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The effect of the substrate status on bottom fauna in Aswan reservoir, Egypt

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Abstract

This study is carried out to assess the response of benthic fauna to water quality variables as well as the substrate status of bottom sediments in Aswan Reservoir during spring, summer and autumn of 2008 and winter of 2009. Nineteen bottom fauna species belonging to Oligochaetae (3 species), Chironomidae (7 species), Mollusca (7 species), Hirudinea (1 species) and Decapoda (1 species) were identified from Aswan Reservoir, of which Oligochaetae was the most common group. The magnitude of the standing crop of bottom fauna showed that the highest counts and biomass occurred during summer (avg. 2827 org./m^2 & 11.1 gm/m^2) and autumn (avg. 5269 org./m^2 & 31.0 gm/m^2) associated with the increased amount of organic carbon (avg. 3.4 & 3.3 wt%, respectively) and calcium carbonate in the sediments (avg. 10.06 & 9.06%, respectively). The study shows that the physico-chemical parameters and the substrate status of bottom sediments give high standing crop of bottom fauna in Aswan Reservoir. The selection of Aswan Reservoir for construction of a fish farm could be an important mean for increasing fish production.

Keywords: Aswan Reservoir, water quality, bottom sediments, bottom fauna, community composition

1. Introduction

The old Aswan Dam was built in 1902, and updated twice in 1912 and 1934 to increase its storage capacity. This area is bounded within Egypt by geographic coordinates extending between latitudes 23° 59` and 24° 0.3` N and longitudes 32° 51` and 32° 55` E (Figure 1). The geologic rock units exposed in the eastern and western banks of Aswan Reservoir are represented by Aswan granites, Nubia Sandstone, Quaternary old Nile sediments and recent sand sheets. The geological and zoobenthos studies on the area between the High Dam and the old Aswan Dam have a minor interest. The only study on the sediments was made by El Dardir (1994 & 1995) who regarded the relation between geochemical and mineralogical composition with grain size, organic matter and $CaCO_3$. While Iskaros (1988) studied the distribution and seasonal variations of bottom fauna, and recorded 25 species belonging to Mollusca (11 species), Aquatic Insecta (9 species), Annelida (4 species) and Platyhelminthes (1 species). The objective of this study is to consider the distribution and seasonal variations of bottom fauna in relation to the dominant environmental conditions, particularly the substrate status of bottom sediments, which are studied for the first time.

2. Materials and methods

Aswan Reservoir Figure 1 represents the area between the two dams, the High Aswan Dam and Low Aswan Dam. It extends for about 6.5 km to the Low Aswan Dam and has an average width of about 1.5 km. The maximum water depth is 18 m at 108 m above mean sea level. Two stations were selected in Aswan Reservoir at Tongara (western bank) and at El-Shallal (eastern bank) during spring (April), summer (August) and autumn (November) of 2008 and winter (January) of 2009. Sixteen water samples were colleted using Van-Dorn bottle at two levels (surface and bottom). According to procedures described by the American Public Health Association (APHA) (1995) transparency, water temperature, dissolved oxygen and hydrogen ion concentration were measured. Eight bottom sediment samples were collected using Ponnar bottom grab (area 225cm^2) (1/44m^2). The bottom sediments samples were mechanically analyzed, using the sieving and pipette techniques (Carver, 1971). The total organic carbon content was determined, using WR.112 USA LECO Carbon Analyzer in the Egyptian Ferroalloys Company of Edfu, Egypt. Calcium carbonate was also determined, using Collin-Calcimeter. Sampling of bottom fauna were also collected seasonally. At each station, two dredges were collected, using the same grab. The samples were then thoroughly washed from muds in a metalic sieve with mesh size of 0.44 mm. The bottom organisms were sorted directly in the field and then preserved in 5% formaline solution. In the laboratory, the number of the different species or genera (No. ind./m^2)and their biomass (gm/m^2) were also determined. The shells of molluscs were removed as their flesh weights were only determined.

For the identification of oligochaetes, Brinkhurst and Jamieson (1971) and Pennak (1978) were used and were further checked by Dr. E.G. Easton from the British Museum. The main references used for molluscs included that of Demian (1959); Brown (1980) and Brown *et al.* (1984). While, Wirth & Stone (1968), Mason (1973) and Hilsenhoff (1975) were used for the chironomid larvae. Correlation coefficient was determined by Minitab 12.21 under Windows XP (2002).

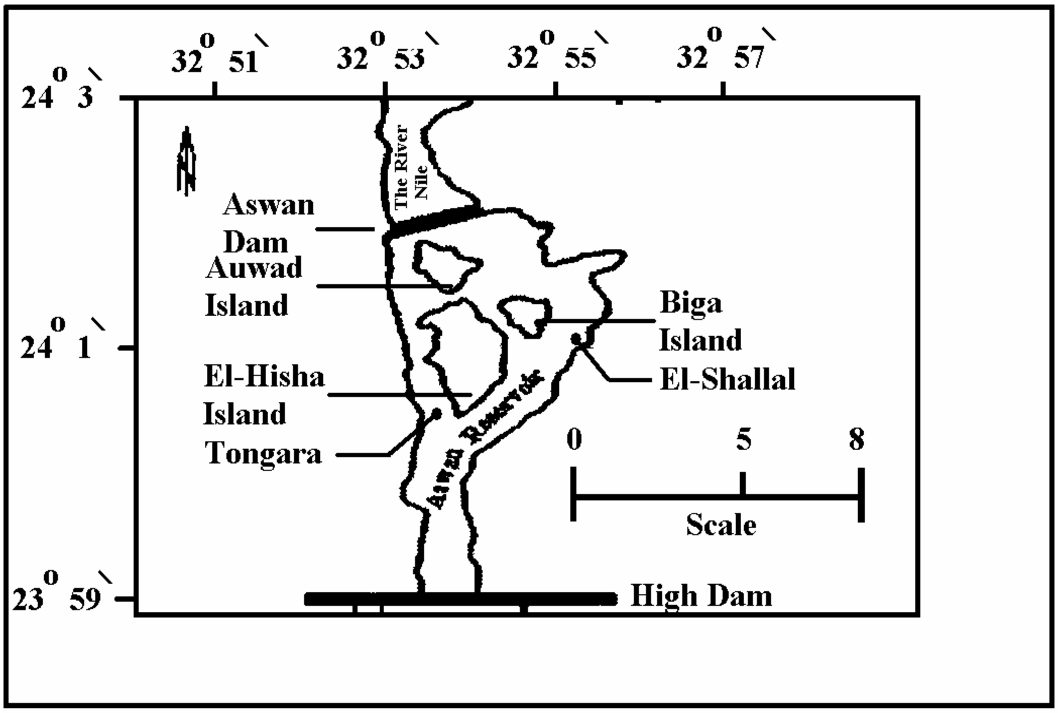

Figure 1: Aswan area and location of samples (●)

3. Results

3.1. Physico-Chemical Characteristics

3.1.1. Transparency.

Transparency in Aswan Reservoir varied between 300-330, 250-350, 350-375 and 500-550 cm during spring, summer, autumn and winter, respectively Table 1. The highest Secchi disc reading was recorded during winter, when the speed of water was slow. While, there was a relative decrease in transparency in the other seasons, due to the increase of water discharge from Lake Nasser loaded with more detritus particles and also create a strong turbulence between the bottom and different water layers (Iskaros *et al.*, 2008).

3.1.2. Water Temperature

The water temperature in Aswan Reservoir fluctuated between 18.8 - 21.8, 25.2 - 25.8, 21.9 - 23.1 and 17.6 - 18.4°C during spring, summer, autumn and winter, respectively Table 1. During the different seasons, the water column was isothermic, possibly due to the vertical mixing caused by the daily inflow of water from the High Dam to Aswan Reservoir.

3.1.3. Dissolved oxygen

The measured values of dissolved oxygen in Aswan Reservoir fluctuated between 6.7-8.9, 3.8-4.1, 5.3-5.7 and 8.4-8.9 mg/1 during spring, summer, autumn and winter, respectively Table 1. The highest oxygen content was in winter and spring, may be related to the flourishing of phytoplankton (range: 4200-7900 unit $x10^3 \, 1^{-1}$ & 5306- 8361unit x $10^3 \, 1^{-1}$, respectively), when compared with summer and autumn (range: 1576-2926 unit $x10^3 \, 1^{-1}$ & 3725-6174 unit x $10^3 \, 1^{-1}$, respectively) (El-Otify, 1991).

3.1.4. Hydrogen-ion concentration (pH)

The pH values in the studied reservoir ranged between 8.00 - 8.40, 7.82 - 8.02, 8.07 - 8.27 and 8.32-8.56 during spring, summer, autumn and winter, respectively Table 1, with a maximum values of 8.40 and 8.55 recorded at the surface and bottom waters of El-Shallal and Tongara during spring and winter, respectively. The relative alkaline pH values recorded

Table 1: Physico-Chemical parameters in Aswan Reservoir during the study.

Sampling Station	Depth	Secchi disc (cm)				Temperature (°C)				Dissolved oxygen (mg/l)				pH value			
		sp.	su.	au.	w.	sp.	su.	au.	w.	sp.	su.	au.	w.	sp.	su.	au.	w.
East (El-Shallal)	Surface	300	250	350	550	21.8	25.3	22.5	17.6	8.9	4.1	5.6	8.9	8.4	8.02	8.17	8.32
	Bottom					21.0	25.6	22.1	18.0	7.3	3.9	5.3	8.5	8.2	7.98	8.15	8.33
West (Tongara)	Surface	330	350	375	500	20.6	25.2	23.1	18.1	8.9	4.1	5.5	8.4	8.0	7.98	8.27	8.33
	Bottom					18.8	25.8	21.9	18.4	6.7	3.8	5.7	8.9	8.2	7.82	8.07	8.56
Average		315	300	363	525	20.6	25.5	22.4	18.0	8.0	4.0	5.5	8.7	8.2	7.95	8.17	8.39

Note: sp. spring su. = summer au. = autumn w. = winter

in the reservoir were the result of photosynthetic uptake of CO_2 by the phytoplankton (El-Otify, 1991).

3.2. Bottom sediments characteristics

3.2.1. Grain size

Grain size analysis revealed that the studied bottom sediment samples in Aswan Reservoir were composed of sand (53.8-74.5%), silt (22.3-42.0%) and clay (3.2-12.1%). Seasonally, these fractions showed low range of variability among the investigated stations Table 2.

3.2.2. Total organic carbon content

The organic carbon content of a sediment represents a direct measure of its organic richness (Hunt, 1972). The highest concentrations of organic carbon were found during summer and autumn (range: 4.74-4.78% and 2.07-1.74% respectively for the two stations) Table 3, which may reflect their gradual accumulation during spring, and also explained by the high production of bottom fauna (range: 1496 - 6776 org./m^2 & 7.3 - 49.8 gm/m^2) Figure 2, while the winter sustained the lowest values coinciding with the water convection.

Table 2: Percentages of sand silt and clay of the analyzed bottom sediment samples in Aswan Reservoir during the study.

Sampling Stations	Depth (m)				Sand (%)				Silt (%)				Clay (%)			
	sp.	su.	au.	w.	sp.	su.	au.	w.	sp.	su.	au.	w.	sp.	su.	au.	w.
East (El-Shallal)	3.0	7.0	5.0	6.0	67.0	61.2	61.0	54.2	29.8	26.8	26.9	41.6	3.2	12.0	12.1	4.2
West (Tongara)	4.0	4.0	4.0	6.0	67.0	53.8	73.0	74.5	29.5	42.0	23.0	22.3	3.5	4.2	4.0	3.2
Average	3.5	5.5	4.5	6.0	67.0	57.5	67.0	64.4	29.7	34.4	25.0	31.9	3.3	8.1	8.0	3.7

Note: sp. spring su. = summer au. = autumn w. = winter

Table 3: Organic carbon and calcium carbonate contents of the analyzed bottom sediments in Aswan Reservoir during the study.

Sampling Station	Depth (m)				Organic carbon (%)				Calcium carbonate (%)			
	sp.	su.	au.	w.	sp.	su.	au.	w.	sp.	su.	au.	w.
East (El-Shallal)	3.0	7.0	5.0	6.0	1.65	4.74	4.78	1.28	4.57	9.14	8.23	3.88
West (Tongara)	4.0	4.0	4.0	6.0	1.30	2.07	1.74	1.33	5.49	10.98	9.88	4.96
Average	3.5	5.5	4.5	6.0	1.50	3.40	3.30	1.30	5.03	10.06	9.06	4.42

Note: sp. spring su. = summer au. = autumn w. = winter

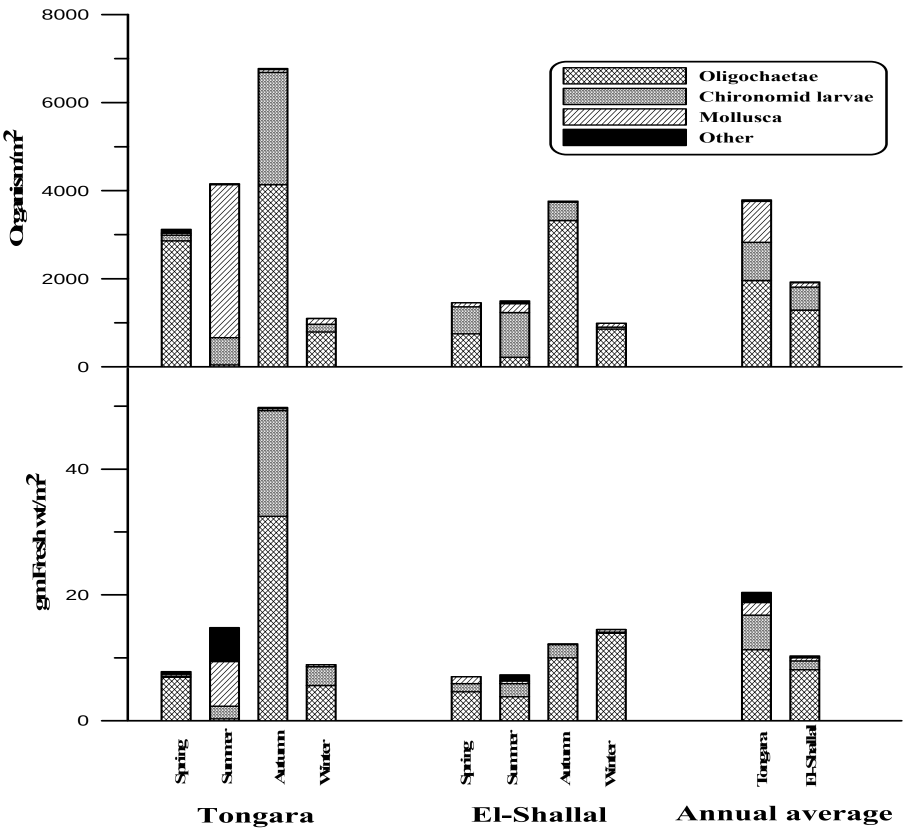

Figure 2: Distribution and seasonal variations of bottom fauna (org./m^2 & gm/m^2) in Aswan reservoir.

3.2.3. Calcium carbonate content

$CaCO_3$ content of the analyzed bottom sediments in Aswan Reservoir ranged between 3.88% at El-Shallal during winter and 10.98% at Tongara during summer Table 3. The highest concentrations were found at Tongara during summer and autumn (10.98 and 9.88%, respectively). The $CaCO_3$ abundance is not related to the pH values in the water Table 1. This indicates that the $CaCO_3$ abundance is not controlled by chemical precipitation. Consequently, the $CaCO_3$ content is related to encrusting organisms i.e. biogenic origin. El Dardir (1984) concluded that the $CaCO_3$ concentration in the bottom sediments can indirectly help promoting the primary productively in Lake Nasser.

3.3. Bottom fauna

3.3.1. Community composition, distribution and seasonal variations

Nineteen species of benthic fauna belonging to Oligochaeta (3 species), Chironomida (7 species), Mollusca (7 species), Hirudinea (1 species) and Decapoda (1 species) were identified from Aswan Reservoir. In addition two unknown species of Anisoptera and Zygoptera (nymph of Odonata) were also recorded. According to their relative abundance, they constituted numerically about 56.8, 24.3, 18.0, 0.5, 0.3 and 0.1% of the total benthos, respectively. The dominance of oligochaetes in the reservoir is possibly due to their ability to adapt many kinds of habitat and their tolerance to low oxygen content or anoxic conditions.

The highest density and biomass of benthic biota in Aswan Reservoir were recorded at Tongara Figure 2(avg. 3791 org./m^2 & 20.4 gm/m^2) where there were some patches of macrophytes which numerous stiff leaves protect many animals and their eggs from predators, and also provide a large surface for the growth of epiphytic food-organisms (Hann, 1995). On the other hand, the community decreased to about the half at El-Shallal (avg. 1929 org/m^2 & 10.3 gm/m^2) which was characterized by vegetation-free bottom zone. The annual average numbers and biomass of benthic fauna for all the reservoir amounted to 2858 org./m^2 & 15.4 gm/m^2, respectively.

Zoobenthos populations in Aswan Reservoir Figure 2 were the highest during summer (avg. 2827 org./m^2 & 11.1 gm/m^2) and autumn (avg. 5279 org./m^2 & 31.0 gm/m^2) with peaks at Tongara (4158 org./m^2 & 14.8 gm/m^2 and 6776 org./m^2 & 49.8 gm/m^2, respectively).

This is due to the increased numbers of molluscs (3476 org./m^2 with 7.1 gm/m^2) and oligochaetes (4136 org./m^2 with 32.5 gm/m^2) and low chironomid larvae (1980 larvae/m^2 with 13.8 gm/m^2), respectively. Water temperature varied between 21.9 & 25.8 °C Table 1. On the contrary, the lowest values of benthic fauna were observed during winter (avg. 1000 org./m^2 with 11.7 gm/m^2) when the water temperature was below 18.4 °C.

3.3.2. Populations of oligochaeta

Oligochaeta were the most abundant animals among the benthic community inhabiting Aswan Reservoir Figure 2. Their annual average numbers and biomass were amounted to 1623 org./m^2 and 9.7 gm/m^2 with a peak at Tongara (avg. 1958 org./m^2 with 11.3 gm/m^2). Oligochaetes were represented by 3 species, *Limnodrilus udekemianus* Claparede, *L. hoffmeisteri* Claparede and *Branchiura sowerbyi* Beddard. They were found numerous during autumn Figure 2 at Tongara (4136 org./m^2 with 32.5 gm/m^2) and El-Shallal (3322 org./m^2 with 10.0 gm/m^2) and in spring at the former station (2860 org./m^2 with 6.9 gm/m^2), mainly consisting of *L. udekemianus* Figure 3 which contributed 40.3 & 71.0 % (avg. 1152 org./m^2) of total bottom fauna and oligochaetes, respectively. *Branchiura sowerbyi* ranked the second in importance (20.7% of the oligochaetes with 336 org./m^2), while *L. hoffmeisteri* contributed 8.3% (avg. 135 org./m^2), being confined to autumn and winter with a peak at El-Shallal during the latter (660 org./m^2) Figure 3.

3.3.3. Populations of chironomid larvae

Larvae of Chironomida contributed the second important group with an annual average of 616 larvae/m^2 and 3.5 gm/m^2 where Tongara also sustained the highest values Figure 2 (avg. 869 larvae/m^2 & 5.5 gm/m^2). They were represented by 7 species larvae, namely; *Dicrotiendipes modestus*, *Nilodorum* sp., *Chironomus* sp., *Procladius* sp., *Microtiendipes* sp., *Cryptochironomus* sp. and *Circotopus* sp. Chironomid larvae peaks were in summer and autumn Figure 2 at El-Shallal (1012 larvae/m^2 with 2.1 gm/m^2) and Tongara (1980 larvae/m^2 with 13.8 gm/m^2), respectively. *Dicrotiendipes modestus* was the dominant taxon Figure 3, contributing 11.7 & 54.4% (avg. 335 larvae/m^2) of the total bottom fauna and chironomid larvae, respectively. This peak was recorded during autumn, particularly at Tongara (1430 larvae/m^2). *Nilodorum* sp. Figure 3 contributed 31.2% (avg. 192 larvae/m^2) where its major occurrence appeared at El-Shallal (avg. 225 larvae/m^2) with a peak during summer (avg. 572 larvae/m^2). On the other hand, their larvae of the other species Figure 3 were rarely recorded from one season to another (range 22 – 132 larvae/m^2), contributing collectively 14.4% (avg. 89 larvae/m^2).

Pupae, probably of *Nilodorum* sp. appeared once during autumn at Tongara and El-Shallal (572 & 66 pupae/m^2, respectively).

3.3.4. Populations of mollusca

Mollusca was the third important group with an annual average of 514 org./m^2 and 1.3 gm/m^2. Tongara sustained the highest values (avg. 930 org./m^2 and 2.0 gm/m^2) Figure 2 where there is a riverine conditions due to the daily inflow of water from the High Dam to the reservoir. Six gastropod species included *Valvata nilotica* Jackeli, *Biomphalaria alexandrina* Ehrenberg, *Bulinus truncatus* Audouin, *B. forskallii* Ehrenberg, *Physa acuta* Darparnoud and *Melanoides tuberculata* Müller and the bivalve *Psidium pirothi* Jickeli were recorded. Their peak was confined to summer Figure 2, particularly at Tongara (3476 org./m^2 with 7.1 gm/m^2). That peak contained large number of *Valvata nilotica* Figure 3 which accounted for 14.9 & 82.9% (avg. 426 org./m^2) of the total bottom fauna and molluscs, respectively. *Biomphalaria alexandrina* Figure 3 contributed 10.1% (avg. 52 org./m^2), being confined to spring (22 org./m^2) and summer (396 org./m^2) at Tongara. Other molluscs (*B. truncatus*, *B. forskallii*, *Physa acuta*, *Melanoides tuberculata* and *Psidium pirothi*) Figure 3 appeared in few individuals from one season to another (range 22 – 44 org./m^2), contributing collectively 7.0% (avg. 36 org./m^2).

3.3.5. Rare fauna

Species of rare occurrence (Figures 2 and 3) were recorded in the reservoir included the hirudinean *Helobdella conifera* Moore which was confined to Tongara during spring (88 org./m^2 & 0.4 gm/m^2)) and autumn (22 org./m^2 & 0.2 gm/m^2), the crustacean *Cardinea nilotica* Roux and nymph of Odonata which appeared once at El-Shallal (66 org./m^2 & 1.0 gm /m^2) and Tongara (22 nymph/m^2 & 5.4 gm/m^2) during summer, respectively.

4. Discussion

The benthic communities quantities and qualities are largely influenced by a number of factors, including physical, chemical and biological ones. The substrate status of bottom sediments is also of great importance.
According to Welch (1952), the nature of bottom sediments has a selective influence on the quality of benthos and many species live in close association with some type of substrate. Thus, most of the Chironomini species breed in beds of aquatic vegetation (Oliver, 1971) or in bottom muds (Wirth & Stone, 1968). The aquatic plant belt of Aswan Reservoir, particularly at Tongara form a suitable substrate for the growth of Chironomini types such as *Dicrotiendipes modestus*

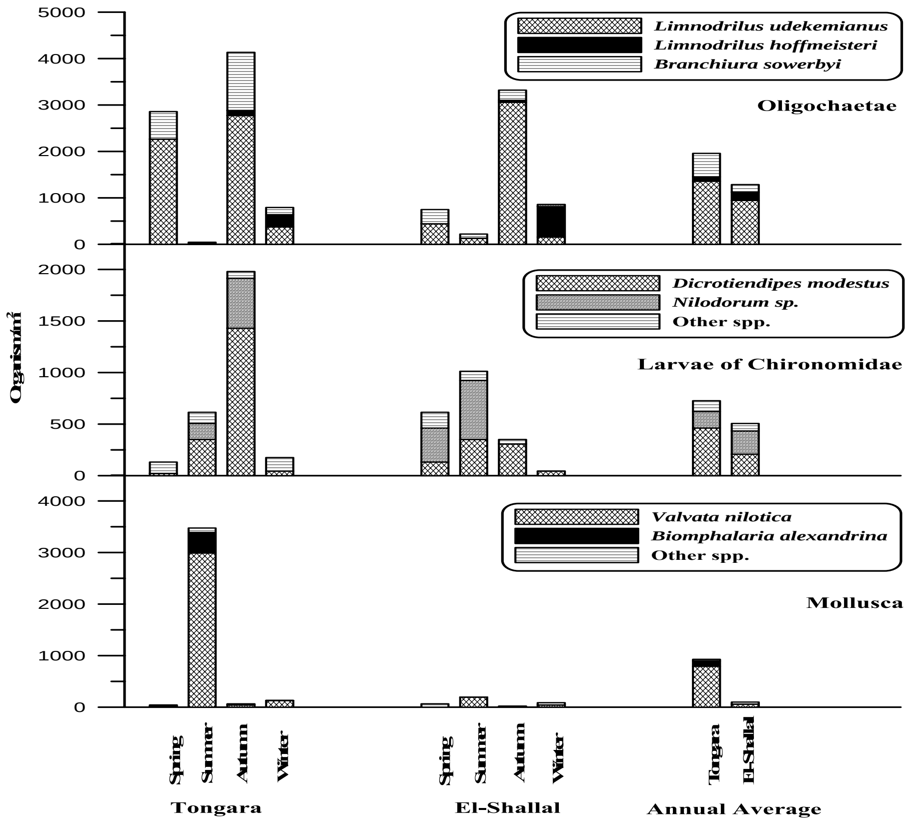

Figure 3: Distribution and seasonal variations of bottom fauna species (org./ m^2) in Aswan reservoir.

Figure 3 whereas *Nilodorum* sp. and its pupa live in muddy tubes. The distribution of *Valvata nilotica*, *Biomphalaria alexandina*, *Bulinus truncatus* and *Physa acuta* were mainly confined to the aquatic vegetationand this is in agreement with the observation of Dazo *et al*. (1966) in the canals and drains of lower Egypt. However, *Melanoides tuberculata* in the reservoir was recorded in the areas devoid of hydrophytes. Leveque (1972) considered the sandy bottom as the favourable biotope for this species in Lake Chad. Moreover, *Limnodrilus hoffmeisteri* which also survives in muddy tubes reached its maximum abundance at El-Shallal Figure 3 that is characterized by a high percentage of silt and clay Table 2. In Khor Kalabsha (Lake Nasser), Iskaros (1993) observed that the same species rather abundant at the offshore stations (clayey silt) than in the littoral ones (mainly sand).

The increase of $CaCO_3$ in the sediments during summer (avg. 10.06%) and autumn (avg. 9.06%) Table 3 was generally in concomitance with a parallel increase in density of bottom fauna Figure 2. Thus, a positive correlation stands for the abundance of most bottom fauna species and $CaCO_3$ Table 4. This indicates that $CaCO_3$ content may be important relative to population growth of bottom fauna in Aswan Reservoir. The present results were already confirmed by Brown (1980), Krzyanek (1986) and Ali *et al*. (2007) who stated that the great the amount of organic matter with Ca increase the greater in development of detritophagus, chiefly the oligochaetes and molluscs.

The organic carbon in the sediments which is used as an index of the amount and type of food available to benthic animals (Byers *et al*., 1978), reached its highest amount in Aswan Reservoir during summer (avg. 3.4%) and autumn (avg. 3.3%) Table 3 Our results, however, showed different reactions between organic carbon and the different species Table 4. The presence of main species i.e. *Limnodrilus udekemianus*, *Dicrotiendipes modestus* and *Nilodorum* sp. is correlated positively with the amount of organic carbon while the other species showed an inverse relation.

The temperature range of Aswan Reservoir was from 17.6 to 25.8 °C with the minimum during winter and the maximum in summer Table 1. The difference in temperature along the year round considered as a controlling factor related to range of tolerance of species. From the correlation coefficient Table 4, molluscs and chironomid larvae species reacted positively to water temperature, contrary to the oligochaetes. We believe that the reproduction of these species is affected with temperature. Brown (1980) mentioned that the growth and reproduction of molluscs are apparently related to both the available food supply including decaying algae and water temperature. The pH values of Aswan Reservoir lie on the alkaline side (7.82 – 8.56) Table 1. This alkaline water habitat was generally found to be favoured by oligochaetes, chironomid larvae and molluscs. Our results indicated that most of the dominant species inhabiting the reservoir are alkaliphilous forms which attained their maximum abundance when the pH values were varied between 7.82 & 8.27.

A total of 19 benthic fauna species, representing 5 groups were recorded in Aswan Reservoir during the present study while Iskaros (1988) recorded 25 species, besides unidentified species of chironomid pupae, nymphs of Odonata and Ephmeroptera. Consequently, there was highly changed with time in the community composition, seasonal variations Tables 5 & 6 and the species number Table 7. Four new species were recorded during the present study while 11 species disappeared, most of them belonging to Mollusca and chironomid larvae which are usually adapted to live amongst the aquatic vegetation. Thus, the disappearance of such species may be attributed to the shortage of suitable substrates, resulting from the introduction of grass carp to Aswan Reservoir which is fed mainly on aquatic plants.

It should be noted that the species of Mollusca recorded in the present study as well as the other species which disappeared and the decapod *Cardinea nilotica* are endemic riverine species. The others including oligochaetes and chironomid larvae are world wide distribution.

The present study has shown that Aswan Reservoir is a fertile reservoir. It sustains diversified flora consisting of Chlorophyta, Bacillariophyta and Cyanophyta, while members of Pyrrophyta appeared infrequent (El-Otify, 1991) where the standing crop of phytoplankton gave an average value of $4971x10^3 l^{-1}$. Also, the zooplankton is rich and diversified (Iskaros *et al.*, 2008) where its standing crop amounts to 34314 org./m^2 with 35 species belonging Rotifera (27 species), Copepoda (3 species) and Cladocera (5 species) of which the former constituted 49.7% of the total zooplankton. The benthic fauna represent the third components among the food chain in the fresh water habitats. They convert sediment detritus, micropes and other small preys into their body's flesh that is available to fish. Iskaros (1988 & 1993) noticed that the different groups of benthos serve as an important food for various fish species in Lake Nasser. Comparing the average biomass of benthos recorded in Aswan Reservoir with that of Lake Nasser and the Egyptian Delta Lakes, Table 8 illustrates that the reservoir sustains higher values than that of these lakes. More investigations are needed to follow up the changes in the different biota which contribute to the development of the Nile fisheries.

Table 4: Correlation coefficient between some ecological parameters and bottom fauna species during the study.

	T	O.C.	$CaCO_3$	Lim. ud.	Lim. ho.	Bran. so.	Dicr. mo.	Nilo. sp.	Other l.	Valv. ni.	Biom. al.
O.C.	-0.619										
$CaCO_3$	-0.864	-0.484									
Lim. ud	-0.143	-0.197	-0.204								
Lim. ho.	-0.608	-0.389	-0.539	-0.285							
Bran. so.	-0.132	-0.252	-0.212	-0.691	-0.215						
Dicr. mo.	-0.346	-0.078	-0.642	-0.471	-0.200	-0.788					
Nilo. sp.	-0.611	-0.311	-0.486	-0.096	-0.400	-0.355	-0.613				
Other l.	-0.130	-0.228	-0.041	-0.248	-0.629	-0.003	-0.185	-0.174			
Valvata. ni	-0.599	-0.056	-0.583	-0.385	-0.232	-0.326	-0.015	-0.035	0.184		
Biom. al.	-0.560	-0.095	-0.558	-0.333	-0.250	-0.294	-0.001	-0.084	0.189	0.995	
Other mo.	-0.252	-0.317	-0.122	-0.311	-0.062	-0.209	-0.081	-0.093	0.134	0.679	0.711

T = Temperature
O.C. = Organic carbon
Lim. ud. = *Limnodrilus udekemianus*
Lim. ho. = *Limnodrilus hoffmeisteri*
Bran. so. = *Branchiura sowerbyi*
Dicr. mo. = *Dicrotiendipes modestus*
Nilo. sp. = *Nilodorum* sp.
Other l. = Other larvae
Valv. ni. = *Valvata nilotica*
Biom. al. = *Biomphalaria alexandrina*
Othr mo. = Other molluscs.

Table 5: Annual average values of bottom fauna (org./m^2 & gm fresh wt/m^2) and their percentage frequencies in Aswan Reservoir during the period June, 1982 – May, 1983. (After Iskaros, 1988).

Groups	No/m^2	%	gm/m^2	%
Mollusca	1223	53.8	08.6	48.0
Chironomid larvae	0675	29.7	01.0	05.6
Oligochaetes	0291	12.8	06.9	38.5
Rare occurrence Platyhelminthes	0045	02.0	00.4	02.2
Hirudinea	0006	00.3	00.2	01.1
Nymph of Odonata	0026	01.1	00.8	04.5
Nymph of Ephmeroptera	0003	00.1	-	-
Pupae of Chironomida	0003	00.1	-	-
Total	2272	100	17.9	100

Table (6): Monthly variations of bottom fauna (org./m^2 & gm fresh wt/m^2) in Aswan Reservoir during the period June, 1982 – May, 1983. (After, Iskaros, 1988).

Seasons		Summer			Autumn			Winter			Spring			Total
Months		June 1982	July 1982	August 1982	September 1982	October 1982	November 1982	December 1982	January 1983	February 1983	March 1983	April 1983	May 1983	
Mollusca	No/m^2	1230	310	680	720	280	190	700	600	1660	2450	3690	2170	14680
	gm/m^2	10.6	3.5	4.9	4.5	1.9	1.2	3.2	2.8	10.4	18.6	24.3	17.9	103.8
Chironomld larvae	No/m^2	150	460	610	300	140	250	520	380	690	1940	1900	760	8100
	gm/m^2	0.2	0.6	0.7	0.5	0.2	0.4	0.8	0.4	1.0	2.4	3.0	1.3	11.5
Oligochaetae	No/m^2	320	570	430	140	270	110	150	460	360	280	140	260	3490
	gm/m^2	9.7	11.5	10.2	2.5	5.3	2.1	4.2	8.6	9.3	6.3	5.4	7.5	82.6
Platyhelminthes	No/m^2	80	10	0	0	0	0	10	20	60	40	200	120	540
	gm/m^2	0.9	0.05	0	0	0	0	0.04	0.1	0.2	0.2	1.9	1.0	4.4
Hirudinea	No/m^2	0	0	0	20	0	0	20	10	0	10	10	0	70
	gm/m^2	0	0	0	0.4	0	0	0.8	0.4	0	0.4	0.4	0	2.4
Nymph of Odonata	No/m^2	10	10	0	10	0	10	50	120	20	20	60	0	310
	gm/m^2	1.2	0.9	0	0.5	0	0.9	0.4	3.3	0.5	0.4	1.6	0	9.7
Nymph of Ephmeroptera	No/m^2	0		0	0	0	0	0	10	0	0	20	0	30
	gm/m^2	0	0	0	0	0	0	0	0.05	0	0	0.1	0	0.15
Pupae of Chironomidae	No/m^2	0	10	20	0	0	0	0	0	0	0	0	0	30
	gm/m^2	0	0.05	0.1	0	0	0	0	0	0	0	0	0	0.15
Total	No/m^2	1790	1370	1740	1190	690	560	1450	1600	2790	4740	6020	3310	27250
	gm/m^2	22.6	16.6	15.9	8.4	7.4	4.6	9.4	15.65	21.4	28.3	36.7	27.7	214.7

Table 7: Check list of bottom fauna species recorded in Aswan Reservoir during the different periods.

Taxa	**1982 – 1983 (Iskaros, 1988)**	**2008 – 2009 The present work**
Oligochaeta		
Branchiura sowerbyi Beddard	+	+
Limnodrilus udekemianus Claparede	+	+
Limnodrilus hoffmeisteri Clapared	+	+
Hirudinea		
Helobdella conifera Moore	+	+
Platyhelminthes		
Planaria sp.	+	-
Chironomid larvae		
Procladius sp.	+	+
Ablabesmyia sp.	+	-
Dicrotiendipes modestus	+	+
Einfeldia sp.	+	-
Cryptochironomus sp.	+	+
Chironomus sp.	+	+
Nilodorum sp.	-	+
Tanytarsus sp.	+	-
Microtiendipes sp.	-	+
Circotopus sp.	+	+
Orthocladius sp.	+	-
Pupae of Chironomida*	+	+
Nymph of Odonata*	+	+
Nymph of Ephemeroptera*	+	-
Mollusca		
Theodoxus niloticus Reeve	+	-
Bellamya unicolor Olivier	+	-
Coleopatra bulmoides Olivier	+	-
Valvata nilotica Jickeli	+	+
Melanoides tuberculata Müller	+	+
Bulinus truncatus Audouin	+	+
Bulinus forskallii Ehrenberg	-	+
Biomphalaria alexandrina Ehrenberg	+	+
Lymnaea natalensis Krauss	+	-
Physa acuta Darparnoud.	+	+
Spharieum sp.	+	-
Psidium pirothi	-	+
Corbicula fluminalis Müller	+	-
Crustacea		
Cardinea nilotica Roux	-	+
Total	**25**	**19**

* Unidentified species
(+) Present (-) Absent.

Table 8: Average biomass of benthos (gm fresh wt./m^2) recorded in Aswan Reservoir and in the different lakes in Egypt.

Lake	gm/m^2	Author
Aswan Reservoir	15.4 17.9	Iskaros (The present work) Iskaros (1988)
Lake Nasser	13.1	Iskaros (1988)
Nozha Hydrodrome	06.3	Elster & Jensen (1960)
Lake Edku	11.3	Samaan (1977)
Lake Burollus	09.9	Aboul-Ezz (1984)

5. Conclusions

Oligochaetes, larvae of Chironomids, Mollusca, Hirudinea and Decapoda were the benthic invertebrate groups identified from Aswan Reservoir with 19 species, of which the former constituted 56.8 and 63.0% of the number and biomass of bottom fauna. The highest standing crop of benthic fauna was recognized during summer and autumn accompanied by the increased amount of organic carbon and calcium carbonate content in the sediments. Spatially, the highest standing crop of benthos recorded at Tongara where patches of macrophytes that protect the invertebrates or provide them with accumulated organic matter for feeding. A noticeable decrease in density was observed at El-Shallal due to the absence of aquatic plant, resulting from the introduction of grass carp which mainly feeds on them. The physico-chemical features as well as the substrate status of bottom sediments of Aswan Reservoir are in favour of procuring high standing crop of bottom fauna which in turn provide the main food items for most fish inhabiting the reservoir.

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تأثير الخصائص الطبيعية و الكيميائية على حيوانات القاع فى خزان أسوان – مصر

إسحاق عجايبى اسكاروس – نزيه نجيب جندى

المعهد القومي لعلوم البحار والمصايد – أسوان – مصر

تمت دراسة تأثير الخواص الطبيعية والكيميائية وكذلك خصائص القاع على حيوانات القاع فى خزان أسوان خلال الفترة من ربيع 2008 حتى شتاء 2009. ولقد تم تسجيل 19 نوعا من حيوانات القاع تنتمي إلى الديدان قليلة الأشواك ويرقات الهاموش والرخويات والعلقيات والقشريات. وكانت الديدان قليلة الأشواك هى الأكثر وفرة في منطقة البحث وعلى الأخص خلال فصل الخريف. وبلغ متوسط الإنتاج السنوي لحيوانات القاع في خزان أسوان 2858 كائن/م^2 و 15.4 جرام/م^2. ولقد بينت الدراسة أن الخصائص الطبيعية والكيميائية مثل شفافية ودرجة حرارة المياه وكمية الأكسجين الذائب ودرجة الأس الهيدروجيني وكذلك خصائص رسوبيات القاع مثل نوع الرواسب وكربونات الكالسيوم والكربون العضوي هي من أهم العوامل المناسبة والمؤثرة في زيادة كثافة حيوانات القاع التي تمثل الغذاء الرئيسي للأسماك التي تعيش في خزان أسوان.