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Ecological Study of Some Macroinvertebrates in the Intertidal Sediments of Khor Al Zubair, Basra City, Iraq

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ABSTRACT

This study aimed to investigate the species composition and relative abundance of aquatic macroinvertebrates **(**mollusks, crustaceans, and annelids**)** in the intertidal zone of the Khor Al-Zubair area. Sampling was conducted from January to May 2024 at three stations along Khor Al-Zubair to determine the dominant species and distribution patterns. Physical and chemical parameters—including water temperature, pH, dissolved oxygen, and salinity—were measured. Results indicated that all parameters were within normal ranges, except for salinity, which reached a notably high level of 62 ppt. Many macroinvertebrate species were absent from the dataset, and the overall diversity appeared low, likely due to the negative impact of elevated salinity on species richness. Based on species that contributed significantly to the ecological structure, four main types of macroinvertebrates were identified. Dominant taxa included the crab *Scylla serrata*, the annelid *Namalycastis annandalei*, the oyster *Crassostrea cucullata*, and the barnacle *Balanus amphitrite*.

INTROUCTION

The Arabian Gulf, an open region with numerous ships, ports, and oil wells, has undergone significant environmental changes due to oil pollution and resource depletion, becoming one of the world's most important conduits for the transport of oil pollutants **(Asadi, 1996)**. This anthropogenic impact has caused ecological disturbances that have adversely affected the diversity of sediment biota **(Montana *et al.*, 2023)**. Macroinvertebrates possess distinct characteristics that set them apart from other invertebrates; some species exhibit a high tolerance to pollution, while others are more sensitive **(Merritt *et al.*, 2008)**. Sediment-dwelling organisms are also influenced by abiotic factors such as temperature **(Haimi *et al.*, 2005)**, sediment moisture **(Tan *et al.*, 2021)**. Among these factors are the sediment texture and structure **(Michael, 1993)** in addition to pH **(Carey, 2004)**. In this context, the availability of micro- and macronutrients **(Hotta *et al.*, 1986; Callaham Jr. *et al.*, 2003)** is to be considered. Their distribution in marine environments also

depends on land type, channel morphology, and flood velocity **(Callisto *et al.*, 2005)**. The intertidal zone is a coastal area defined by its alternating exposure—submerged during high tides and exposed during low tides **(Paul, 2024)**. These exposed sediments, although not permeable to light, are often rich in phytoplankton and diatoms **(Beltrame *et al.*, 2009; Cook *et al.*, 2014)**, making them a favorable habitat for various organisms, including birds and invertebrates. Some of these species have developed adaptations that allow them to tolerate wide fluctuations in salinity, enabling them to reproduce and thrive in this harsh and dynamic environment **(Akuma, 2008; Sundaramanickam *et al.*, 2008)**.

MATERIALS AND METHODS

Study area

The study was conducted in the area of Khor Al-Zubair, southwest of Basra. Khor Al Zubair overlooks the Arabian Gulf and is the main waterway for the ports of Umm KSR and Khor Al Zubair **(Khalid *et al.*, 2017)**. Khor Al-Zubair is characterized by its tidal flats along the northwestern coast of the Arabian Gulf **(Muhammad Ali,1988)**. These tidal flats are subject to daily fluctuations in salinity due to the influence of marine and freshwater sources **(Michel *et al.*, 1986; Ismail *et al.*, 2007)**. The fresh water comes from the Shatt al-Arab River in the southeast, while a mixture of fresh and brackish water comes from the Shatt Al-Arab canal in the northwest **(Ismail *et al.*, 2007)**. Khor Al-Zubair, including its port, is not only a significant ecological site but also an important commercial hub. The study was conducted at three stations along the Khor Al-Zubair waterway: Station 1 (30°19′21.0″ N; 47°49′05.2″ E), Station 2 (30°14′51.6″ N; 47°51′46.8″ E), and Station 3 (30°13′27.3″ N; 47°51′46.4″ E), as shown in Picture (2).

Picture 1. Map of Khor Al-Zubair showing the sampling stations (1-3)

The three selected stations were located on mudflats, where various invertebrates are visible during low tide. These sites featured substrates that supported attached invertebrate species, as well as the presence of metal pipes, wood, stones, and even a sunken ship from the Gulf War (Picture 2).

Picture 2. The image showing some invertebrates attached to a sunken ship in Khor Al-Zubair

After identifying and counting the various invertebrates from the collected data, the following ecological metrics were calculated: Density (D), relative density (RD), and species similarity (Sj), using the formulas outlined below:

$$RD = \frac{\boldsymbol{DOGenuseI}}{\boldsymbol{Total\ Do\ fallgenrta}} \times 100$$

$$D = (Number\ of\ individual\ GenusN)/(Areas\ sampledA$$

J=C/**(**A+B-C**)** ×100 **(Jaccard, 1908; Southwood, 1978)**

A=Number of species shared between the two communities

B= Number of species in the first community **(**excluding shared species**)**

C=Number of species in the species community **(**excluding shared species**)**

RESULTS AND DISCUSSION

The water quality parameters of Khor Al-Zubair

The water quality parameters of Khor Al-Zubair were analyzed to evaluate the physical and chemical properties of the estuaries' environment. The water temperature in Khor Al-Zubair showed considerable variation during the sampling period: 13 and 32°C (Fig. 1). The highest temperatures were recorded in summer, which may affect the metabolic activity of aquatic organisms **(Clarke & Fraser, 2004)**. The highest salinity was measured in summer at 62ppt at station 2 (Fig. 2). The pH value was between 7.9 and 8.3 (Fig. 3). A pH in the neutral to slightly alkaline range generally supports the health of most aquatic species, although deviations beyond this range can negatively affect sensitive taxa **(Wetzel, 2001)**. Dissolved oxygen concentrations ranged between 3.5 and 10mg/ L (Fig. 4). The lowest DO values were found in areas with stagnant water and high organic matter content, probably due to oxygen consumption by decomposition processes. The relatively low oxygen concentrations in some regions could stress aquatic species and jeopardize their survival and reproductive success **(Masese, 2009)**.

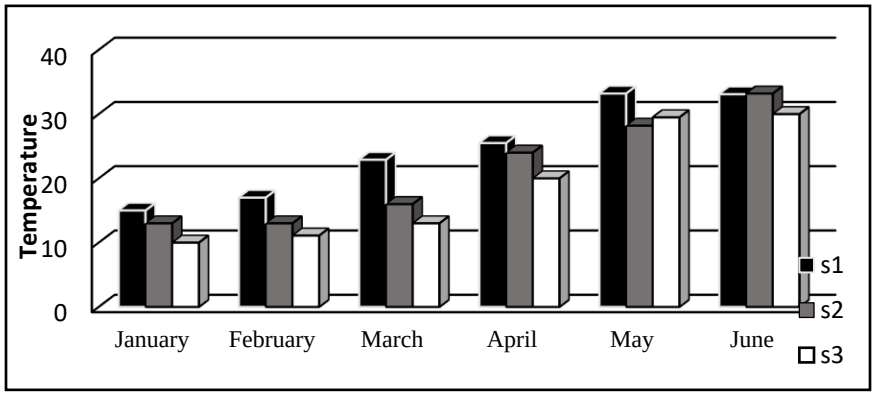

Fig. 1. Monthly variations of water temperature at the study stations

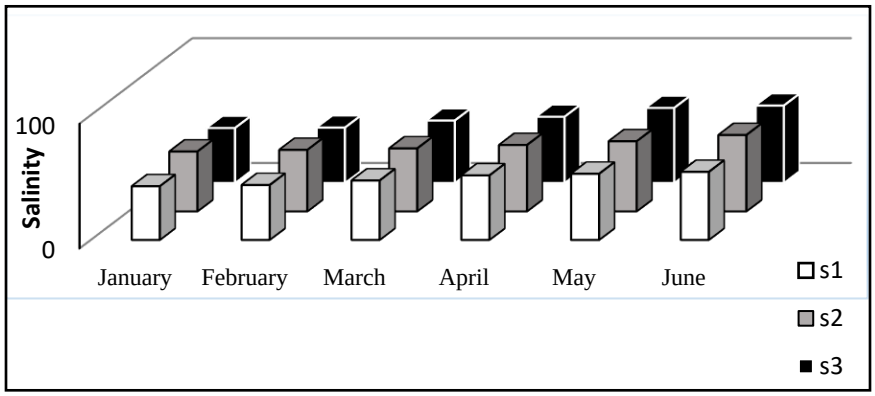

Fig. 2. Monthly variations of water Salinity at the study stations

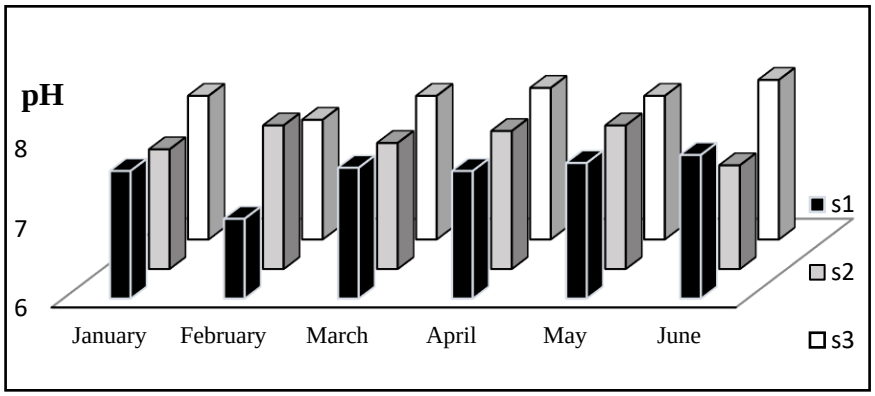

Fig. 3. Monthly variations of water pH at the study stations

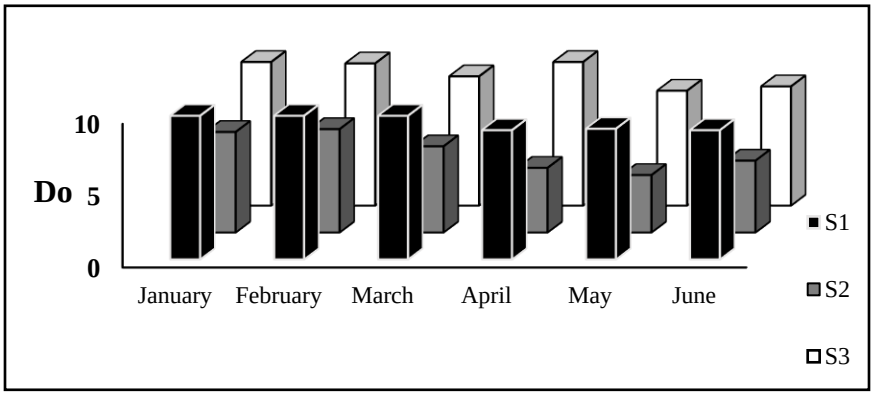

Fig. 4. Monthly variations of dissolved oxygen **(**DO**)** mg\L at study stations

The diversity of macroinvertebrates

Four species of benthic macroinvertebrates were recorded: crab species *Scylla serrata*, the annelid *Namalycastis annandalei*, the oyster *Crassostrea cucullata*, and the barnacle *balanuse amphitrite*. Aquatic invertebrates play an important role in the transfer of energy flow in marine ecosystems, and the study of benthic communities is a suitable criterion for assessing the ecological status of these ecosystems **(Mieszkowska *et al*., 2014)**. Numerous studies have shown that human activities such as rural, industrial and agricultural waste introduce large amounts of pollutants into the aquatic environment, which affect the diversity and abundance of macroinvertebrates **(Hutchings, 1998)**.

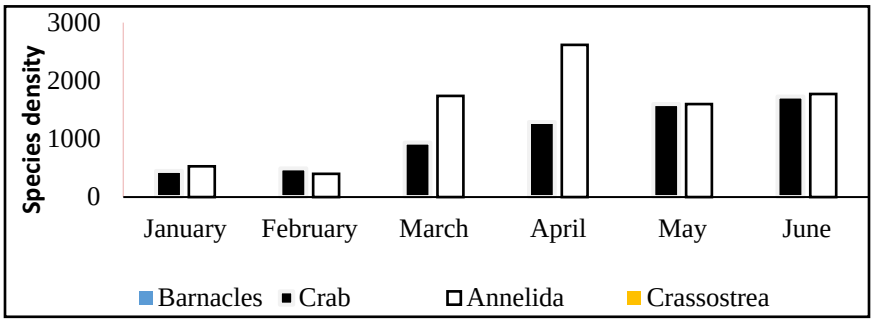

Fig. 5. Species density **(**individuals/m²**)** at Station 1 under study

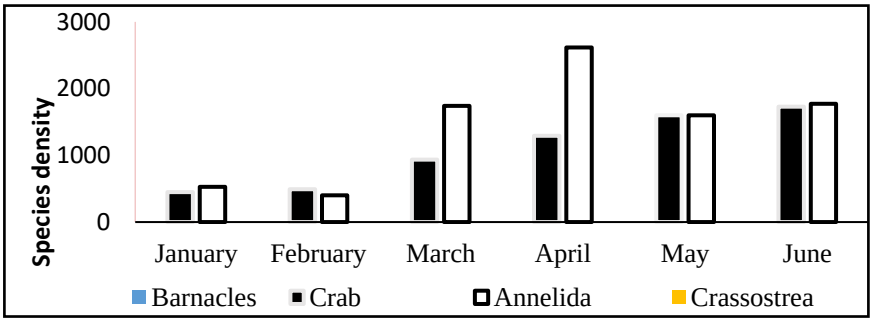

Fig. 6. Species density **(**individuals/m²**)** at Station 2 under study

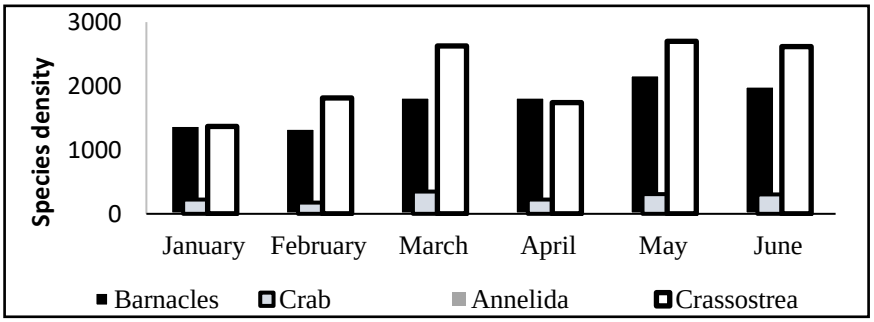

Fig. 7. Species density **(**individuals/m²**)** at Station 3 under study

In this study, barnacles and crabs were the most abundant organisms, with the highest density recorded at Station 1 (1824 individuals/m²) (Fig. 5) and a relative density of about 50% (Fig. 10). Meanwhile, barnacles (2268 individuals/m²) were recorded at Station 1 with a relative density of 50% (Fig. 8). The main factors contributing to the increased abundance of these species at Station 1 are agricultural and municipal effluents and mangrove vegetation. Annelids are a common species in most water bodies and are one of the resilient communities in disturbed water bodies. The most abundant species at Station 3 was Annelid (57% relative density) (Fig. 10), which is probably due to the shallow waters at this station. Station 3 had a type of macroinvertebrate that was not found at Station 1 and Station 2. The predominant species was *Crassostrea* with a relative density of 52% (Fig. 9) due to the presence of iron pipes and a wrecked ship to which it was attached.

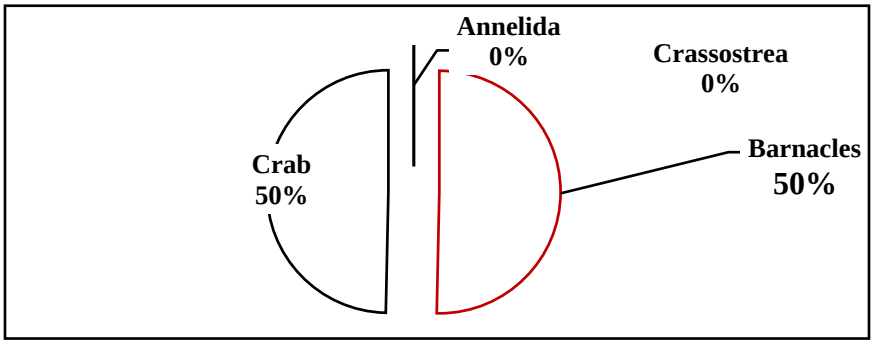

Fig. 8. Relative density of S1

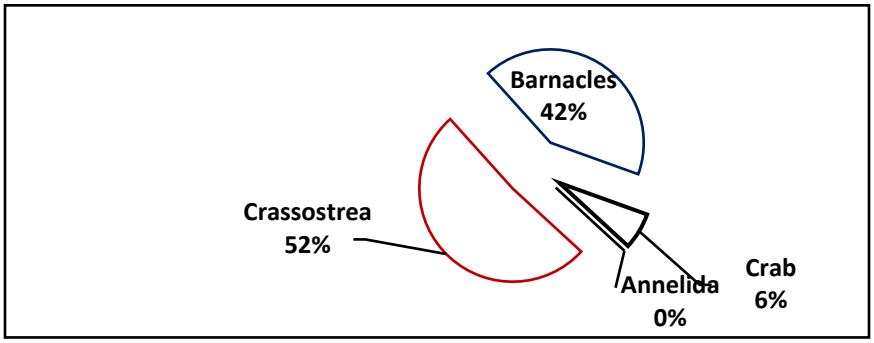

Fig. 9. Relative density of S2

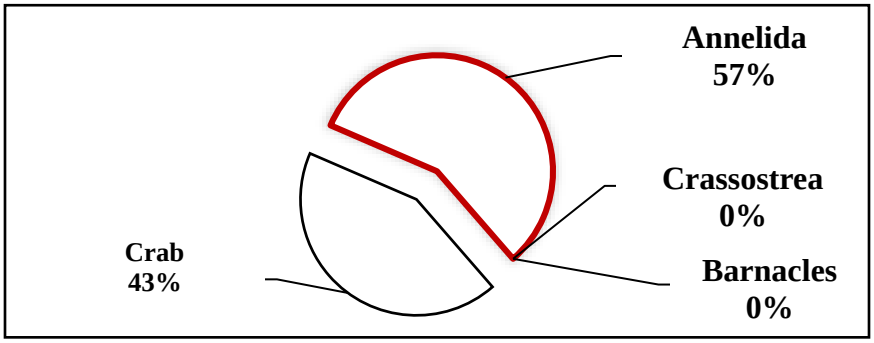

Fig. 10. Relative density of S3

Jaccard similarity illustrates the similarity between stations based on species composition and measure changes in community composition in aquatic habitats **(Abandon, 2013)**. Jaccard similarity used to determine the similarity between the study stations based on the occurrence of species throughout the study period (Table 1) clearly shows that the strongest similarity relationship was found between Station 3 and Station 1 with 69.4%, followed by a high similarity between Station 1 and Station 2, which reached 49.8%. There was also a similarity between station 2 and 3, which reached 43.5%. This similarity is due to the significant similarities in the physical, chemical and hydrological properties of khor Al-Zubair **(Adam *et al.*, 2014)**.

Table 1. Jaccard similarity matrix for benthic invertebrate communities between the study stations in Khor Al-Zubair

Station	2	3
1	49.8	69.4
2		43.5

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