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Species Composition, Distribution and Morphometric Parameters of four Penaeid Shrimp Species from Lake Burullus

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ABSTRACT

The species composition, abundance and morphometric relationships of Penaeid shrimp species were subjected to study using monthly samples collected from Burullus Lake. In the lake catches, four species were recorded; namely, *Penaeus semisulcatus*, *Metapenaeus stebbingi*, *Metapenaeus monoceros* and *Marsupenaeus Japonicus*. The overall composition of shrimp by number showed that *M. monoceros* was the most abundant constituting more than 30% of the catch of shrimp, followed by *P. semisulcatus* (27.3%) and *M. stebbingi* (23.3%). While, *M. Japonicus* was recorded as the least abundant species, with a percentage of 18.6. The shrimp overall composition by weight revealed that *P. semisulcatus* was the most represented shrimp species in the catch (47%) followed by *M. monoceros* (24%) and the other two species *M. Japonicus* (16 %) and *M. stebbingi* (13%), showing the least abundant existence in the catch weight. The results showed that autumn months are the most shrimp productive months, while winter and early spring are the least productive months. The occurrence and distribution of shrimp in the lake are influenced by salinity and the geographical distribution is restricted on the northern part of the lake in the areas close to Boughas Al-Burullus. The morphometric relationships were investigated for each sex separately by fitting regressions to total length on total weight, carapace length on total weight and total length on carapace length for the four studied species. The correlations were all statistically significant ($Ps<0.001$). The results showed that females of these species reach larger sizes and gain more weights than males. These results may help in the maintenance of these valuable stocks in the lake.

INTRODUCTION

Lake Burullus, one of the five northern lakes (Mariout, Edko, Burullus, Manzala and Bardawil from west to east), is a brackish water lake lying in the northern of the Nile Delta in Egypt. It is located in Kafr El-Sheikh Governorate east of Rashid Branch of the Nile, bordered by the Mediterranean Sea in the north and the agricultural land to the south. It is considered a lake and wetlands site of global importance under the Ramsar Convention. A narrow sandbar separates it from the Mediterranean Sea (Boughas Al Burullus). It is a shallow, brackish, Mediterranean coastal lagoon with an area of 410 km2; a maximum length of 47 km and a maximum width of 14 km. Its depth varies between 40 and 200 cm **(Shaltout & Khalil, 2005)**.

Fisheries in the lake provide the principal life-support system for the local inhabitants with a production of 81 146 tons (in 2019), 2901 licensed fishing vessels and 17000 licensed fishermen depend on these resources for their living **(GAFRD, 2019)**.

Shrimp is one of the most economic fish resources in Lake Burullus. During the last ten years, its average catch was approximately 2000 tons, with an average percentage of 4 of the lake production and more than 70% of the Egyptian lakes shrimp production **(GAFRD, 2019)**.

Based on the available literature, the only study conducted on shrimp fisheries in Burullus Lake was that of **El-Damhogy *et al.* (2017)**. On the other hand, the biology and population dynamics of shrimp species were the subject of many studies in other Egyptian waters **(Yassien, 1992; Abdel-Razek *et al*, 1993; Ezzat *et al*, 1993; Zaghloul, 1995; Abdel-Razek & Taha, 2001; Yassien, 2003, 2004; Abdel-Razek *et al.*, 2008; El Ganainy & Yassien, 2012; Hussien *et al.*, 2016)**.

The main objective of the present study was to shed light on the distribution, species composition and morphometric relationships of four Penaeid shrimp species in the Burullus Lake to help in the maintenance of these valuable stocks.

MATERIALS AND METHODS

Data collection

The present study was carried out during the period from January to December 2018. During this period an extensive data collection program was applied through the collection of monthly random samples of shrimp species from the commercial catch of Lack Burullus. The data were based on prawn samples caught by small scale gear called trawling (Shrimp set net) or locally called (Dewar), it consists of two parts, a weir (fence) and a catching box (Fig. 1). A total of 9544 shrimp specimens were collected during the study period. Sampling was applied to 2226 specimens of *M. stebbingi*, 2606 specimens of *P*. semisulcatus, 2933 specimens of M. *Monoceros* and 1779 specimens of *M. Japonicus*.

Fig. 1. Gear used for shrimp fishing (Shrimp set net) in Lake Burullus

Measurements

Each sample of prawn species was separated according to its sex and its frequency distribution. The total length (TL) of each prawn individual was measured using a ruler from the tip of the rostrum to the end of the telson, with the abdomen fully stretched. Total length estimates was determined to the nearest 1 millimeter above and assorted afterwards in successive length groups of 0.5 centimeter interval, in the usual procedure of double sampling technique. Carapace length (CL) was taken from the tip of the rostrum to the posterior mid-dorsal edge of the carapace to the nearest 1millimeter. Total weight (T. Wt) which is the weight of the total body to the nearest 0.1 gram, was measured with a precision electric balance.

Data analysis

Morphometric relationships

For each sex, the total length-total weight and carapace length-total weight relationships were calculated, following a logarithmic transformation for the exponential regression formula **(Hile, 1936 & Le Cren, 1951)** as follows:

$$W = a L^{b}$$

Where, *W* is the total weight in gm; ***L*** is the length in cm, and ***a*** and ***b*** are Constants.

The total length-carapace length relationship was estimated from the linear equation of:

$$Y = a + b X$$

Where, *Y* is the carapace length; ***X*** Its total length; and ***a*** and ***b*** are Constants. For each relationship the upper and lower 95% confidence limits were estimated to determine whether the growth is isometric or alometric according to the method of **Rhoads and Lutz (1980)**.

RESULTS AND DISCUSSION

Species composition and population abundance

The species composition of Penaeid shrimp caught from the Burullus Lake comprises four species; *Penaeus semisulcatus*, *Metapenaeus stebbingi*, *Metapenaeus monoceros* and *Marsupenaeus japonicus*. The overall composition of shrimp (Fig. 2) showed that *M. monoceros* was the most represented, constituting more than 31% of the catch of shrimp, followed by *P. semisulcatus* (27.3%) and *M. stebbingi* (23.3%). While, the least abundant species was *M. Japonicus*, which was represented by 18.6% of the shrimp catch in the Burullus Lake. The abundance percentage of shrimp species (Fig. 3) revealed that *P.*

semisulcatus was the most abundant shrimp species in the catch (47%), followed by *M. monoceros* (24%) and the other two species, including *M. Japonicus* (16 %) and *M. stebbingi* (13%)s showing the least abundance.

El-Damhogy *et al.* (2017) registered only three shrimp species (*M. stebbingi*, *M. monoceros* and *P. semisulcatus*). They were dominated by *P. semisulcatus*, which constituted 51% of the annual mean of shrimp number, while *M. monoceros* was ranked the second, with 35% of the annual mean of shrimp number. Meanwhile, the *M. stebbingi* the third with respect to the annual mean of shrimp number by 14%.

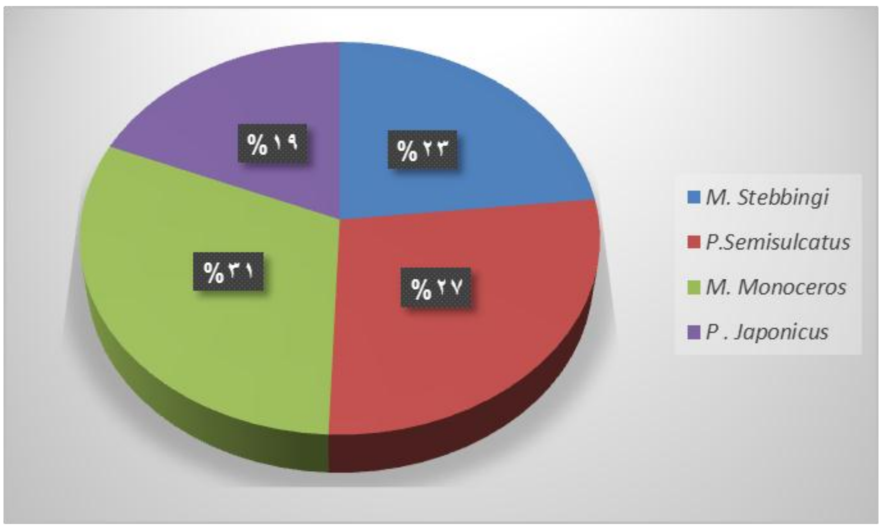

Fig. 2. Species composition of shrimp in Burullus Lake

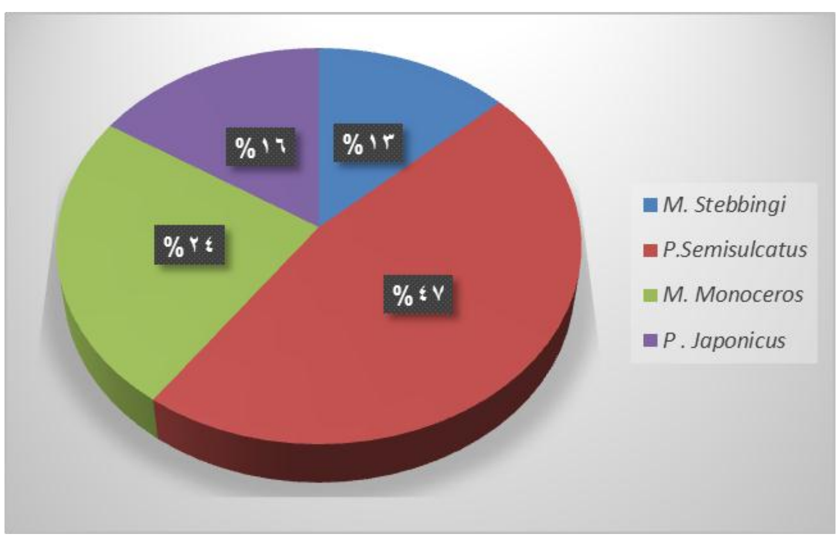

Fig. 3. Percentage of abundance of shrimp species in Burullus Lake

Monthly variations in shrimp composition and abundance

The monthly variations in shrimp species composition by number and weight (Figs. 4, 5) showed that autumn months (September, October, November and December) are the most productive months, while winter and early spring (January, February and March) are the least productive months. The results showed that *P. semisulcatus* is the most abundant shrimp species all the year round, except for January. *M. japonicus* appeared in very few numbers and quantities on winter and then its abundance increased gradually from April till December. *M. stebbingi* and *M. monoceros* distributed fairly on all fishing months.

El-Damhogy *et al.*, (2017) indicated that *M. stebbingi* was present in the period from April to June but *P. semisulcatus* and *M. monoceros* present in the period from September to December respectively. All shrimp species absent in the periods from January to March at the mean water temperature ranged between 13.73 –16.84°C and from July to august where it ranged between 33.10–33.16°C.

This difference in the species composition and abundance of shrimp in Lake Burullus may be attributed to the dredging and cleaning operations in the Lake, which have a positive effect led to the increase of abundance of marine fish (e.g. Seabream and Seabass) and shrimp species.

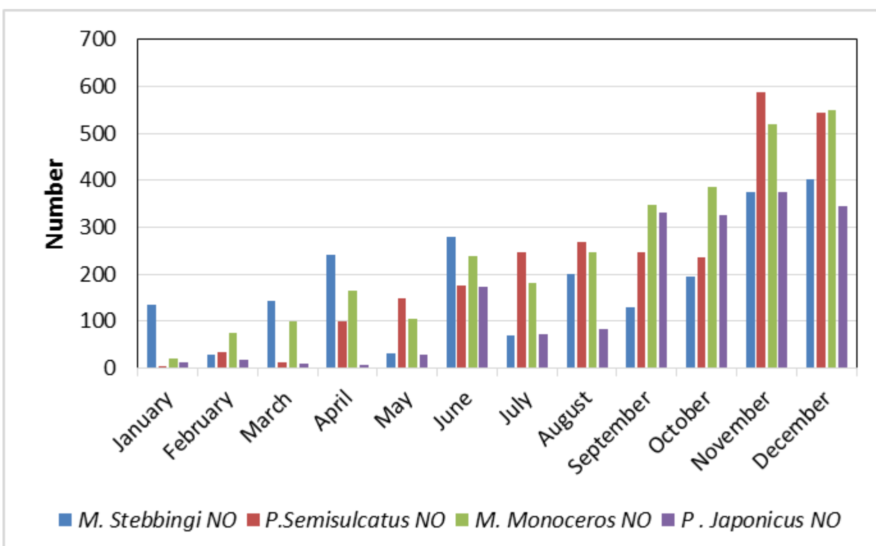

Fig. 4. Monthly shrimp species composition in Burullus Lake.

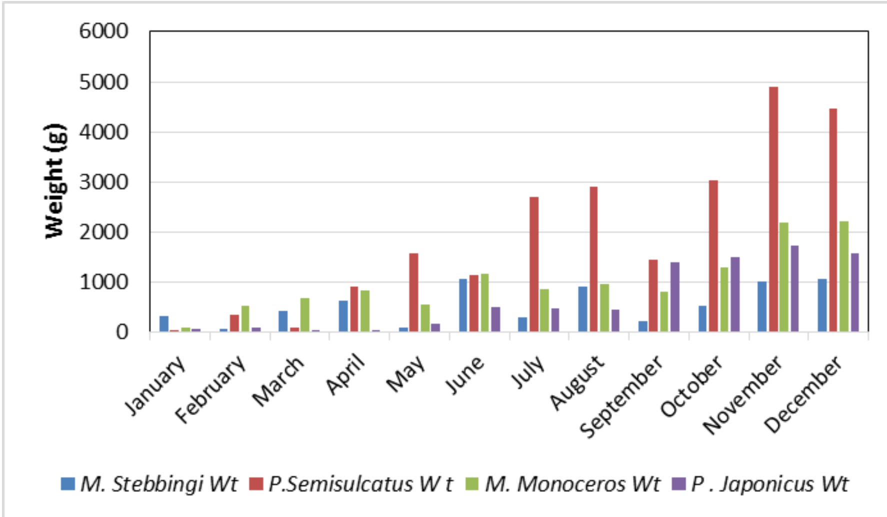

Fig. 5. Monthly abundance of shrimp species in Burullus Lake

Occurrence and distribution

The geographical distribution of Penaeid shrimp in Lake Burullus is restricted on the northern part of the Lake in the areas close to Boughas Al-Burullus which is the inlet or Breachway to the Mediterranean Sea (Fig. 6). The occurrence and distribution of shrimp in the Lake is influenced by salinity i.e. they occur only in the saline areas (about 12 ppt) close to the connection to the Sea. **El-Damhogy *et al.* (2017)** reported a positive correlation between shrimp abundance and salinity.

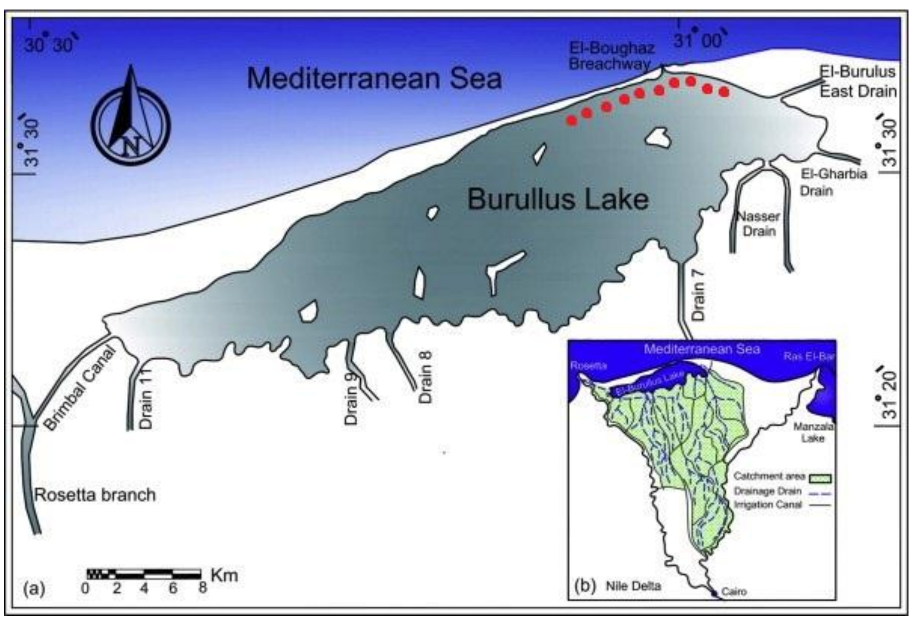

Fig. 6. Geographical distribution of shrimp (Red circles) in Burullus Lake.

Morphometric relationships

Some authors considered the total length as the most reliable measure of size in prawns **Hall, (1962)**, while others have been using carapace length **(Garcia and Le Reste, 1981; Garcia, 1985)** in assessing growth and other characteristics. Some morphometric relationships were investigated for each sex separately by fitting regressions to total length on total weight, carapace length on total weight and total length on carapace length (Figures 7, 8, 9 and 10). Table (1) shows the constants (a and b) of the applied equations for each relationship The correlations were all statistically significant ($Ps<0.001$); since it was observed that females of these species reach larger sizes and gain more weights than males, which could be related to their ability to have a higher ovarian volume **(Abello and Sarda, 1989).** The correlation coefficient of all preformed regressions is high and the constants of the regressions (a and b) lie in the normal range (Table 1).

The lower and upper 95% confidence limits showed that growth in total and carapace length were different than the total weight. The slops (b) of the regressions were significantly less than 3 (Table 1) indicating allometric growth for all species except male *P.semisulcatus*, where the b value is 3.28 indicating isometric growth. On the other hand, the prawn grows in total length at the same proportion as the carapace length, the slops were not significantly different than 1 (Table 1). The results are comparable with previous studies (Table 2).

Table (1): Summary of the different morphometric relationships for Shrimp species from Lake Burullus.

X	Y	a	b	r2	95%confidence		x	y	a	b	r2	95%confidence	
					lower	Upper						lower	Upper
Penaeus semisulcatus													
Male							**Female**						
Carapace Length	Total weight	0.19	2.83	0.98	2.785	2.867	Carapace Length	Total weight	0.19	2.84	0.97	2.794	2.88
Total Length	Total weight	0.004	3.23	0.96	3.169	3.3	Total Length	Total weight	0.01	2.82	0.83	2.704	2.931
Carapace Length	Total Length	1.07	2.37	0.97	0.835	0.864	Carapace Length	Total Length	1.73	2.36	0.92	0.94	1.019
MetaPenaeus stebbingi													
Male							**Female**						
Carapace Length	Total weight	0.21	2.84	0.92	2.746	2.931	Carapace Length	Total weight	0.23	2.72	0.92	2.646	2.79
Total Length	Total weight	0.03	2.34	0.93	2.268	2.411	Total Length	Total weight	0.02	2.36	0.91	2.294	2.428
Carapace Length	Total Length	0.61	2.73	0.87	0.714	0.786	Carapace Length	Total Length	0.91	2.59	0.89	0.773	0.834
MetaPenaeus monocerus													
Male							**Female**						
Carapace Length	Total weight	0.32	2.39	0.93	2.332	2.459	Carapace Length	Total weight	0.3	2.43	0.91	2.374	2.495
Total Length	Total weight	0.01	3.07	0.86	2.954	3.189	Total Length	Total weight	0.01	3.01	0.85	2.904	3.108
Carapace Length	Total Length	1.91	2.33	0.93	1.223	1.303	Carapace Length	Total Length	1.72	2.41	0.93	1.196	1.256
MarsuPenaeus japonica													
Male							**Female**						
Carapace Length	Total weight	0.29	2.38	0.89	2.29	2.473	Carapace Length	Total weight	0.26	2.49	0.92	2.415	2.566
Total Length	Total weight	0.02	2.43	0.88	2.331	2.535	Total Length	Total weight	0.02	2.52	0.9	2.439	2.618
Carapace Length	Total Length	1.01	2.5	0.91	0.951	1.021	Carapace Length	Total Length	0.99	2.49	0.91	0.947	1.009

Male (N=443) Female (N=504)

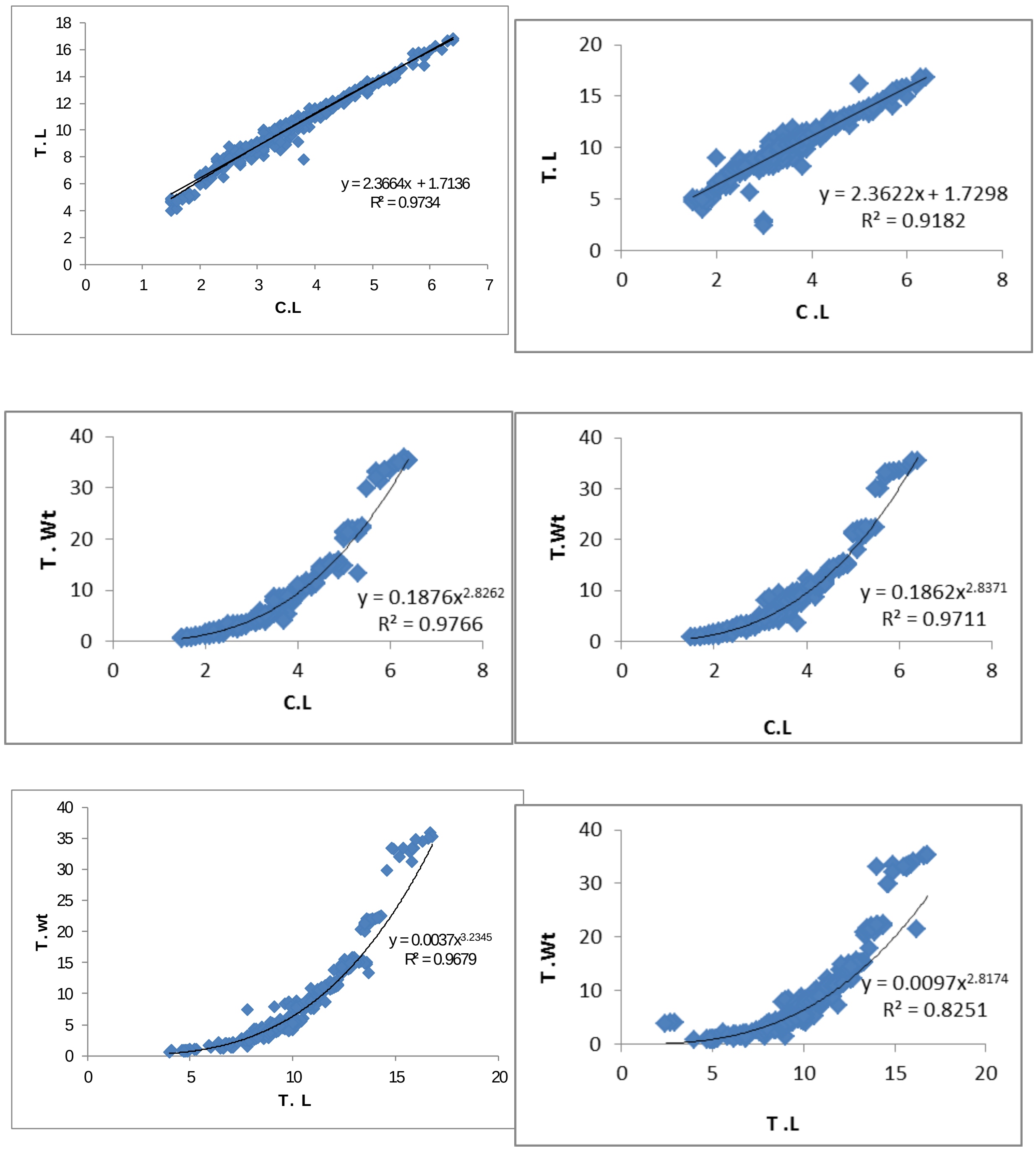

Fig. 7. Morphometric relationships of male and female *P. semisulcatus*

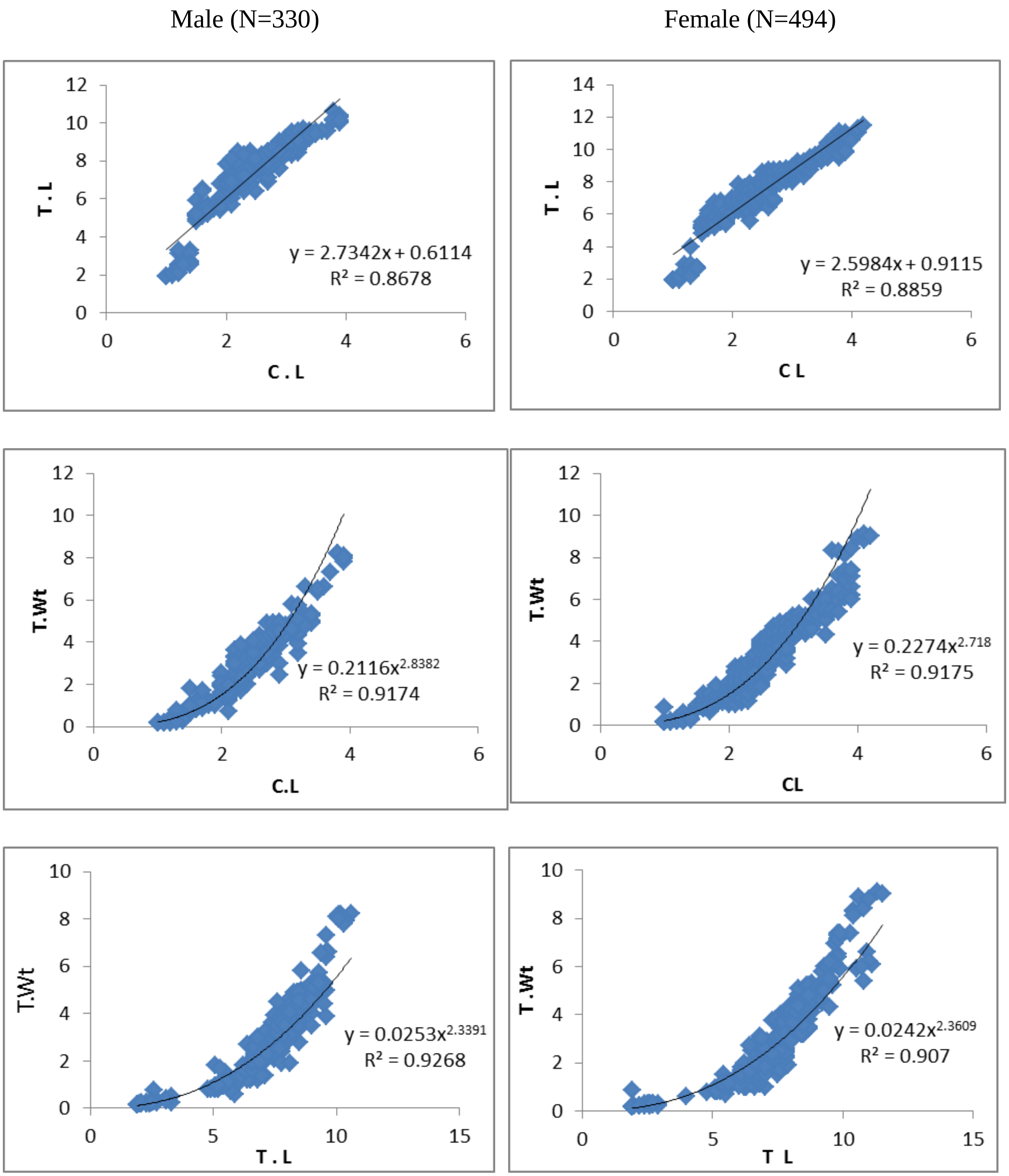

Fig. 8. Morphometric relationships of male and female *M. stebbingi*

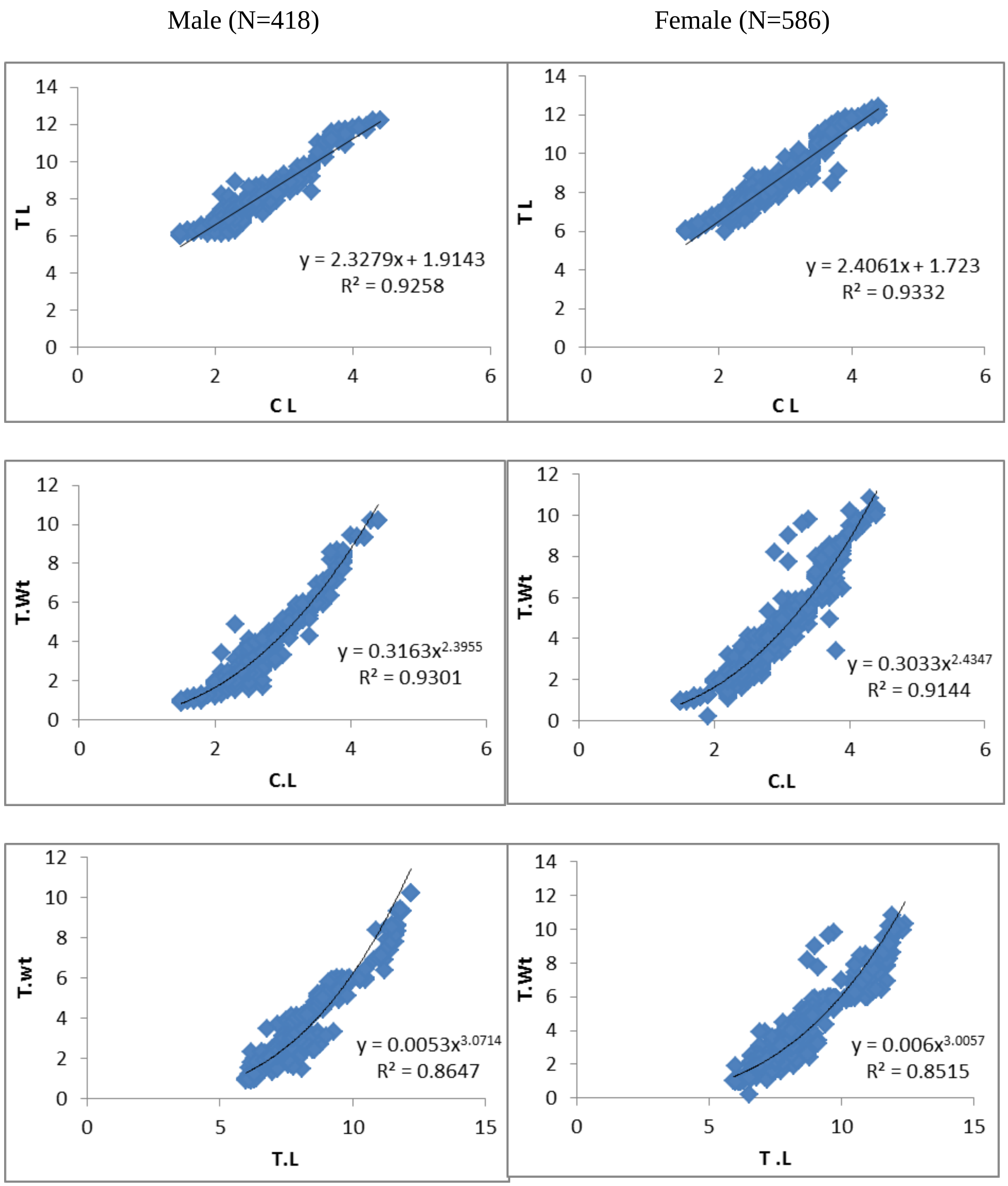

Fig. 9. Morphometric relationships of male and female *M. Monoceros*

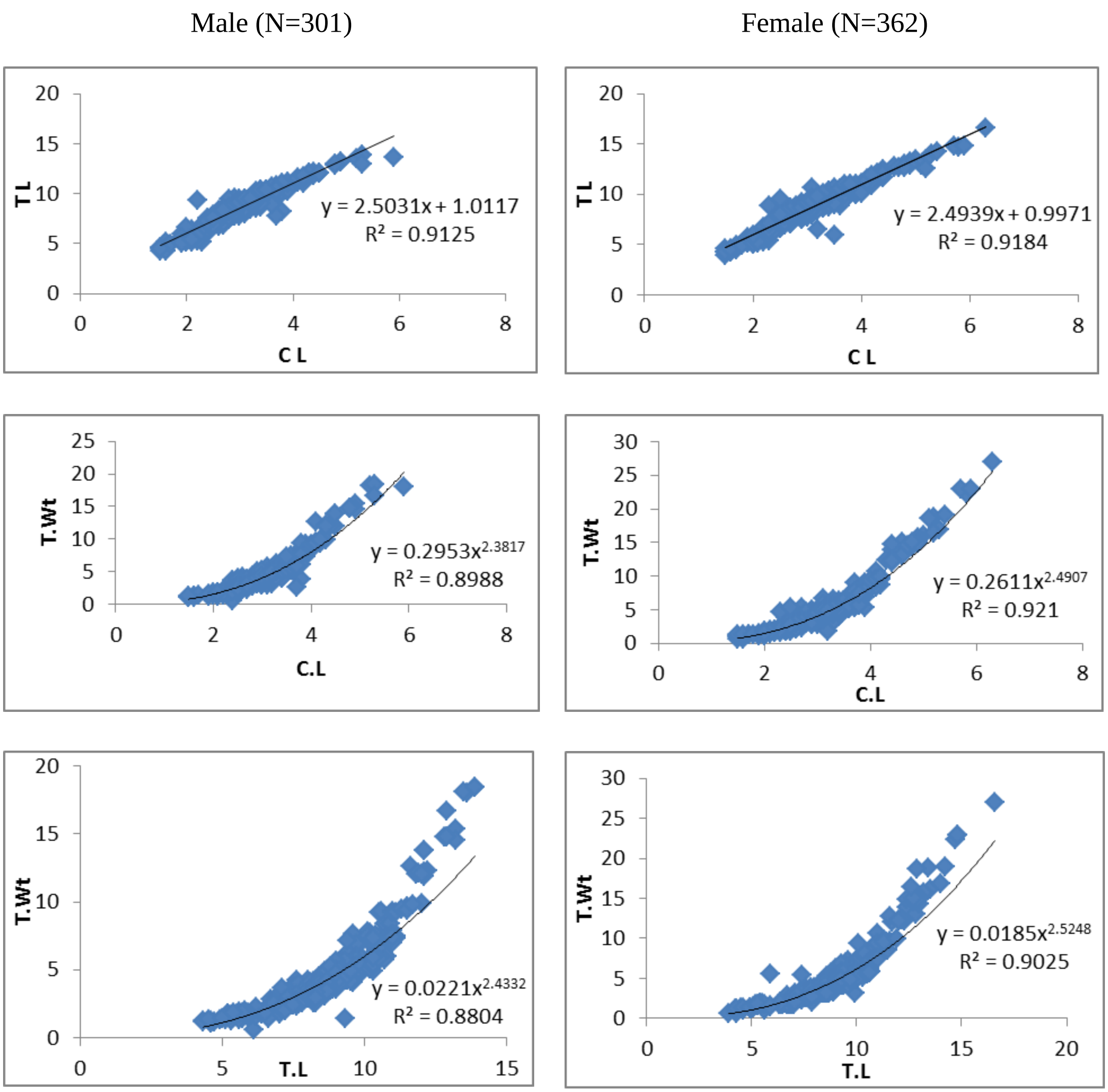

Fig. 10. Morphometric relationships of male and female *M. Japonicus*

Table (2): Summary of the different morphometric relationships for Shrimp species from Burullus Lake in comparison with previous studies.

Species	Author	Location	Sex	a	b	Relation
Penaeus semisulcatus	Present study	Burullus lake	Male	0.19	2.83	$W=aCL^b$
				0.004	3.23	$W=aL^b$
				1.07	2.37	TL=a+b CL
			Female	0.19	2.84	$W=aCL^b$
				0.01	2.82	$W=aL^b$
				1.73	2.36	TL=a+b CL
	Abdel Azim, (2016)	Bardawil Lagoon	Male	0.175	2.97	$W=aCL^b$
				0.006	3.07	$W=aL^b$
				0.306	2.692	TL=a+b CL
			Female	0.117	3.258	$W=aCL^b$
				0.004	3.219	$W=aL^b$
				0.084	2.76	TL=a+b CL
	Hassanien, (2017)	Burullus Lake	Male	28.17	1.432	$W=aCL^b$
				0.0298	2.633	$W=aL^b$
				1.377	1.45	TL=a+b CL
			Female	24.57	1.49	$W=aCL^b$
				0.0166	2.778	$W=aL^b$
				1.46	1.497	TL=a+b CL
	Samer, (2021)	Bardawil Lagoon	Combined	0.078	2.81	$W=aCL^b$
				0.0031	3.208	$W=aL^b$
				0.547	0.495	TL=a+b CL
	El Ganainy & Yassien, (2012)	Gulf of Suez, Red Sea	Combined	0.417	2.558	$W=aCL^b$
	Salem and El-Aiatt (2012)	Bardawil Lagoon	Male	0.0003	2.866	$W=aL^b$
			Female	0.0002	2.985	$W=aL^b$

	Abdel Razek, *et al*. (2008)	Bardawil Lagoon	Male	0.0231	2.538	W=aL^b
			Female	0.0067	3.074	W=aL^b
	Yassien, (2004)	Bardawil Lagoon	Male	0.0125	2.811	W=aL^b
				0.3321	2.542	W=aCL^b
				0.1115	0.343	TL=a+b CL
			Female	0.0098	2.929	W=aL^b
				0.1981	2.9797	W=aCL^b
				0.1009	0.3447	TL=a+b CL
MetaPenaeus stebbingi	Present study	Burullus lake	Male	0.21	2.84	W=aCL^b
				0.03	2.34	W=aL^b
				0.61	2.73	TL=a+b CL
			Female	0.23	2.72	W=aCL^b
				0.02	2.36	W=aL^b
				0.91	2.59	TL=a+b CL
	Abdel Azim, (2016)	Bardawil Lagoon	Male	0.34	2.001	W=aCL^b
				0.007	2.92	W=aL^b
				1.619	2.189	TL=a+b CL
			Female	0.3	2.36	W=aCL^b
				0.005	3.08	W=aL^b
				1.47	2.288	TL=a+b CL
	Hassanien, (2017)	Burullus Lake	Male	11.13	1.852	W=aCL^b
				0.024	2.687	W=aL^b
				1.204	1.304	TL=a+b CL
			Female	24.344	1.561	W=aCL^b
				0.0104	2.897	W=aL^b
				1.189	1.325	TL=a+b CL

	Samer, (2021)	Bardawil Lagoon	Combined	0.068	3.258	$W=aCL^b$
				0.0037	3.248	$W=aL^b$
				0.0749	0.394	TL=a+b CL
MetaPenaeus monocerus	Present study	Burullus lake	Male	0.32	2.39	$W=aCL^b$
				0.01	3.07	$W=aL^b$
				1.91	2.33	TL=a+b CL
			Female	0.3	2.43	$W=aCL^b$
				0.01	3.01	$W=aL^b$
				1.72	2.41	TL=a+b CL
	Abdel Azim, (2016)	Bardawil Lagoon	Male	0.34	2.32	$W=aCL^b$
				0.018	2.58	$W=aL^b$
				0.834	2.505	TL=a+b CL
			Female	0.305	2.41	$W=aCL^b$
				0.009	2.9	$W=aL^b$
				1.653	2.178	TL=a+b CL
	Hassanien, (2017)	Burullus Lake	Male	12.49	1.622	$W=aCL^b$
				0.0282	2.646	$W=aL^b$
				0.99	1.281	TL=a+b CL
			Female	11.17	1.67	$W=aCL^b$
				0.016	2.7869	$W=aL^b$
				1.11	1.339	TL=a+b CL
	Samer, (2021)	Bardawil Lagoon	Combined	0.0462	2.988	$W=aCL^b$
				0.0019	3.357	$W=aL^b$
				0.3255	0.501	TL=a+b CL
	Gobashy, *et al.*, (2009)	Egyptian Mediterranean Waters	Male	0.033	2.364	$W=aL^b$
				1.724	4.366	TL=a+b CL
			Female	0.0086	2.948	$W=aL^b$

				2.103	2.722	TL=a+b CL
MarsuPenaeus japonicus	Present study	Burullus lake	Male	0.29	2.38	$W=aCL^b$
				0.02	2.43	$W=aL^b$
				1.01	2.5	TL=a+b CL
			Female	0.26	2.49	$W=aCL^b$
				0.02	2.52	$W=aL^b$
				0.99	2.49	TL=a+b CL
	Abdel Azim, (2016)	Bardawil Lagoon	Male	0.12	3.05	$W=aCL^b$
				0.009	2.87	$W=aL^b$
				0.035	2.67	TL=a+b CL
			Female	0.184	2.8	$W=aCL^b$
				0.012	2.801	$W=aL^b$
				0.072	2.609	TL=a+b CL
	Samer, (2021)	Bardawil Lagoon	Combined	0.046	2.988	$W=aCL^b$
				0.0019	3.357	$W=aL^b$
				0.3255	0.501	TL=a+b CL
	El Ganainy & Yassien, (2012)	Gulf of Suez, Red Sea	Combined	0.379	2.508	$W=aCL^b$

CONCLUSION

In present study the shrimp in Burullus Lake are represented by four species (*Metapenaeus stebbingi*, *M. monoceros, Penaeus semisulcatus and MarsuPenaeus japonicus*).The geographical distribution of Penaeid shrimp in Burullus Lake is concentrated in the northern part of the Lake in the areas near to Boughas Al-Burullus which The occurrence and distribution of shrimp in the Lake is influenced by salinity. And we recommend work to periodically purify and deepen the Boughas Al-Burullus in order to increase the entry of economic fish -which Penaeid shrimp one of them- from the Mediterranean to Lake Burullus.

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