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Aquatic Oligochaeta (Annalida:Clitellata) as Bio Indication for Sediment Quality Assessment in Tigris River Within Baghdad City /Iraq

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Abstract:

Aquatic Oligochaeta is an important group of Macroinvertebrates that has been very remarkable as bioindicators for assessing water pollution and determining its degree in water bodies. Hence, the idea of the current study aims at studying the impact of Baghdad effluents on the Tigris River by using oligochaetes community as bioindicators . For this purpose, four sites along the inside of Baghdad has been chosen. Site S1 has been located upstream, site S2 and S3 has been at midstream and site S4 at the downstream of the River.This investigation has used different types of biological indicators, including the percentage of oligochaeta within benthic invertebrates, which ranged from 49.2-51.28%. The highest percentage of the tubificid worms in the benthic samples has been 26.95% and recorded at S4, while the lowest percentage has been 14.45% recorded at S1. Pollution index D ranged between 0.34 and 0.52. The highest value of the ratio of oligochaeta to Chironomidae larvae has been 3.5 recorded at S4, while the lowest value has been 2.6 reported at S1. The percentage of L. *hoffmeisteri* within the oligochaetes community has been from 35-56%. The highest value of biological quality index I_o has been 9.89 recorded at S1, and the lowest value has been (5.57) recorded in S4. A Composite index of Biological quality (Eo) index recorded as C_5 in S1 and C_4,D_3 and E_3 in the other sites. Oligochaeta index of sediment bioindication (IOBS) values ranged between 2.55 at S1 and 1.15 at S4. The tubicid index of sediment TUSP reported at d the highest value (52.57%) at S4 where as the lowest value has been 28.68% at S1. The highest species richness value has been 7.35 recorded at S1 and the lowest value has been 6.12 at S3. Shannon- Weiner diversity index (H) ranged from 0.06-0.049 Bit/ind. Species uniformity index (E) has been 0.018-0.016.It is clear from the results that most of the biological indices indicate that the Tigris River sediment has been slightly impacted by anthropogenic activity during its passage through the Capital Baghdad. S1 is considered as a reference site, as it has presented the first point of entry of the Tigris River to Baghdad and then the sediment gradually has become polluted to reach its highest degree in the last site S4 after passing through several slightly polluted sites.

Keywords: Aquatic Oligochaeta , Sediment quality, Tigris River.

Introduction:

Bio-indicators are defined as biological processes, species, or communities that are used to assess the quality of the environment and how it changes over time. Changes in the environment are often attributed to anthropogenic disturbances, which form the primary focus of bioindicator researches such as pollution (1). The living community exposed to pollution reflects a comprehensive and integrated picture of impacts for the present and future environment, making it a useful tool as an indicator of pollution (2).

There are many different types of organisms that can be used as bio indicators to assess water quality such as diatoms (3), aquatic vegetation (4), benthic invertebrates (5 , 6). Benthic macroinvertebrates are useful and convenient indicators of ecological health of water bodies and terrestrial ecosystems. They are almost always present, and are easy to sample and to be identified. They are important indicators of river health and some species have bioindicative potential (7). Within benthic macroinvertebrates, the aquatic oligochaeta have been received much attention as good bioindicators. Many environmental metrics for pollution assessment are based on aquatic oligochaetes community results that were

summarized by (8). In Iraq, most of the researchers concentrated on the study of biodiversity and distribution of aquatic oligochaetes community within the benthic fauna (9- 16), so the aim of the current study is to use the aquatic oligochaetes as bio- indicators to detect any anthropogenic impact on Tigris River passing across the Capital, Baghdad .

Material And Methods

Sediment samples were collected monthly during the period from February 2017 to February 2018 by sediment sampler (Grab samplers). Four sites along Tigris River within the city of Baghdad have been selected to conduct the present study, S1 has been located upstream near Al-Muthana Bridge (33°25'42.7"-44°20'42.3), S2 near Al-Sarafiya Bridge (33° 21'13.6"N-44°22'22.4"E); S3 near Al-Shuhada'a Bridge (33°20'17.1"N-44° 23'16.7"E). The two latter sites represent the midstream, while the last site S4 (33° 17'1.9"N - 44 ° 26'51.8"E) downstream, at Al-Dora district (Fig. 1). Each sample has been placed separately in a plastic container, with a little amount of river water, and then transferred to the laboratory. In the laboratory the sediment samples have been sieved by 0.5 mm sieve. Large worms can easily be sorted out from the residue by spreading the sediment on a white tray; with the help of a magnification hand lens. The sorting worms have been preserved in 70% alcohol. For identification, permanent slides have been prepared, examined under compound microscope and identified to species level according to (17, 18). After identification, the result has been arranged as groups, and different indices including community indices, pollution indices , and ecological indices have been calculated as follows:

1- The percentage of aquatic oligochaeta in the benthic community as: (Olig%) < 60% Good water quality; 60-80 % Doubtful ; ≥80 % highly polluted (either organic or industrial) (19).

2- The rate of Oligochaetes worms to Chironomid larvae.(20)

3- Percentage of *L. hoffmeisteri* to the total tubificid worms.

4- **Pollution index D**: relation of individuals number of tubificid worms to total oligochetes community. values ≥ 0.30 have been considered as good ; 0.30-0.55 slightly polluted; 0.56-0.80 polluted and ; 0.81-1 heavily polluted. (21)

5- **Index of biological quality I_0** based on the equation proposed by (22) $I_0=10ST^{-1}$ S= Total number of species found in the sediment. T = Relative abundance of Tubificids without hair setae

6- **Composite index of Biological quality E_0,**

The letters representing the code of relative abundance of tubificid worms without hair chaetae arranged as:

A ≥ 91% ; B = 71-90%; C = 46-70% ; D = 36-45% ; E=35-16; and F ≤ 15 Subindex is a code of oligochaete species richness, (22).

7- Oligochaeta index of sediment bioindication (IOBS) expressed by the equation: **$IOBS=10ST^{-1}$ ---------- (23)**

S = total number of oligochaete species,

T = percentage of dominant tubificid group (either with or without hair chaetae) to the total oligochaete worms.

8- **TUSP index** = Percentage of tubificid worms without hair setae in total number of Oligochaeta (23).

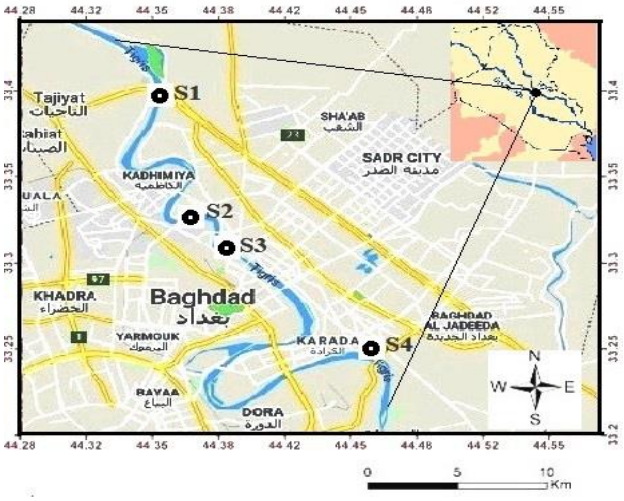

Figure 1. Map of study sites on Tigris River within Baghdad city.

Results and discussion:

According to the data gathered in Table 1, tubificid worms without hair chaetae have been predominant at all sites and represented by *Limnodrilus spp* especially *L. hoffmisteri,* which are well-known to be polluted tolerant species in large river sediment (8). The tubificids with hair chaetae have been represented by rare species, including, *Tubifex tubifex, Psammorhyctides barbarta* , and *Branchiura sowerbyi.*

Table 1. Data used to assess the sediment pollution in in Tigris River within Baghdad city using Aquatic Oligochaeta as bio-indicators

The calculated Data	Study sites			
	S1	S2	S3	S4
Individual number of oligochaetes worms	1841	2059	1854	2041
Individual number of tubificid worms with hair chaetae	132	32	48	12
Individual number of tubificid worms without hair chaetae	516	675	760	1055
Total individual number of tubificid worms (with & without hair chaetae)	648	707	808	1067
Relative abundance of tubificid / total oligochaetes	35.19	34.34	43.58	52.27
Number of oligochaetes species	9	7	6	6
Total number of Chironomidae	705	628	672	582
Total number of benthic invertebrates	3753	4120	3615	3980
Number of Macroinvertebrates species	14	15	14	15

Table 2 present values of biological indices calculated, using aquatic oligochaete worms as bioindicators for pollution.S1 is considered as a reference site. The percentage of Oligochaeta to the total benthic invertebrates ranges from 49.2-51.28. The highest percentage of tubificid to total benthic invertebrates has been recorded at S4 (26.95%), while the lowest percentage has been recorded at S1 (17.26%). The percentage of Oligochaeta to Chironomidae larvae ranges between 2.6 recorded at S1 and 3.5 recorded at S4. Both groups are considered as pollution tolerant, but for gross polluted sediment the oligochaetes will be the most abundant group (13). Pollution index (D) ranges between 0.29-0.53. This result indicates that Tigris River is slightly polluted according to the scale arranged by (21). The highest I_o index value is 9.89 recorded at S1, and gradually declined downstream to reach its lowest value of 5.57 at S4. This index depends upon the presence of tubificid worms without hair chaetae in relation to the total benthic species, since they are more tolerant to oxygen deficit produced by different types of pollutants such as organic pollution(22). IOBS use relative abundance of tubificid worms both with or without chaetae to the total oligocheates worms, reached its highest value (2.55) at S1 , then decreased gradually to reach a value of (1.15) at S4. This index depends on the relative abundance of tubificid worms (with or without hair chaetae) to the number of oligochaetes species. TUSP index shows its highest value (52.57 %) at S4 where as the lowest value has been (28.68%) represented at S1. Eo index, represents by C_5 in the reference site S1 , and by the letter C_4 for S2 ,D_3 for S3 and E_3 for S4. The results indicate that the fine sediment at S2, S3 and S4 are slightly polluted, and are close to the result recorded by (22) in rivers of east of France. The highest species richness valueis 7.35 recorded at S1 and the lowest value is 6.12 at S3. Shannon- weiner diversity index (H) ranges from (0.06-0.049) Bit/ind. Species uniformity index (E) is (0.018-0.016).

Table 2. Biological indices using aquatic oligochaeta to assess the sediment pollution in Tigris River within Baghdad city

Biological indices	Study sites			
	S1	S2	S3	S4
Oligocheata / total benthic invertebrates (%)	49.2	49.97	51.28	51.28
Tubificid worms / benthic invertebrates (%)	17.26	17.16	21.05	26.95
Oligochetes / Chironomid larvae	2.61	3.27	2.76	3.50
Pollution index D	0.36	0.34	0.44	0.52
Index of biological quality I_0	9.89	8.96	6.66	5.57
Oligochaeta index of sediment bioindication (IOBS)	2.55	2.04	1.38	1.15
Percentage of Tubificid worms without hair setae in total number of Oligochaeta TUSP	28.68	33.5	40.99	52.57
Composite index of Biological quality E_0	C_5	C_4	D_3	E_3
Species richness	7.355	6.94	6.12	6.95
Shannon-weiner diversity index(H)(Bit/Ind)	0.06	0.052	0.049	0.053
Species uniformity index (E)	0.018	0.016	0.016	0.017

Conclusion:

Most of the biological indices indicate that the sediments of Tigris River is slightly affected during its passage through Baghdad, and the impact of pollution has increased downstream. S1 has been considered as a reference site, and represent the first point of entry of Tigris River to Baghdad and then the sediment has gradually been impacted by different types of effluents.

Authors' declaration:

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine ours. Besides, the Figures and images, which are not mine ours, have been given the permission for re-publication attached with the manuscript.
- The author has signed an animal welfare statement.
- Ethical Clearance: The project was approved by the local ethical committee in University of Baghdad.

References:

1. Parmar TK, Rawatani D,Agrawal YK. Bioindicators: the natural indicator of environmental pollution. FRONT LIFE SCI:.2016;9 (2):110-118.
2. Asif N , Malik MF, Chaudhry GN. A review of on environmental pollution bioindicators. Pollut. 2018;4 (1):111-118.
3. Lavoie I, Morin S, Laderriere V, Fortin C .Freshwater diatoms as indicators of combined long –term mining and urban stressors in Junction Creek (Ontario,Canada). Environments. 2018;(5):30.
4. Azza SH, Al-Saad HT, Al-Adhub AY. Using Two Species From Common Aquatic Plants as Bio-indicators of Pollution With Hydrocarbons Compounds in Al-Kahlaa River -Missan Province/ Iraq. Int. J. Mar. Sci.. 2016; 6(3): 1-4 (doi: 10.5376/ijms.2016.06.0003)
5. Patang F,Soegianto A, Hariyanto S. benthic Macroinvertebrates diversity as bioindicator of water quality of some river in east Kalimantan,Indonesia. Hindawi. Int. J. Ecol.2018;11p. https://doi.org/10.1155/2018/5129421
6. Britoa JG, Martinsa RT, Oliveiraa VC, Hamadaa N, Nessimianc JL, Hughesd RM, et al. Biological indicators of diversity in tropical streams: Congruence in the similarity of invertebrate assemblages. Ecol. Indic. 2018; 85 :85–92
7. Arslan N, Sular A, Kalyoncu H , Marcan D, Barişik B, Odabaşi DA. The use of WBMP and ASPT indices for evaluation of water quality according to Macroinvertebrates in Küçük Mendares River. Biologia. 2016. 71(1):49-57
8. Rodriguez P, Reynoldson TB. The pollution biology of aquatic oligocheates. Springer Science and Business. Dordrecht Heidelberg London New York. 2011.ISBN 978-94-007-1718-3, 270 pp.
9. Jaweir HJ. A new records of three tubificid species (Annelida: Oligochaeta) from Al-Hawieza marsh. Iraq . Mesopot. J. Mar. Sci. 2011;26(2):114-121.
10. Jaweir HJ. Checklist of aquatic oligochaete species in Tigris-Euphrates rivers basin. Baghdad J Sci. 2014; 11(3):1397-1404
11. Ali LA, Latef BA. A study of invertebrate communities in Lesser Zab River /Kurdistan Region-Iraq. Zanco j. Pure Appl. Sci. 2017; 29(1):54-64.
12. Jaweir HJ, Alwan AM .Sludge worms species (Oligochaeta : Naididae : Tubificinae) from different aquatic habitat in Baghdad/ Iraq. Baghdad J Sci.. 2013;10(2): 269-281.
13. Jaweir HJ , Salman MD. Study of Naidid worms associated with two species of aquatic plants in River Tigris inside Baghdad City/Iraq. Baghdad Sci. J. 2014;11(3).
14. Jaweir HJ, Al-Sarai MH. The aquatic annelid community in Lake Al-Delmage / Iraq. Biologia. 2016; 71(1):1-6
15. Nashaat MR, Rahi AG, Mohaammad AA , Reassn KH . impact of Al-Rasheed Power Plant effluents on biodiversity of benthic fauna in Tigris River , southern Baghdad .Ibn-Al-Haitham J. Pure Appl. Sci.2017;30(1).
16. Jaweir HJ , Sebtie HA, Al-Mukhtar EA. Aquatic Oligochaetes of Iraq's Southern Marshes Baghdad J Sci. 2012; 9(3): 472-480.
17. Brinkhurst RO, Jamieson BGM. Aquatic Oligochaeta of the World. Univ. of Toronto Press, Canada. 1971.860pp.
18. Timm T. A guide to the freshwater Oligochaeta and Polychaeta of North and Central Europe. Lauterborina. 2009. 66:1-235.
19. Goodnight CJ, Whitley LS. Oligochaetes as indicators of pollution .Proc.Am.waste conf. Purdue. Univ,15 th . 1960.139-42.
20. Parele EA, Astapenok EB. Tubificids (Oligochaeta :Tubificidae) indicators of water body quality. Latv.PSR.Zinat.Akad.Vest. 1975; 9:44-46.
21. Slepukhina TD. Comparison of different methods of water quality evaluation by means of oligochaetes. InAquatic Oligochaeta 1984 (pp. 183-186). Springer, Dordrecht.
22. Lafont M. Oligocheate communities as a descriptors of pollution in the fine sediments of rivers. Hydrobiologia. 1984; 115:127-129.
23. Rosso A, Lafont M, Exinger E. Impact of heavy metals on benthic oligochaete communities in River III and its tributaries. Water.Sci.Techno. 1994; 29:241-248.

قليلة الاهلاب المائية (ديدان حلقية/ السرجيات) كمؤشرات احيائية لتقييم نوعية الراسب في نهر دجلة ضمن مدينة بغداد/ العراق

دلوفان كمال الجاف **هيفاء جواد جوير**

قسم علوم الحياة ،كلية العلوم للبنات ،جامعة بغداد،بغداد،العراق

الخلاصة:

تشكل الديدان قليلة الاهلاب المائية مجموعة مهمة من لافقريات القاع الكبيرة التي حظيت بأهمية بالغة كمؤشرات احيائية جيدة لتقييم التلوث وتحديد درجته في المسطحات المائية . ومن هنا جاءت فكرة الدراسة الحالية التي استهدفت دراسة تأثير مخلفات مدينة بغداد على نهر دجلة بأستخدام مجتمع قليلة الاهلاب المائية كمؤشرات احيائية. واخُتيرت لهذا الغرض اربع مواقع على طول نهر دجلة داخل مدينة بغداد ، اذ كان الموقع الاول (م1) في اعلى مجرى النهر، والموقعان الثاني والثالث (م2 وم3) في وسط مجرى النهر، اما الموقع الرابع (م4) فكان اسفل مجرى لنهر. استخدمت في الدراسة الحالية العديد من الادلة الاحيائية ،فتراوحت النسبة المئوية لافراد قليلة الاهلاب المائية ضمن اللافقريات مابين 49.2-51.28% ، اما النسبة المئوية لافراد Tubificidaeضمن لافقريات القاع فسجلت اعلى نسبة لها في الموقع (م4) و بلغت 26.95% واقل نسبة في (م1) كانت 14.45% ، وتراوحت قيم دليل التلوث D بين 0.34-0.52 ، بينما كانت اعلى نسبة افراد قليلة الاهلاب المائية الى يرقات ثنائية الاجنحة في (م4) اذ بلغت 3.5 واقل نسبة لها 2.6 في (م1) ، وتراوحت النسبة المئوية لافراد النوع *L.hoffmisteri* بين 35-56%، اما دليل الجودة الاحيائي I_o فسجل اعلى قيمة 9.89 في (م1) واوطأ قيمة 5.57 في (م4)،في حين سجل الدليل المركب للجودة الاحيائية (E_o) قيمة C_5 في (م1)بينما سجل قيمة C_4 وD_3 و E_3 في المواقع الثلاثة الاخرى، اما قيم دليل التلوث للراسب IOBS فتراوحت بين 2.55 في (م1) و 1.15 في (م4) وسجلت النسبة المئوية لافراد تحت العائلة Tubificinae عديمة الاهلاب الشعرية ضمن قليلة الاهلاب المائية (TUSP) اعلى قيمة لها (52.57%) في (م4) واقل قيمة (28.68 %) في (م1) . بلغت اعلى قيمة لمؤشر غزارة الانواع 7.35 في (م1) واقل قيمة 6.12 في (م3)، و سجل مؤشر شانون وينر قيم متقاربة في مواقع الدراسة فتراوحت بين 0.06 و 0.049 بت/فرد ، اما قيم مؤشر تجانس ظهور الانواع فتراوحت بين 0.016 و 0.018. وبالاستناد الى المؤشرات اعلاه ،يتأثر نهر دجلة بالفعاليات البشرية اثناء مروره بمدينة بغداد ويُعد ملوثاً تلوثاً خفيف ، اذ اعتبر الموقع (م1) اقل المواقع تلوثاً كونه اول نقطة لدخول نهر دجلة لمدينة بغداد وبعدها بدأ التلوث بالازدياد التدريجي وصولاً الى الموقع الاخير (م4).

الكلمات المفتاحية: ديدان قليلة الاهلاب المائية، نوعية الراسب، نهر دجلة .