



## Some Data About the Daily Vertical and Horizontal Distribution of Culturable Heterotrophic Bacteria in Offshore Central Adriatic Sea

### KEYWORDS

Adriatic Sea, cultural heterotrophic bacteria, oligotrophic.

**Dr. Sotir Mali.**

Faculty of Natural Sciences, University "Aleksander Xhuvani" of Elbasan, Albania.

**ABSTRACT** *The Albanian coast line and continental shelf is a typical alternation among the erosive and accumulative types and the Delta Buna-Drini of is typical accumulative one. The aim of this paper is to present some data on cultural heterotrophic bacteria in the "open sea", in the central part of the Adriatic Sea in a line passing the continental shelf from the Delta Buna-Drini to the isobaths of 1100 m. This is the first study in the Albanian part which is not published before. In order to achieve the planed intention, 22 samples of water were collected during the May 2009 in different depths and distances from the seashore further on analyzed in laboratory. Some physical and chemical parameters (temperature, salinity, transparency, oxygen dissolved, etc) were analyzed as well following recent techniques of CTD. The results prove that daily vertical distribution of cultural heterotrophic bacteria in offshore central Adriatic Sea is interrelated with physical and chemical parameters, especially by temperature and the depth mixed by wind and down welling currents. The comparison of these data with those taken by the other authors in the coastal and the depth of Adriatic Sea, especially in Italian and Croatian parts shows that this area shows an oligotrophic water quality from the trophic state point of view.*

### Introduction

The Adriatic Sea is a part of the Mediterranean Sea which separates the Italian Peninsula from the Balkan Peninsula. It extends northwest from 40° to 45° 45' N, with an extreme length of about 770 km and a mean breadth of about 160 km, although the Strait of Otranto through which it connects at the south with the Ionian Sea, is only 85-100 km wide. (4). The deepest part of the sea lies east of Monte Gargano, south of Dubrovnik and west of Durrës where a large basin gives depths of 900 m and upwards, and a small area in the south of this basin falls below 1,460 m. The mean depth of the sea is estimated at 240 m. Based on its oceanographic, bathymetric and hydrological features, the Adriatic Sea is divided into three sub basins: the northern, central and southern Adriatic basin, (L. Stabili & al, 2004). Many papers are published about the plankton in costal and offshore Adriatic Sea areas, including, viroplankton, bacteroplankton etc.

For instance about the biodiversity of the culturable heterotrophic bacteria in the Southern Adriatic Sea Italian coastal waters (L. Stabili, & al 2004), Large-Scale Spatial Distribution of Virioplankton in the Adriatic Sea: Testing the Trophic State Control Hypothesis (C. Corinaldesi, & al 2003), about heterotrophic bacteria density at one coastal and one open sea station in the central Adriatic and seasonal distribution of heterotrophic bacteria for the 1968-1988 period. (Šoljæ, and al 1991). Many other studies which are focused on the different kind of pollutions in the coastal Adriatic Sea water including those caused by pathogenic bacteria were carry out. Also about the culturable heterotrophic bacteria in seawater and *Mytilus galloprovincialis* from a Mediterranean area in the Northern Ionian Sea – Italy was carry out, (R. A. Cavallo, and al 2008). Some of these studies are more related to our study for instance the seasonal and spatial distribution of bacterial production and biomass along a salinity gradient in the Northern Adriatic Sea, (A. Puddul & 1998). Our study is focused on the vertical distribution of the culturable heterotrophic bacteria and some physico-chemical parameters in central open Adriatic Sea, starting from the Albanian coastal.

### Materials and Methods

The Sampling was carried out in four offshore stations during a common Croatian-Albanian expedition which was carry out in central offshore Adriatic Sea during the

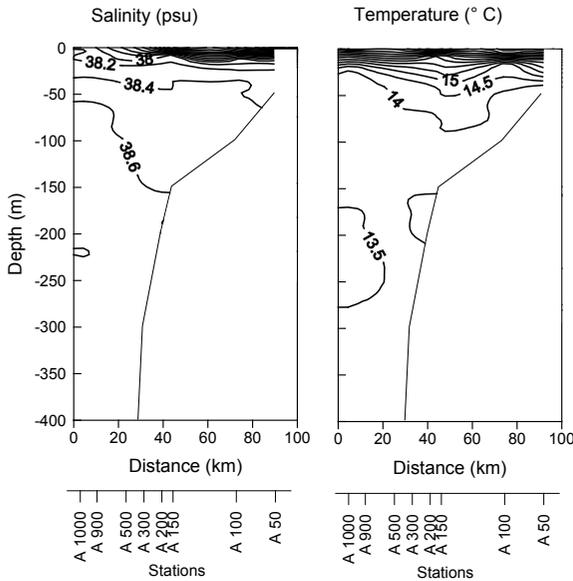
May 12, 2009. The coordinates of the sampling stations are shown in table1. At station A50, water samples were collected at depths 0.5 m, 5 m, 20 m, and 40 m, meanwhile for each other stations ( 2, 3, and 4) they were collected at standard depths (0.5 , 5 , 20, 50, 75, and 100 m) by using a Ruttner water sampler. The measure of physical and chemical parameters (oxygen, pressure, temperature, salinity, and turbidity vertical profiles at all stations) was carried out by using a CTD Sea Bird Electronics SBE 911. The samples were transported by portable fridges which provided temperatures lower than 5°C. The spread of the water samples was, in a few cases, done 2-3 h after the taking of the samples in the determined medium. The work method was based on the standard methods for the examination of the surface and polluted waters (APHA, 1988). The method with coverage and the spread in the surface in the MPA medium is used for heterotrophic bacteria.

**Table1. The coordinates of the samples stations**

COORDINATES				
Stations	j	l	depth (m)	Time (h) 12 May 2009
A50	41° 41.7712' N	17° 21.4638' E	50	9.10-9.45
A100	41° 36.4127' N	19° 10.7828' E	100	11-11.30
A150	41° 33.2887' N	19° 01.4581' E	150	12-13.30
A200	41° 31.3900' N	18° 55.6163' E	200	14-15.20
A300	41° 29.4535' N	18° 50.9721' E	300	16.30-10.10
A500	41° 25.8758' N	18° 42.4729' E	500	19.45-20
A900	41° 24.7456' N	18° 37.1148' E	900	20.30-22.45
A1000	41° 24.5702' N	18-32.3585' E	1000	23-1 am

Results and Discussions

Figure1. Distribution of salinity and temperature along the investigated profile



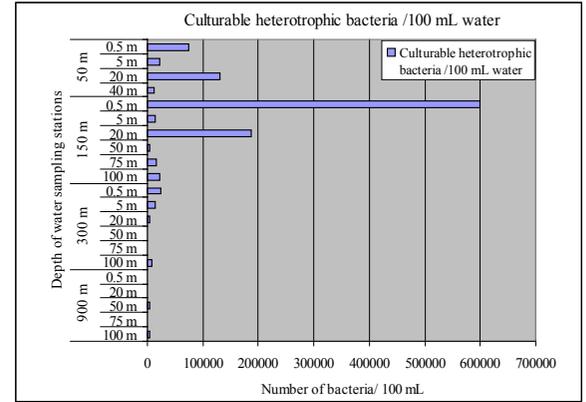
In the fig.1 the values of the salinity and temperatures are presented. Regarding to the salinity and temperatures the results show that the lower values of salinity are registered on the station A50 and they increase from the surface to the bottom, meanwhile the temperatures values decrease with the increase of the depth.

Table 2. The bacteriological data according to the samples stations

Sample stations	Water depth of the sampling stations	Culturable heterotrophic bacteria /100 mL water
A50	0.5 m	74000
	5 m	22500
	20 m	130000
	40 m	12500
A150	0.5 m	600000
	5 m	14500
	20 m	188000
	50 m	3500
	75 m	16000
	100 m	23000
A300	0.5 m	25000
	5 m	15000
	20 m	4500
	50 m	3000
	75 m	3000
	100 m	9000

A900	0.5 m	2500
	20 m	2500
	50 m	3500
	75 m	3000
	100 m	4500

Figure 2. Culturable heterotrophic bacteria / 100 mL water according to the sample stations



In our study the higher values of heterotrophic culturable bacteria are registered on the station A50 and A150 respectively in the depth 20 m and 0.5 m. The highest value is measured in the depth 20 m of the station A 150, 6.105 bacteria / 100 mL of water. In the ocean, bacterioplankton abundance averages about 0.5 billion per liter in continental shelf waters and above 200 m including *Prochlorococcus* spp and about 0.05 billion per liter in the deep ocean more than 200 m deep. The culturable heterotrophic bacteria (CFU) ranged between 0.1 and 22% of the total bacterioplankton with a maximum percentage in surface samples of coastal zones, (Ferguson L & al 1984). In our study the mean values of the heterotrophic culturable bacteria which are ranged from  $6 \cdot 10^6$  / liter to  $2.5 \cdot 10^4$  / liter are comparable with the acceptable values for the surface and depth ocean which are from  $5 \cdot 10^5$  to  $5 \cdot 10^4$ /L. The acceptable values can be less, or exceed this range, by an order of magnitude. But these values compared with those registered in the costal area of the Southern Adriatic Sea of Italy, from  $4.3 \cdot 10^7$  to  $6.7 \cdot 10^7$ /L, are average from ten to one hundred times lower, (L. Stabili & al 2004). According to the other authors, the mean number of total bacteria in seawater adjacent to the corals was  $1.9 \cdot 10^5$  -  $3.1 \cdot 10^4$  cells/ ml, (Yael, L & al 2006).

Mean values of bacterial densities were  $5.3 \times 10^4$  CFU/ml in Brindisi,  $5.8 \times 10^4$  CFU/ml in S. Cataldo,  $4.3 \times 10^4$  CFU/ml in Otranto and  $6.7 \times 10^4$  CFU/ml in S. M. di Leuca, (L.Stabili & al 2004).

In our study the differences in bacterial densities between the samples stations were estimated. The hydrodynamic circulation, the trophism and the geographical position of the examined sites contribute to justify the different bacterial density trends.

Conclusions

- The mean values of the heterotrophic culturable bacteria measured in the offshore central Adriatic Sea are lower than those measured by the other authors in the costal parts of the Adriatic Sea.
- The highest values of the heterotrophic culturable bacteria are registered in the depth of 0.5 m of the station A150 which are comparable with values registered by the other authors in the continental shelf waters.
- The main causes of the different values in bacterial densities are hydrodynamic circulation, the trophism and the geographical position of the samples stations.

**REFERENCE**

• "Adriatic Sea" Britannica Encyclopedia (2008). Online Library Edition 7. | • APHA (1988) Standard Methods for the Examination of Water and Wastewater. 20th Edn. American Public Health Association, Washington, DC | • Cavallo R.A, Acquaviva MI, Stabili L. (2009). Culturable heterotrophic bacteria in seawater and *Mytilus galloprovincialis* from a Mediterranean area (Northern Ionian Sea-Italy). *Environ Monit Assess.* 2009 Feb;149 (1- 4):465-75. | • Corinaldesi., E. Crevatin., P. Del Negro., M. Marini., A. Russo., S. Fonda-Umani., and R. Danovaro, (2003). Large-Scale Spatial Distribution of Virioplankton in the Adriatic Sea: Testing the Trophic State Control Hypothesis. *Applied Environmental Microbiology* 2003 May; 69(5): 2664–2673. | • Ferguson R L, Buckley E N, Palumbo A V. (1984), Response of marine bacterioplankton to differential filtration and confinement. *Appl Environ Microbiol*, 47:49–55. | • Puddu., R. La Ferla, A. Allegra, C. Bacci, M. Lopez, F. Oliva & C. Pierotti. (1998). *Hydrobiologia* 363: 271–282. Seasonal and spatial distribution of bacterial production and biomass along a salinity gradient (Northern Adriatic Sea) | • Stabili L., Cavallo R.A. (2004). Biodiversity of culturable heterotrophic bacteria in the Southern Adriatic Sea Italian coastal waters: *Scientia Marina* ISSN 0214-8358, Vol. 68, N°. Extra 1, 2004 pages. 31-41. | • Yael Lampert, Dovi Kelman, Zvy Dubinsky, Yeshayahu Nitzan & Russell T. Hill2 (2006). Diversity of culturable bacteria in themucus of the Red Sea coral *Fungia* scutaria. *FEMS Microbiol Ecol* 58 (2006) 99 –108 c - 2006 Federation of European Microbiological Societies. |