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BATHYMETRICAL DISTRIBUTION, BIOMETRICAL CHARACTERISTIC AND LENGTH - DRY WEIGHT RELATIONSHIPS OF *ACARTIA (PARACARTIA) LATISETOSA* (COPEPODA - CRUSTACEA) OF LAKE QAROUN

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Key words: *Acartia latisetosa*, Copepoda, bathymetrical distribution, biometrical characteristics, length-dry weight relationships, Qaroun Lake.

ABSTRACT

Samples of *A. latisetosa* were collected monthly from 22 stations among Lake Qaroun during January – December 1993. The bathymetrical distribution, the different biometrical characteristics and length – dry weight relationships were estimated.

The nauplius larvae represented 88.31 % of the total number of the developmental stages followed by copepodite stages (7.96 %), whereas the adult stage represented 3.73 % only.

The maximum counts of the total number were recorded at the east and south of the lake. The peak of flourishing for nauplius larvae, copepodite stages and adults was mostly recorded during winter, summer, and spring respectively.

The total body length ranged between 0.7164 mm to mm 0.9060 for females and 0.8171 mm to 0.8994 mm for males. The average dry weight of females was 3.520 µg whereas that of males was 2.202 µg.

INTRODUCTION

Lake Qaroun was originally a fresh water lake, and changed to a saline water lake. At present, it has an area of about 220 km^2 which lies between the longitude 30°25´and 30°50´E and latitude 29°24´and 29°33´N. It lies at 90 km SW of Cairo. It's maximum depth is 8.2 m. The main source of the lake water is the agricultural drainage water of El-Fayoum province through El-Wadi and El-Bats drains at the east of the lake. The lake salinity has reached about 42 gm/l (Sabae, 1993 and 1996). As a result of increasing salinity, the freshwater fishes have disappeared (Boraey *et al*,1980). To compensate the loss of freshwater fishes, various species have been introduced from the Mediterranean Sea (Ishak, 1980).

Acartia (Paracartia) latisetosa (Kriczaguin, 1873) was transported to the lake through the transplantation of the marine fishes from the Mediterranean Sea at Alexandria. *A. latisetosa* is one of the most important food items for most marine fishes and plays a major role in the transfer of energy to higher trophic levels (Gaudy, 1984 and Moraitou – Apostolopoulou *et al.*, 1986). Like most Acartiidae, it is restricted to coastal, brackish and marine waters (Belmonte, 1992). In these environments, the Acaritiidae are abundant, sometimes being the dominant component of zooplankton (Tranter & Abraham, 1971 and Gastel & Courties, 1982). It has been found in many localities of the Mediterranean Sea (Steuer, 1929; Carli & Crisafi, 1983), and in Suez canal at a fairly high salinity (46 ‰) (Fox, 1927). It was also recorded from Mauritania (Rose, 1993), Madagascar (Dussart, 1989) and a coastal lagoon in the southern Adriatic Sea (Belmonte *et al*, 1987). Dowidar and El Nady (1982), Khalifa (1994) and Mageed (1998) recorded *A. latisetosa* in Lake Qaroun.

Most of the previous studies that related to *A. latisetosa* concerned with counts of organisms. No previous work was so far done to assess the length – dry weight relationships. There is an obvious need

for conversion factor that reliably define the relationship between dry weight and total length. The objective of this paper is to reveal the relationship between dry weight and length in addition to other parameters, as well as determination of the bathymetrical distribution of *A. latisetosa in* Lake Qaroun.

MATERIAL AND METHODS

A. latisetosa was collected monthly with zooplankton samples from Lake Qaroun during January – December, 1993. The samples were collected from 22 stations on the lake (Fig.1) using plankton net of 55-μ mesh size. The net was towed vertically from near the bottom layer to the water surface. 264 samples were collected to be preserved directly with 4 % formalin solution. The volume of each sample was concentrated to 100 ml and three sub-samples of 5 ml were transferred into a counting cell, and each individual of *A. latisetosa* stages was identified under binocular research microscope.

The total length, prosome length and width, urosome length and width, furcal rami length and width and left first antenna length and width of twenty adult females and males were measured in mm. These individuals were sorted from the preserved samples. The measurements were done by an eyepiece micrometer using light microscope (Carl-Zeiss) at X 40 magnification. To achieve dry weight of these individuals, each one of twenty individuals was washed in distilled water and transferred after the measurements to a pre-dried (at 105°C for 24 hours) and weighed small aluminum boat. It was then transferred to a glass vial of 5 cm long and 1 cm in diameter and then dried in an oven for 24 hours at 60° C. The glass vials were closed and stored in a desiccator until cooled, and the boats were weighed again, using Mettler-Toledo GmbH balance readable to 0.1 μg. The dry weight of the specimens was

balance readable to 0.1 μg. The dry weight of the specimens was determined by subtracting the dry boat weight from the total weight of the dry boat and specimens weight. The linear regression between dry weight, total length and other relations of *A. latisetosa* has been described using a computer excel (Ver. 5.0) software.

RESULTS

Bathymetrical distribution:

The different developmental stages of *A. latisetosa* were recorded. The annual average of the total number was 29205 organisms/m^3. The maximum counts of the total number of these stages were recorded at the east and south of the lake. The number decreased towards the northern part (Fig. 2). Nauplius larvae represented 88.31% of the total number of the developmental stages followed by copepodite stages (7.96 %), where as the adult stage represented 3.73 % of the total copepod numbers.

Nauplius larvae:

Nauplius larvae were concentrated at the eastern side of the lake, and decreased towards the west and the north (Fig. 3).

Copepodite stages:

The maximum numbers were observed at the east, northern east, and southern middle (Fig. 4).

Adult stage:

The number of adult organisms increased in the east towards the north and in the middle towards the south, whereas at the west the number decreased towards the far west (Fig. 5).

Seasonal variations:

Nauplius larvae: -

The peak of nauplius larvae was recorded during winter, their number deceased gradually during the other seasons (Fig. 6).

Copepodite stages:

Summer season witnessed the highest counts of the copepodite stages (4012 organisms / m^3) whereas the lowest counts were observed during winter season (Fig. 7).

Adult stage:

The highest numbers were recorded during spring while the lowest were recorded in winter (Fig. 8).

2-Biometrical characteristic of adults:

Body length ranged between 0.9060 mm to 0.7164 mm for females and 0.8994 mm to 0.8171 mm for males (Table 1).

Prosome length represented 79.57 % and 75.74 % of the total body length for females and males respectively, whereas urosome length represented 13.30 % and 20.99 % of the total body length for females and males respectively. The left first antenna length reached 77.90 % and 69.86 % of the total length for females and males respectively.

The linear regression relationship of the lengths of the different body parts is shown in Table (2) whereas that of body length and width is in Table (3).

3- Length – dry weight relationships: -

The average dry weight of females was 3.520 µg, whereas that of males 2.202 µg. The dry weight measurements of the adult stage of females and males were plotted against their respective length as shown in figures 9 and 10. The relationships depicted in these graphs are expressed by the formula $y = a + bx$. The length of the organisms is measured in mm, the dry weight in microgram. The linear regression equation between the total length and the dry weight is:

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Total length = 0.8079 + 0.0214 DW for females

r^2=0.4649

Total length = 0.8004+ 0.0154 DW for males

r^2 = 0.4344

From these equations, it is possible to calculate the length or the dry weight of adults, if any one has been available.

DISCUSSION

The water temperature of Qaroun Lake ranges from 14°C in January to 32°C in July. The difference in temperature between surface and bottom is no more than 2°C. There is no thermal startification (Wilbert, 1995). According to radiocarbon tests of fossil pollen in the lake sediment, it had existed for 9000 years (Mehringer *et al.*, 1979) . In this time, the lake was a freshwater lake whereas now it is a saline lake of about 42 gm salts/l (Sabae, 1993 & 1996).

A. latisetosa has been acclimatized with the new environment of Qaroun Lake after transportation from the Mediterranean Sea. The salinity tolerance of nauplair stages is a major factor affecting the abundance of the copepod in Lake Qaroun. Tester and turner (1991) concluded that *A. latisetosa* prefers or requires lower salinity than other copepods. In the present study, its maximum numbers were reported at the east of the lake, where the agricultural drainage water discharges and lowering salinity.

Nauplius larvae and copepodite stages were found dominating during winter and summer respectively, whereas adult stage appeared with maximum counts during spring. Belmonte (1992,1997, and 1998) suggested that the distribution in space and time may owe a lot to the fact that a number of *Acartia* species are known to produce diapause eggs that

September with annual average of 1490 organisms/m^3 . He observed *A. latisetosa* in Lake Qaroun in addition to other rare copepod species, with 99.40 % of the total adult copepods.

Dowidar and El Nady (1982) observed *A. latisetosa* as the most abundant zooplankton species in the lake, as it contributed from 75 – 100 % of the total zooplankton counts, but they collected their samples by plankton net of 158 micrometers mesh size.

Belamote *et al* (1987) collected zooplankton samples monthly from March to November 1987 in Acquatina Lake, Italy. They found *A. latisetosa* as the dominant species from June to November.

Matthews & Hestad (1977) and Lovegroue (1996) recommended the use of dry weight as an expression of biomass and demonstrated that careful use of accepted techniques gives reproducible results.

In the present study, the dry weight was estimated for the preserved individuals with formaldehyde inspite of several reports that have been made about decreases in dry weight of formalin preserved marine plankton (Williams and Robins, 1982). Such preservation allows the different measurements of the body parts of each individual in comparison with its dry weight. To avoid losses of volatile components during dry weight measurements, drying was done for 24 hours in an oven at 60°C according to Giese (1967) and Palerini & Bianchi (1994).

Dowidar and El Nady (1982) measured the average dry weight of 100 individuals of *A. latisetosa* in Qaroun Lake as 293 microgram. Christon and Verriopoulos (1993) calculated the dry weight of *A. clausi* in the eastern Mediterranean Sea at Greece. They found the mean weight of adult females has been ranged from 3.86 to 6.18 microgram, whereas that of adult males ranged between 2.84 and 4.16 microgram. In the present study, the average dry weight of females was 3.520 microgram

of adult females has been ranged from 3.86 to 6.18 microgram, whereas that of adult males ranged between 2.84 and 4.16 microgram. In the present study, the average dry weight of females was 3.520 microgram whereas that of males was 2.202 microgram. Uye (1982) noted that the dry weight of zooplankton varies with sex.

Hussien and Abdel–Aziz (1997) concluded that the length and weight of females were always higher than the males. In the present study, the female length ranged between 0.906 mm and 0.716 mm, whereas that of male ranged between 0.899 mm and 0.817 mm. Rose (1933) measured the length of *A. latisetosa* as 0.82 – 0.93 mm for females and 0.81 – 0.91 mm for males.

Dowidar and El-Nady (1982) pointed out that the mean length of *A. latisetosa* varied between a minimum of 0.9 mm in summer and maximum of 1.1 mm in winter. They also estimated the protein, lipid, and carbohydrate content of *A. latisetosa* (12.9, 2.97 and 0.6 % respectively of the total wet weight). They and Russel–Hunter (1970) reported that, at least three quarters of the marine protien productivity at the second trophic level occurs in the zooplankton, which is in turn the direct food of zooplankton feeding animals.

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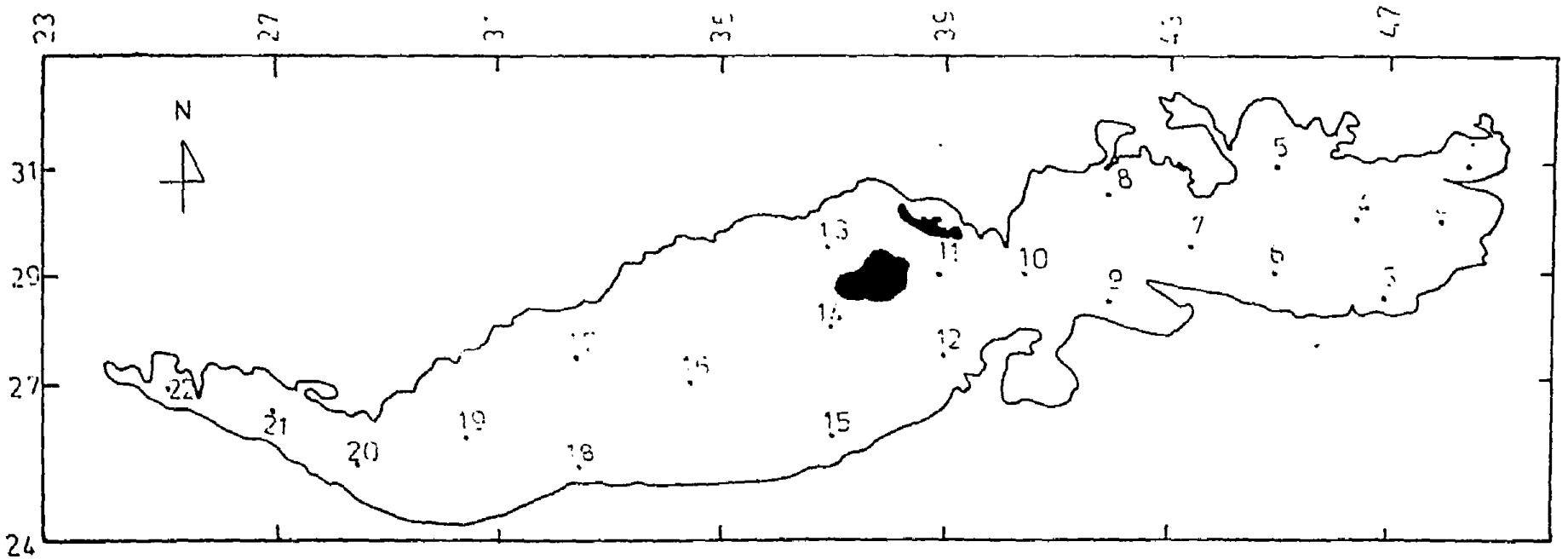


Figure (1) : Map of Lake Qaroun showing stations of study

Table 1. Total length (mm), prosome length and width (mm), urosome length and width (mm), furcal rami length and width (mm), and left first antenna length and width (mm) of female and male *Acartia latisetosa* of Qaroun Lake.

Sex		Female			Male		
Items	**Range**	Maximum	Minimum	Average	Maximum	Minimum	Average
Total length		0.9060	0.7164	0.8578	0.8994	0.8171	0.8385
Prosome	L.	0.7244	0.5612	0.6672	0.6748	0.6155	0.6497
	W.	0.2425	0.20.5	0.2237	0.2411	0.1581	0.2105
Urosome	L.	0.1156	0.0794	0.1115	0.1975	0.1531	0.1801
	W.	0.1813	0.0706	0.1066	0.0534	0.0662	0.0589
Furcal Rami	L.	0.0889	0.0581	0.0748	0.0316	0.0263	0.0282
	W.	0.0425	0.0306	0.0379	0.0277	0.0198	0.0248
Left A1	L.	0.7242	0.5839	0.6532	0.6284	0.5592	0.5993
	W.	0.0237	0.0156	0.0185	0.0319	0.0158	0.0213

Table 2. Linear regression between lengths (mm) of the different parts of *Acartia latisetosa* of Qaroun Lake.

	Total length (TL)		Prosome length (PL)		Urosome length (UL)	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Furcal rami length (FR)	FL=0.0223TL+0.0561 R^2=0.014	FL=0.0104TL+0.0193 R^2=0.0244	FL=-0.0045PL+0.0778 R^2=0.0005	FL=0.0323PL+0.0072 R^2=0.1823	FL=0.2413UL+0.0515 R^2=0.0997	FL=0.0356UL+0.0352 R^2=0.0754
Urosome length (UL)	UL=0.1272TL-0.0102 R^2=0.2659	UL=0.3848TL-0.15 R^2=0.6677	UL=0.0156PL+0.0861 R^2=0.0033	UL=0.4107PL-0.0868 R^2=0.3282		
Prosome length (PL)	PL=0.8505TL-0.0459 R^2=0.875	PL=0.6158+0.1215 R^2=0.879				

Table 3. Linear regression between length (mm) and width (mm) of the different parts of *Acartia latisetosa* of Qaroun Lake.

	Antennule	**Prosome**	**Urosome**	**Furcal rami**
Female	W=0.0078L+0.0134 R^2=0.0163	W=0.2125L+0.0819 R^2=0.4766	W=1.3047L-0.0193 R^2=0.3014	W=-0.0274L+0.0399 R^2=0.0037
Male	W=-0.085L+0.0722 R^2=0.1171	W=0.2647L+0.0386 R^2=0.0545	W=-0.0132L+0.0616 R^2=0.0019	W=-0.135L+0.0286 R^2=0.0104

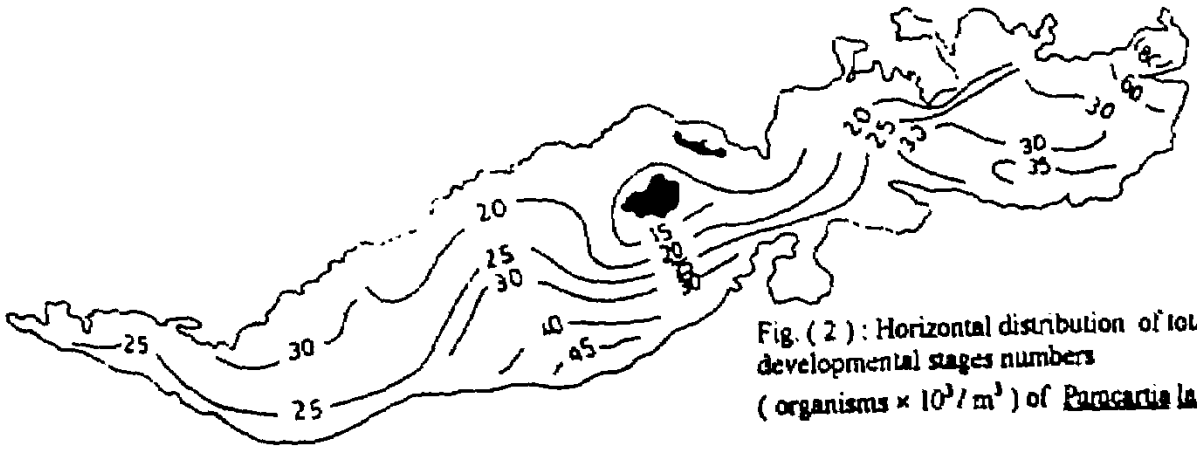


Fig. (2) : Horizontal distribution of total developmental stages numbers (organisms × 10^3 / m^3) of Paracartia latisetosa .

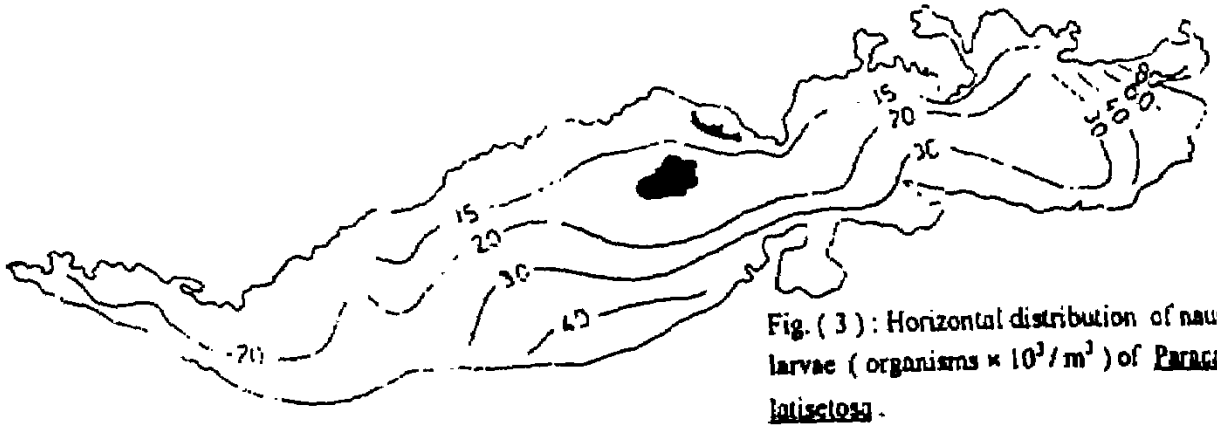


Fig. (3) : Horizontal distribution of nauplius larvae (organisms × 10^3 / m^3) of Paracartia latisetosa .

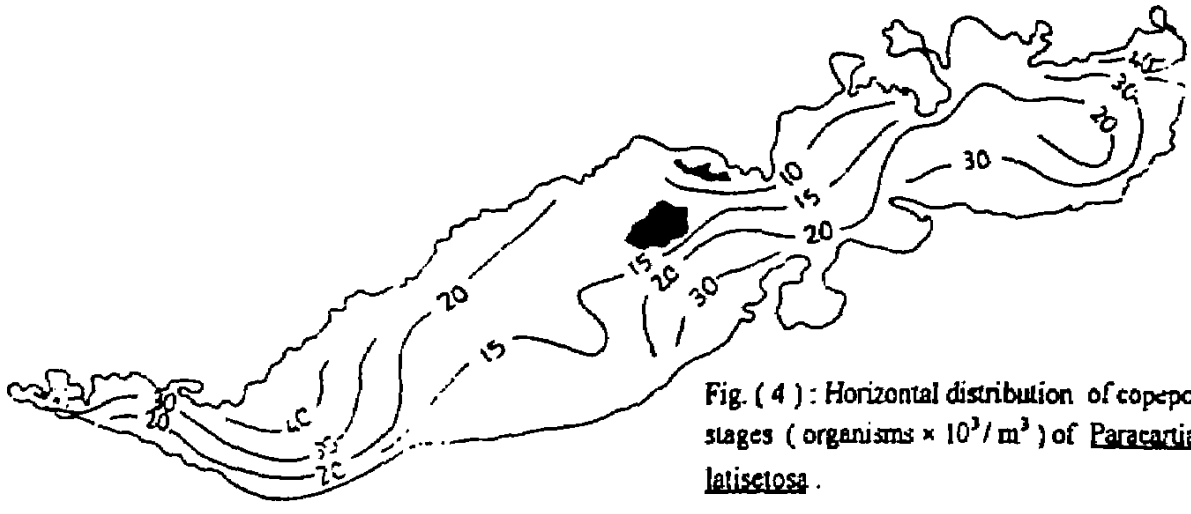


Fig. (4) : Horizontal distribution of copepodite stages (organisms × 10^3 / m^3) of Paracartia latisetosa .

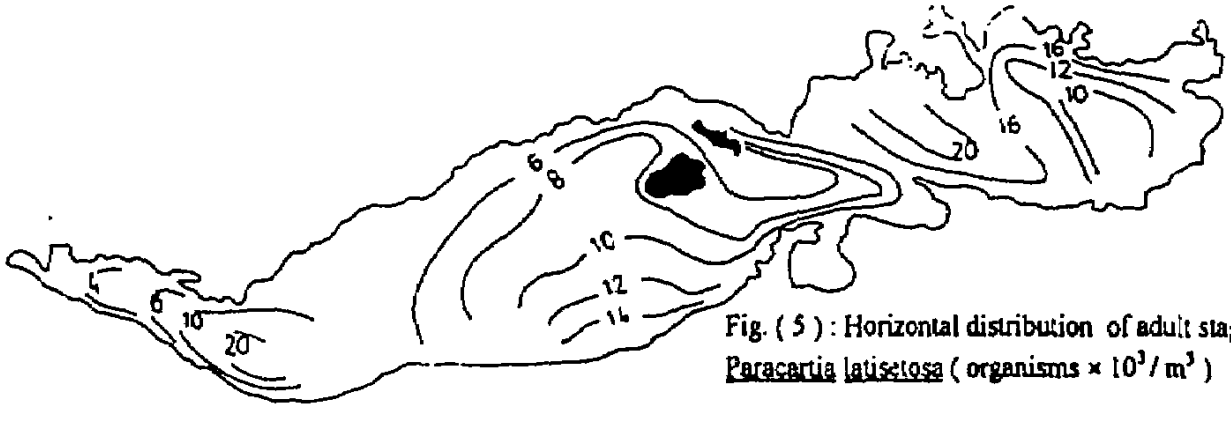


Fig. (5) : Horizontal distribution of adult stage of Paracartia latisetosa (organisms × 10^3 / m^3)

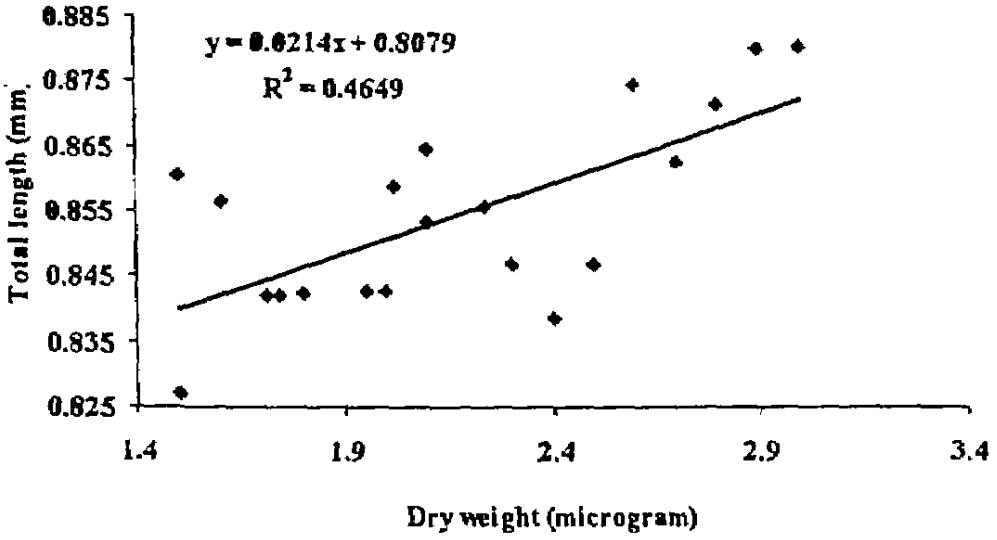


Fig. 9. Relationship between dry weight (microgram) and total length (mm) of female Acartia latisetosa of Qarun Lake.

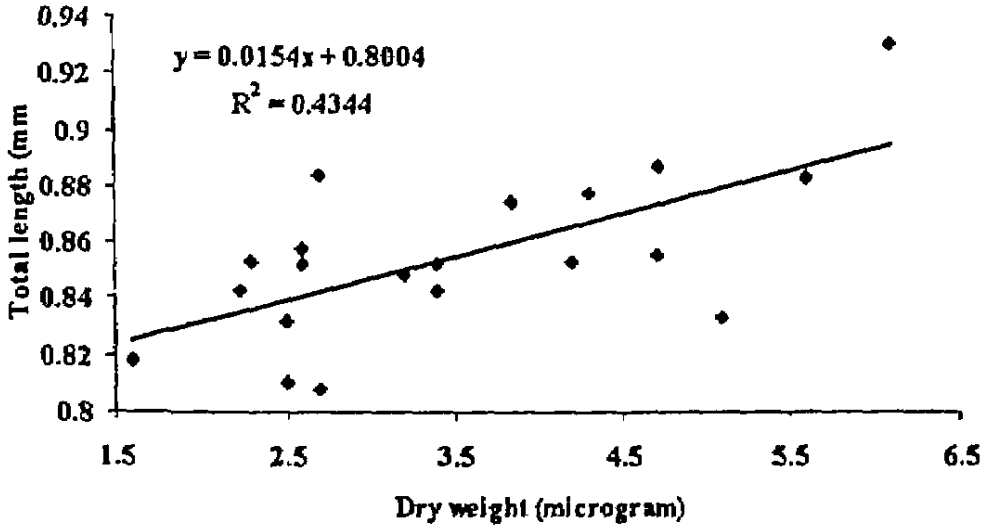


Fig. 10. Relationship between dry weight (microgram) and total length (mm) of male Acartia latisetosa of Qarun Lake.

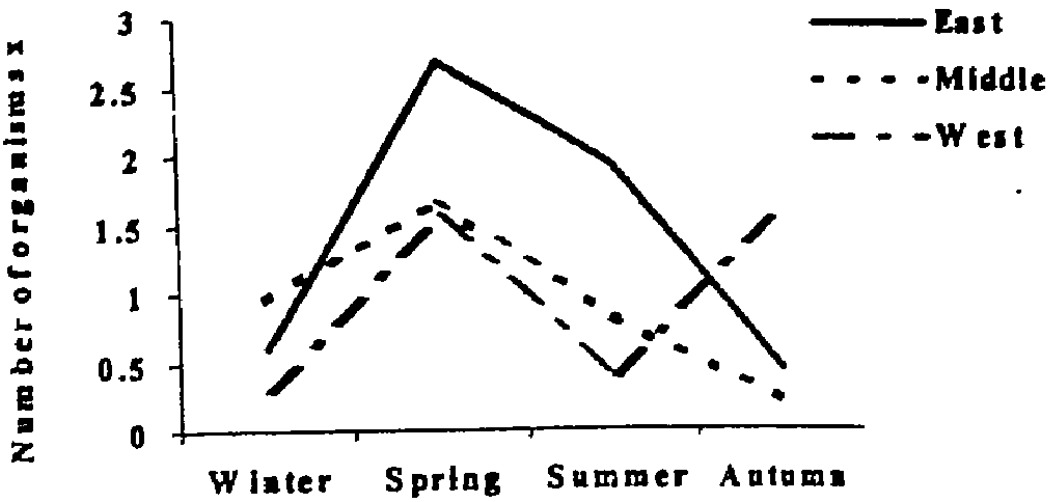
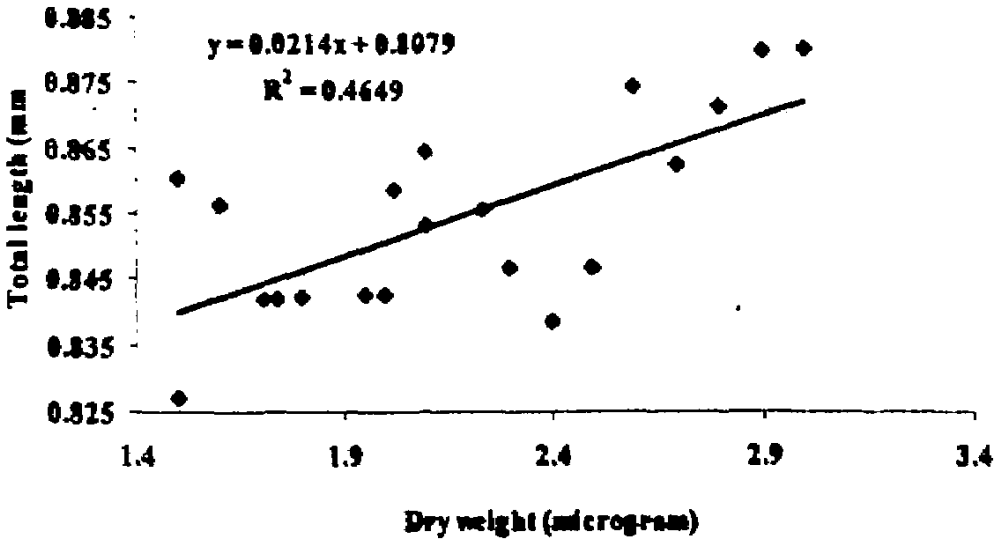


Fig. 8. Average numbers of (organisms/m3) of adult stage of A. latisetosa of Lake Qaroun



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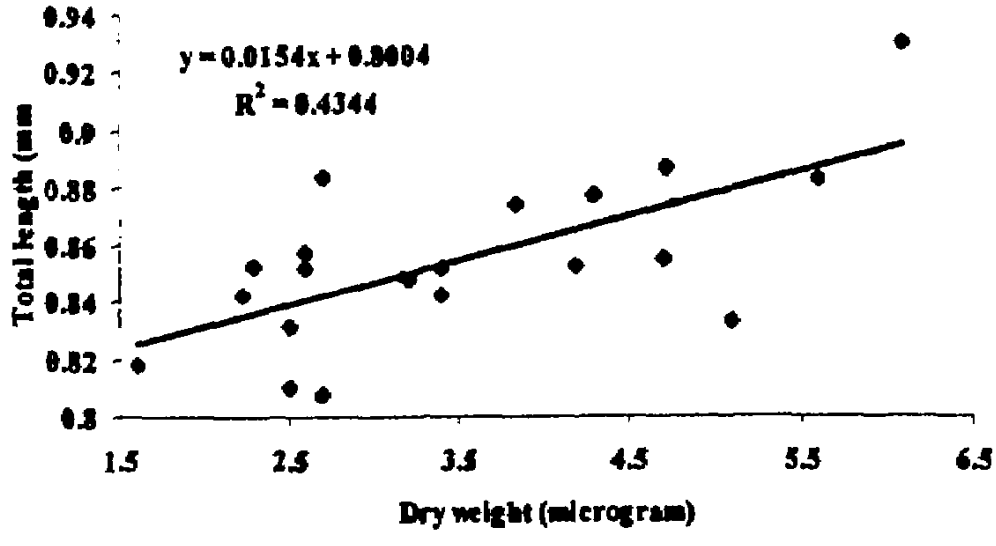

Fig. 10. Relationship between dry weight (microgram) and total length (mm) of male Acartia latisetosa of Qarun Lake.