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# Zooplankton (Cladocera) density and identification during seven successively months in in Anzali wetland and compare with estuarine region and The Caspian Sea

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**ABSTRACT**

*This research was done to assess the density of Cladocera an Anzali Swamp and Compare it with its density in estuarine regions and the Caspian Sea. Therefore, sampling was done during 7 months with 45-day interval from March, to September, 2011 at 5 stations including 3 stations in Anzali wetland, 1 station in estuary and 1 station in the Caspian Sea using 30-micron Planktonic nets. According to the achieved data, only 6 genera were found in this branch whose most density was at west swamp entry station with 41 numbers per liter. The maximum Cladocera density was seen during April with 22 numbers per liter. The results of such study showed that compared with three regions of Anzali Swamp, estuary and the Caspian Sea, the density of Cladocera was more in Anzali Swamp, then in estuary and it had the least density in the Caspian Sea. The statistical Analysis and one way variance results showed that the average Cladocera zooplanktonic density had a significant difference at various stations as well as different months. Also, there was a relation between physio- chemical factors and Cladocera density. Such relation was straight between pH and water temperature with Cladocera while it was inverted between transparencies and electrical conductive with their density.*

**Key words:** Anzali wetland, Cladocera, the Caspian Sea, Estuary.

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## INTRODUCTION

Cladocera is a primarily-freshwater monophyletic group, an important component of the microcrustacean zooplankton. They inhabit most types of continental fresh and saline water habitats, occurring more abundantly in both temporary and permanent stagnant waters. Cladocera (water fleas) play a key role in freshwater ecosystems because of their pivotal position in the food web, sandwiched between top-down regulators (fish and invertebrate predators) and bottom-up factors (phytoplankton). The intermediary position occupied by cladocerans underlies their significance for nutrient cycling in freshwaters [14, 24] and as sentinels of environmental change [13, 14 and 15]. they are particularly significant in the food web of stagnant waters. Cladocera are able to passively disperse between wetlands via birds [9], and it has been suggested that wetlands frequented by more migratory birds should hold a higher species richness of Cladocera [10].

Salinity is amongst the most important environmental factors with the potential to significantly influence estuarine communities [22]. Therefore, fluctuations in salinity and other environmental factors (e.g. temperature, pH, nutrients and transparency) play major ecological roles promptly controlling the composition and distribution of species [16, 18].

The purpose of this study was to identify Cladocera in the category of genus as well as their density assessment at different station of Anzali Swamp and the Caspian Sea in various months. Other purposes included description of

physio- chemical factors relations (temperature, salinity, pH and oxygen) with Cladocera and the statistical difference assessment of the stations according to the density of such fauna**.**

## MATERIALS AND METHODS

### Description of the Study Area

Present study was carried out in Anzali Swamp which is located on the Southern margin of Gilan, Sefidrood delta western coast and Gilan coastal plain**.**

### Sampling Stations

5 sampling sites were selected for the study. The names and the geographical locations of such stations are shown in table-1.


**Fig1- Maps of the study sites in the Anzali wetland in Iran**

**Table-1. Location of the study area**

| No. | station location | longitude | latitude |
|---|---|---|---|
| 1 | **Sea** | 49º, 27□,31□ | 37º, 29□,5□ |
| 2 | **estuary** | 49º, 27□,43□ | 37º, 28□,43□ |
| 3 | **Nahangrooga** | 49º, 27□,55□ | 37º, 27□,50□ |
| 4 | **Swamp entry** | 49º, 24□,44□ | 37º, 26□,23□ |
| 5 | **Sorkhankol** | 49º, 27□,6□ | 37º, 25□,6□ |

### Zooplankton sampling

For zooplankton analysis, samples were collected from each water body once in 45 days at different stations from the depth to the surface by using Polika pipe from the water column. . About 30 liters of water is filtered by passing water through plankton net made up of bolting silk cloth having mesh size of 30 micrometer. Samples were then washed into sampling container and were preserved by adding in 4% formalin . Further analysis was done by putting 5 ml of the preserved sample on Bogarf cell and studying it under an inverted microscope. For qualitative analysis, the keys given in Williams (1966), Sabaneef (1952), Rylove (1963) and Edmonson (1959) were utilized and results were expressed in No./L. Meanwhile, the methodology was done based on Boney (1989) and Omori and Ikeda (1984).

**Physical and chemical water parameters**

**Air and Water Temperature:** This was determined using mercury-in glass thermometer by dipping it into the water and allowed to stabilize for 5 seconds removed and reading immediately recorded [1].

**pH and Electrical Conductivity**: These were measured using pH/EC meter. pH of water was determined at the sites by using a portable electronic digital pH meter.


**Fig2- pH meter (BECKMAN)**

**Fig3- EC meter (CM_20S)**

**Dissolved Oxygen (DO)**: It was performed at the sites by Winkler's modified technique according to [1].

**Transparency:** The transparency of the water was measured using 20cm diameter Secchi disk, which was dipped into the water till the disk disappeared and the depth was recorded, it was then dipped further and then withdrawn carefully and the depth at which it became visible was also recorded. Actual measurement was obtained by taking the average of the two readings [1].

**Fig4- Secchi disk**

**Statistical Analysis**:

The achieved results were first assessed by Shapiro-Wilk Test to make sure about normality. Since the achieved data were about Zooplanktonic communities, they did not have a normal density. The data assessment showed a great range of differences. Therefore, non-parametric Test of Kruscall-Wallis was used to compare the months and different stations. By using this test, the differences among the groups were first determined generally, then the groups were separated from one another by using Man-Whitney Test. SPSS software was used for data statistical analyze. The physical and chemical effects were calculated via correlation statistical Tests. Variance Analysis was used to assess the significant differences of the communities on a time scale, ie. various sampling months or to compare the community structure among different stations.

## RESULTS AND DISCUSSION

3-1. The achieved results of the Cladocera identification

**Fig5- *Alona***

**Fig6- *Diaphnosoma***

**Fig7- *Moina***

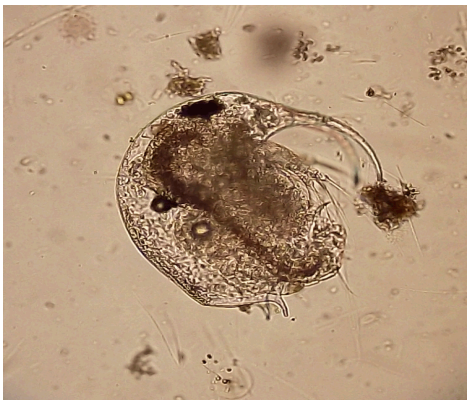

**Fig8- *Bosmina***

During the sampling, the abundance of Cladocera and its variety were at low levels. Of this branch, no genus was seen at the Caspian Sea station. Shaban Nejad (2000) reported a genus in the estuarine region and 3 genera of Cladocera branch were identified in such a region. During a 2-year planktonic sampling done by Makaremi et al, from July 1997 to July 1999 in Anzali Swamp, 19 genera of Cladocera were identified. In this research, 6 genera were reported in Anzali Swamp. There were 6 genera at the west Swamp entry, 4 genera at Sakhankol and 5 genera at Nahang rooga stations.

*3-2. The achieved results of the density*

3-2-1. The results of the density assessment of Cladocera in the months of the assessment

**Table-2. The density variations average of Cladocera in different months**

| Treatment | Mean±S.D | minimum | Maximum |
|---|---|---|---|
| March | 9.67 ± 20.65 abc | 0 | 75 |
| April | 22.4± 44.03 c | 0 | 156 |
| June | 13.53 ± 23.71 bc | 0 | 78 |
| August | 1.53 ± 2.67 ab | 0 | 9 |
| September | 0.73 ± 1.79 a | 0 | 7 |

** The non-common English letters show the differences among the treatments (P<0.05)*

According to Valis-Kroscal Test, it could be inferred that There was a significant difference in the density of Cladocera among the months of the assessment ($p<0.05$).

(Chi-Square= 12.393 df=4 sig=0.015)

Whitney-Man Test showed that between April-August and September and also June – September, there is a significant difference in a Cladocera density in pairs.

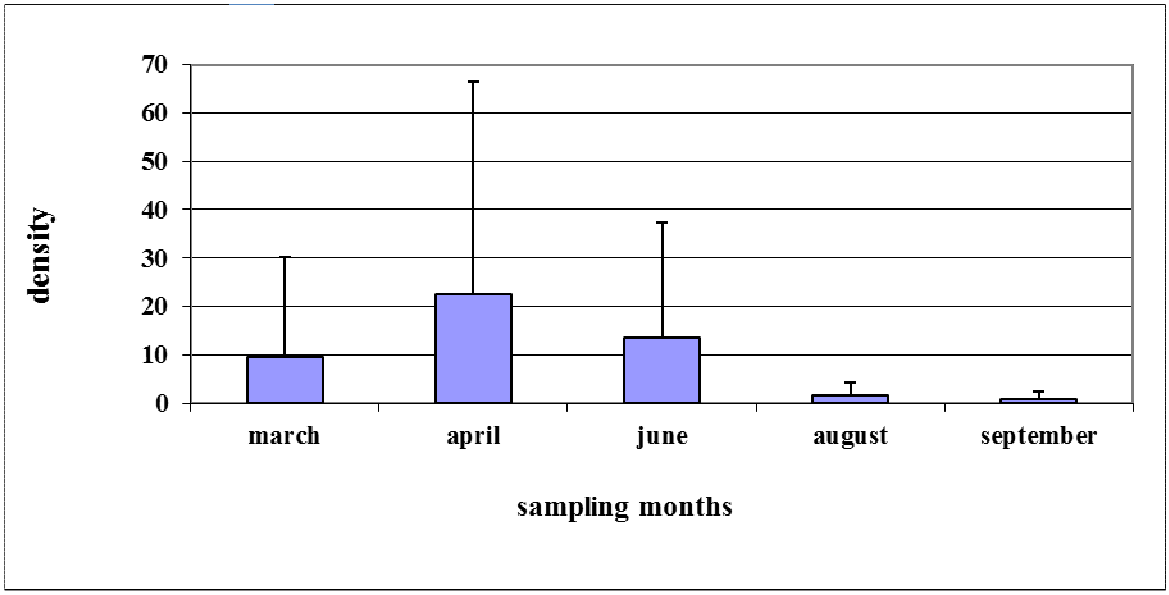


**Fig-9. The average of Cladocera density changes in the months of the assessment**

According to Fig-9, Cladocera order had the most density in April compared to other months of studying whose reasons could have been a decent temperature for their growth and the amount of rainfall. Basically, Cladocera could grow very well up to the temperature of 25ºc and upper than such a temperature; the amount of growth would decrease. The second reason was rainfall. Hodgkiston (1970) pointed out that rainfall could increase the density of Cladocera due to having a lot of nutritions and also washing the farms and bringing the minerals to the mouth of the swamp as well as an appropriate temperature. The decrease of Cladocera density in August and September could have been for different reasons. First, the temperature could have been more than 25ºc, which was not suitable for Cladocera growth. Seconds the increase of the temperature in August could gradually lead Cladocera to reproduction phase and ephipiom. Therefore, the dormant eggs took a long time to start the proliferation. Another reason in Cladocera decrease could have been the reduction of bacteria due to the increase of Cyanophyta algae in salinity, a suitable pH and high temperature or on the second thought, incapability of Cladocera in feeding on filamental green-blue algae, which caused the decrease of Cladocera density in the swamp due to the increase of flamental green-blue algae density.

Keriochcova reported that if green-blue algae had had the maximum amount of the algae mixture, a crustacean such as Cladocera could have survived when the density of such algae had been at low levels since the toxic secretion among the cells of such algae would have prevented the minerals from absorption by Cladocera. He also pointed out that when green-blue algae had increased in water, some Cladocera would have emerged damages. Researchers reported that the increase of green-blue algae could cause the decrease of Cladocera because such algae could decrease the bacteria on which Cladocera fed.

3-2-2. The results of Cladocera density assessment at the mentioned stations:

**Table -3. The results of Cladocera density assessment at the mention stations**

| Stations | Mean±S.D | Minimum | maximum |
|---|---|---|---|
| The Caspian Sea | 0 a | 0 | 0 |
| Estuary | 1.07 ± 1.16 b | 0 | 4 |
| Nahang rooga | 1.4 ± 1.96 b | 0 | 6 |
| Swamp Entry | 40.87 ± 43.99 d | 0 | 156 |
| Sorkhankol | 4.53 ± 4.37 c | 0 | 12 |

** The non-common English letters show the differences among the treatments (P<0.05)*

According to Valis-Kroskal done among the mentioned stations, a significants difference was found in the density of Cladocera ($p<0.05$).

(Chi-Square= 12.393 df=4 sig=0.015)

Whitney-Mn Test showed that there was a significant difference in the density of Cladocera among the sea station – other stations, Sarkhankal- other stations and Nahang rooga- the west Swamp entry in pairs.

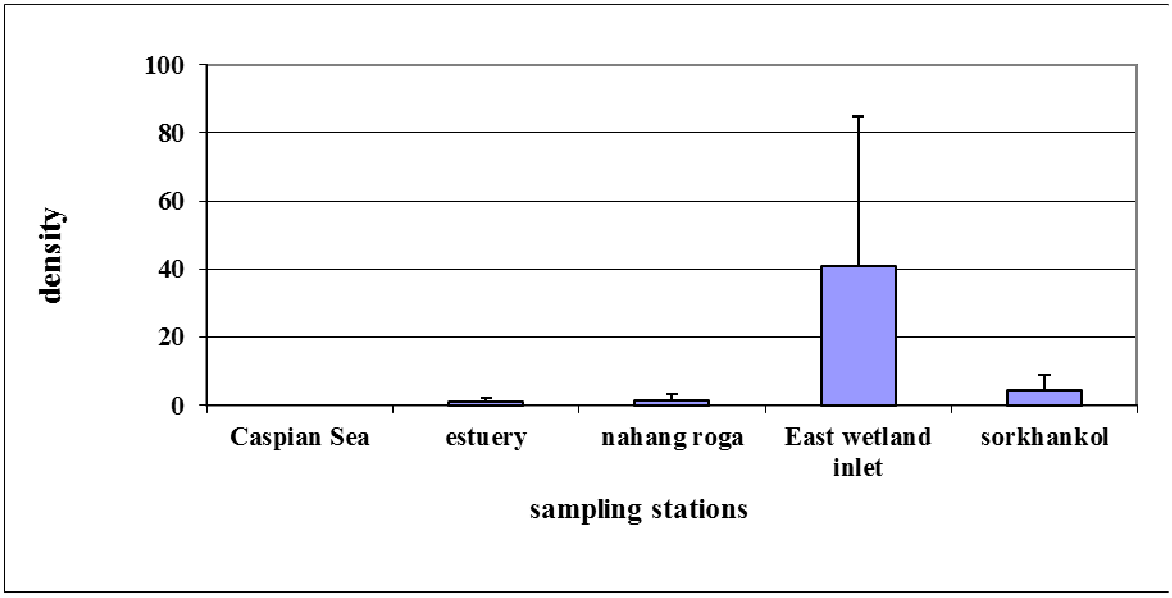


**Fig-10. The average of Cladocera density at the assessed stations**

Fig-10 shows the density of Cladocera at different stations. According to this figure, the density of such fauna was at the most level at the west swamp entry station. The reasons of more Cladocera density at the swamp entry station than eastern and central regions could be listed as water wide space, relative stagnation and stand of water, the depth of water in this region, the amount of pH compared to the suitable pH of Cladocera bloom [7] and the amount of dissolved oxygen. In addition, referring to Russian studies, Cladocera were found in the regions covered with reeds. The west swamp entry had more reeds compared to other sampling regions which had less plant coverage and more salinity. Moreover, the increase of Cyanophyta algae caused the decrease of Cladocera community [7]. According to the achieved results by the superior counseling engineers, Cladocera were fewer in Anzali Swamp and the maximum numbers were in the west of the Swamp.

**Table-4. The equation of the regression line and the correlation between the density of Cladocera and physio- chemical factors**

| **Cladocera** | **Zooplankton** / **Factors** |
|---|---|
| Y=13.489-0.036X<br>r = -0.154 | Transparency |
| Y=-57.069+8.073X<br>r = 0.141 | pH |
| Y=17.083-0.763X<br>r = -0.071 | Dissolved oxygen (DO) |
| Y=18.095-1.339X<br>r = -0.331 | Electrical conductivity (EC) |
| Y=20.672-0.448X<br>r = -0.068 | Air temperature |
| Y=31.134-0.867X<br>r = -0.169 | Water temperature |

Referring to Table-4, pH increase caused the increase of Cladocera, while the increase of electrical conductivity (salinity) resulted in the decrease of the density. Cladocera decreased of the density. Cladocera decreased in high temperatures, therefore, it decreased in summer. Abiotic Parameters fluctuation such as alkalinity, nitrogen and total phosphate, pH, dissolved oxygen and temperature affected the zooplanleton growth. Low zooplankton abundance had direct relation with physical, chemical and biotic processes. Zooplanktonic species survived in a vast range of biotic conditions and their survival depended on physio-chemical and biotic factors [23]. Zooplanktonic communities reacted to a wide range of disorders including the amount and capacity of the nutrients [5], acidity, fish density and sediment entrance [4].

*3-2-3. The comparison of Cladocera density in the caspian sea, estuary and Anzali Swamp*

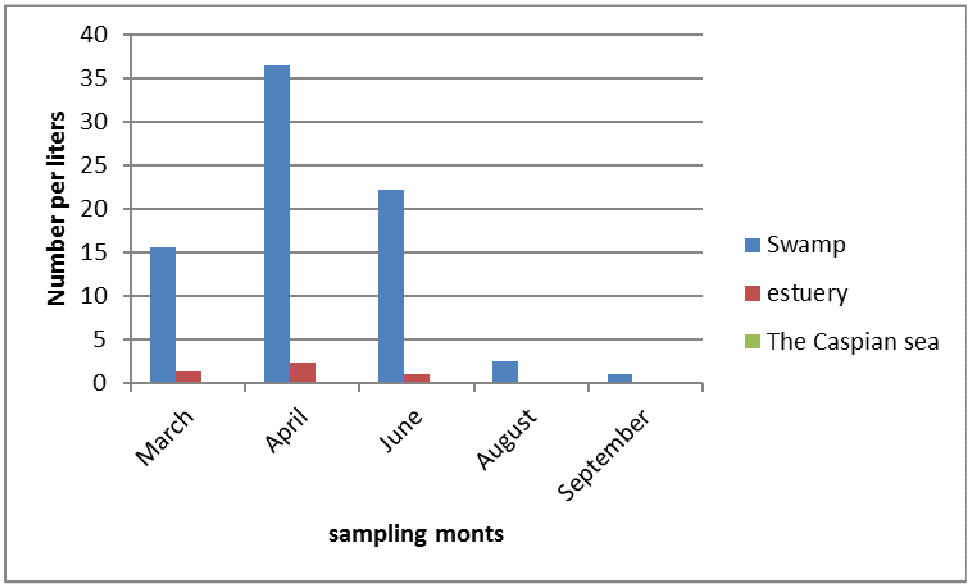


**Fig-11. The average of Cladocera density in the regions of the Caspian Sea, estuary and Anzali Swamp**

According to Fig-11, the density of Cladocera was more in Anzali Swamp than in the estuarine region, while no genus was found in the Caspian Sea because Cladocera belong to freshwater and can't survive in saltwater of the sea. Sea species severely decreased and few numbers could be found in deeper parts. There was no genus in the estuarine region, while three genera of *Bosmina*, *Chydrous* and *Diaphnosoma* were seen in both Swamp and estuarine regions. The genera of *Alona*, *Macrothrix* and *Moina* were found in Anzali Swamp and belong to this region. The genus of *Chydrus* was more in April than other months which was in accordance with what Fallahi (1993) had found. The reason could be the vicinity of rice farms to this station. Rice farms zooplankton including *Chydrus* entered such a region. According to Fallahi's studies in 1993, the genus of *Diaphnosoma* was replaced by the genera of *Alona* and *chydrus* of Cladocera order due to high temperature. In this research, the genus of *Diaphonsoma* increased remarkably in June and was replaced by the genus of *Chydrus* which had a bloom in April and then in June decreased significantly because *Alona* and *Chydrus* entered through rice farms irrigation and at the end of the irrigation, their density decreased.

**Table-5. The presence of Cladocera genera in the regions of the Caspian Sea, estuary and Anzali Swamp**

| ***Region*** <br> ***Cladocera*** | The Caspian Sea | Estuery | Anzali Swamp |
|---|---|---|---|
| *Alona* | - | - | + |
| *Bosmina* | - | + | + |
| *Chydorus* | - | + | + |
| *Diaphnosoma* | - | + | + |
| *Macrothrix* | - | - | + |
| *Moina* | - | - | + |

In Table-5, the presence of the sea genera in three regions of the Caspian Sea, estuary and Anzali Swamp is shown.

## CONCLUSION

In general, Cladocera decreased remarkably in Anzali Swamp due to low oxygen level, high amount of minerals resulting from agricultural and human activities, pollution, Azolo blooming, oxygen decrease in some regions and the increase of green-blue algae in some other places. Another factor in decreasing Cladocera community could have been turbidity. Brook & Rzoska (1952) reported that turbidity itself prevented organisms filtering function directly. It also stopped Alks photosynthetic activity. Therefore, filter feeders died and Cladocera decreased. The achieved results could show and prove this. Some other researches such as sabaneef (1952) believed that water turbidity indirectly prevented organisms filtering function, while Rylov (1963) pointed out that non-selective feeding of Cladocera in the condition of turbidity resulted in silt density in digestive parts and finally, it made this organism deposit in water. Fallahi (1999), who studied Anzali Swamp Plankton from 1992 to1996, reported that the density of Cladocera having a good nutritious value decreased and instead, Sarcodina orders which were the indices of polluted

regions and Ciliate (some of them were the indices of pollution), which had less nutritious value than Cladocera, increased. This fact indicated the pollution of Anzali Swamp.

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