



Effect of Pollution on Macrobenthic Invertebrates in Some Stations on the River Nile in Greater Cairo

Thesis Submitted to Faculty of Science, Ain Shams University, In Partial Fulfillment of Master Degree of Science (M. Sc.)

By

Hadeel Mohammed Omar Medani

(B. Sc., 2011)

Zoology Department, Faculty of Science, Ain Shams University

Under the Supervision of

Prof. Dr. Abd El-Halim A. Saad

Prof. Dr. Waheed M. Emam

Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University

Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University

Dr. Hesham R. Abdel Mola

Assistant Professor of Aquatic Invertebrates, National Institute Of Oceanography & Fisheries (NIOF), El-Qanater Research Station

2018

Approval sheet

Effect of pollution on Macrobenthic Invertebrates in Some Stations on the River Nile in Greater Cairo

By

Hadeel Mohammed Omar Medani

B.Sc. Zoology (2011)

This thesis for M. Sc. degree has been approved by:

Prof. Dr. Awaad Abdo M. El- Sayed...

Professor of Invertebrates, Zoology Department, Faculty of Science, Al- Azhar University

Prof. Dr. Khalid M. El- Moselhy ...

Professor of Aquatic Ecology, National Institute of Oceanography & Fisheries, Suez branch

Prof. Dr. Abd El-Halim A. Saad ...

Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University

Prof. Dr. Waheed M. Emam ...

Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University

Date of examination: 14/5/2018



Student Name: Hadeel Mohammed Omar Medani

Scientific Degree: M.Sc.

Faculty Name: Faculty of Science – Ain Shams

University

Department: Zoology

Graduation Year: 2011

Granting Year: 2018

Contents

Acknowledgem	entI
List of Figures	II
List of Tables	VII
Abstract	XII
1. Introduction	
2. Literature Re	eview 7
3. Materials and	d Methods22
1. Stations o	description22
2. Collection	n of samples25
2.1.	Water samples25
2.2.	Sediment samples
2.3.	Macrobenthic invertebrates samples 26
3. Analysis o	of samples27
3.1.	Physico-chemical parameters 27
3.2.	Heavy metals analysis 31
	3.2.1. Heavy metals in water 31
	3.2.2. Heavy metals in sediment 32
3.3.	Macrobenthic invertebrates

	4	. Sta	ntistical analysis	33
4.	R	esult	t s	35
	1.	Phy	sico-chemical parameters	35
		1.1.	Water temperature	35
		1.2.	Water transparency	37
		1.3.	Electrical conductivity (EC)	38
		1.4.	Hydrogen ions concentration (pH)	40
		1.5.	Dissolved oxygen (DO)	41
		1.6.	Biological oxygen demand (BOD)	43
		1.7.	Chemical oxygen demand (COD)	44
		1.8.	Bicarbonate alkalinity (HCO3 ⁻)	46
		1.9.	Carbonate alkalinity (CO3)	47
	2.	Hea	vy metals	49
		2.1.	Heavy metals in water	49
			2.1.1. Iron (Fe)	49
			2.1.2. Manganese (Mn)	51
			2.1.3. Zinc (Zn)	52
			2.1.4. Copper (Cu)	54
			2.1.5. Cadmium (Cd)	55
		2.2.	Heavy metals in sediment	57
			2.2.1. Iron (Fe)	57
			2.2.2. Manganese (Mn)	59

2.2.3. Zinc (Zn)60	
2.2.4. Copper (Cu)	
2.2.5. Cadmium (Cd)	
3. Macrobenthic invertebrates	
3.1. Composition and abundance 65	
3.2. Spatial and seasonal distribution 68	
3.3. Annelida	
3.3.1. Spatial and seasonal distribution	
3.3.2. Species composition	
3.3.3. <i>Limnodrilus</i> spp 75	
3.4. Mollusca	
3.4.1. Spatial and seasonal distribution 77	
3.4.2. Species composition	
3.4.3. Melanoides tuberculata	
3.5. Arthropoda	
3.5.1. Spatial and seasonal distribution	
3.5.2. Species composition	
3.5.3. Chironomus sp. larvae	
5. Statistical Analysis 87	
5. Discussion 100	
7. Summary 120	
8. Conclusion And Recommendations 127	

9.	References	29)
10	المستخلص	٠. ١	
11.	الملخص العربي	۲	

Acknowledgement

First and foremost, praises and thanks to Allah, Al-Kareem, for his showers of blessings throughout my research work to complete this dissertation successfully.

I would like to express my deep gratitude for Prof. Dr. Abd El-Halim A. Saad, Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University, for his keen interest and devoted work to produce this thesis as clear as possible.

I would like to express my respectful thanks to Prof. Dr. Waheed M. Emam, Professor of Aquatic Ecology, Zoology Department, Faculty of Science, Ain Shams University, for his fruitful notes and stimulating generous support during the whole time of thesis writing.

I am greatly indebted to Dr. Hesham R. Abdel Mola, Assistant Prof. of Aquatic Invertebrates, National Institute of Oceanography and Fisheries, for his great effort with me during sampling, statistical analysis and continuous help whenever needed.

I would like to thank my family, especially my beloved father, whose love and help had motivated me to achievements beyond my own expectations as well as my friends who encouraged me during this work.

List of Figures

No.	Figure	Page
1	Map showing the location of the selected stations on the River Nile in Greater Cairo.	23
2	General views of the selected stations during the study.	24
3	Ekman dredge bottom sampler.	26
4	Multi-probe portable meter (Model CRISON-Spain).	27
5	Secchi disc.	27
6	Seasonal variations of water temperature (°C) at the investigated stations during the period from May 2013 to February 2014.	36
7	Seasonal variations of water transparency (cm) at the investigated stations during the period from May 2013 to February 2014.	38
8	Seasonal variations of electrical conductivity (µmhohs/cm) at the investigated stations during the period from May 2013 to February 2014.	39
9	Seasonal variations of hydrogen ion concentration (pH) at the investigated stations during the period from May 2013 to February 2014.	41
10	Seasonal variations of dissolved oxygen (DO) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	42

11	Seasonal variations of biological oxygen demand (mg/l) at the investigated stations during the period from May 2013 to February 2014.	44
12	Seasonal variations of chemical oxygen demands (COD) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	45
13	Seasonal variations of bicarbonates (HCO ₃ ⁻) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	47
14	Seasonal variations of carbonate alkalinity (CO ₃ ⁻) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	48
15	Seasonal variations of Fe in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	50
16	Seasonal variations of Mn in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	52
17	Seasonal variations of Zn concentration in water (μ g/l) at the investigated stations during the period from May 2013 to February 2014.	53
18	Seasonal variations of Cu concentration in water (μ g/l) at the investigated stations during the period from May 2013 to February 2014.	55
19	Seasonal variations of Cd concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	56

20	Seasonal variations of Fe concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	58
21	Seasonal variations of Mn concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	60
22	Seasonal variations of Zn concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	61
23	Seasonal variations of Cu concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	63
24	Seasonal variations of Cd concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	64
25	Community structure of macrobenthic invertebrates at the investigated stations during the period from May 2013 to February 2014.	67
26	Spatial distribution of macrobenthic invertebrates at the investigated stations during the period from May 2013 to February 2014.	70
27	Seasonal distribution of macrobenthic invertebrates (org./m²) at the investigated stations during the period from May 2013 to February 2014.	71

28	Spatial and Seasonal distribution of macrobenthic invertebrates (org./m²) at the investigated stations during the period from May 2013 to February 2014.	71
29	Spatial and Seasonal distribution of Annelida (org./m²) at the investigated stations during the period from May 2013 to February 2014.	73
30	Average density (org./m²) of Annelida species at the investigated stations during the period from May 2013 to February 2014.	75
31	Spatial and seasonal distribution of <i>Limnodrilus</i> spp. at the investigated stations during the period from May 2013 to February 2014.	76
32	Spatial and seasonal distribution of Mollusca (org./m²) at the investigated stations during the period from May 2013 to February 2014.	78
33	Average density (org./m²) of Mollusca species at the investigated stations during the period from May 2013 to February 2014.	81
34	Spatial and seasonal distribution of <i>Melanoides tuberculata</i> (org./m²) at the investigated stations during the period from May 2013 to February 2014.	82
35	Spatial and seasonal distribution of Arthropoda (org./m²) at the investigated stations during the period from May 2013 to February 2014.	84
36	Average density (org./m ²) of Arthropoda species at the investigated stations during the period from May 2013 to February 2014.	85

37	Seasonal variations of <i>Chironomus</i> Sp. larvae (org./m²) at the investigated stations during the period from May 2013 to February 2014.	86
38	Principle component analysis (PCA) for physico-chemical parameters and macrobenthic invertebrates during the present study.	88
39	Principal component analysis (PCA) for heavy metals in water parameters and macrobenthic invertebrates.	91
40	Principal component analysis (PCA) for heavy metals in sediments parameters and macrobenthic invertebrates.	94
41	Dendrogram produced by Cluster analysis (Bray-Curtis similarity index) showing the similarity among the studied stations in the different seasons according to macrobenthic community structure.	99

List of Tables

No.	Table	Page
1	Latitudes, longitudes and average depths for the investigated Stations.	22
2	Seasonal variations of water temperature (°C) at the investigated stations during the period from May 2013 to February 2014.	36
3	Seasonal variations of water transparency (cm) at the investigated stations during the period from May 2013 to February 2014.	37
4	Seasonal variations of electrical conductivity (µmhohs/cm) at the investigated stations during the period from May 2013 to February 2014.	39
5	Seasonal variations of hydrogen ion concentration (pH) at the investigated stations during the period from May 2013 to February 2014.	40
6	Seasonal variations of dissolved oxygen (DO) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	42
7	Seasonal variations of biological oxygen demand (mg/l) at the investigated stations. during the period from May 2013 to February 2014.	43
8	Seasonal variations of chemical oxygen demands (COD) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	45

9	Seasonal variations of bicarbonates (HCO3 ⁻) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	46
10	Seasonal variations of carbonate alkalinity (CO3 ⁻) (mg/l) at the investigated stations during the period from May 2013 to February 2014.	48
11	Seasonal variations of Fe concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	50
12	Seasonal variations of Mn concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	51
13	Seasonal variations of Zn concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	53
14	Seasonal variations of Cu concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	54
15	Seasonal variations of Cd concentration in water (µg/l) at the investigated stations during the period from May 2013 to February 2014.	56
16	Seasonal variations of Fe concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	58
17	Seasonal variations of Mn concentration in sediments ($\mu g/g$) at the investigated stations during the period from May 2013 to February 2014.	59