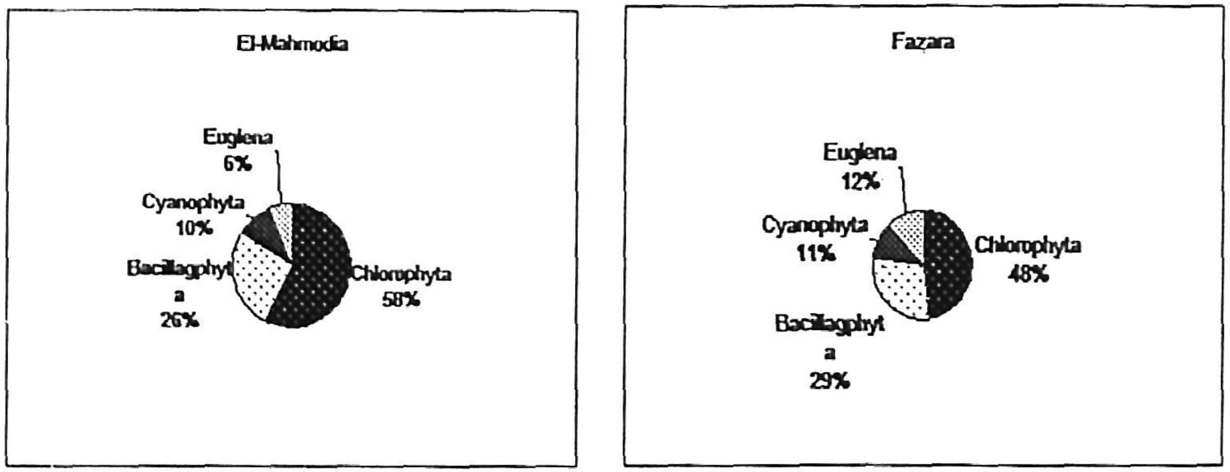
Table (13): Average growth performance and carcass composition of sliver carp cultivated in cages as affected with initial weight, season and location regardless stocking density at Mahmoudia Fazara and Rasheed branch of River Nile

Size g	season	Locations	Final weight g	Net gain g	Daily gain g	Survival %	SGR	K	Length cm	Muscles g	Head g	Skeleton g	Stomach g
5	First	El-Mahmoudia	1404	1399	9.33	95.1	3.75	1.14	49	728	297	150	234
		Fazara	1227	1222	8.15	85.6	3.54	1.26	433	503	211.5	111.5	200
		Idfina	600	595	3.97	62.9	3.07	1.28	36	270	137	67	126
	Second	El-Mahmoudia	1127	1122	7.48	93.5	3.59	1.23	45.3	580	240	129	178
		Fazara	939	934	6.22	83.7	3.48	1.27	42.6	462.5	190	99.5	184
		Idfina	467	462	3.1	62.4	2.97	1.29	32.7	207	104.5	55.5	103
10	First	El-Mahmoudia	1848	1838	12.3	93.6	3.48	1.16	53.3	941	375	191	341
		Fazara	1295	1285	8.57	84	3.24	1.18	47.6	676	272	145	198
		Idfina	820	810	5.4	64	2.97	1.29	41	386	179	89	166
	Second	El-Mahmoudia	1457	1447	9.6	92	3.29	1.16	50.3	758	292	161	245
		Fazara	1150	1140	7.9	82	3.19	1.19	45.6	592	240	129	188.6
		Idfina	600	590	3.9	74.7	2.71	1.29	36	271	138	68	122.5

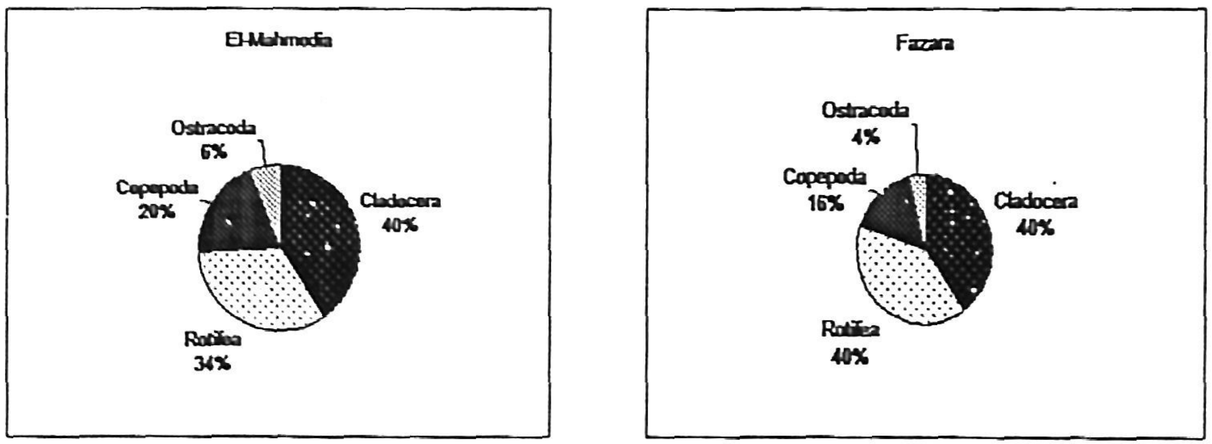
Table (14): Average growth performance and fish carcass composition of sliver carp cultivated in cages as affected with initial weight regardless stocking and season in different location at Rasheed branch of River Nile.

Size	Locations	Final weight g	Net gain g	Daily gain g	Survival %	T. Prod./M ^{3}kg	SGR	K	Length cm	Muscles g	Head g	Skeleton g	Stomach g
5	El-Mahmoudia	1265.5 ± 133a	1260.5 ± 132a	8.41 ± 1.52a	94.3 ± 4.5a	11.9 ± 1.05a	3.58 ± 0.48a	1.19 ± 0.13a	47.2 ± 2.4a	654 ± 56.5b	268.5 ± 24.2ab	139.5 ± 9.5b	206 ± 8.5b
	Fazara	1083 ± 111.5b	1078 ± 112b	7.18 ± 1.11b	84.7 ± 3.8b	7.3 ± 0.92b	3.51 ± 0.44a	1.26 ± 0.11a	43 ± 2.2a	483 ± 52b	200.8 ± 21.3b	105.5 ± 6.3b	192 ± 6.5b
	Idfina	533.5 ± 76.6c	528.5 ± 77c	3.5 ± 0.76c	62.7 ± 3.2c	2.1 ± 0.24c	3.02 ± 0.39b	1.29 ± 0.12a	34.4 ± 2.2b	238.5 ± 33.8c	120.8 ± 12.2c	61 ± 3.2c	114.5 ± 4.1c
10	El-Mahmoudia	1652.5 ± 178.2a	1642.5 ± 178a	10.95 ± 1.36a	92.8 ± 4.8a	15.3 ± 1.34a	3.38 ± 0.44a	1.16 ± 0.12a	51.8 ± 3.1a	849.5 ± 62.4a	333.5 ± 27.4a	176 ± 11.5a	293 ± 11.4a
	Fazara	1222.5 ± 106.5b	1212.5 ± 108b	8.08 ± 1.05b	83 ± 4.2b	8.1 ± 1.02b	3.21 ± 0.36a	1.19 ± 0.13a	46.6 ± 2.6a	634 ± 46.4b	256 ± 20.3ab	137 ± 9.4b	193.3 ± 10.2b
	Idfina	710 ± 91.4c	700 ± 92c	4.67 ± 0.64c	69.3 ± 3.1c	2.95 ± 0.32c	2.84 ± 0.29b	1.29 ± 0.14a	38.5 ± 2.1b	328.5 ± 34.4c	158.5 ± 13.8c	78.5 ± 7.8c	144.3 ± 7.2c

Means in the column followed by different letters are significantly different (Duncan s Multiple Range Test P<0.05).



(A)



(B)

Fig (1): phytoplankton (A) and zooplankton (B) classification as percentage regardless stocking density, initial weight and season in all locations during experimental period