Chapter 8
Macrobenthos

The benthic invertebrates in aquatic ecosystems play an important role in the transformation of the organic matter sediment on the bottom to its own flesh and subsequently contribute to the basic nutrition of fish. The composition of the benthic fauna has largely been considered as a good indicator of water quality because, unlike planktonic species, they form relatively stable communities in the sediments which do not change over long time intervals and reflect characteristics of both sediments and upper water layer.

The few studies, which specially deal with benthic fauna in Lake Burullus include Aboul-Ezz (1984), who stated that the most important bottom dwellers inhabiting the Lake were *Gammarus, Corophium* (Amphipoda), *Mesenthura* (Isopoda), *Cheatogaster* (Oligochaeta) and *Corbicula* (Bivalvia). Samaan *et al*. (1989a) mentioned that the highest biomass of benthos appeared in the western region of the lake and decreased gradually eastwards. Samaan *et al*. (1989b) studied the general ecology and periodicity of the different changes in community structure, abundance and biomass of macrobenthos in relation to changes of lake hydrographic regime. Khalil and El-Shabrawy (2002) studied the biodiversity, density and population dynamics of macrobenthic invertebrates in Lake Burullus in relation to salinity and eutrophication changes of the lake. Bedir (2004) studied the ecological aspects of zooplankton and macrobenthos communities in relation to physical and chemical properties of Lake water.

8.1. BIODIVERSITY OF MACROBENTHOS

Throughout 2002 survey (Fig. 8.1), 33 benthic species belonging to three main groups (Arthropoda, Annelida and Mollusca) were recorded (Khalil and El-Shabrawy 2002). The benthic community consisted of 3 common species, 13 moderately common species, 11 rare species, and 6 very rare species (Table 8.1). There was no sign of the occurrence of 8 marine species which have been previously recorded in Lake Burullus by Aboul-Ezz (1984) and Anonymous (1984). These are: 3 of Arthropoda (*Mesanthura* sp., *Sphaeroma* sp. and *Balanus improvisus*), 2 of Annelida (*Chaetogaster limnaei* and *Ficopomatus enigaticus*), and 3 of Mollusca (*Cerastoderma edula, Cerastoderma glaucum* and *Abra ovata*).

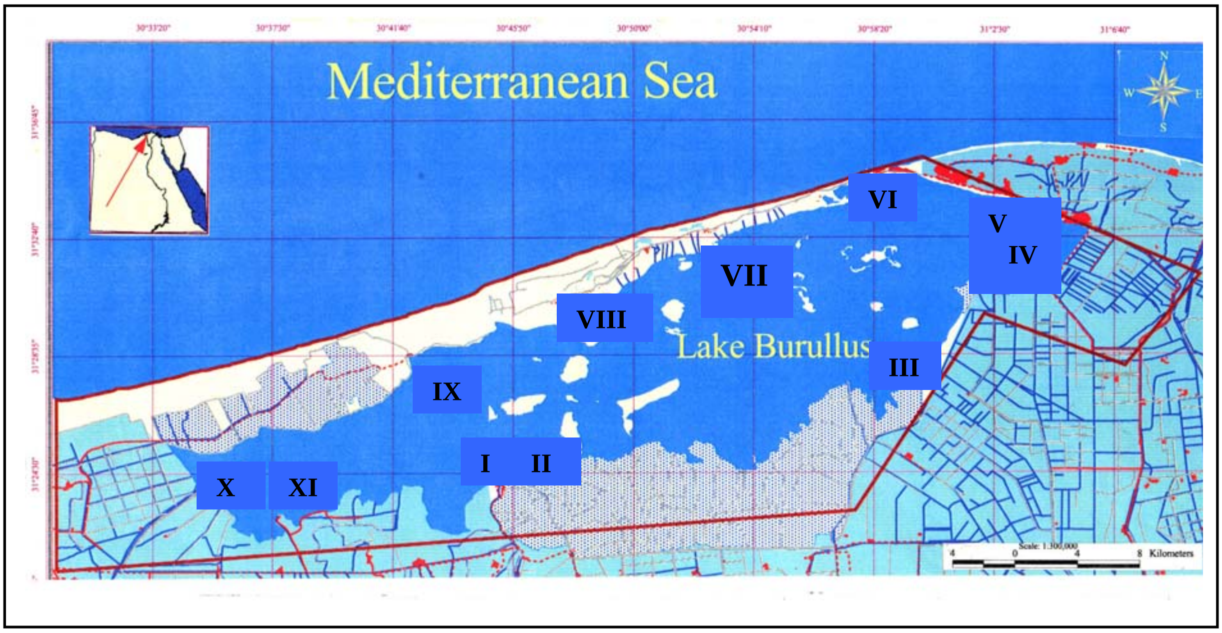


Fig. 8.1. **Map of Lake Burullus showing the location of sampling sites (after Khalil & El-Shabrawy 2002).**

Seventeen benthic species (fresh water in origin) were recorded for the first time in the Lake during 2002. The majority of these species were highly associated with the lake macrophytes these were: 7 of Arthropoda (Nymph of *Neurocordula* sp., Nymph of *Ischneura* sp., Nymph of *Enallaga vansomerni, Micronecta plicata*, *Lethocerus niloticus, Sternolophus solieri* and aquatic spiders), 7 of Annelida (*Branchiura sowerbyi*, *Limnodrilus hoffmeisteri, Limnodrilus udekemianus, Limnodrilus claparedeianus, Potamothrix hammoniensis*, *Helobdella conifera* and *Salifa perspicax*) and 3 of Mollusca (*Bellamya unicolor*, *Hydrobia ventrosa* and *Succinea cleopatra*).

8.2. SEASONAL VARIATION OF COMMON SPECIES

8.2. 1. Arthropoda

8.2.1.1. *Corophium orientale*

Corophium orientale was the most common and dominant benthic species in Lake Burullus, forming 87.4% and 72.1% of the total arthropod number and biomass, respectively (Khalil and El-Shabrawy 2002). Two density peaks with

Table 8.1: **Checklist of benthos species recorded in Lake Burullus during different time periods (1978-2002). C: Common, MC: Moderately Common, R: Rare, VR: Very Rare, F.W. Freshwater, M.W. Marine water (1978 & 1979: after Aboul-Ezz 1984; 1982: after Anon. 1984; 2001 - 2002: after Khalil & El-Shabrawy 2002).**

Species	1978 1979	1982	2001 2002	Present status	Habitat	Location
Arthropoda						
Corophium volutator (Pallas)	+				M.W.	Lake Sediment
Corophium orientale (Schellenberg)		+	+	C	F.&M.W.	Lake Sediment
Gammarus lacustris (Fabricius)	+				F.&M.W.	Macrophytes associated
Gammarus (aequicauda)		+	+	MC	F.&M.W.	Macrophytes associated
Gammarus orinicornis		+			F.&M.W.	Macrophytes associated
Mesanthura sp.	+				F.&M.W.	Under Rocks
Sphaeroma sp.		+			M.W.	Macrophytes associated
Balanus improvisus		+			M.W.	Macrophytes associated
Palaemon elegans		+	+	MC	F.&M.W.	Macrophytes associated
Pasiphaeidae sp.		+			M.W.	Lake Sediment
Mysis relicta (Loven)	+		+	R	M.W.	Macrophytes associated
Tandipos tentans (Meigen)	+	+	+	R	F.&M.W.	Macrophytes associated
Nymph of *Neurocordula* sp.			+	VR	F.W.	Macrophytes associated
Nymph of *Ischneura* sp. (Pinhey)			+	VR	F.W.	Macrophytes associated
Nymph of *Enallaga vansomerni*			+	R	F.W.	Macrophytes associated
Micronecta plicata (Costa)			+	MC	F.W.	Macrophytes associated
Lethocerus niloticus (Stal)			+	R	F.W.	Macrophytes associated
Sternolophus solieri (Lapouge)			+	R	F.W.	Macrophytes associated
Decapod zoeae		+	+	MC	F.&M.W.	Macrophytes associated
Aquatic spiders			+	VR	F.W.	Macrophytes associated
Annelida						
Branchiura sowerbyi (Beddard)			+	MC	F.W.	Lake Sediment
Limnodrilus hoffmeisteri (Claparede)			+	C	F.W.	Lake Sediment
Limnodrilus udekemianus			+	MC	F.W.	Lake Sediment
Limnodrilus claparedeianus (Ratzel)			+	MC	F.W.	Lake Sediment
Potamothrix hammoniensis (Mich)			+	C	F.W.	Lake Sediment
Chaetogaster limnaei (K. Von Beak)	+				F.W.	Lake Sediment
Nereis limnoicola (Johnson)	+				F.W.	Lake Sediment
Nereis diversicolor		+	+	R	M.W.	Rocks and Shells
Ficopomatus eniqaticus		+			M.W.	Rocks and Shells
Helobdella conifera (Moore)		+	+	VR	F.W.	Rocks and Shells
Salifa perspicax (Blanchard)			+	VR	F.W.	Rocks and Shells
Glossiphonia sp.		+			F.W.	Rocks and Shells
Mollusca						
Melanoides tuberculata (Muller)	+	+	+	MC	F.W.	Macrophytes and sed.
Theodoxus niloticus (Reeve)	+	+	+	MC	F.W.	Macrophytes and sed.
Buliuns truncatus (Audouin)		+	+	R	F.W.	Macrophytes
Gyraulus ehrenbergi (Beck)		+	+	R	F.W.	Macrophytes
*Physa acuta (*Draparanud)		+	+	VR	F.W.	Macrophytes
Cleopatra bulimoides (Olivier)		+	+	MC	F.W.	Macrophytes
Bellamya unicolor (Olivier)			+	MC	F.W.	Macrophytes
Lanistes carinatus (Olivier)		+	+	R	F.W.	Macrophytes
Biomphalaria alexandrina (Ehr.)		+	+	R	F.W.	Macrophytes
Hydrobia ventrosa (Montagu)			+	MC	F.W.	Lake Sediment
Succinea cleopatra (Pallary)			+	MC	F.W.	Lake Sediment
Corbicula consobrina (Cailliaud)	+				F.W.	Mcrophytes
Corbicula fluminalis (Muller)		+	+	R	F.W.	Lake Sediment
Abra ovata		+			M.W.	Lake Sediment
Cerastoderma glaucum		+			M.W.	Lake Sediment
Cerastoderma edula	+				M.W.	Lake Sediment

standing crop of 1427 and 1407 ind. m^{-2} were observed in autumn and spring, respectively. The lowest average abundance of 29 ind. m^{-2} was reported in summer (Tables 8.2 and 8.3 and Figs. 8.2 and 8.3). In reference to species biomass, it was more or less following its standing crop, except during spring when heavy biomass individuals were present. The highest biomass value of *Corophium orientale* was 43.63 g wet wt. m^{-2}, recorded at station IV in spring, while it was infrequently recorded at the western sector of the lake. Moller and Rosenberg (1982) mentioned that *Corophium volutator* has two annual generations in the coast of Sweden. *C. orientale* seems to have two generations in Lake Burullus. Contrarily to this study, Hickin *et al*. (1980) showed that *C. volutator* was the most abundant both numerically and in biomass in summer. El-Shabrawy (1996) recorded 3 density peaks of *C. orientale* in Wadi El-Rayan lakes during April, August and November. Anderson (1972) mentioned that *Corophium* in general inhabits sediments predominantly of silt-size particles, while Stopfer (1951) and Gee (1961) advocated that this genus was found in mud or muddy sand, containing approximately 37% silt or clay. They also reported that it was not found in heavy polluted areas.

8.2.1.2. *Gammarus aequicauda*

Khalil and El-Shabrawy (2002) recorded a few individuals of this species at station IV in spring and at stations I, III, VII and XI during summer. *Gammarus aequicauda* was common in the macrophytes belt in Lake Burullus. This agrees with the findings of Ezzat (1959), Samaan and Aleem (1972), Samaan (1977), Anon. (1984), Ibrahim (1993) and El-Shabrawy (1996). They stated that *Gammarus* mainly lived among the leaves of macrophytes and fed on the epiphytes growing on them.

Table 8.2. **Standing crop of *Corophium orientale* (ind. m^{-2}) in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
I	180	0	2700	0	**720**
II	270	90	90	45	**124**
III	1935	270	270	0	**619**
IV	225	360	6885	0	**1868**
V	5040	45	180	90	**1339**
VI	5400	2655	2520	0	**2644**
VII	855	360	270	0	**371**
VIII	90	45	1890	135	**540**
IX	270	0	585	45	**225**
X	0	0	45	0	**11**
XI	+	0	45	0	**15**
Average	**1427**	**348**	**1407**	**29**	**803**

Table 8.3. **Biomass of *Corophium orientale* (wet wt. m^{-2}) in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	0.66	0.00	8.78	0.00	**2.36**
II	1.36	0.39	0.48	0.19	**0.61**
III	10.88	1.33	1.11	0.00	**3.33**
IV	1.39	1.17	43.63	0.00	**11.55**
V	15.17	0.20	0.59	0.45	**4.10**
VI	14.89	6.94	16.38	0.00	**9.55**
VII	3.12	1.08	1.62	0.00	**1.46**
VIII	0.28	0.32	6.93	0.59	**2.03**
IX	1.09	0.00	3.15	0.28	**1.13**
X	0.00	0.00	0.21	0.00	**0.05**
XI	+	0.00	0.33	0.00	**0.11**
Average	**4.88**	**1.04**	**7.56**	**0.14**	**3.41**

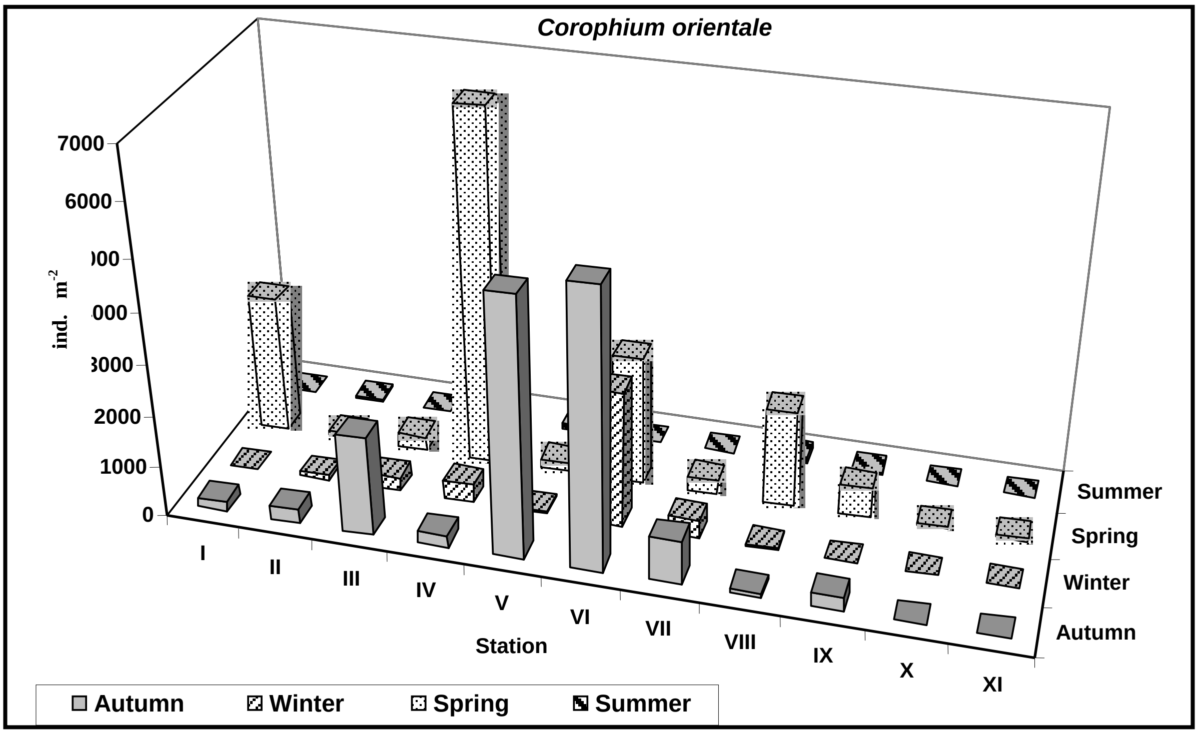


Fig. 8.2. **Standing crop of *Corophium orientale* in Lake Burullus during 2001/02**.

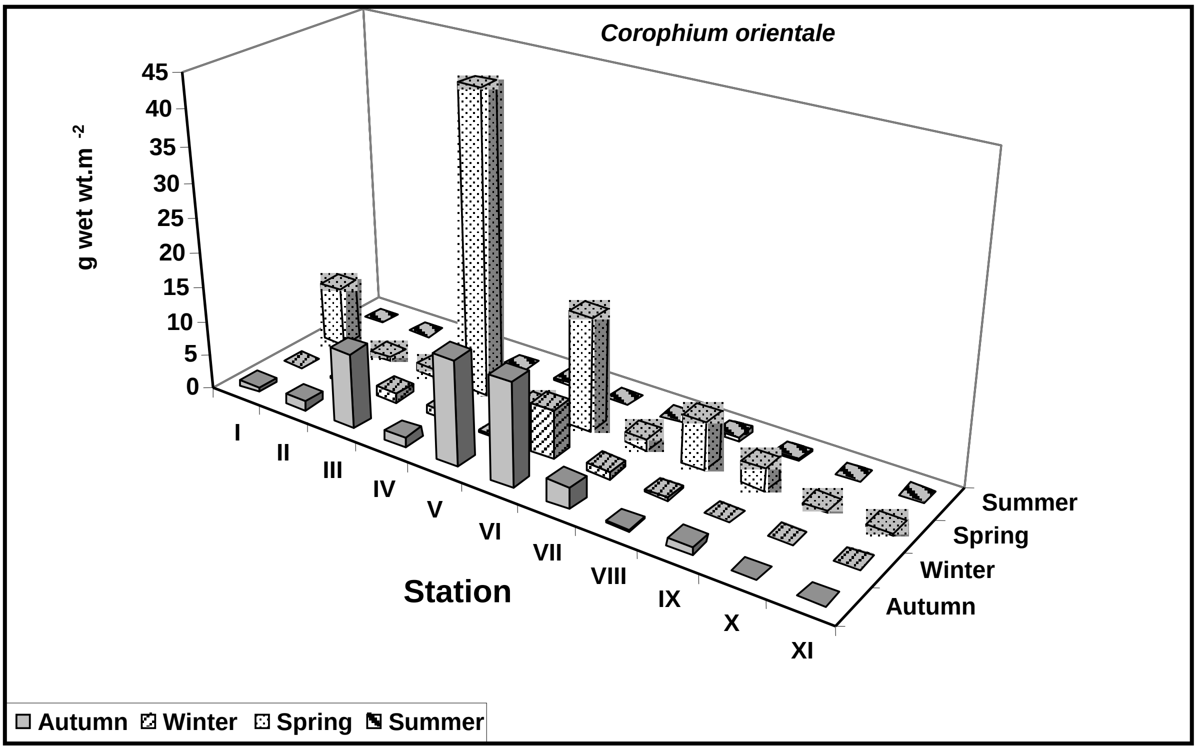


***Fig. 8.3*. Biomass of *Corophium orientale* in Lake Burullus during 2001/02. (Khalil & El-Shabrawy 2002).**

8.2.2. Annelida

8.2.2.1. *Limnodrilus hoffmeisteri*

Limmodrilus hoffmeisteri, numerically, is the most predominant bottom animal inhabiting Lake Burullus. Khalil and El-Shabrawy (2002) recorded it at all sampling stations during the entire period of their study. *L. hoffmeisteri* contributed 72.7 and 45.8 % of total annelids count and biomass, respectively, with annual average of 1173 ind. m^{-2}, weighing 1.51 g fresh wt. m^{-2}. The flourishing of this species has been recorded in spring with a major peak of 9450 ind. m^{-2} at station VIII. The lowest abundance of this species was during autumn (Tables 8.4 and 8.5 and Figs. 8.4 and 8.5). Its biomass was generally proportional to its numbers. Qi Sang (1987) mentioned that *L. hoffmeisteri* is dominant and favored in organic polluted water, and it is known by its ability to tolerate low oxygen levels. Milbrink (1973) stated that *L. hoffmeisteri* inhabits polluted lakes together with *L. edukemianus* and *L. claparedeianus*. The same association of species was generally found to occur at grossly polluted sites of the Guangzhou Reach, which is located in the Subtropics (Qi Sang 1987) and Lake Burullus. Verdonschot (1987) stated that this species has a positive relation with pH, nitrate and bicarbonate. *L. hoffmeisteri* showed a positive relation with EC and organic matter in Lake Nasser (El-Shabrawy and Abdel-Regal 1999). It has been defined in the literature as an eutrophic species (Milbrink 1979, 1980; Lang & Lang Dobler 1980).

Table 8.4. **Standing crop of *Limnodrilus hoffmeisteri* (ind. m^{-2}) in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
I	90	180	5766	2900	**2234**
II	0	1980	4635	2250	**2216**
III	45	90	270	90	**124**
IV	0	90	2115	135	**585**
V	90	270	1350	360	**518**
VI	45	90	5940	90	**1541**
VII	90	90	4500	2610	**1823**
VIII	45	45	9450	720	**2565**
IX	45	90	900	1665	**675**
X	45	270	270	675	**315**
XI	+	0	360	810	**390**
Average	**50**	**290**	**3232**	**1119**	**1173**

Table 8.5. **Biomass of *Limnodrilus hoffmeisteri* (g wet wt. m^{-2}) in Lake Burullus during 2001/ 02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
II	0.00	1.72	5.78	2.78	**2.57**
III	0.09	0.20	0.42	0.10	**0.20**
IV	0.00	0.14	2.84	0.18	**0.79**
V	0.13	0.65	1.54	0.28	**0.65**
VI	0.02	0.24	8.02	0.16	**2.11**
VII	0.28	0.15	5.26	3.48	**2.29**
VIII	0.08	0.08	13.89	0.88	**3.73**
IX	0.10	0.18	1.14	2.22	**0.91**
X	0.07	0.55	0.42	0.58	**0.41**
XI	+	0.00	0.50	0.86	**0.45**
Average	**0.09**	**0.39**	**4.26**	**1.31**	**1.51**

8.2.2.2. *Potamothrix hammoniensis*

Potamothrix hammoniensis ocuupied the second predominant position among annelids, contributing 13.7% of the total number of annelids and 7.9% of its biomass (Khalil and El-Shabrawy 2002). This species is wide spread in the Lake, but not abundant anywhere. The highest standing crop of 401 ind. m^{-2} weighing 0.47 g wet. wt. m^{-2} occurred in winter, while the least yield of 78 ind. m^{-2} weighing 0.04 g was recorded in summer (Tables 8.6 and 8.7 and Figs 8.6 and 8.7). Verdonschot (1987) mentioned that this species has a positive linear correlation with pH and water depth. Milbrink (1980) stated that *P. hammoniensis* is one of the commonest species in shallow eutrophic lakes allover Europe. Timm *et al*. (2001) considered *P. hammoniensis* as a moderate pollution indicator.

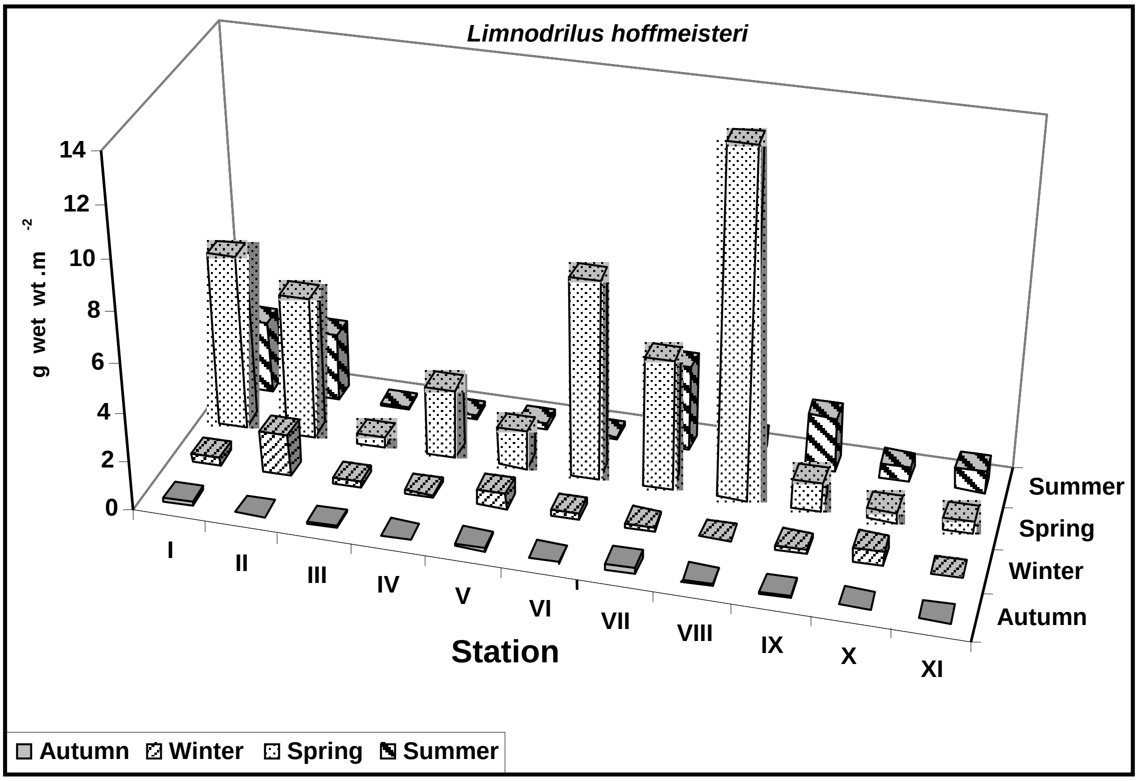


Fig.8.4. **Standing crop of *Limnodrilus hoffmeisteri* in Lake Burullus during 2001/02.**

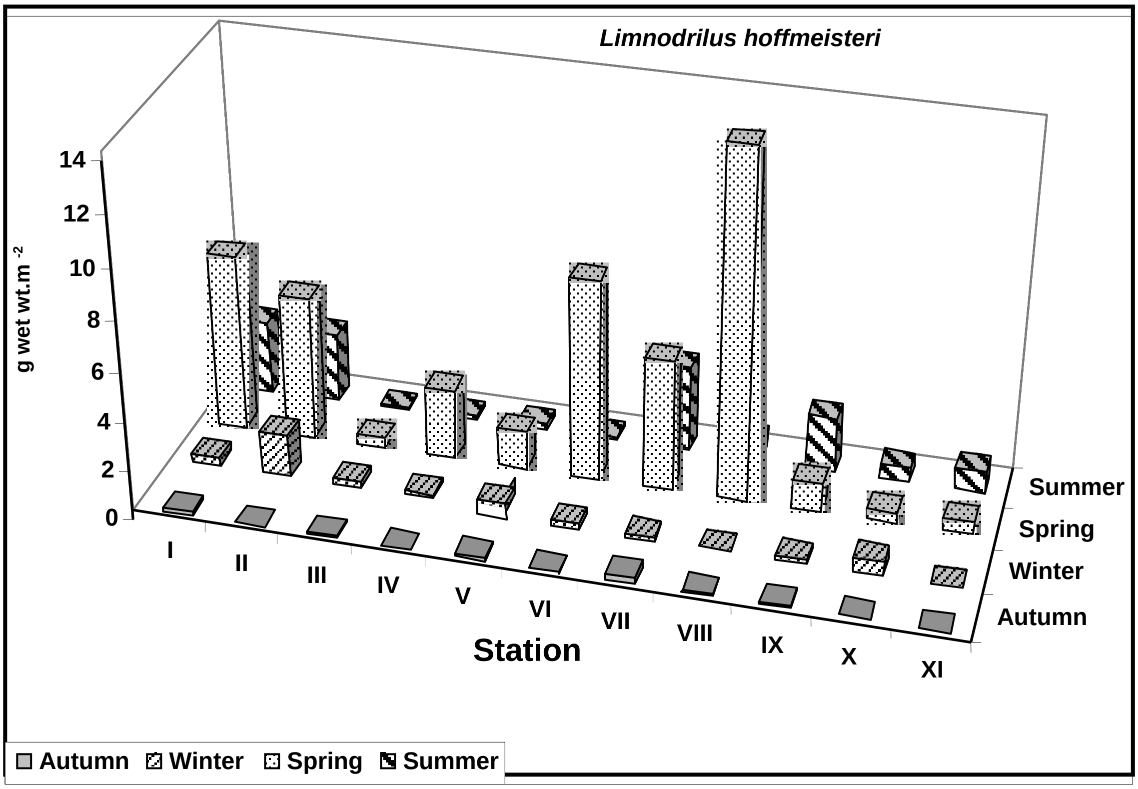


Fig. 8.5. **Biomass of *Limnodrilus hoffmeisteri* in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

***Table 8.6*. Standing crop of *Potamothrix hammoniensis* (ind. m^{-2}) in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
I	0	45	225	90	**90**
II	450	1125	0	0	**394**
III	180	360	45	0	**146**
IV	45	450	900	0	**349**
V	45	495	270	45	**214**
VI	135	180	180	0	**124**
VII	180	315	90	90	**169**
VIII	90	360	675	90	**304**
IX	0	270	315	180	**191**
X	450	450	0	0	**225**
XI	+	360	0	360	**240**
Average	**158**	**401**	**245**	**78**	**220**

***Table 8.7*. Biomass of *Potamothrix hammoniensis* (g wet wt. m^{-2}) in Lake Burullus during 2001 / 02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	0.00	0.02	0.16	0.04	**0.06**
II	0.65	1.65	0.00	0.00	**0.58**
III	0.18	0.44	0.01	0.00	**0.16**
IV	0.16	0.61	1.08	0.00	**0.46**
V	0.20	0.59	0.13	0.01	**0.23**
VI	0.19	0.15	0.06	0.03	**0.11**
VII	0.24	0.46	0.02	0.01	**0.18**
VIII	0.38	0.28	0.78	0.07	**0.38**
IX	0.00	0.31	0.42	0.00	**0.18**
X	0.99	0.32	0.00	0.00	**0.33**
XI	+	0.33	0.00	0.24	**0.19**
Average	**0.30**	**0.47**	**0.24**	**0.04**	**0.26**

8.2.2.3. *Branchiura sowerbyi*

Branchiura sowerbyi was infrequently recorded in Lake Burullus during 2002 (Khalil and El-Shabrawy 2002). Contrarily to its low numbers (avr. 35 ind. m^{-2}, forming 2.2 % of total annelids account) the contribution of this species to annelids biomass is high (29.1 %). *B. sowerbyi* had long duration in the lake during spring, while it was restricted only to stations I and III during the rest of year. The biomass of this species exhibits a positive correlation to its count. Milbrink (1973) mentioned that *B. sowerbyi* is an indicator of warm water and is known to tolerate high degree of organic pollution. El-Shabrawy and Abdel-Regal (1999) infrequently recorded this species in Lake Nasser.

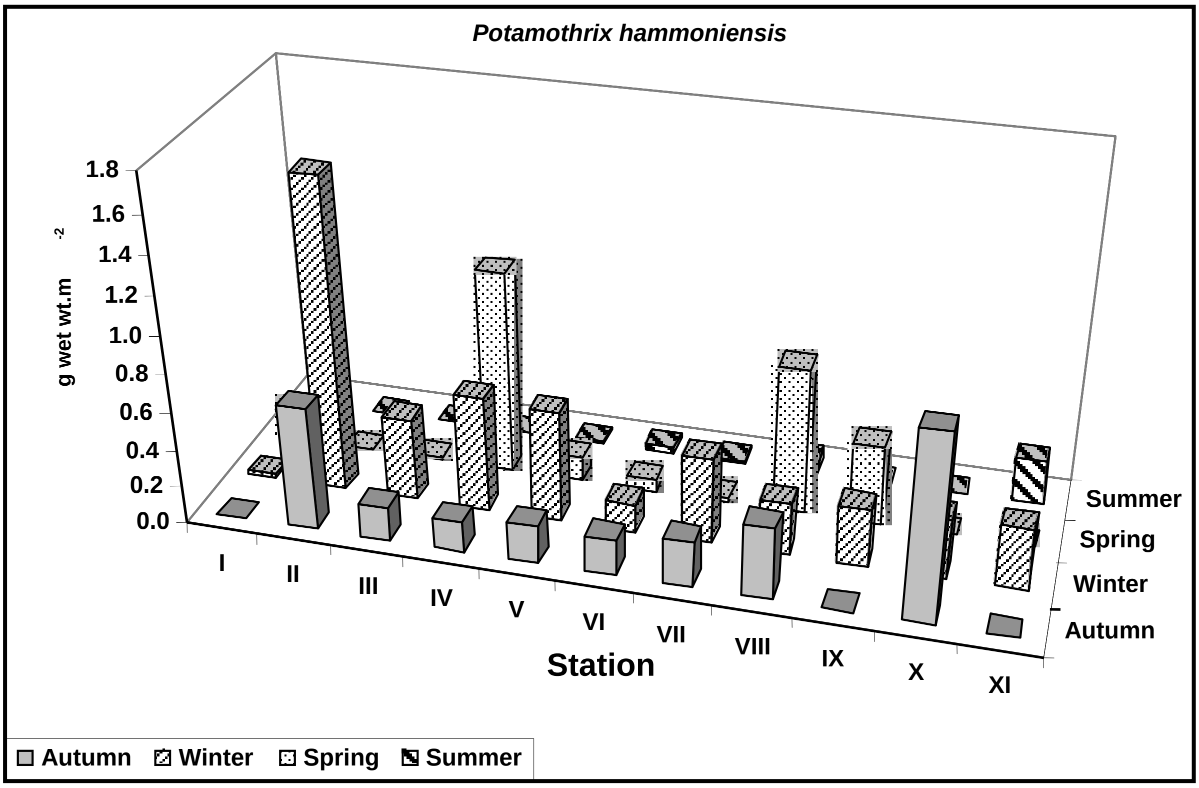


Fig. 8.6. **Standing crop of *Potamothrix hammoniensis* in Lake Burullus during 2001/02.**

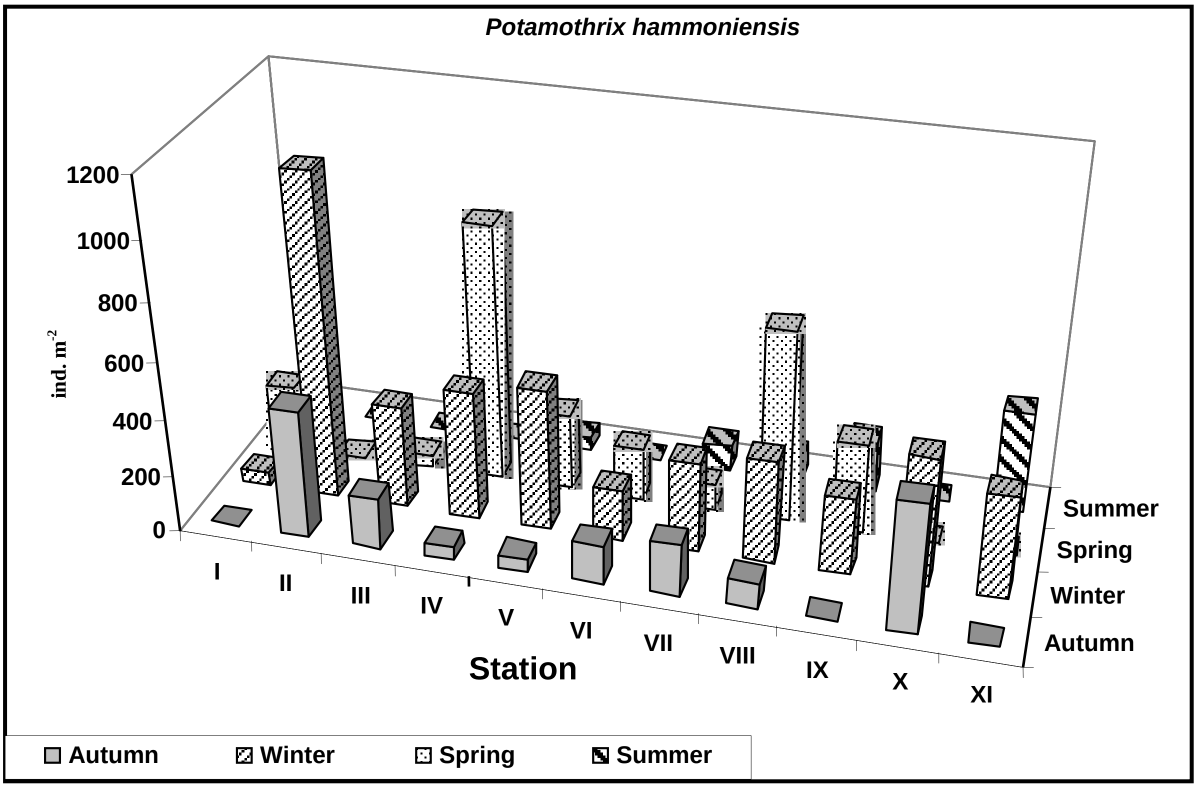


Fig. 8.7. **Biomass of *Potamothrix hammoniensis* in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

8.2.3. Mollusca

8.2.3.1. *Melanoides tuberculata*

Melanoides tuberculata is the most common gastropod in Lake Burullus and occupied the first position, regarding standing crop of total molluscs, forming 42.2 % of its total numbers (Khalil and El-Shabrawy 2002). The share of this species in molluscan biomass was relatively low (23.4%). Summer showed highest abundance of this species (avr. 180 ind. m^{-2} weighing 8.68 g wet wt. m^{-2}), while it was poorly represented during the rest of year (Tables 8.8 and 8.9 and Figs. 8.8 and 8.9). The biomass of this species followed the same general trend as its count. *M. tuberculata* is widely distributed, not only in Africa (Brown 1980) but also in Asia (Fernando 1969). It lives in stagnant and slowly running waters, can tolerate a moderate salinity and is highly associated with aquatic macrophytes (Brown 1980 ; Ibrahim *et al*. 1999). In Lake Burullus, *M. tuberculata* was recorded in sediments as well as associated with macrophytes (Khalil and El-Shabrawy 2002).

8.2.3.2. *Theodoxus niloticus*

The perennial occurrence of this species is restricted to the western sectors of the lake (Khalil and El-Shabrawy 2002). It collectively contributed 17.1 and 6.5 % of the total molluscan standing crop and biomass, respectively. Autumn was relatively rich with this species with an average standing crop of 59 ind. m^{-2}. *T. niloticus* lives in all types of freshwater bodies. It usually occurs in colonies over and under rocky limestone and associated with many macrophytes (Ibrahim *et al*. 1999).

***Table 8.8*. Standing crop of *Melanoides tuberculata* (ind. m^{-2}) in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
II	45	0	0	0	**11**
III	0	0	0	450	**113**
IV	90	0	0	90	**45**
V	0	45	0	45	**23**
VI	0	0	0	45	**11**
VII	0	0	0	315	**79**
VIII	0	0	0	225	**56**
IX	45	0	0	180	**56**
X	135	90	90	270	**55**
XI	+	360	45	315	**240**
Average	**54**	**49**	**20**	**180**	**76**

Table 8.9. **Biomass of *Melanoides tuberculata* (g wet wt.m^{-2}) in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	33.42	9.45	12.15	6.30	15.33
II	7.21	0.00	0.00	0.00	1.80
III	0.00	0.00	0.00	16.20	4.05
IV	3.47	0.00	0.00	3.46	1.73
V	0.00	0.72	0.00	1.80	0.63
VI	0.00	0.00	0.00	2.94	0.74
VII	0.00	0.00	0.00	28.35	7.09
VIII	0.00	0.00	0.00	0.45	0.11
IX	0.93	0.00	0.00	10.35	2.82
X	18.02	3.45	6.08	9.90	3.81
XI	+	12.94	0.93	15.75	7.41
Average	6.31	2.41	1.74	8.68	4.79

8.2.3.3. Bellamya unicolor

Khalil and El-Shabrawy (2002) recorded few individuals of this species (avr. 10 ind. m^{-2}), forming 5.7% of the total molluscans standing crop. In contrast to its count, *B. unicolor* plays a major role in formation of molluscan biomass.

8.3. COMMUNITY COMPOSITION AND LONG-TERM CHANGES

In Lake Burullus, a total of 33 benthic species were recorded. They belong to 3 main groups (Arthropoda, Annelida and Mollusca). The total benthos shows a wide regional and seasonal variation (Tables 8.10 and 8.11, Figs. 8.10 and 8.11). Regarding seasonal variation, spring maintained the highest abundance of these organisms, with a major peak of 13365 ind. m^{-2}, weighing 64.31 g wet wt. m^{-2}. The lowest yield of these invertebrate organisms occurred in winter. Aboul-Ezz (1984) recorded only 11 species with standing crop of 440 ind. m^{-2}, weighing 13.7 g wet wt. m^{-2}. During 2002 study (Khalil and El-Shabrawy 2002) the standing crop of the benthos remarkably increased to 2707 ind. m^{-2} weighing 28.48 g wet wt. m^{-2}. Annelida and Mollusca were found to have the highest percentage frequency (%) of benthos standing crop and biomass, respectively (Fig. 8.12).

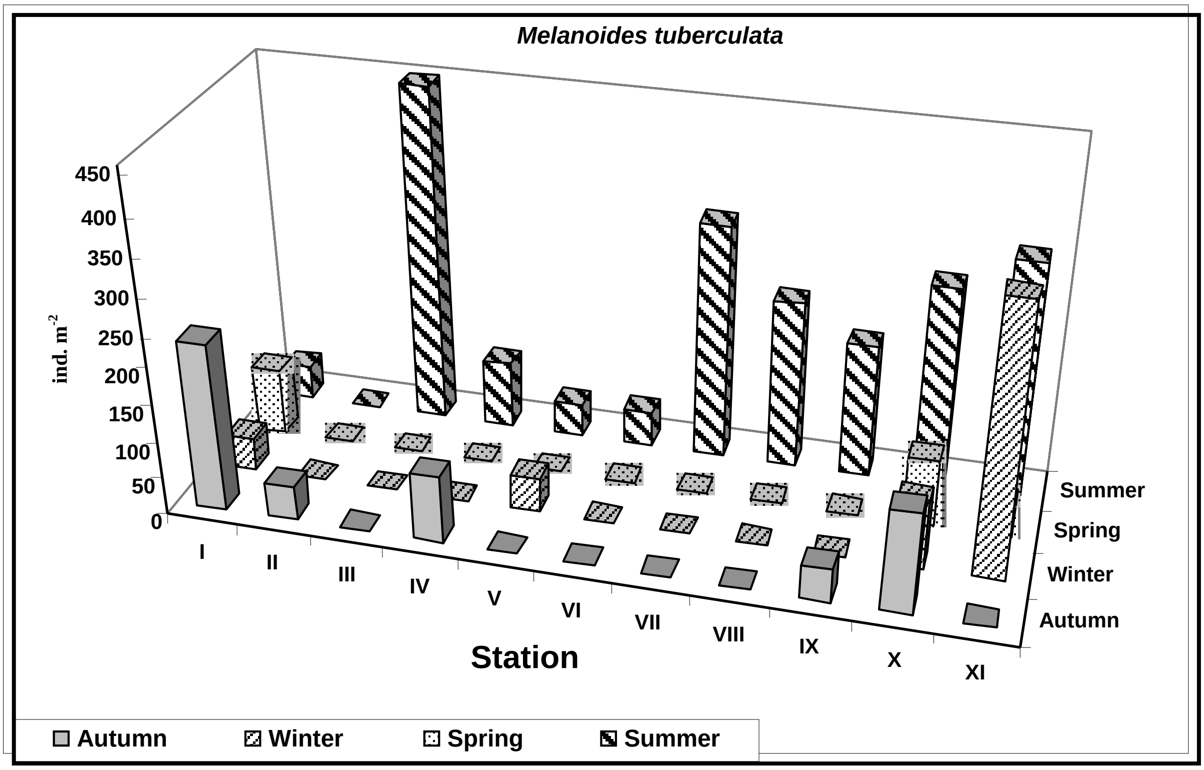


Fig. 8.8. Standing crop of *Melanoides tuberculata* in Lake Burullus during 2001/02.

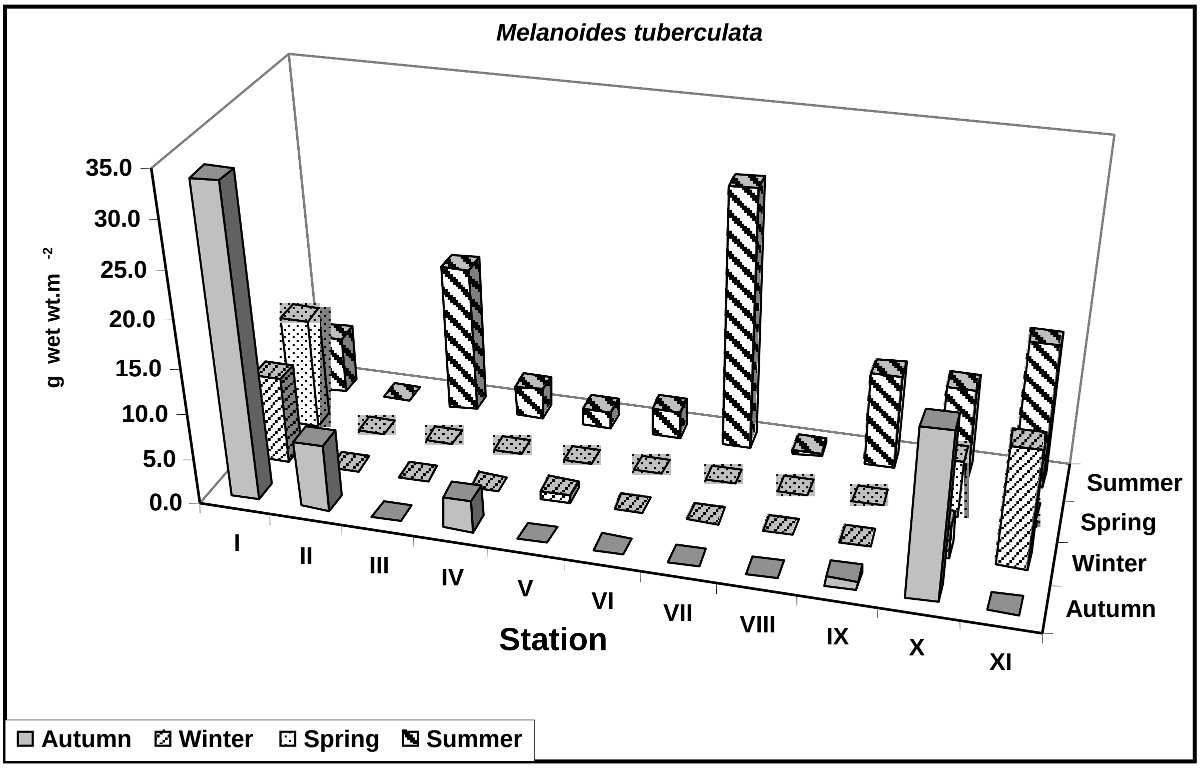


Fig. 8.9. Biomass of *Melanoides tuberculata* in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).

***Table 8.10*. Standing crop of total benthos (ind. m^{-2}) in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
II	1215	3780	5265	2565	**3206**
III	2385	1035	1170	945	**1384**
IV	450	1080	10125	315	**2993**
V	5175	855	2295	765	**2273**
VI	5580	2925	9945	765	**4804**
VII	1350	810	5445	4455	**3015**
VIII	360	540	13365	1350	**3904**
IX	585	720	1980	2430	**1429**
X	1125	1305	765	1170	**1091**
XI	+	1035	720	2385	**1380**
Average	**1908**	**1338**	**5645**	**1937**	**2707**

***Table 8.11*. Biomass of total benthos (g wet wt. m^{-2}) in Lake Burullus during 2001/02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	97.08	80.21	61.89	154.77	**98.49**
II	43.31	5.88	37.03	5.66	**22.97**
III	69.25	36.21	3.88	30.79	**35.03**
IV	7.05	4.63	69.30	4.70	**21.42**
V	15.50	2.16	3.00	103.43	**31.02**
VI	15.10	7.33	26.06	4.56	**13.26**
VII	4.20	1.70	7.44	63.07	**19.10**
VIII	5.27	0.86	64.31	11.16	**20.40**
IX	11.67	4.61	5.52	13.20	**8.75**
X	26.06	13.59	42.82	11.70	**30.05**
XI	+	19.98	6.50	21.22	**11.93**
Average	**29.45**	**16.11**	**29.80**	**38.57**	**28.48**

Annelida is considered the most common and abundant group among the bottom animals in Lake Burullus. It constituted about 59.6% of the total benthos numbers, with annual average of 1613 ind. m^{-2}. However, their participation in benthos biomass is small, forming only 11.6%. The population density of these organisms reached its maximum in spring (3837 ind. m^{-2}), weighing 6.89 g wet wt. m^{-2}; while autumn sustained the lowest yield of 243 ind. m^{-2}, weighing 1.21 g wet wt. m^{-2}. The Annelida biomass had a positive relation with its numbers, except in winter when relatively a small number with heavy biomass occurred (Tables 8.12 and 8.13, Figs. 8.13 and 8.14). Khalil and El-Shabrawy (2002)

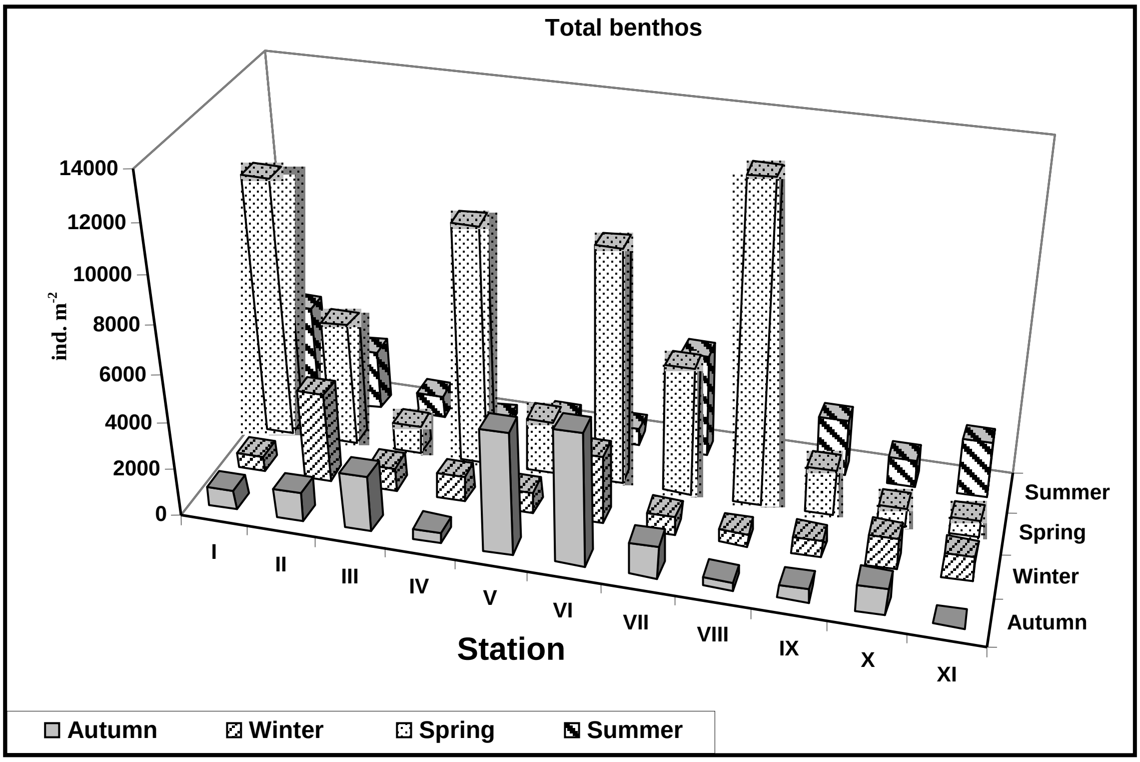


***Fig. 8.10.* Standing crop of total benthos in Lake Burullus during 2001 / 02.**

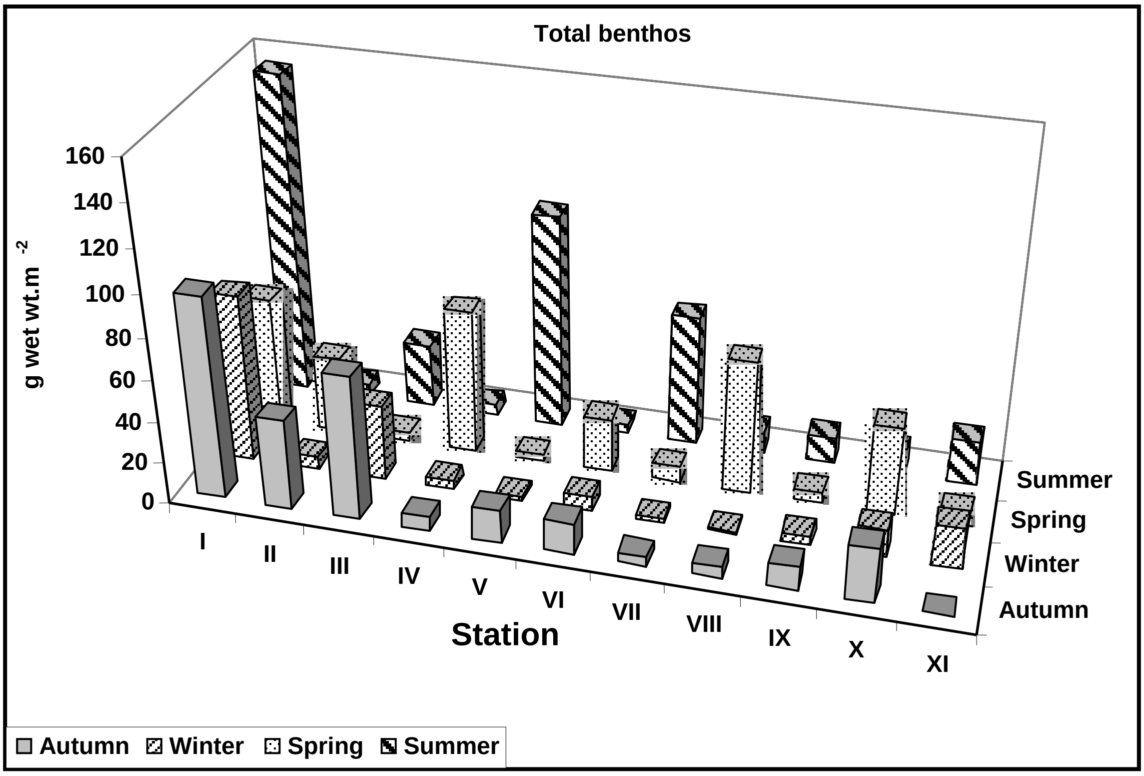
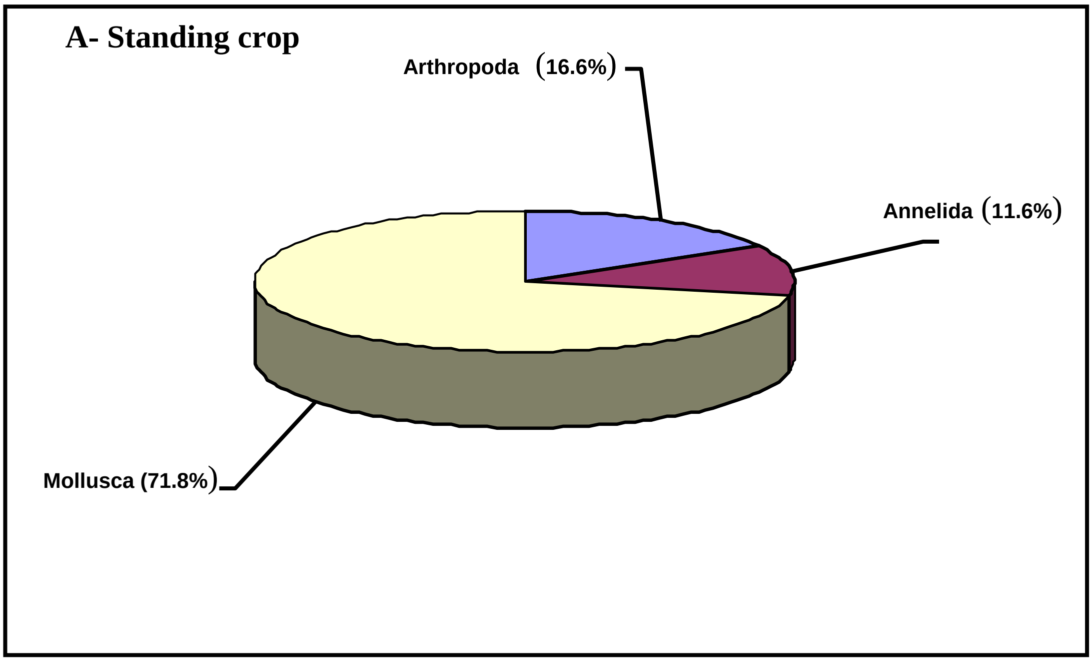


***Fig. 8.11.* Biomass of total benthos in Lake Burullus during 2001/ 02**



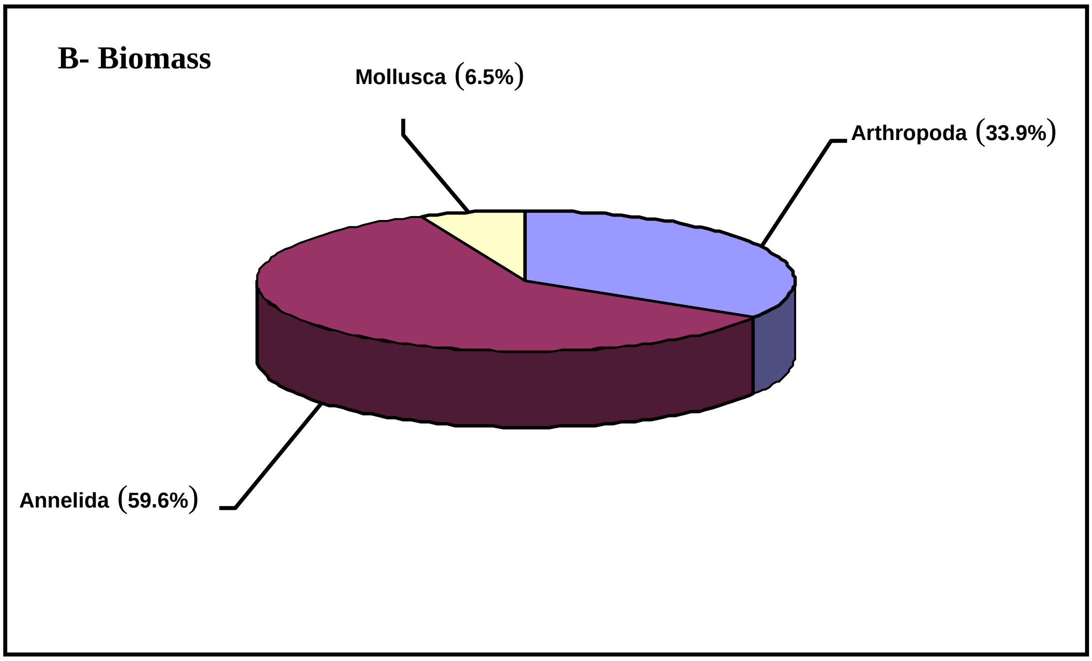


Fig. 8.12. **Community composition of total benthos during 2002**

Table 8.12. **Standing crop of total Annelida in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
I	315	315	6615	3710	**2739**
II	495	3465	5040	2475	**2869**
III	270	675	450	180	**394**
IV	45	675	3060	180	**990**
V	135	765	1980	540	**855**
VI	180	270	7020	675	**2036**
VII	270	450	5175	3825	**2430**
VIII	135	400	10845	990	**3093**
IX	45	495	1260	2205	**1001**
X	540	900	360	810	**1823**
XI	+	450	405	1620	**825**
Average	**243**	**805**	3837	**1565**	**1613**

Table 8.13. **Biomass of total Annelida in Lake Burullus during 2001/ 02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	6.75	2.29	9.41	10.94	**7.35**
II	1.60	3.71	27.49	3.60	**9.10**
III	0.90	6.66	0.47	0.96	**2.25**
IV	**0.16**	3.21	3.95	0.20	**1.88**
V	0.33	1.24	2.04	0.38	**1.00**
VI	0.21	0.39	8.85	0.69	**2.54**
VII	0.52	0.62	5.82	4.59	**2.89**
VIII	0.46	0.36	15.21	**1.12**	**4.29**
IX	0.10	3.37	1.59	2.57	**1.91**
X	1.07	6.00	0.47	0.62	**3.69**
XI	+	0.96	0.53	1.52	**0.75**
Average	**1.21**	**2.62**	**6.89**	**2.47**	**3.30**

recorded eight annelids species, while Aboul Ezz (1984) and Anonymous (1984) recorded only 2 and 4 species respectively. *Limnodrilus hoffmeisteri, Potamothrix hammoniensis* and *Branchiura sowerbi* are the most common annelids (Fig. 8.15).

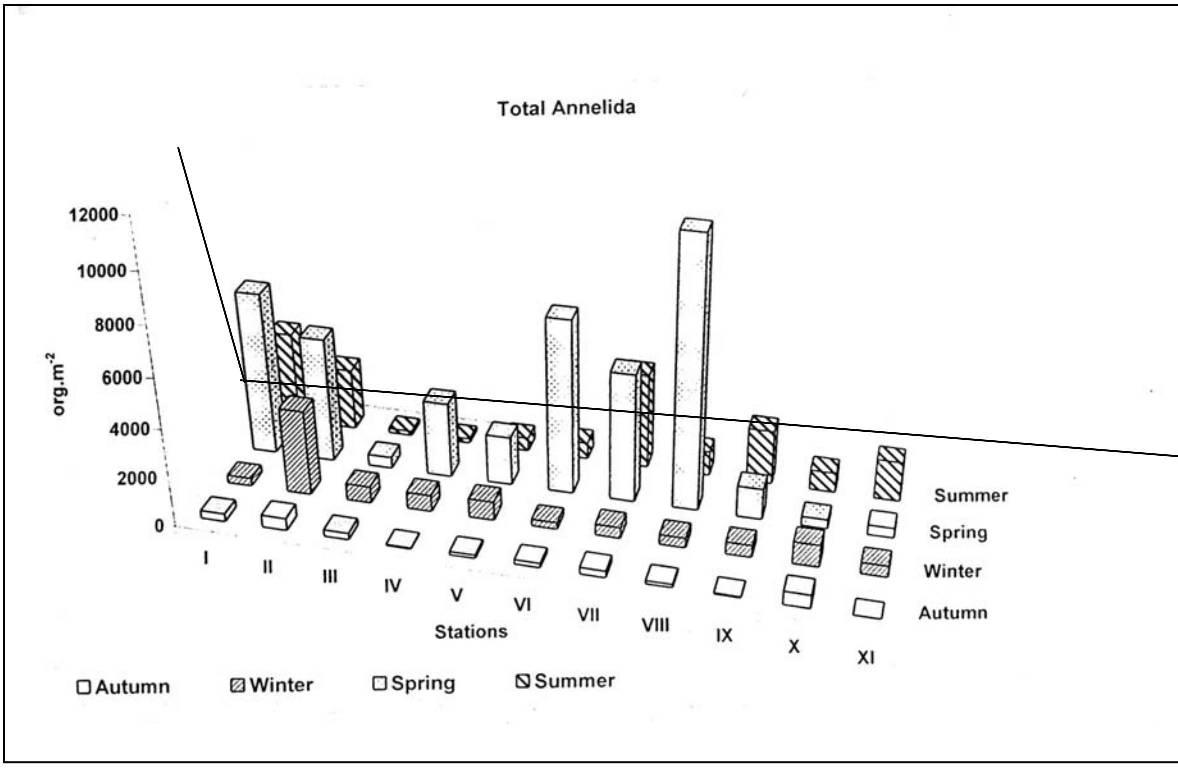


Fig. 8.13. **Standing crop of total Annelida in Lake Burullus during 2001/02.**

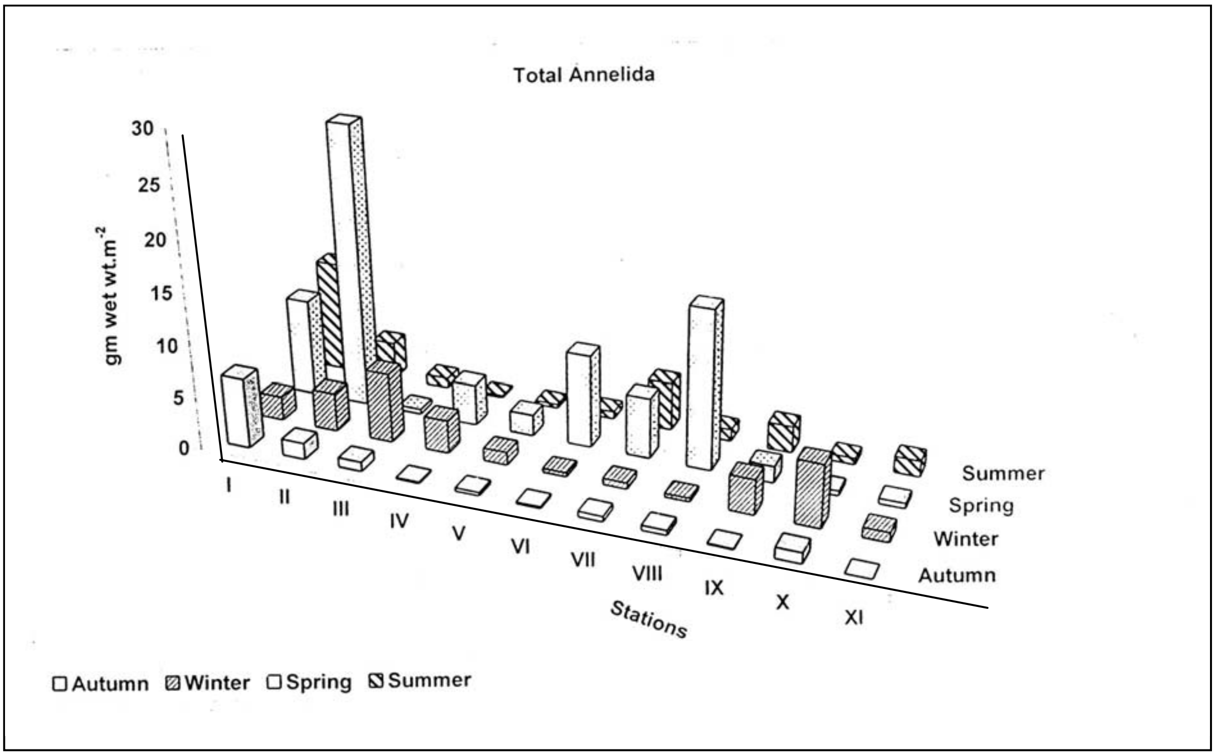
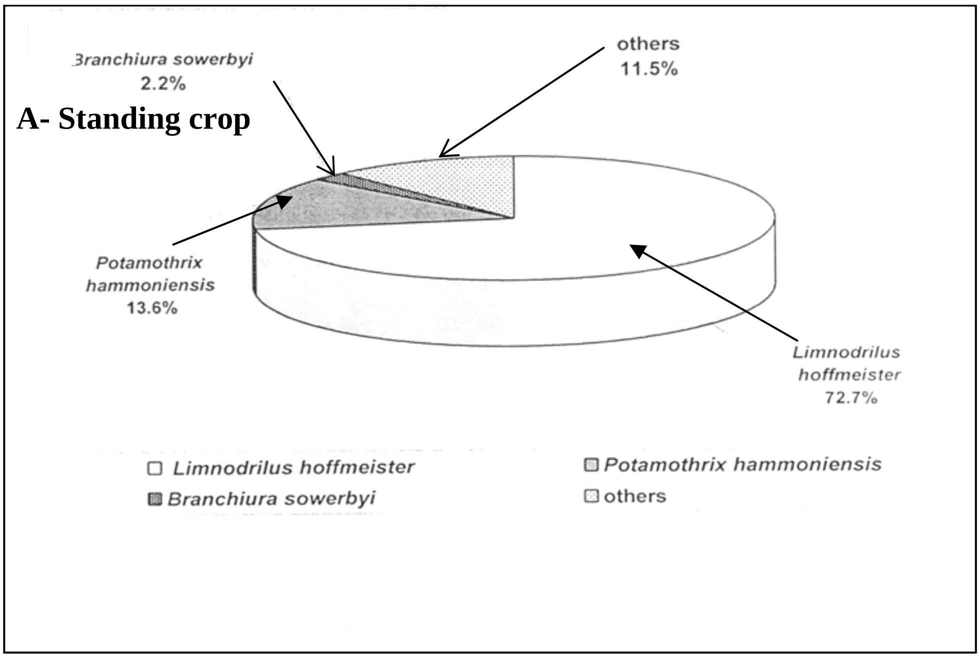


Fig. 8.14. **Biomass of total Annelida in Lake Burullus during 200/02.**



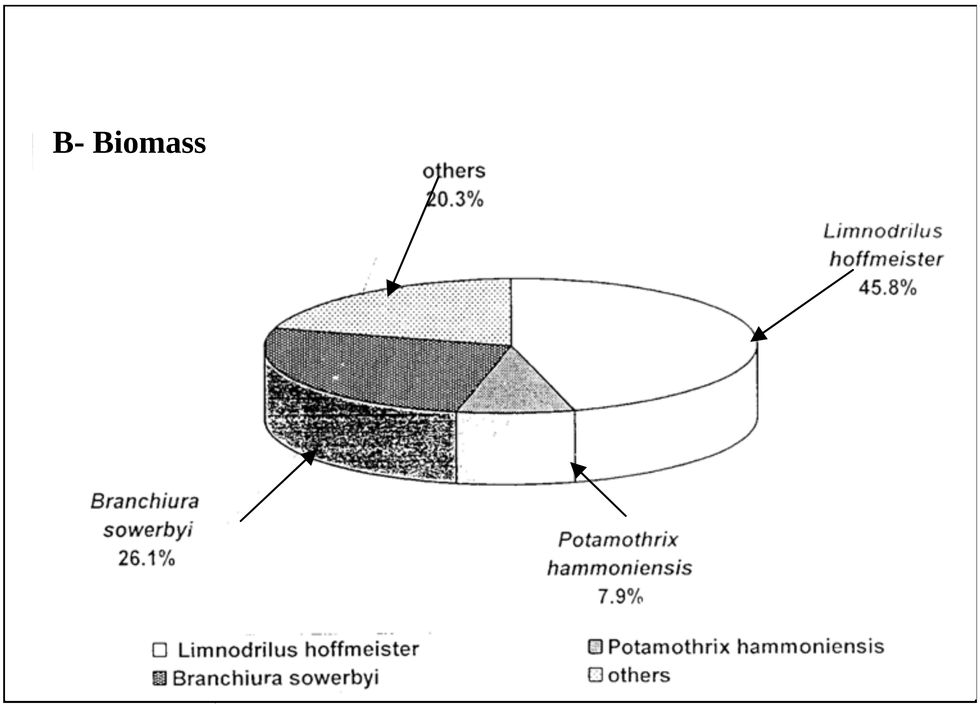


***Figure 8.15*. Community composition of Total Annelida during 2002.**

Arthropoda occupies the second position among benthic groups, with an overall average of 919 ind. m^{-2}, contributing about 33.9% of the total benthos numbers. The highest population density of these animals occurred in spring (Avr. 1694 ind. m^{-2}), while summer was the poorest period sustaining these arthropods. Regarding biomass, spring maintained the highest value of 8.44 g wet wt. m^{-2}; while winter sustained the lowest (1.72 g wet wt. m^{-2}) (Tables 8.14 and 8.15, Figs. 8.16 and 8.17).

Table 8.14. **Standing crop of total Arthropoda (ind. m^{-2}) in Lake Burullus during 2001/02.**

Station	Autumn	Winter	Spring	Summer	Average
I	270	135	4275	90	**1193**
II	315	180	135	45	**169**
III	1935	270	360	225	**698**
IV	225	360	7020	45	**1913**
V	5040	45	270	90	**1361**
VI	5400	2655	2925	45	**2756**
VII	855	360	270	180	**416**
VIII	90	45	2475	135	**686**
IX	270	135	585	45	**259**
X	360	270	135	45	**1050**
XI	+	135	180	45	**120**
Average	**1476**	**417**	**1694**	**90**	**919**

Table 8.15. **Biomass of total Arthropoda (g wet wt. m^{-2}) in Lake Burullus during 2001 / 02 (after Khalil & El-Shabrawy 2002).**

Station	Autumn	Winter	Spring	Summer	Average
I	1.59	0.69	11.98	0.16	**3.61**
II	1.62	1.50	1.66	0.19	**1.24**
III	10.88	1.33	1.43	2.74	**4.10**
IV	1.39	1.17	44.47	1.04	**12.02**
V	15.17	0.20	0.75	0.45	**4.14**
VI	14.89	6.94	17.21	0.93	**9.99**
VII	3.12	1.08	1.62	29.67	**8.87**
VIII	0.28	0.32	8.30	0.59	**2.37**
IX	1.09	0.52	3.15	0.28	**1.26**
X	3.92	3.92	1.43	0.44	**5.29**
XI	+	1.22	0.81	0.21	**0.56**
Average	**5.40**	**1.72**	**8.44**	**3.34**	**4.72**

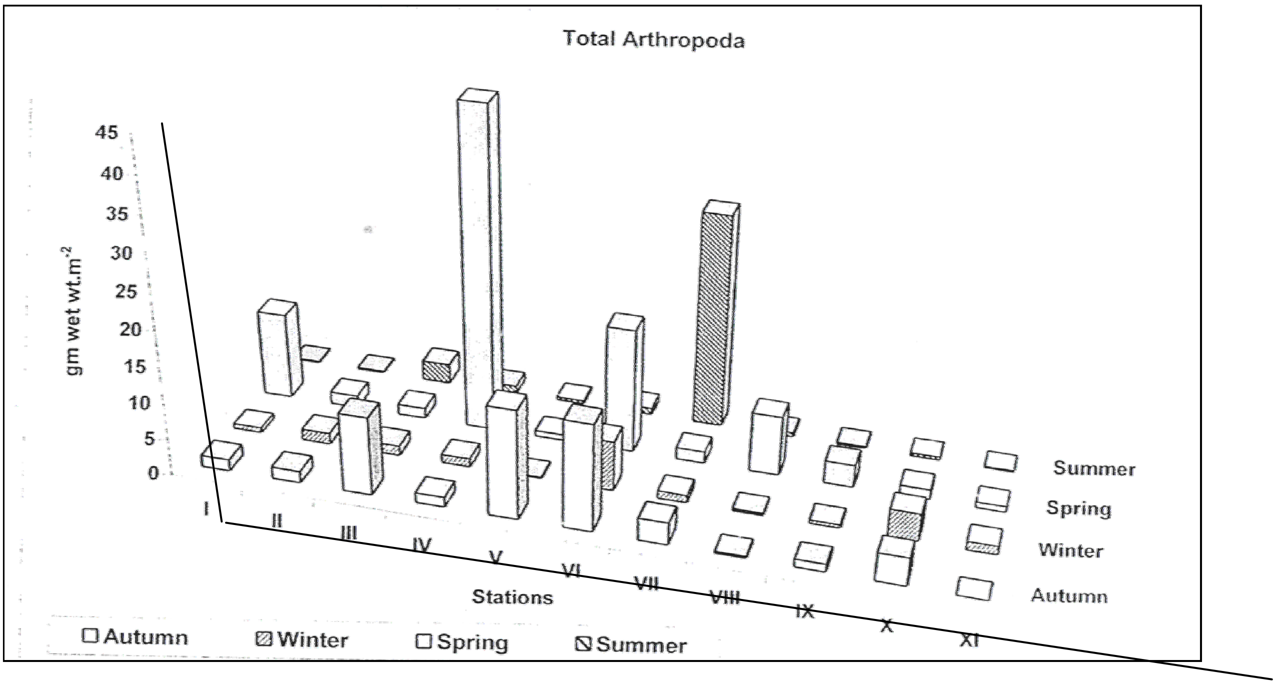


Fig. 8.16. **Standing crop of total Arthropoda in Lake Burullus during 2001/02.**

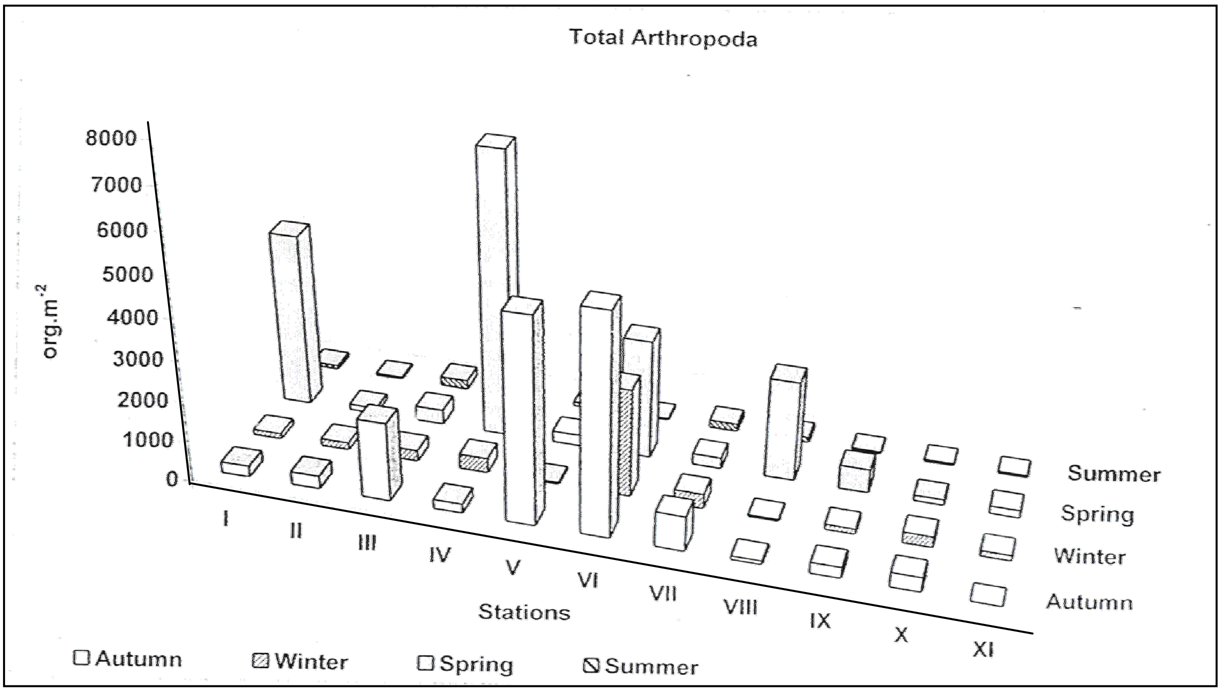


***Fig. 8.17*. Biomass of total Arthropoda in Lake Burullus during 2001/02.**

Aboul-Ezz (1984) previously recorded 5 species of arthropods with standing crop of 208 ind. m^{-2}, weighing 0.39 g wet wt m^{-2} in 1978 - 1979, while Anonymous (1984) recorded 9 arthropods in 1982. Khalil and El-Shabrawy (2002) recorded 13 species of which *Corophium orientale* monopolized the other arthropods (Fig. 8.18).

Depending on the standing crop values, Mollusca occupied the 3rd position among the total benthos groups, with overall average of 175 ind. m^{-2}, forming 6.5 % of the total benthos number (Bedir 2004). In contrast with standing crop, mollusca plays a major role in formation of the total benthos biomass, contributing about 71.8%, with an average of 20.46 g wet wt. m^{-2}. On seasonal basis, summer was the richest with these organisms (282 ind. m^{-2}), weighing 32.79 g wet wt m^{-2}, while the least crop occurred in winter and spring (Tables 8.16 and 8.17 and Figs. 8.19 and 8.20). Aboul Ezz (1984) recorded 4 molluscan species during 1978 – 1979 in the Lake, with an average standing crop of 49 ind. m^{-2}, weighing 13.08 g wet wt. m^{-2} (Table 8.18). Anonymous (1984) recorded 11 species of Mollusca, while Khalil and El-Shabrawy (2002) recorded 12 species (Table 8.19). *Melanoides tuberculata, Theodoxux niloticus* and *Bellamya unicolor* were the most dominant molluscan species (Fig. 8.21).

8.3.1. Other zooplankton components

These are infrequent or rarely recorded and constituted collectively about 1% of total zooplankton. Member of Ciliophora had not been recorded in all seasons except in winter at stations I, II and III, with a peak of 200,000 ind. m^{-3} at station I; they attained an overall average of 7272 ind. m^{-3} forming about 89% of total Protozoa and 0.8% of total zooplankton. Rhizopoda showed no records in most seasons but had been collected from stations I, II, III, IX and X in summer with a highest density of 10000 ind. m^{-3}; they reached to an overall average of 431 ind. m^{-3}, forming 5.3 % of total protozoa and 0.04 % of total zooplankton. *Globigerina* sp. Foraminifera was rare in most seasons, but flourished in winter at stations I, II and III, with a highest density of 10000 ind. m^{-3} at station I.

Free living nematodes were recorded in most seasons, with maximum frequency in summer. Stations I, V, VI, VII and VIII showed the highest density and this indicates that they dominated in the eastern and middle part of lake and showed a gradual decrease westwards. Insect larvae had no records in most seasons, but were collected in summer from stations II, III and V, with maximum counts of 2000 ind. m^{-3} and forming an overall average of 113 ind. m^{-3} and 0.01 % of total zooplankton in the lake. *Mysis* sp. was rare in all seasons except in summer, when it had been recorded in all stations, with a highest density of 10000 ind. m^{-3} at station I. Members of Ostracoda were rare in all seasons except in summer, when it was recorded at a moderate density in stations I, VII, VIII, IX, X and XI.

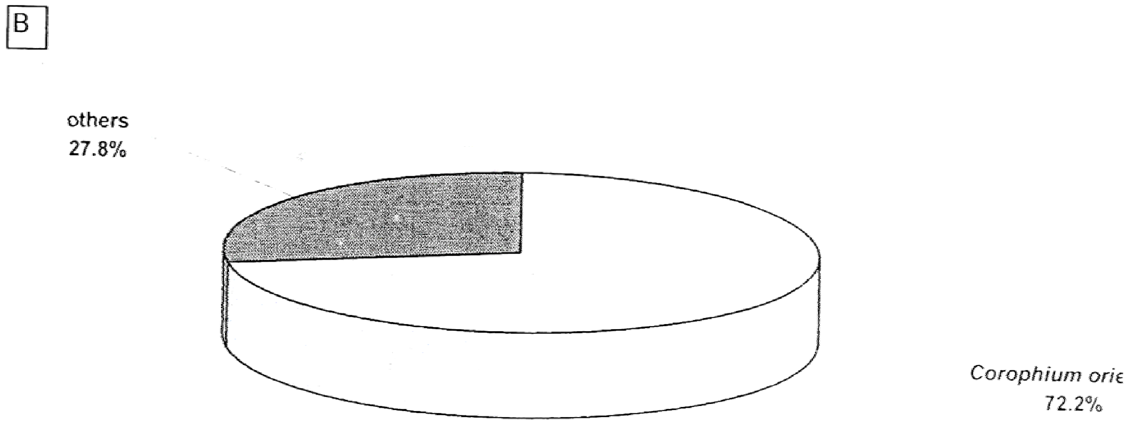


Fig. 8.18. **Community composition of total Arthropoda in 2002.**