

Original Article

Ecological study of microscopic protozoa in Abbasiya Canal, Iraq

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Abstract: Microscopic protozoa are water-based organisms. They pose significant concerns for human health, as serious diseases have been linked globally. This study aimed to identify and document the microscopic protozoa taxa of the Abbaseya watercourse and record some abiotic factors of their habitats and the watercourse's pollution level. Three sites along the Abbaseya watercourse were selected for collecting microscopic protozoa using a net with 55 µm mesh openings. The abiotic factors assessed included total dissolved solids (TDS), electrical conductivity (EC), water flow, turbidity, pH, chloride ion concentration, and magnesium ion concentration. In total, 23 protozoan species of the classes Ciliata and Sarcodina were recorded. The diversity indices used were Jaccard's similarity index and the Shannon-Weiner index. The highest Jaccard's similarity index value, 0.79, was observed between April and May. The protozoan taxa identified in the Abbaseya watercourse are classified primarily into two classes: Ciliata and Sarcodina, with Ciliata having significantly higher taxa. A thorough assessment of protozoan species is vital for evaluating water quality, as it offers valuable insights into the ecological health of aquatic environments.

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Introduction

Water is essential for all sustainable development goals, supporting economic growth, fostering healthy ecosystems, and being vital for the life cycle. Therefore, it is important to study their abiotic factors and the organisms in their watercourses. Protozoa are a diverse group of unicellular eukaryotic organisms that are mostly microscopic. While most are invisible to the naked eye, some larger species, such as *Spirostomum* and *Stentor*, can be seen without magnification. These microscopic protozoa are ecologically significant and sensitive to environmental changes. They can be parasitic or free-living (Panno, 2014). Certain waterborne protozoa pose risks to human health and are among the main sources of infections worldwide each year (Ma et al., 2022; Fradette et al., 2022).

Protozoa are classified based on several criteria: cell structure, host, and motility. They serve a critical function in the biotic system through nutrient cycling, serving as initial consumers in the microbial trophic

structure (Fenchel, 1987). They enhance the distribution of algal and bacterial production to higher trophic levels and permit the enhancement of microbial proliferation. Most independently living protozoan taxa thrive in similar natural environments across diverse geographic regions (Lee and Patterson, 1999; Fenchel and Finlay, 2004). No surveys have been conducted on protozoa in the Abbaseya Watercourse, Al-Najaf Province, Iraq; however, a few studies have been conducted in other geographical zones of Iraq. Kadhim (2022) identified 23 taxa, including five new records from the Tigris Watercourse in Baghdad, and Al-Samarrai et al. (2022) investigated parasitic protozoa in drinking water from 10 locations in Samarra, finding that 80% of the samples were infected with *Entameba histolytica*, *Giardia lamblia*, and *Cryptosporidium parvum*. Therefore, the main goal of the study is to identify protozoan taxa and analyze water indicators and abiotic factors to assess the level of watercourse pollution.

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Table 1. Protozoan species identified in the Abbaseya waterbodies at sampling sites (+ = Present, and – Absent).

Class	Taxa	Site1	Site2	Site3
Ciliata	<i>Cinetochilum margaritaceum</i>	+	-	+
	<i>Colpoda campyla</i>	+	-	-
	<i>Ctedoctema acanthocrypta</i>	-	+	+
	<i>Eschaneustyla brachytona</i>	+	-	+
	<i>Euplotes charen</i>	-	+	-
	<i>Halteria grandinella</i>	+	-	-
	<i>Hastatella radians</i>	+	-	+
	<i>Holosticha vernalis</i>	-	+	+
	<i>Homostyla elliptica</i>	+	-	+
	<i>Loxophyllum rostratum</i>	-	+	+
	<i>Metopus sigmoides</i>	+	-	-
	<i>Ophryoglena atra</i>	-	+	-
	<i>Paramecium caudatum</i>	+	-	+
	<i>Scyphidia fromentellii</i>	-	+	+
	<i>Spirostomum ambiguum</i>	+	+	+
	<i>Stylonychia notophora</i>	+	-	+
	<i>Trichoda pura</i>	+	-	+
	<i>Urocentrum sp.</i>	+	-	+
<i>Vorticella campanula</i>	-	+	+	
Sarcodina	<i>Amoeba limax</i>	-	+	+
	<i>Amoeba sp.</i>	+	+	+
	<i>Hyalosphenia sp.</i>	-	+	-
	<i>Pelomyxa palustris</i>	+	+	-

Materials and Methods

Sampling: Three sites along the Abbaseya Watercourse were selected for sampling. The first site is located near the Wahhabi Watercourse. The second site is approximately 1.5 km downstream from the first site, and the third site is about 2 km downstream from the second site. Monthly samples were collected from each site from March to October 2019 using polyethylene containers for both biological and abiotic analyses.

Measurement of water quality parameters: Total dissolved solids and electrical conductivity were directly measured using a multi-parameter instrument. The pH was measured with a pH meter, and the water flow was measured with a flow meter. Chloride and magnesium ion concentrations were determined following the guidelines of A.P.H.A. (2012). Water turbidity was measured using a turbidity meter.

Identification of protozoa and indices: Protozoans were collected by filtering 55 liters of water through a 55 µm mesh net. The identification of protozoa was done following the methods described by Edmondson (1959), Smith (2001), Ruppert et al. (2003), and Thorp and Covich (2010). The Jaccard index and Shannon-Weiner diversity index, as described by Stilling

(1999), were employed to calculate similarity and diversity indices.

Results and Discussions

Figure 1 shows the abiotic features. TDS, a measure of the water-soluble components, varied between 409-756 mg/L in October and August, respectively. Bicarbonate, chloride, calcium, sulfate, and magnesium concentrations together contribute to changes in TDS values. There is a robust relationship between TDS and conductivity (Shareef et al., 2009). Conductivity readings ranged from 800 to 1983 µS/cm, with the increase in conductivity attributed to the rise in total dissolved solids (A.P.H.A., 2012).

pH levels remained within a narrow, mostly alkaline range due to the chemical buffering capacity of Iraqi waters, which generally contain moderate amounts of calcium bicarbonate. The higher pH observed at site two may be linked to increased photosynthetic activity by hydrophytes (Salman, 2006; Fahd and Abdalwahad, 2022; Alsaadoon et al., 2023). Changes in water flow significantly affect biota (Smith, 2004), with flow rates ranging from 6 to 18 cm/min, influenced by precipitation, bulkheads, and environmental variability (Morgan et al., 1993;

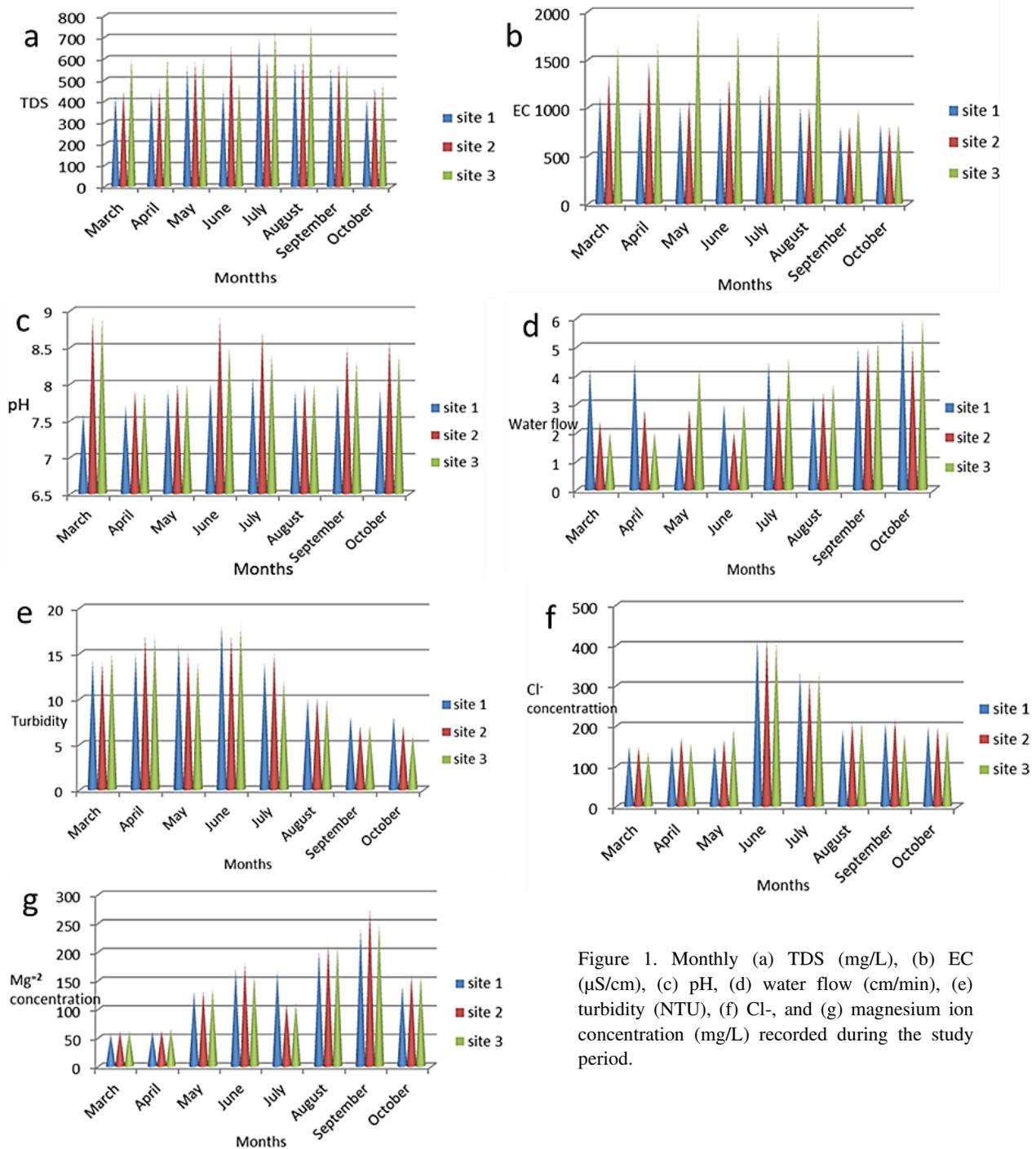


Figure 1. Monthly (a) TDS (mg/L), (b) EC ($\mu\text{S}/\text{cm}$), (c) pH, (d) water flow (cm/min), (e) turbidity (NTU), (f) Cl^- , and (g) magnesium ion concentration (mg/L) recorded during the study period.

Alsaadoon et al., 2023).

Turbidity ranged from 2 to 6 NTU, due to the presence of organic or inorganic materials, similar to previous results (Al-Ameen, 2013). Chloride ion concentrations varied from 120 to 418 mg/L at Site 3 and Site 1, respectively. Although chloride anions are naturally present in both freshwater and saltwater, elevated levels may indicate contamination, often caused by production residues, sewage, or saltwater intrusion (Bertram and Balance, 1996). Magnesium

ion concentrations ranged from 56 to 250 mg/L, affected by water level reductions and excessive evaporation or consumption by aquatic organisms (Al-Essa, 2004).

Several protozoan taxa were identified during the study period, with a total of 23 taxa (Table 1). These were classified into two groups: Sarcodina (4 taxa) and Ciliata (19 taxa). The higher number of taxa in the Ciliata class aligns with previous studies (Saad et al., 2012; Kadhim and Mahmood, 2014). *Amoeba* sp. and

Table 2. Jaccard's similarity index values measured across months during the study period.

	April	May	June	July	August	September	October
March	0.66	0.73	0.75	0.42	0.56	0.77	0.6
April		0.79	0.58	0.37	0.5	0.57	0.55
May			0.57	0.58	0.52	0.55	0.53
June				0.6	0.55	0.62	0.54
July					0.44	0.56	0.52
August						0.58	0.7
September							0.68

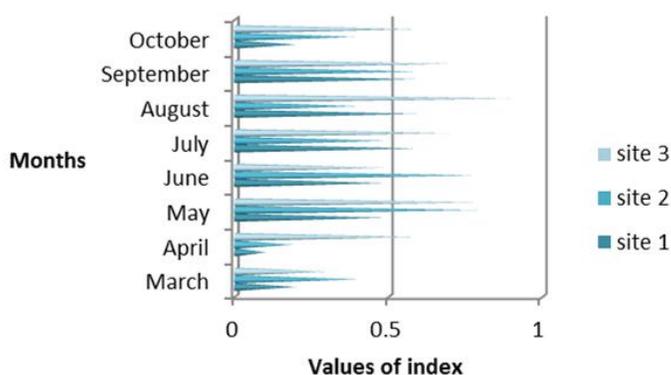


Figure 2. The value of Shannon-Weiner index among the months during the study period.

Spirostomum ambiguum were present at three sites. The reduced number of taxa could result from changes in the biotic-abiotic system, the defined study area, and the mesh size of the net used. Wilkinson and Mitchell (2010) pointed out that the number of individuals and taxa, whether land-based or water-based, can be influenced by the organic matter content.

Table 2 shows the similarity index for species observed across months, with the lowest similarity between August and May at 0.37%, and the highest similarity between April and June, reaching 83%. The similarity index relates to abiotic or biotic attributes, including microorganisms or minerals. Diversity indices, such as the Shannon-Weiner index, are used to assess the impact of environmental variations on invertebrate communities. The species diversity metrics in the Shannon-Weiner index varied between 0.1 and 0.9 bit/ind (Fig. 2), with the minimum value observed at Site 1 in April and the maximum at Site 3 in August. The variation in diversity between Sites 1 and 3 may be associated with contamination levels or

the availability of trophic sources such as plankton. As stated by Goel (2008), a Shannon-Weiner index reading > 3 bit/ind indicates an uncontaminated setting with high biodiversity, while a reading < 1 suggests polluted water and a decrease in some taxa.

Conclusion

This study identified the protozoa taxa present in the Abbasiyah Watercourse into two categories: Ciliates and Sarcodina. The higher diversity in Ciliates indicates notable ecological fluctuation, possibly due to the different environmental conditions within the watercourse. The results highlight the importance of a comprehensive systemic analysis of protozoan species for assessing water quality, as these organisms serve as valuable indicators of the ecological and health status of the aquatic system.

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