Additional Records of Freshwater Shrimp (Malacostraca: Crustacea) from Greater Zab River and Their Banks, Iraq

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ABSTRACT

Physicochemical and biological samples in two artificial sand mine ponds and Greater Zab River were collected during July to December 2015, in order to evaluate water quality of these studied ecosystems and their effect on existing of two freshwater shrimps, *Mysis relicta* which was recorded and described as a new record for Iraqi fauna while *Macrobrachium nipponense* was recorded in southern part of Iraq before more than decades but it regarded as new record in the northern part of Iraq (Kurdistan region). Results showed that pH values were in alkaline side of neutrality, EC in pond 1 was higher than other two sites, dissolved oxygen did not fall under 5 mg.l⁻¹ and BOD₅ values were high and not suitable for drinking purpose. Sources of nutrient in the studied sites comes from runoff and domestic discharge. *Mysis relicta* characterized by living in cooled, well aerated ecosystem, but in the present study we found it in ponds with water temperature over 20 °C and oxygen content less than 9.5 mg.l⁻¹.

1. INTRODUCTION

Sand mining led to degradation of the river banks, bed and buffer zone as a results for production of sand and gravel a precious resource in the construction industry [Pereira & Ratnyaka, 2013; Ashraf *et al.*, 2011; Magna *et al.*, 2013]. Produced pits or ponds from mining activities are very valuable freshwater ecosystems, with special physical, ecological and geochemical characteristics [Soni *et al.*, 2014], which supporting many unique and rare species, and it play essential role of sustaining high regional biodiversity [Miguel-Chinchilla *et al.*, 2014; Soomets *et al.*, 2016]. Malacostraca contains almost three-quarters of all known species of crustacean among them shrimp, their body distinctly segmented with a fixed number of segments, it divided into head (six segments), thorax (eight segments) and abdomen (six or seven segments) with a telson constituting a post segmented region. *Mysis relicta* Lovén, 1862 is a member of Mysidaceae that regarded as a true freshwater species, it is feeds on detritus and benthic invertebrates in profundal zone during the day and feeds on zooplankton and phytoplankton during night in pelagic zone [Gledhill *et al.*, 1993; Lasenby and Langford, 1973]. On the other hand, *Macrobrachium nipponense* (De Haan, 1849) is a native oriental river prawn, it is presence range comprises of China, Japan, Korea, Vietnam, Myanmar, Taiwan, Singapore and most recently in southern Iraq and in Iran [Cai and Dai, 1999; Cai and Ng, 2002; Salman *et al.*, 2006; Grave and Ghane, 2006].
2. MATERIALS AND METHODS

2.1. Description of the study area.

Khabat subdistrict located on the Greater Zab River, with distance about 37 km on west of Erbil city. In addition to their activity in agriculture, tourism and fishing, the area characterized by production of raw construction material from huge numbers of artificial open sand mine ponds on shore along both sides of Greater Zab River. In the present study, two artificial sand mine ponds was selected approximately (100-150 meter) apart from the main course of Greater Zab River near Kundik village, in addition to one site on Greater Zab River near Khabat subdistrict (Figure 1). Studied ponds was chosen at the end of excavation phase, when these ponds became hydrologically mature, its depth differ greatly from pond to other but as a mean it ranged from 6 to 12 meter. Water source of these ponds either fed mainly by groundwater from river (because it haven’t directly inlet or outlet connection to the river) or in wet months from rainfall.

2.2. Sample collection and analysis

Water samples for physico-chemical and biological analysis was collected from studied ponds and Greater Zab River at regular monthly intervals from July to December 2015. Laboratory analyses were carried out for chemical analysis by using Standard procedures as described by [APHA, 2012]. Water temperature was measured by using mercury thermometer, pH and electrical conductivity (EC) by using (pH-EC meter, HI 9812, Hanna Instrument) in the field. Dissolved oxygen and biochemical oxygen demand (BOD₅) by using Winkler azide method, nitrate content with using UV-spectrophotometer, ammonium using indophenols’ blue method, and reactive phosphate using phosphomolybdate-ascorbic acid reduction procedure. While for shrimp collection plankton net (of 55 μm mesh size) was used and samples were fixed in 5% formalin in the field and preserved with 70% ethanol in the laboratory.

Fig. 1: Maps Shows A: Northern part of Iraq, B: Studied area and C: Sampling artificial sand mine ponds and Greater Zab River (From Google earth).
3. RESULTS AND DISCUSSION

Water quality variables of artificial sand mines ponds and Greater Zab River during studied period were summarized in Table (1). Water temperature was ranged from 20- 22°C in pond 1 and 22- 24°C in pond 2, while it was 21.5- 23°C in Greater Zab river. [Akindele et al., 2013] demonstrated that the changes in water temperature may be due to variation in weather condition, seasonality, nature of area and time of sampling. Same results were observed by many researchers in different area [Shekha, 2016; Mohammed Amin and Shekha, 2016]. pH value was tend to be in the alkaline side of neutrality, with mean value ranged from 7.1 to 7.7 in sand mine ponds, but it was higher in Greater Zab River with maximum pH value 7.85, it may be attributed to catchment area and dominated of carbonate ions. This come in accordance with result of [Ali, 2010] and lower than that obtained by [Shekha, 2009]. Conductivity value of pond 1 is higher than pond 2, which ranged from 465 to 480 µS.cm⁻¹. The nature of pond 1 differ from pond 2 due to containing of more nutrients and organic matter as shown in (table 1). Generally, higher concentration of nutrients were observed in pond 1 compared to pond 2 with maximum value 1.91 mg NO₃-N.l⁻¹ and 11.1 µg NH₄-N.l⁻¹ for NO₃ and NH₄ respectively. Most of these nutrients comes from agricultural activities and fertilizers in the area [Dodds and Whiles, 2010]. [Jun et al., 2012] reported that NH₄ concentration in aquatic ecosystem depend on quantity of oxygen, pH decomposition of organic matter and water temperature. Low ammonium concentration in Greater Zab River may be related to good aeration lead to oxidize it to nitrate. [Welch et al., 2004] stated that nitrification process depend on oxygen availability.

Phosphate concentration was ranged from 3.2 to 7.8 µg.l⁻¹ in the studied ponds, meanwhile, it was highest in Greater Zab River with 20- 135 µg PO₄-P.l⁻¹. The sources of phosphate content comes from domestic sewage enriched with detergent, fertilizers and erosion of soil [Lampert and Sommer, 2007]. This was lower than found by [Shekha et al., 2017; Shekha and Al- Abaychi, 2013] and higher than that observed by [Mohammed Amin and Shekha, 2016]. Dissolved oxygen concentration in pond 1 fall below 5 mg.l⁻¹ which coincided by high BOD₅ content (5- 5.5 mg.l⁻¹), while pond 2 characterized by higher oxygen content 6- 6.3 mg.l⁻¹, with less BOD₅ values (2- 4.1 mg.l⁻¹). [O’ Sullivan and Reynolds, 2004] noted that dissolved oxygen is consumed as a result of activity of organisms and decomposition of organic matter.

In this study, two species of shrimp were recorded in studied areas, *Mysis relicta* which was collected in two artificial sand mine ponds, and *Macrobrachium nipponense* was collected from Greater Zab River. The full descriptions and details of both recorded species are as follow:

**Descriptions of Mysis relicta Loven, 1862**

Male length 11-17mm, female length 17-23mm. Eyes; large stalked, pear shaped with ocular papilla, cornea wider than stalk about 0.4 of whole eye. Antenna; antennal scale elongated and setose all over, apex rounded, with a small terminal suture, antennal peduncle about 0.5 the length of antennal scale, longer and more robust in the males. Mandibles; first segment of mandibular palp is minute without setae, second segment about 4 times as long as broad, distal segment about 4-5 times as long as broad, on the lower margin there are a row of thick serrated setae distally and several simple setae proximally. Maxilla; distal segment of endopod expanded with a row of terminal strong setae. Maxillipede 1; a small lamellar naked epipod on the coxa, and three expanded lobes on the endopod covered densely with different types of setae.
Table 1: Some water quality characteristics for sand mine ponds and Greater Zab River, data represented as minimum and maximum values.

<table>
<thead>
<tr>
<th>Water variables</th>
<th>Sand mine pond 1</th>
<th>Sand mine pond 2</th>
<th>Greater Zab River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>20-22</td>
<td>22-24</td>
<td>21.5-23</td>
</tr>
<tr>
<td>pH</td>
<td>7.1-7.5</td>
<td>7.5-7.7</td>
<td>7.3-7.85</td>
</tr>
<tr>
<td>EC (μS.cm⁻¹)</td>
<td>465-480</td>
<td>425-433</td>
<td>230-410</td>
</tr>
<tr>
<td>DO (mg.l⁻¹)</td>
<td>4.30-4.50</td>
<td>6.00-6.30</td>
<td>5.8-7.3</td>
</tr>
<tr>
<td>BOD₅ (mg.l⁻¹)</td>
<td>5.00-5.50</td>
<td>2.00-4.10</td>
<td>1.7-2.5</td>
</tr>
<tr>
<td>PO₄ (µg PO₄-P.l⁻¹)</td>
<td>6.50-7.80</td>
<td>3.20-4.70</td>
<td>20-135</td>
</tr>
<tr>
<td>NO₃ (mg NO₃-N.l⁻¹)</td>
<td>1.82-1.91</td>
<td>2.20-2.31</td>
<td>1.5-5.9</td>
</tr>
<tr>
<td>(µg NH₄-N.l⁻¹)</td>
<td>10.3-11.1</td>
<td>6.2-7.03</td>
<td>5.9-7.5</td>
</tr>
</tbody>
</table>

Maxillipede 2; expanding up to labrum, ischium about 2 times as long as broad with many long setae on the medial margin, merus about 3 times as long as broad with short setae on the medial margin and many short and long setae distally on the lateral margin, dactylus about 2 times as long as broad with thick serrated setae on the distal third of the segment, no nail is present.

Carapace; produced anteriorly into a rostral plat with blunting angle end between the eyes stalks, carapace anterolateral angles rounded, posterior margin of carapace emarginated, leaving 0.5-1.5 of the posterior thoracic somites exposed dorsally, a traverse row of pores in a cardial position. Thoracic sternites are longer and well developed in males.

Abdomen; segments 4 and 5 sub equal in length, while segment 6 about 1.5-2 times longer than segment 5 (Fig. 2).

The male penis with 8-10 distal and many lateral setae. All female pleopods and male pleopods 1, 2 and 5 are reduced to simple unsegmented setose plates. Male pleopod 3 biramous with sub marginal row of setae on the sympod, exopod 5-6 segmented, endopod unsegmented, setose, with medially extending proximal apophysis bearing 3-5 setae. Male pleopod 4 biramous, endopod similar to that of pleopod 3, exopod elongated, extending beyond telson in mature males composed of 6 segments. Uropods; exopod about 1.4 times the length of endopod, exopod and endopod setose all around, medial margin of endopod with several spine setae. Length of telson is equal to the length of the last abdominal somite, broadest at the base and tapering distally, lateral margins armed with spine setae, distal margin with a V-shaped cleft serrated with about 30-40 laminae.

**Macrobanchium nipponense (De Haan, 1849)**

Male total length 80-97mm, carapace length 41-43 mm. Female length 62-84mm, carapace length 20-32mm. Rostrum strait, dorsal rostrum with about 11-14 teeth, ventral rostrum with 2-4 teeth (Fig. 3, 4). Broader part of rostrum at the middle (with about ¼ length), extending beyond antennal peduncle and beyond tip of scaphocerite (excluding setea). Two of dorsal rostral teeth behind orbit. Hepatic spine at a level lower than antennal spine.

In adult male the second pair of pereiopods are equal in size, long and all segments covered densely with short pubescence. Carpus longer than merus and shorter than propodus. Chela with stiff hairs on entire surface, cutting edge of finger of propodus with 1 proximal tooth, cutting edge of dactylus without tubercules.

The descriptions and measurements of two present specimens are nearly close to those reported by [Salman, 2006; Grave and Ghane, 2006; Sherman et al., 1987; Brophy and Penk, 2008].
In spite of the presence of definite number of lakes, streams and ponds in Iraq, studies of Malacostraca are very few and concentrated in middle and southern parts. However, *Macrobrachium nipponense* was recently recorded for the first time by [Salman et al., 2006] in Abu-Zirig Marsh. But there is no previous recording of this species in Kurdistan region and the present record regarded as a first occurrence of *M. nipponense* in this region.

It is worth to mention that there are no precious reports about *Mysis relicta* in Iraq. The present record represents the first one in this country. Most studies referred to that *M. relicta* favored cooled aerated ecosystem. The unfavorable physicochemical variables of water in ponds at the present study may be behind reduction of the population of *M. relicta*. [Horppila et al., 2003] suggested during their investigation on *Mysis relicta* in eutrophic Lake that without predation larger part of the mysid population would probably have survived in the narrow corridor between the layers of too low oxygen and high temperature (assuming that the tolerance limit of *M. relicta* is 3 mg.l\(^{-1}\) in dissolved oxygen and 14°C in water.
temperature. [Smith, 1970; Smith, 2001] commented that the *M. relicta* can tolerate a wide range of temperatures, but the upper limit for long exposure times is 10–14°C. The reported oxygen tolerance limits of *M. relicta* have varied between 1 and 4 mg.l\(^{-1}\) [Dadswell, 1974; Sherman et al., 1987].

**Fig. 3:** *Macrobrachium nipponense*; a. whole amount; b. rostrum (4X); c. tail fan (3X); e. pereiopod (3X).

**Fig. 4:** *Macrobrachium nipponense* male; a. lateral view; b. rostrum; c. scaphocerite; d. second pereiopod (hair removed); e. tail fan; f. telson.
4. REFERENCES


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