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Sediment Assessment of Al-Hindya and Al-Abbasyia River / Iraq by aquatic oligochaeta community as bioindicators

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Abstract:

Bioindicators have an important role in assessing the quality of water bodies. Aquatic oligochaetes, was used as a bioindicator to assess the sediment quality of Al-Hindya and AL-Abbasyia river (branches of Euphrates River in Iraq). Two sites in each river have been chosen for this purpose, site S1 was located at Al-Hindya River and S2 at Al-Abbasyia River. Some kinds of biological indices were used in this study, comprising the percentage of oligochaetes in benthic invertebrates, ranged from 20.3-60.16%. While the percentage of Tubificidae within benthic invertebrates was close 43.3-43.9%. Index of pollution D ranged from 0.13-0.21. The maximum percentage of aquatic oligochaetes to insects larvae of family Chironomidae larvae was recorded at S2 90% while at S1 60%. I_0 was scored high value at S1 36.06 whilst only 30.56 at S2. E_0 was A_8 at S1 and A_9 at S2. while IOBS was 15.26 at S2 and 7.07 at S1. The percentage of subfamily Tubificidae (TUSP) showed the highest value 21.21% at S1 while 11.79% at S2.

Keywords: Aquatic oligochaetes, Benthic invertebrates, Bioindicators, Sediment quality.

Introduction:

Bioindicators are qualitative situation of the environment; they are responsible for different types of pollutants gradually. They play a key role in monitoring changes in the environments and can discover the effects of incidental as well as cumulative pollution and habitat shifts ¹.

Many organisms such as plants, planktons, fishes are used as bioindicators ². The benthic macro invertebrates like Oligochaeta are most commonly used to evaluate the water health, they are subclass of class Clitellate, phylum Annelida, predominantly aquatic and terrestrial, used as an indicator for water and sediment quality ³. About 1700 rightful species of Oligochaetes are recognized to date; of these nearly 1,100 are freshwater. The most group is the Tubificidae, with more than 1000 described species including 582 being considered as freshwater inhabitants, Tubificid worms which belong to Naididae family were the most group of aquatic oligochaetes used as bioindicator to assess water quality ⁴.

In Iraq, many studies refer to Oligochaeta in Euphrates River such as ⁵⁻⁸, and in Tigris River⁹⁻¹². The present study adds a new scope on the

relevance between the aquatic oligochaetes and quality of sediment in both of Al-Hindya, at Al-Kifil region and AL-Abbasyia rivers, both of these two rivers are branches of Euphrates River in Iraq run through agricultural places.

Material and Methods:

Sediment samples were collected monthly during the period from March to August 2020 by sediment sampler as three replicates for each site as in (Fig.1) by using an Ekman grab 15X15cm with a total area of 225 cm² just 1 m from river edge. The samples were collected in suitable size plastic containers filled with river water. Site one (S1) located at Al-Hindya River, (32°13'26.15"N , 44°21'46.40"E) which is a main branch of Euphrates River after Al-Hindya dam. It passes through Karbala and Babil Provinces to wide spaces of farm lands and palm trees orchards in Al-Kifil region at the south of Iraq / Babil province and (S2) at Al-Abbasyia River (32°07'11.09"N, 44°23'43.07"E), other branches of Euphrates River, about five kilometer after AL-Kifil city. It passes through Babil and Al-Najaf provinces to wide

spaces of farmlands, and there is a barrage on it known as AL-Abbasyia barrage which was constructed in 1984. By using 0.5 mm sieve, the sediment samples have been checked in lab that by circulate on the white plate, and big worms can easily be sorted from the remains, using enlargement hand lens, divided into groups¹³. Different indices as in¹⁴⁻¹⁸ comprise community indices, pollution indices and the following ecological indices have been calculated.

a. In benthic community, percentage of aquatic Oligochaetes worm as: (Olig. %) < 60% Good water quality; 60-80 % Dubitable; ≥ 80 % hardly polluted, whether organic or industrial.

b. Oligochaetes worms to Chironomid larvae ratio.

c. *L. hoffmeisteri* accounts for the percentage of the entire tubificid worms.

d. Pollution index D: relevance number of tubificid worms to entire oligochaetes community values ≥ 0.30 considered good; 0.30-0.55 a little polluted; 0.56-0.80 polluted and ; 0.81-1 hardly polluted.

e. Biological quality Index I_0 setup on proposed equation: $I_0=10ST^{-1}$, S= The total number of benthic invertebrates species found in the sediment. T = tubificids relative abundance that have no hair setae

f. Comprehensive index of Biological quality E_0 , The relative abundance code of tubificid worms that have no hair setae indicate by the letters arranged below ,as: A ≥ 91% , B = 71-90% , C = 46-70% , D = 36-45% , E=35-16, and F ≤ 15 Subindex is a symbol of species richness of the oligochaete.

g. Oligochaeta index of sediment bioindication (IOBS) indicate by the equation: $IOBS=10ST^{-1}$.

S = Oligochaete total species number. T = Dominant tubificid Percentage that cohort (with or without hair chaetae) to the total oligochaete worms.

h. TUSP index = tubificid worms percentage have no hair setae in total Oligochaeta.

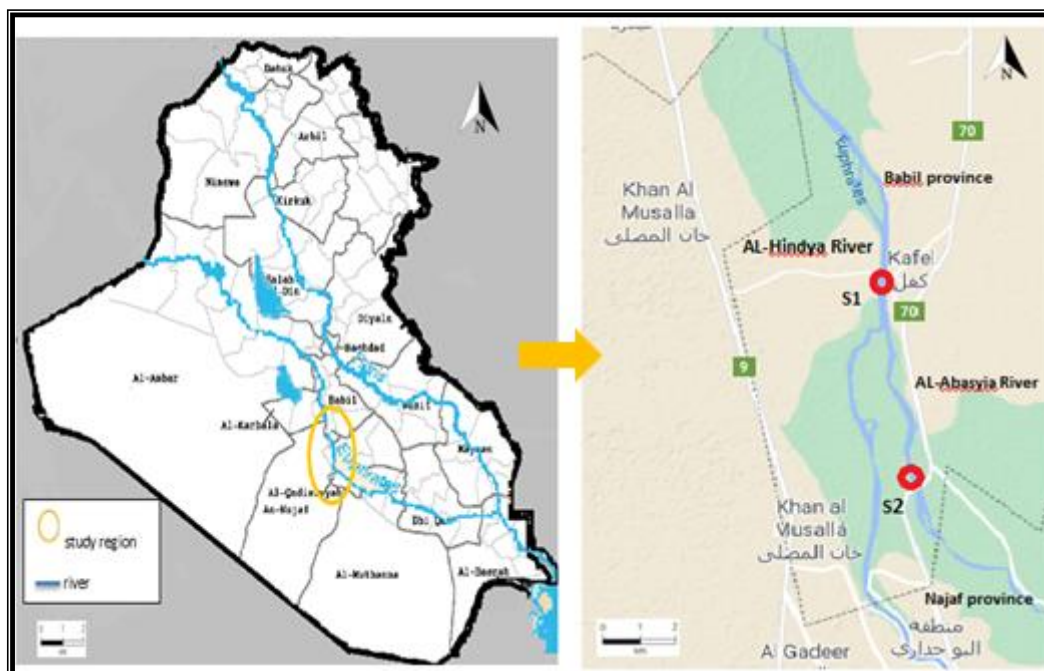


Figure 1. Study sites map of on Euphrates River in Babil Province.

Result and Discussion:

Depending to the information illustrated in (Table 1), the dominance was to the tubificid worms that have no hair setae at the both study sites, which are known as pollution tolerant organisms¹⁹, where tubificid worms with hair chaetae occurred in rare number.

The data used to calculate some of biological indices are represented in (Table 2). To overall benthic invertebratesm, the oligochaeta

percentage was extending from (60.16-20.3) % if (Olig.%) < 60% Good water quality; 60-80 % Dubitable; ≥80 % hardly polluted, whether organic or industrial that mean. The percentage of tubificid worms to total benthic invertebrates were almost close in study sites (43.3-43.9) % .the percentage of oligochaetes to Chironomidae larvae stretched between 60% in (S1) and 90% in (S2). Both groups are considered as pollution tolerant^{20, 21}. Pollution index (D) was extend between (0.21-0.13) and that

indicate the Euphrates river is good according to ¹⁶, if values ≥ 0.30 considered good; 0.30-0.55 a little polluted; 0.56-0.80 polluted and; 0.81-1 hardly polluted. I_0 index value was (36.06) recorded in (S1), and reduce gradually as proceed downstream to reach its lowest value of (30.56) recorded in (S2). This point depends upon the turnout of hairless tubificid worms associated with total benthic species, because they are more resistant to oxygen nude created by various types of pollutants such as organic pollution ^{17, 22}. The highest value was showed shown at (S2) 15.26 and the lowest value at (S1) 7.07 according to IOBS which represented the tubificid worms relative abundance jointly with or without chaetae to total oligocheates worms. TUSP index reached the highest percentage at (S1) 21.21% and the lowest at (S2) 11.79%. E_0 index, represents by A_8 and A_9 for (S1) and (S2) respectively.

Table 1. Data used to calculate the biological indices

Data	Study sites	
	S1	S2
oligocheates number	811	1035
Number of tubificid worms with hair chaetae	1	15
Number of tubificid worms without hair chaetae	172	122
Total tubificid worms number (with & without hair chaetae)	173	137
Relative abundance of tubificid/total oligocheates	21.33	13.23
Number of oligocheates species	15	18
Total number of chironomidae	1348	1143
Total number of benthic invertebrates	3993	3120
Number of Macroinvertebrates species	36	44

Table 2 . Use aquatic oligocheata to evaluate the sediment pollution biological indices

Biological indices	Study sites	
	S1	S2
Oligocheata/total benthic invertebrates (%)	60.16	20.3
Tubificid worm /benthic invertebrates(%)	43.3	43.9
Oligocheates/chironomid larvae (%)	60	90
Pollution index D	0.21	0.13
Index of biological quality I_0	36.06	30.56
Oligocheata index of sediment bioindication IOBS	7.07	15.26
Tubificid worms percentage that have no hair setae in total oligocheata TUSP	21.21	11.79
Composite index of biological quality E_0	A_8	A_9

Conclusion:

Further biological indices indicate that the sediment of Euphrates River at the study sites (S1, S2) is slightly polluted and may be that pollution is related with the activities of humans and presence of some animals such as buffalo and ducks that were seen in those sites, pollution reduction can occur by increasing the water supply from the Hindyia dam towards the Abbasyia River in some months, where pollutants are pushed or diluted and the opposite can happen with a lower water levels.

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.
- Ethical Clearance: The project was approved by the local ethical committee in University of Baghdad.

Authors' contributions statement:

N.I.A. conceived of the presented idea and the data of the oligochaeta worms by collection of the samples from the rivers while D.K.A. was analyzed the data by using the indexes, the authors discussed the results and contributed to the final manuscript.

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تقييم نوعية الراسب في نهري الهندية والعباسية/العراق باستخدام مجتمع قليلة الالهلاب المائية كمؤشرات حيوية

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الخلاصة:

حظيت المؤشرات الاحيائية باهمية كبيرة في تقييم التلوث في المسطحات المائية. وقد استخدمت في هذه الدراسة ديدان قليلة الالهلاب المائية كمؤشر احياي لتقييم نوعية راسب نهري الهندية والعباسية/ نهر الفرات في محافظة بابل في العراق. اذ اختيرت لهذا الغرض موقعين احدهما S1 يقع على نهر الهندية و موقع S2 على نهر العباسية. في الدراسة الحالية استخدمت العديد من الادلة الاحيائية، وتراوحت النسبة المئوية لافراد قليلة الالهلاب المائية ضمن اللافقرات ما بين (20.3-60.16) %، اما النسبة المئوية لافراد Tubificidae ضمن لافقرات القاع فكانت متقاربة في موقعي الدراسة (43.3-43.9) %، وتراوحت قيم دليل التلوث D ما بين (0.13-0.21)، بينما كانت اعلى نسبة افراد قليلة الالهلاب المائية الى يرقات ثنائية الاجنحة في (م2) والتي بلغت 90% واقل نسبة لها في (م1) 60%، اما دليل الجودة الاحيائي I₀ فسجل اعلى قيمة 36.06 في (م1) بينما في (م2) كانت 30.56، في حين سجل الدليل المركب للجودة الاحيائية (E₀) في (م1) قيمة A₈ وفي (م2) قيمة A₉، اما قيم دليل التلوث للراسب IOBS فكانت قيمته في (م2) 15.26 وفي (م1) 7.07. وسجلت النسبة المئوية لافراد تحت العائلة Tubificinae عديمة الالهلاب الشعرية ضمن قليلة الالهلاب المائية (TUSP) اعلى قيمة لها 21.21% في (م1) بينما في (م2) 11.79%.

الكلمات المفتاحية: ديدان قليلة الالهلاب مائية، لافقرات القاع، ادلة حيوية، نوعية الراسب