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## RESEARCH ARTICLE

### Zooplankton communities inhabiting inland waters of Al-madinah almonawwarah region; Saudi Arabia.

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#### Abstract

The present paper deals with a survey on common zooplankton inhabiting inland waters of Al-Madinah region; Saudi Arabia. The sites investigated included 42 sites. Twenty eight taxa, belonging to phylum Rotifera and Arthropoda were recorded. Arthropods included crustaceans (50%), insects (43%) and water mites (4%). Rotifers constituted 4% of the collected taxa.

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#### Introduction

Zooplanktons are diverse floating and drifting animals having limited power of locomotion. They play an important role in the faunal bio-diversity of aquatic ecosystems and include representatives of almost every taxon of the animal kingdom. The zooplanktons are utilized to assess energy transfer at secondary trophic level. They feed on phytoplankton and facilitate the conversion of plant material into animal tissue and in turn constitute the basic food for higher animals including fishes, particularly their larvae. Certain planktonic organisms are capable of concentrating radioisotopes and can act as indicator of certain pollutants (Goswami, 2004). To monitor the aquatic ecosystems and integrity of water, plankton has been used recently as bio indicator (Beaugrand et al., 2000 and Li and Denman, 2000).

Zooplankton distribution is affected by both abiotic (David et al., 2005 and Marques et al., 2007a, b) and biotic parameters (e.g. predation, competition) (Isari et al., 2007). Spatial distribution of these zooplankton species varies based on different physical factors (e.g. temperature, salinity, turbidity, and currents) and nutrient availability (Breitburg et al., 1997; Boesch et al., 2001; Epifanio and Garvine, 2001; Kimmel et al., 2006). The biotic interactions in freshwater ecosystem represent the most important factor determining species selection and structure of biological communities (De-Bernardi et al., 1987).

Knowledge about freshwater fauna in the Arabian Peninsula is limited (Victor and Al-Mahrouqi, 1996 and Burt, 2003). Balian et al. (2008) indicated the lack of data from the Afro tropical (e.g. Southeast Asia) about biodiversity in freshwater ecosystems. On reviewing literature carried out on the inland water fauna of Saudi Arabia, revealed that it covered only small regions of the Peninsula. For example Al-Asgah et al. (1989) investigated the perennial freshwater reservoirs and valleys in Saudi Arabia to determine zooplankton species. The survey of Krupp et al. (1990) was conducted in the central and western parts of Saudi Arabia. The work of Siddiqui and Al-Harbi (1995) included a preliminary study of the ecology of Wadi Hanifah stream with reference to animal communities. Alain (1996) studied large branchiopod (Crustacea: Anostraca, Notostraca, Spinicaudata, Laevicaudata) from temporary inland waters of the Arabian Peninsula. Obuid-Allah (2000) studied zooplankton communities inhabiting Tabuk. Fathi and Al-Kahtani (2009) studied water quality and planktonic communities in Al-Khadoud spring, Al-Hassa, Saudi Arabia. Al-Ghanim (2012) studied the distribution and composition of zooplankton in Wadi Hanifah stream Riyadh. Abd El-Wakeil and Al-Thomali (2013) studied the community

structure of aquatic macro invertebrates inhabiting Wadi Al-Arj, Taif. Montaser et al. (2014) studied community structure of zoobenthos in some freshwater bodies in Taif, Saudi Arabia. The objective of the present study to make a survey on zooplankton communities, except Protozoa, inhabiting inland water of Al-Madinah region; Saudi Arabia.

### Materials and Methods:

Random samples were collected during day time on February and March 2014 using zooplankton net with mesh size about 100  $\mu\text{m}$ . Samples were preserved in absolute ethanol in the field. Examination of samples was carried out under a binocular microscope (Model; AmScope MU series-software ver.3.5). During sampling; some physico-chemical parameters were taken using two probe electrodes. One probe measures pH/conductivity/total dissolved salts (TDS)/salinity and temperature (Model: Multi-Parameter PCSTester tm 35-series. UOM: EA BOO4G8PWBO) and the other electrode measures dissolved oxygen (Model: DO600-ExStik II). For identification of samples, different keys and references were used: Lehmkuhl (1979), Rogers (2002), Carling et al. (2004), Witty (2004) and Timms (2012). The map was prepared using remote sensing data where the achieved images data of the map was downloaded by Landsat 8 (2014) given by United States Geological Survey (USGS) (<http://earthexplorer.usgs.gov/>). Also, the environment visualizing images (ENVI) software version 5 was used for layer mosaics, stacking and image sub-sitting. Imported co-ordinates and map lay-out were prepared using ARCMAP10.1 software.

### Results:

#### Sites of collection (Fig. 1).

The sites investigated included 42 sites covering Al-Madinah region. Sites could be classified into the following types: **1-Permanent Lakes** (Sites 34 and 35): They included natural lakes formed as a result of accumulation of rains especially in winter. **2- Temporary Ponds** (Sites 1:3, 6:20, 22:26, 29:30, 32, and 36: 39): The majority of investigated sites included ponds. They are formed as a result of rains. They receive water from higher lands and Wades surrounding them. They included large and small ones. This type of ponds are mostly subjected to desiccation and become dry during summer months. **3- Springs** (Sites: 4, 5, 31 and 33): Springs investigated originate from the ground, four springs were investigated; two springs are situated at Khaybar district (Sites 4 and 5) and the other two are situated at Al-Madinah district (Sites 31 and 33). **4- Dams: (Site 42):** Dams investigated are man-made to reserve water. Only one dam was investigated at Al-Ola district. **5-Wells and reservoirs** (21, 27, 28, 40 and 41): The wells and reservoirs investigated are man-made, their water originate from the ground or rains or from both. They are used as reservoirs for irrigation; so they are found inside farms. Only one well was investigated (Site 28). This well is an old one; its age is about 1000 years. The reservoirs investigated are made from concrete taking quadrangle or rectangular shape. The physicochemical parameters were measured in the above-mentioned sites. The height above sea level ranged between 460m at site (32) and 1154m at site (42). The maximum depth at the investigated sites ranged between 0.5m at sites (17, 26, 31, 32, 36, 40, and 41) and 10m at sites (28 and 42). The temperature of air ranged between 19°C at site (9) and 36°C at site (33). Temperature of water ranged between 17°C at site (9) and 32°C at Site (4). Conductivity ranged between 137.6 $\mu\text{S}$  at site (10) and 10660 $\mu\text{S}$  at site (21). Total dissolved salts ranged between 90.3 ppm at site (18) and 7550 ppm at site (21). The dissolved oxygen ranged between 2.33mg/L at site (38) and 9.27 mg/L at site (13). The pH ranged between 7 at site (21) and 10 at sites (6, 22, 24, and 25).

#### Taxa recorded (Table1):

The study indicated the presence of twenty eight taxa. The major taxa included two phyla: Arthropoda and Rotifera. Phylum Arthropoda included insects, crustaceans, and water mites. Insects were represented by 12 taxa constituted 43% of the total taxa collected and belonging to six orders: Hemiptera (3 families), Coleoptera (one family), Diptera (2 families), Odonata (2 families), Ephemeroptera (one family), and Collembola (one sub-order: Arthropleona). Crustaceans were represented by 14 taxa constituted 50% of the total taxa collected and belonging to: Order Anostraca (2 species), Order Notostraca (one species), Order Conchostraca (one species), Order Cladocera (3 families), Sub-Class Copepoda (2 orders) and Class Ostracoda. Water mites and rotifers each constituted about 4% of the total taxa collected. The above mentioned taxa were divided into constancy classes according to the system adopted by Weis-Fogh (1948) and used by several authors like Hussein (1972), Obuid-Allah (2000), Mahdy (2005) and Abdel-Wakeil and Al-Thomali (2013) as follows:- Constant taxa: present in more than 50% of the samples. - Accessory taxa: present in 25-50% of the samples. - Accidental taxa: present in less than 25% of the samples.

According to the system mentioned above, the constant taxa recorded were represented by 5 taxa namely: Calanoida (71%), Ostracoda (62%), *Moina micrura* (60%), Diptera pupae (57%), and Cyclopoida (52%). The

accessory taxa were represented by 8 taxa: *Daphnia longispina* (50%), *Daphnia retrocurva* (45%), Chironomidae (45%), *Streptocephalus seali* (40%), *Coenestheriella* sp. (40%), Pleidae (31%), Dytiscidae (29%) and *Artemiopsis stephanssoni* (29%).

The accidental taxa recorded were represented by the rest of taxa which were represented by 14 taxa.

**Table (1): Illustrates different taxa collected from the investigated sites and their occurrence during the period of investigation.**

Taxa No.	Taxa Collected	F	%F
	<b>Class: Insecta:</b>		
	<b>a-Order: Hemiptera</b>		
1	Family: Pleidae	13	31
2	Family: Notonectidae	10	24
3	Family: Corixidae	5	12
	<b>b-Order: Coleoptera</b>		
4	Family: Dytiscidae	12	29
	<b>c-Order: Diptera</b>		
5	Diptera pupa	24	57
6	Family: Chironomidae	19	45
7	Family: Culicidae(Larva)	3	7
8	Family: Ceratopogonidae	1	2
	<b>d-Order: Odonata</b>		
	<b>-Anisoptera</b>		
9	Family: Libellulidae	3	7
	<b>- Zygoptera</b>		
10	Family:Coenagrionidae	1	2
	<b>e-Order: Ephemeroptera</b>		
11	Family: Siphonuridae	6	14
	<b>f- Order: Collembola</b>		
12	<b>S.O: Arthropleona</b>	4	10
	<b>Sub-Phylum: Crustacea</b>		
	<b>Class: Branchiopoda</b>		
	<b>1-Order: Anostraca</b>		
13	- <i>Streptocephalus seali</i>	17	40
14	- <i>Artemiopsis stephanssoni</i>	12	29
	<b>2-Order: Notostraca</b>		
	Family: Triopsidae		
15	- <i>Triops longicaudatus</i>	10	24
	<b>3-Order: Conchostraca</b>		
16	- <i>Coenestheriella</i> sp.	17	40
	<b>4-Order: Cladocera</b>		
	Family: Daphnidae		
17	<i>Daphnia longispina</i>	21	50
18	<i>Daphnia retrocurva</i>	19	45
19	<i>Daphnia magna</i>	7	17
20	<i>Ceriodaphnia reticulata</i>	9	21
21	<i>Simocephalus exspinosus</i>	1	2
	Family: Macrothricidae		
22	<i>Macrothrix</i> sp.	5	12
	Family: Moinidae		
23	<i>Moina micrura</i>	25	60
	<b>-Sub-Class: Copepoda</b>		
24	<b>Order: Calanoida</b>	30	71

25	<b>Order: Cyclopoida</b>	22	52
26	<b>-Class: Ostracoda</b>	26	62
27	Mites	4	10
28	<b>Phylum: Rotifera</b>	4	10

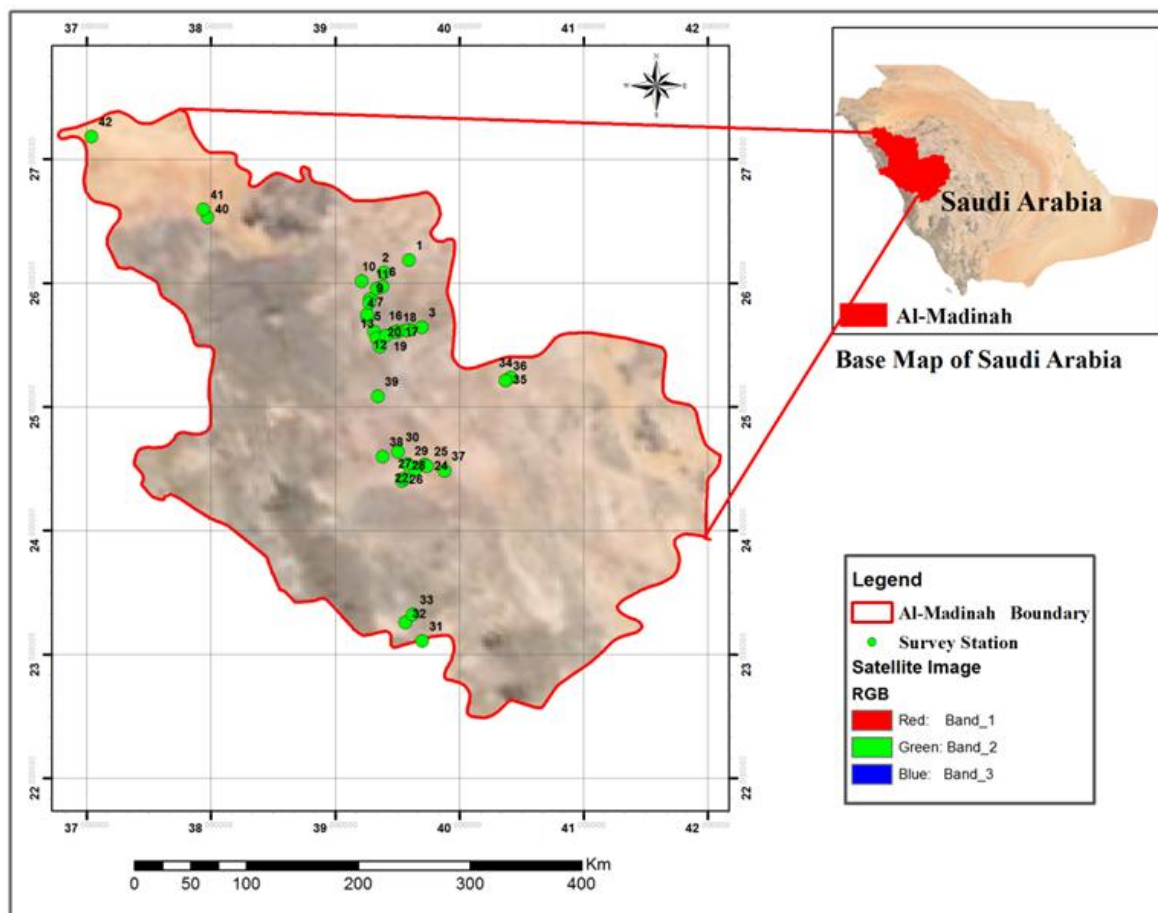


Fig. (1): Map of Saudi Arabia showing Almadinah region and the investigated sites.

### Discussion:

The present investigation indicated that 28 taxa were recorded in the 42 sites studied at Al-Madinah region. The present study compared with that of Obuid-Allah (2000) who studied zooplankton communities at Tabuk; Saudi Arabia depending on 28 samples, recorded 24 taxa only. The increased number of taxa in the present study compared with that of Obuid-Allah (2000) may be due to: 1-differences in the regions investigated. 2- that the present study covered more sites of Al-Madinah region as well as a variety of habitats that included virgin sites but that of Obuid-Allah (2000) was restricted in Tabuk city only. In the present study, crustaceans was represented by 14 taxa and constituted 50% of the total taxa collected. Insects came in the second order where they were represented by 12 taxa and constituted 43% of the total taxa collected. Ostracods, mites and rotifers came in the last order where each of them constituted about 4% of the taxa collected. Obuid-Allah (2000) worked on Tabuk region indicated that aquatic insects constituted the highest percentage of occurrence (93%) in all samples collected, ostracods (82%), copepods (57%), cladocerans (39%), rotifers (32%) and Anostraca (18%). He also noticed, at site (6) where he studied the density of different taxa during 11 months, that copepods dominated other

taxa where they constituted 46% of the total catch during the period of study. Al-Asgah et al. (1989) prepared a list of zooplankton species in Saudi Arabia depending on a preliminary survey of five perennial freshwater reservoirs and valleys in the Kingdom. They recorded 9 species of zooplankton which belong to cyclopoid copepods (2 species), Rotifera (5 species) and Cladocera (one species). Other studies carried out in Saudi Arabia included that of Siddiqui and Al-Harbi (1995) who studied Wadi Hanifah stream at Alryadh region and examined 15 sampling stations along this stream concluded that the invertebrate fauna was generally poor. They noticed that insects were few and were recorded mainly from the lakes; Odonata were recorded at 5 stations, Diptera and Coleoptera were recorded at one station while Hemiptera at 2 stations. Similarly, Crustacea (Ostracoda and Copepoda) were poorly represented; being recorded at 7 stations while Rotifera were recorded from 10 stations. Also, the recent study of Al-Ghanim (2012) on the same Wadi mentioned above (Wadi Hanifah) recorded 19 taxa in this stream. He noticed that Protozoa was the abundant group and indicated that the reduction of zooplankton in this wadi may be induced by sewage and other domestic pollutant discharged in it. Abd El-Wakeil and Al-Thomali (2013) studied the community structure of aquatic macro invertebrates inhabiting Wadi Al-Arj, Taif Kingdom of Saudi Arabia. They recorded 20 taxa belong to three phyla; Annelida, Arthropoda and Mollusca. Compared to the above-mentioned investigations carried out in Saudi Arabia, the present invertebrate fauna recorded at Al-Madinah region appeared richer. Carter et al. (1980) and Shurin (2000) indicated that zooplankton species tend to have wide geographic distributions. In freshwater, the zooplankton assemblages are dominated by the rotifers (Wallace and Snell, 1991) and two groups of micro crustaceans – the cladocerans (Dodson and Frey, 1991) and the copepods (Williamson, 1991). The littoral and benthic regions of freshwater characteristically hold large numbers of the divers and ancient micro crustaceans, the ostracods (Delmore, 1991). The present study indicated that among taxa collected, the calanoid copepods were widely distributed in the investigated region. Depending on the criteria mentioned in the study, it was on the top of constant taxa recorded where they constituted 71% of the collected samples. Obuid-Allah (2000) studied Tabuk city and indicated that there was a marked distribution of aquatic insects belonging to family Chironomidae in the samples collected from all studied sites; where it was recorded in 50% of the samples. In the present study, the accessory taxa were represented by 8 taxa: *Daphnia longispina* (50%), *Daphnia retrocurva* (45%), Chironomidae (45%), *Streptocephalus seali* (40%), *Coenestheriella* sp. (40%), Pleidae (31%), Dytiscidae (29%) and *Artemiopsis stephanssoni* (29%).

Comparing the results of the present investigation with that conducted by different authors in different countries all over the world. Singh et al. (2012) studied the diversity of zooplankton in MahendraNath pond-India, he noticed that the population of zooplankton consisted of rotifers, copepods and cladocerans. Farshad and Venkataramana (2012) studied zooplankton diversity in Nanjangud industrial area-India; they noticed that zooplankton was made up of Rotifera (62%), Copepoda (12.00%), Cladocera (19.50%), Diptera (4.00%) and Nematoda (4.50%). Kumar et al., (2011) studied the seasonal variations in zooplankton diversity of railway pond, Sesaram, Bihar, India and they indicated that in all 76 zooplankton species recorded belonged to Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Out of 76 species, 9 species belonged to Protozoa, 37 species to Rotifera, 15 species to Cladocera, 12 species to Copepoda and only 3 species to Ostracoda. Srivastava (2013) studied the monthly variations in the occurrence of zooplankton in a freshwater body, Ramgarh lake, Gorakhpur, U.P., he concluded that the zooplanktons were represented by three groups of organisms in order Crustacea>Rotifera>Protozoa. Abdulgabar (2013) studied zooplankton communities in Al-Ibrahimiya canal at Assiut, Egypt; she indicated that the collection comprised 73 taxa including 5 groups. Rotifera was the most important group (23 taxa belonging to, at least, 16 genera), Cladocera (18 species), Copepoda (10 adult species, nauplius larvae and copepodite stages), the group of the "other groups" (12 taxa: 10 taxa of insects belonging to 7 orders, Nematoda and the "spiders and mites") and Ostracoda (8 species). Dodson and Frey (1991), Delmore (1991), Wallace and Snell (1991) and Williamson (1991) indicated that the majority of freshwater zooplankton have a strong potential for dispersal and that most species so far investigated are capable of forming resting eggs which are resistant to desiccation, freezing and digestive enzymes and may be brought from time to time on water birds or by wind or floods. Furthermore, many species reproduce by parthenogenesis which allows single females to reproduce. Nevertheless, the cosmopolitan distribution of many species has been questioned by Frey (1982) and newly-discovered exotics are allowing detailed discovery of the dispersal process (Havel et al., 1995).

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