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 I₀ 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 C₅ in S1 and C₄D₃ and E₃ 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
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. hoffmisteri* 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 I₀ based on the equation proposed by (22) I₀=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 E₀.

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)

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

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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*, *Psammorhynctides 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 |
|----------------------------------------------------------|-------------|
| Individual number of oligochaetes worms                  | S1          |
| Individual number of tubificid worms with hair chaetae   | S2          |
| Individual number of tubificid worms without hair chaetae| S3          |
| Total individual number of tubificid worms (with & without hair chaetae) | S4          |
| Relative abundance of tubificid / total oligochaetes     |             |
| Number of oligochaetes species                           |             |
| Tubificid worms / benthic invertebrates (%),             |             |
| Total number of Chironomidae                             |             |
| Total number of benthic invertebrates                     |             |
| Number of Macroinvertebrates species                     |             |

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 IOBS 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 oligochaetes 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 C3 in the reference site S1, and by the letter C4 for S2, D4 for S3 and E4 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 value is 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 |
|---------------------------------------------------------|-------------|
| Oligochaeta / total benthic invertebrates (%)            | S1          |
| Tubificid worms / benthic invertebrates (%)              | S2          |
| Oligochutes / Chironomidae larvae                        | S3          |
| Pollution index D                                       | S4          |
| Index of biological quality I0                          |             |
| Oligochaeta index of sediment bioindication (IOBS)       |             |
| Percentage of Tubificid worms without hair setae in total number of Oligochaeta TUSP |             |
| Composite index of Biological quality E₀                | C₃          |
| Species richness                                        | 7.355       |
| Shannon-weiner diversity index(H)(Bit/Ind)              | 0.06        |
| Species uniformity index (E)                            | 0.018       |

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 republication 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.

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

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الخلاصة:
تشكل الديدان قليلة الاهلاب المائية مجموعة مهمة من لائقريات القاع الكبيرة التي حظيت بأهمية بالغة كمؤشرات إحيائية جيدة لتقييم التلوث وتحديد درجه في المستنقعات المائية. ومن هنا جاءت فكرة الدراسة الحالية التي استهدفت دراسة تأثير مخلفات مدينة بغداد على نهر دجلة باستخدام مجتمع قليلة الاهلاب المائية كمؤشرات إحيائية. وأخترعت لهذا الغرض اربع مواقع على طول نهر دجلة داخل مدينة بغداد، اذ كان الموقع الأول (م1) في أعلى مجرى النهر، والموقعان الثاني والثالث (م2 وم3) في وسط مجرى النهر، أما الموقع الرابع (م4) فكان أسفل مجرى نهر. استخدمت في الدراسة الاحيائية العديد من الادلة الاحيائية، فتراوحت النسبة المئوية لافراد قليلة الاهلاب المائية بين 49.2-51.28 %، اما النسبة المئوية لافراد Tubificidae في تراوحت بين 26.95-49.2 %، اما النسبة المئوية لافراد نوع L.hoffmisteri فتراوحت بين 28.68-52.57 %، اما النسبة المئوية لافراد نوع Tubificinae فقد تراوحت بين 20.5-65.4 %.

الموقع (م4) اقل مخلفة تلوثاً حسب نسبة الافراد، واول مخلفة تلوثاً في (م1) حيث تراوحت نسبة الافراد بين 14.45-50.34 %، وتراوحت نسبة دليل التلوث بين 0.34-0.52، وتراوحت نسبة دليل جودة الاحيائي IOBS بين 1.15-2.55، وتراوحت نسبة دليلجودة الاحيائي I o في (م1) حيث سجلت اعلى نسبة لها 9.89 %، أما في المواقع الثلاثة الاخرى، فتراوحت نسبة I o بين 5.57-9.89، وتراوحت نسبة دليل الشانون وينر بين 0.06-0.099، ولابد من الدراسات مستقبلة للتعرف على النتائج النحوية وتحديد النسب المئوية للنوع السريع في مدينة بغداد أثناء مروره باللدكية، وتحديد نوعية الراسب في نهر دجلة.

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