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Impact of Seawater Pollution with Sewage on the Distribution and Size of *Ammonia Beccarii* (Linne, 1758) in the Northern Gaza Strip

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Abstract: The study focused on effects of seawater pollution on total count, distribution and size of the species Ammonia beccarii through studying the effect of some parameters i.e. Biochemical Oxygen Demand (BOD) and seasonal variation on two locations of Gaza Strip Seashore line. The results showed that in the polluted site the TC change was closer with increase or decrease of BOD_5. In free site, with low concentrations of BOD_5 (no pollution) the TC was more affected by sampling time. The size of the organism was affected relatively in winter season in the polluted site as temperature and related biochemical activities decreased. The low average size in polluted site was higher than the highest average size of free site. The size of Ammonia beccarii was better indicator for organic pollution level in comparison to total count.

Key words: Ammonia beccarii, gaza strip, seawater pollution, organism, BOD

INTRODUCTION

Gaza strip is a land area located along the Mediterranean Sea in the southwestern side of Palestine and northwest of Egypt. The size of the area is about 365 km^2. The population is growing fast where it is estimated to be 1400,000 individuals in 2005 (CZPG, 1996) and that mainly because of high rate of fertility and the large number of immigrants. Current population in the West Bank is 2.2 million and 1.3 million in the Gaza Strip and is expected to double in the next 20 years (Jarrar, 2006, 2007). The coastal zone of Gaza covers an area of about 74 km^2. and roughly consists of the beach and the coastal sand dunes next to the Mediterranean Sea.

The extent of seawater pollution varies according to the quantity and quality of pollutant. However, the problem of seawater pollution is acknowledged worldwide. The lack of wastewater treatment facilities leads to discharge untreated sewage directly into the sea. From the hygienic point of view, seawater and beach in Gaza city and the northern area suffers high degrees of pollution (Affifi *et al*., 2002). In the last three decades, the shore of Gaza suffered from pollution as a result of either authorities or citizens behavior by orienting the sewerage into the seashore. The results of the microbiological and biochemical analysis which were carried out in the last five years in the Environmental and Rural Research center at the Islamic University of Gaza, show that more than 90% of seawater samples exceed the recommended values for bathing water according to the WHO standards in Gaza city and Northern area (Afifi *et al*., 2002).

The microbiological quality of sediments at the sediment-water interface in bathing waters is receiving increased attention (Arakel, 1995). There is evidence that faecal indicator and pathogenic bacteria survive in sediments for longer than in the overlying water and it has been proposed that sediments serve as sinks for faecal bacteria with the potential to pollute the overlying bathing waters (Ashbolt *et al*., 1993; Nix *et al*., 1993; Ghinsberg *et al*., 1994; Howell *et al.,* 1996).

Stream sediments have been shown to contain faecal coliform at concentrations higher than those observed in the overlying water column. Van Donsel and Geldreich (1971) and Ashbolt *et al.* (1993), for example, indicated that sediments may contain 100-1,000 times the number of faecal indicator bacteria contained in the overlying water. Studies on the survival of bacteria indicate that sediments present an environment favorable for growth. Faecal bacteria have been shown to survive and to a certain extent, even to grow in sediments (ElManama *et al*., 2005).

The accumulation of organic mater and bacteria in sediment present a favorable environment for some fauna. Weiss *et al*. (2006) stated in their study, in the intertidal sediments of the Halong Bay, Northern Vietnam, that seven taxa of mostly cosmopolitan forum genera: Ammonia, Elphidium, Discorbia and Asterotalia seem to be sensitive in- situ monitors of marine pollution. Also, Bonetti (2006) in her study "Diagnostic tool to evaluate the benthic habitat quality in lagoons and estuaries of southern Brazilian coast" states that: Six attributes were available in discriminating sites from which the percent abundance of tolerant taxa (e.g., Cribroelphidium and *Ammonia* sp).

Foraminifera can be used as bioindicators for pollution monitoring in marine environments. The short life cycle and fast reactions to environmental changes can be used as signals for pollution (Armynot *et al.*, 2004; Weiss *et al.*, 2007). Benthic forams show a wide range of test deformations which may have been caused by pollution such as heavy metal contamination, other anthropogenic influences e.g., oil sticks, domestic sewage, change of physical and chemical environmental parameters and shortage of nutrients in the environment (Yanko *et al.*, 1998, Stouff *et al.*, 1999; Scott *et al.*, 2001).

In our study, *Ammonia beccarii* is a benthic foraminifera hyaline species, it is a cosmopolitan, (Loeblich and Tappan., 1985) and was picked from the northern shore of Gaza and seemed to be effected from pollution.

This research is carried out in order to study the seasonal distributions and sizes of *Ammonia beccarii* in the selected stations (the free station which suffer the shortage of nutrients and the polluted station with sewage and organic matter) from June 1997-March 1998. In addition, the study focused on effects of seawater pollution either on distribution or size of the species through studying the effect of some parameters i.e. Biochemical Oxygen Demand (BOD_5), size and Total Count (TC) on the survived species Ammonia beccarii (Linne, 1758).

MATERIALS AND METHODS

Selected stations: Two stations were selected along the northern seashore of Gaza Strip, the Sheikh Radwan effluent station and the Gaza Strip green line of northern borders station (Fig. 1). Table 1 shows the stations location description.

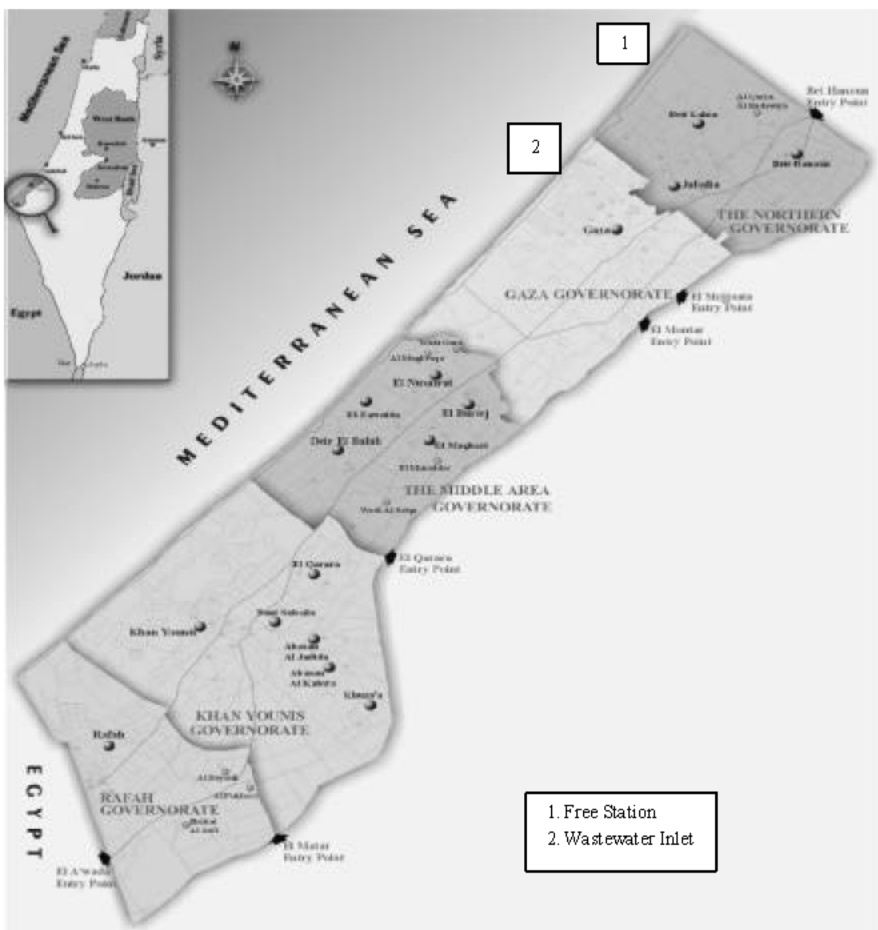

Fig. 1: Location Map of Sampling Stations

Table 1: Sampling locations description

No.	Name of Station	Description	Altitudes
1.	Northern green line borders station (free station)	Directly situated on front of the green line of the northern borders	N 31° 35″ 35.86′ E 34° 24″ 24.55′
2.	Sheikh Radwan effluent Station (wastewater station)	A discharge point of raw wastewater to the seashore, it is about 4 km .from northern borders.	N 31° 32″ 47.5′ E 34° 27″ 14.1′

Sampling frequency: In this study, samples were collected seasonally starting from June 1997-March 1998 and the samples were collected from the two stations with total samples number of 8 (samples collected on March, 1998 were excluded because of the stormy conditions prevailed which affected the validity of collection) It is worthy to note that the inlet was closed on 30-12-1997.

Samples collection: The samples were collected at morning hours about 10 A.M. where the sampler stand in water about 4-6 meters from the seashore and at 1-2 meters deep. The beaker is dragged on the bottom surface taking the upper 5 cm of the bottom surface sediments and the beaker then is filled with sea water while going up to the surface and from different levels.

Parameters measured

Biochemical parameters measurements: Dissolved Oxygen and pH were measured in the field for each seawater sample. Biochemical Oxygen Demand (BOD_5) parameter was measured in the laboratory of Environment and Rural Research Center.

***Ammonia beccarii* tests measurements:**

- Every seasonal sample was brought to laboratory where 2-3 drops of Rose Bengal dye were added to each sample.
- Samples were incubated with Rose Bengal to the next day, where the specimens of living. *Ammonia beccarii* stained with the pinkish color.
- Wet sieve (# 200) analysis was carried out.
- Drying of samples was carried out on the hot plate.
- One hundred grams of each sample were weighed from which specimens of *Ammonia beccarii* were picked, counted and measured (the diameters of the tests were measured and indicated the size of the tests).

RESULTS AND DISCUSSION

From the different field measurements of various parameters, the pH, temperature, DO and TDS showed no significant variations so, they were excluded. The results were focusing only on the BOD_5, size and total count of the *Ammonia beccarii*. Many curves were drawn showing

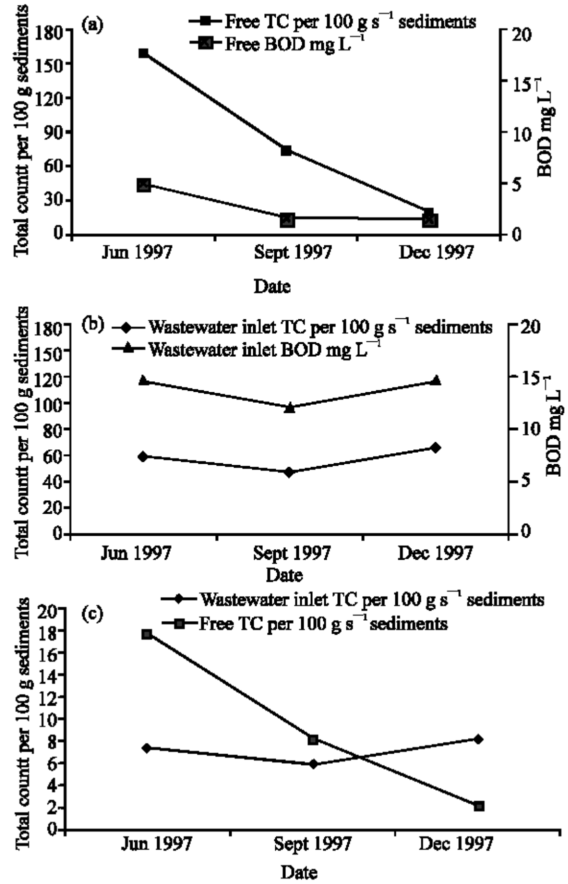

Fig. 2: The relations of total count of *Ammonia beccarii* and BOD_5 with sampling time of both investigated sites

the relation between the previous effective parameters. Total count, size and BOD_5 for both selected stations (northern green line borders station (1) and Sheikh Radwan effluent station (2) and gave some results as follows:

Figure 2 presented the result of the Total Count (TC) of *Ammonia beccarii* and the BOD_5 variation with sampling times in both investigated sites.

The results showed a close relation between TC and BOD_5 concentrations for both sites (Free and Polluted) as given in the curves A and B in Fig. 2. However, in site with wastewater inlet (polluted site), the TC change was closer with increase or decrease of BOD_5. In free site,

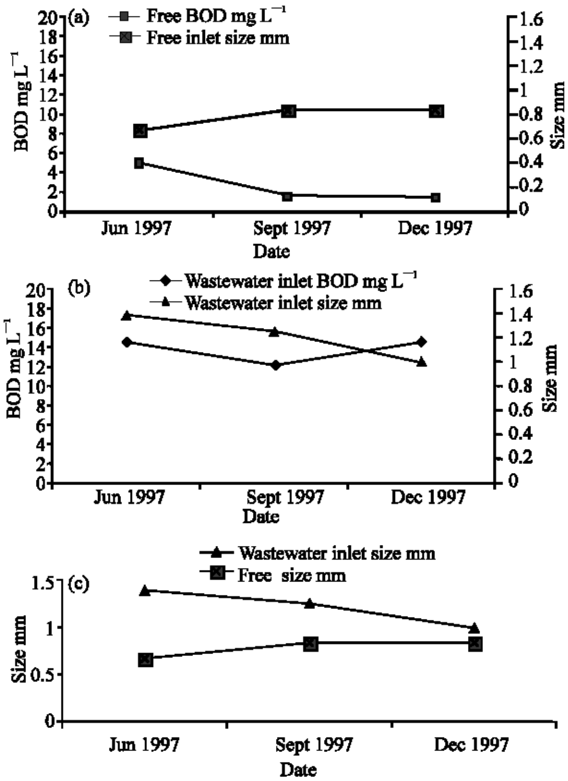

Fig. 3: The relations of the Size of *Ammonia beccarii* and BOD_5 level with sampling time of both investigated sites

with low concentrations of BOD_5 (no pollution) the TC was more affected by sampling time. In summer the TC was significantly higher than in winter, with a total count of 158 individuals (Tests) 100 g^{-1} of sediments and 20 individuals 100 g^{-1} of sediments, respectively.

In general the TC in the polluted site was higher than in free site (Fig. 2c) while in winter the TC was less than the polluted site. This can be interpreted that the relatively high concentration of BOD_5 in polluted site has more influence on the TC as the sewage discharge increases the amount of suspended particulate matter in the water column and contributes large amounts of organic matter and nutrients to the receiving environment. In free site with significantly low BOD_5 level, the seasonal variations of temperatures could have more effects. Figure 3 presented the variations of *Ammonia beccarii* size with BOD_5 level and sampling time on both sampling locations.

The average size of the organism was 1.38 mm in the polluted site and 0.67 mm in the free site. The size of the organism was affected relatively in winter season in the polluted site as temperature and connected biochemical activities decreased. The low average size in polluted site

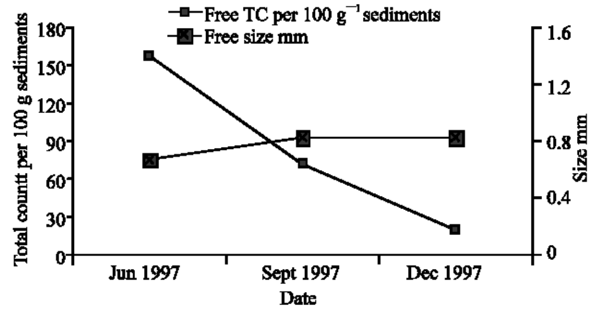

Fig. 4: Relation between TC and Size of Ammonia *beccarii* in Free sampling location

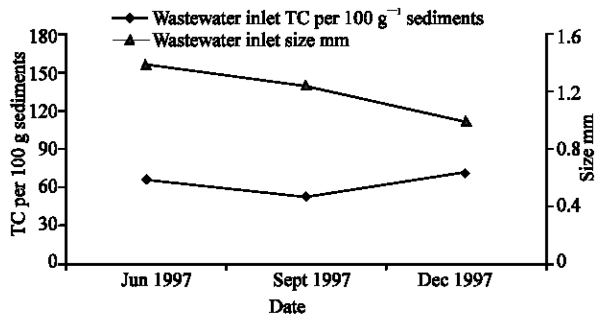

Fig. 5: Relation between TC and Size of Ammonia *beccarii* in Wastewater Inlet sampling location

was higher than the highest average size of free site. Once again the BOD_5 level has more influence on the Ammonia beccarii size as presented in Fig. 2, curves A and B.

Figure 4 showed the relation between the TC and Size of *Ammonia beccarii* in free site in different sampling times. The results showed minor negative relation between the TC and Size. In summer the TC was more than 150 tests per 100 g of sediments and decreased in winter and reached less than 30 tests per 100 g of sediments, while the size was around 0.7 mm in the three sampling times.

Figure 5 showed the relation between the TC and the size of *Ammonia beccarii* in the wastewater inlet sampling location. The results showed a contradictory situation of the free location. In the polluted site the decrease of organism size in winter was considerable. The size deceased from around 1.4 mm in summer to less than 1 mm in winter. The TC was around 70 tests per 100 g of sediments.

These findings could be connected with the organic pollutions level and its nourishment effects on the size of organism in polluted site. This up normal size of organism will be sharply affected by temperature change and by seasonal variation. The normal size in free (not polluted) site continued without significant change with seasonal variations. So, the size of Ammonia *beccarii* could be a good indicator for organic pollution level in comparison to total count. However, the TC in the free site was affected with seasonal variation and this is expected as the population dynamic is connected with temperature of seasonal variation.

CONCLUSION

In the last three decades, the shore of Gaza suffered from pollution as result of either authorities or citizens behavior by orienting the sewerage into the seashore. The results of the microbiological and biochemical analysis show that more than 90% of seawater samples exceed the recommended values for bathing water according to the WHO standards in Gaza city and Northern area. The main aim of the study was to investigate the seasonal distributions and sizes of *Ammonia* beccarii. in the selected stations from June 1997-March 1998. Two stations were selected along the northern seashore of Gaza Strip and samples were collected and analyzed from seawater and seashore sediments.

The results showed that the average size of the organism was 1.38 mm in the polluted site and 0.67 mm in the free site. In summer the TC was more than 150 tests per 100 g sediments and decreased in winter and reached less than 30 tests per 100 g sediments. The TC and organism size changed closer with increase or decrease of BOD5. In addition, the seasonal variation has significant effects on TC and size of *Ammonia beccarii* in both locations. Finally, we can conclude that the size of *Ammonia beccarii* could be a good indicator for organic pollution level in comparison to total count.

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REFERENCES

Afifi, S., S. Bahr and A. Elmanama, 2002: Evaluation of Seawater and Beach Quality in Gaza Governorate/ Palestine. Palestinian Hydrology Group, (5h Edn.), Water Environ. J., pp: 14-27.

Anan, H., 1983. Recent Foraminifera from the coast of Gaza Strip, Palestine. Proc. 1st Jordanian Geolog. Conf., pp: 1-9.

Arakel, A.V., 1995. Towards Developing Sediment quality Assessment Guidelines for Aquatic System: An Australian Perspective. Aus. Earth Sci. 42: 335-369.

Armynot du Châtelet, E., J.P. Debenay, R. Soulard, 2004. Foraminiferal proxies for pollution monitoring in moderately polluted harbors. Environ. Pollut., 127: 27-40.

Ashbolt, N., G. Grohmann and C. Kueh, 1993. Significance of Specific bacterial pathogens in the assessment of polluted receiving waters of Sydney. Water Sci. Tech., 27: 449-452.

Bonetti, C., 2006. Diagnostic Tool to Evaluate the Benthic Habitate Quality in Lagoons and Estuaries of Southern Brazilian Coast. (Abstract), Forams.

CZPG (Coastal Zone Plan for Gaza), 1996. Regional Plan Gaza and West-Bank Governorate, Ministry of Planning and International Cooperation, Sector Report.

Elmanama A., M. Fahad, S. Afifi, S. Abdalla and S. Bahr, 2005. Microbiological Beach Sand Quality in Gaza Strip in Comparisin to Seawater Quality. Elsevier, Environ. Res., 99: 1-10.

Ghinsberg, R., P. Leibowitz, H. Witkim, A. Mates, Y. Seinberg, D. Bar, Y. Nitzan and M. Rogol, 1994. Monitoring of Selected Bacterial and Fungi in Sand and Seawater along the Tel-Aviv Coast. MAP Tech. Rep. Ser., 87: 65-81.

Howell, J., M. Coyne and P. Cornelius, 1996. Effect of Sediment Particle Size and Temperature on Fecal Bacteria Mortality rates and the Feacl Coliform/Feacl Strepto-coci Ratio. J. Environ. Quality, 25: 1216-1220.

Jarrar, A., 2006. Palestinian-Israeli Cooperation in the Water Sector, The international network of basin organizations (INBO news letter). email: inbo@ wanodoo.fr, pp 1-39.

Loeblich, A. and H. Tappan, 1985. Treatise on Invertebrate Paleontology, Part c, Protista 2,(C 606-C607), 2: 511-900.

Nix, P., Daykin, M., Vilkas, K., 1993: Sediment Bags as an Integrator of Fecal Contamination in Aquatic Systems. Water Pes., 27: 1569-1576.

Scott, D.B., F.S. Medioli and C.T. Schafer, 2001. Monitoring of coastal environments using foraminifera and thecamoebian indicators. Cambridge University Press.

Stouff, V., E. Geslin, J.P. Debenay and M. Lesourd, 1999. Origin of morphological abnormalities in *Ammonia* (foraminifera): Studies in laboratory and natural environments: J. Foraminifer. Res., 29: 152-170.

Weiss, C., R. Hofling and H. Tobschall, 2006. Sediment Characteristics and Foraminifera Test Morphology of theHalong Bay, Northern Vietmam (Abstract), Forams.

Weiss, C., R. Hofling and H. Tobschall, 2007. Foraminifera test malformations in intertidal mangrove influenced sediments. Fith International EMMM Conference.

WHO (World Health Organization), 1995. Manual for Recreation Water Quality. Monitoring and Assessment, Region of Office for Europe, European Center for Environment and Health, Draft Report.

WHO (World Health Organization), 1998. Manual for Recreation Water and Beach Quality. Monitoring and Assessment. Regional Office for Europe, European Center for Environment and Health, Draft Report.

Van Donsel, D. and E. Geldreich, 1971. Relationship of Salmonella to Fecal Coliform in Bottom Sediments. Water Resour., 5: 1079-1087.

Yanko, V., M. Ahmad and M. Kaminski, 1998. Morphological deformities of benthic foraminiferal tests in response to pollution by heavy metals: Implications for pollution monitoring: J. Foraminifer. Res., 28: 177-200.