Bathing water profile in the coastal belt of the province of Pescara (Italy, Central Adriatic Sea)

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Abstract

The quality of bathing water is fundamental, not only from an environmental point of view but also due to the economic importance of tourism.

This paper examines the water profile in the coastal belt of the province of Pescara (Italy, Central Adriatic Sea) with reference to the microbiological parameters *Escherichia coli* and intestinal enterococci required by Directive 2006/07 of European Commission.

The water quality of 15 coastal beaches was surveyed; data were produced from monitoring and controls made available by the Abruzzo Regional Environmental Prevention and Protection Agency (ARTA) and extracted and elaborated for the period of interest (2010-2013).

Statistical analysis was used to confirm the aspects deduced from mean values of monitoring and control data for each stretch.

The data highlight critical situations in various parts of the coast; these problems can be attributed to river pollution, mainly due to the malfunctioning of the treatment plants for urban wastewater.

Keywords: bathing water directive, legislation, bacteria indicators, water quality.

1. Introduction

Microbial pollution is a serious ecological and public health concern in marine coastal zones used for recreation, especially those located near highly populated areas. It is believed that human activities can accelerate the rate of nutrient input into water ecosystems. Once discharged into the sea, surface runoff and insufficiently treated urban, municipal, domestic, and industrial waste may encourage intense growth of microplankton or become sources of infectious microorganisms (Wade et al., 2003; Fleisher et al., 1993). In particular, estuaries tend to be naturally eutrophic, with concentrated river water entering coastal sites and supplying nutrients that may support the occurrence and spread of microbial contamination. For prevention of water-borne diseases, regular monitoring of coastal waters is strongly recommended (Sanders et al., 2000; Wheeler et al., 2002).

In fact a large number of people use the sea and coastal environments for food, income and recreation, resulting not only in the (danger of) degradation of marine and coastal habitats but also in increasing conflict between various uses and, within the same use, between commercial, recreational and indigenous interests.

Instruments for environmental and natural resource management can be defined as institutional and administrative mechanisms that are adopted by government agencies to influence the behaviour of

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those who value the natural environment, make use of it, or cause adverse impacts as a side-effect of their activities (Greiner et al., 2000).

As natural resources have become scarcer, governments have looked for new approaches towards environmental management. There are many uncertainties about how to design appropriate administrative systems for achieving environmental objectives.

As a matter of general principle, it is very unusual for a single instrument to be capable of solving a complex problem. Instead, a mix of instruments is necessary both to tackle the variability in biological and physical conditions and to achieve the desired outcome, and this requires concerted activities from a range of stakeholders and individuals. We must thus consider whether direct regulations can and should play a supportive role, and whether the introduction of a wider range of incentive instruments needs to be accompanied by a change in administrative arrangements for the protection of resources and environment.

Government, financial, administrative and community resources are limited and must be deployed where they are most likely to have the greatest positive impact.

Therefore, it is important to assess the strengths and weaknesses of the range of possible incentive instruments in terms of the stated objectives and to identify the circumstances in which they are most likely to make a positive contribution to the desired outcome.

Three core criteria are commonly applied for policy evaluation. They are economic efficiency, equity and environmental implications. In the literature, this core set is expanded to lists of criteria of varying form and number.

Generally, a distinction is drawn between direct regulations and market-based instruments. Regulations are primarily based on legislative and regulatory provisions and are implemented through directives from regulatory authorities. On the other hand, market-based instruments, while supported by legislation, tend to devolve decision-making and opportunities for innovation to the market place. They usually allow for adaptive choice and constrained risk-taking by those whose behaviour is to be modified.

The Adriatic Sea is a region of the Mediterranean sea and is considered a very sensitive area due the scarce water circulation, the shallow waters and the heavy organic, eutrophication substances and other pollutants discharged through the main rivers (Stravisi et al., 1981) as shown in other studies (Scroccaro et al., 2010; Ostoich et al., 2011).

The study presents a preliminary assessment of the water profile through biological parameters required by Directive 2006/07/EC (European Community, 2006) to analyse the coastal belt of the province of Pescara (Italy, Central Adriatic Sea). These are determinant for bathing water quality and therefore critical from an environmental, health and economic point of view.

The purpose is to highlight any critical points where local institutions may use improvement instruments for sustainable management and use of the environment.

1.1 Bathing Waters Directive

People have long enjoyed the benefits, both physical and psychological, of bathing in salt water recreationally (Bartram et al., 2000). The ability of the visitors to access these benefits safely is vital to the tourist industry. Europeans are very concerned about the water quality of the sea, coasts, rivers and lakes since surface and coastal waters are used not only for leisure and recreational activities but also for other purposes including transport, food production and as a repository for sewage and industrial waste (Buckalew et al., 2006). In 1976, one of the first pieces of European environmental legislation came into existence.

The European Union Bathing Water Directive (76/160/EEC) set out standards for designated bathing waters to be complied with by all member states. In Italy, this directive became law in 1982 (DPR 470/82, 8 June). This law has been one of the first and most important elements of European Water Policy; there has been a considerable increase in bathing water quality at specific bathing sites, demonstrating that the directive is achieving its primary aim of protecting public health (Georgiou and Bateman, 2005). The directive required member states to identify popular bathing areas and to monitor bathing waters for indicators of microbiological and chemical pollution throughout the bathing season. In total, there were 19 quality parameters, both microbiological and physicochemical, but most of these substances were only monitored if there was a suspicion that they were present or if there had been a sudden deterioration in water quality.

In 2001, the European Commission began the process of reviewing this old legislation in order to increase the rigor of the directive.

The proposed changes in bacteriological sampling reflect the scientific advances that have been achieved in recent years. Decision no. 1600/2002/EC of the European Parliament and of the Council of 22 July 2002, laying out the Sixth Community Environment Action Programme, includes a commitment to ensuring a high level of bathing water quality. The recommendations were adopted by the European Commission in October 2002 (European Community, 2002). Some countries have expressed reluctance concerning the adoption of these higher standards because they believe that compliance will be difficult and expensive, and they feel that little ‘real’ progress has been made so far.

A new Bathing Water Directive (2006/7/EC) was adopted on 15 February 2006 after a long debate, which required a final agreement between the European Council and Parliament. The main point of deliberation was the higher threshold of health standards that bathing sites must attain to comply with the revised directive (Bartram et al., 2000; Directive 2006/7/EC).

Directive 2006/7/EC (European Community, 2006) on the management of bathing water quality drastically reduced the number of laboratory tests done in routine beach monitoring from an initial 19 (Italian Decree no. 470 of 1982, by which Directive 76/160/EEC on bathing waters was transposed into Italian law, fixed the following quality standard values: total coliforms = 2,000 CFU/100 mL; faecal coliforms = 100 CFU/100 mL; faecal streptococci = 100 CFU/100 mL, *Salmonella* = 0/L) to two key microbiological parameters (intestinal enterococci and *Escherichia coli*). According to available scientific evidence (European Community, 2002) provided by epidemiological studies (good quality: intestinal enterococci max of 200 CFU/100 mL; *Escherichia coli* max of 500 CFU/100 mL) these bacterial indicators provide the best match between faecal pollution and health impacts in recreational waters.

These two new microbiological parameters are thus considered the most sensitive and most important for assessing public health risk during bathing activity and recreational uses of water resources, and have replaced the range of parameters previously used. In fact, other existing parameters (mineral oils, pH, only in inland waters; algal bloom, only in areas at risk) or newly introduced parameters (residual bitumen, tar, floating material as timber, plastic, glass, rubber, etc.) now play a secondary role. The reduction in the number of parameters determines substantial cost savings without reducing the level of protection for citizens. Moreover, it results in a simplification of the activity and a decrease in costs related to the number of sampling points established on our territory. This activity focuses on those points, which may be more significant for further investigation. These parameters will be used to monitor and evaluate the quality of bathing waters identified, and to classify them by quality (Mansilha et al., 2009).

Both the Water Framework Directive 2000/60/EC (transposed into Italian law by Italian Decree no. 152 of 2006) and Directive 2006/7/EC on the management of bathing water quality, introduce an approach to microbiological impact assessment that is based on an integrated analysis of the different aqueous matrices involved: water (river, transitional and coastal water) monitoring, control of pressure sources, assessment of intervention measures.

Italy, like other member states, had two years, beginning 24 March 2006, during which to bring into force any new national laws, regulations or administrative processes needed to comply with the revised directive. However, it will take longer than this to bring the directive into full effect, as there are a number of deadlines to be met, the last of which is in 2015. By this date, the revised directive should be in operation across the entire European Union. The revised directive alters the method by which water quality is measured, focusing on the most relevant analytical parameters, which include microbiologic indicators such as intestinal enterococci and *Escherichia coli*, and setting new standards for inland and coastal bathing sites.

There is considerable epidemiological evidence in the literature to suggest that contact with polluted recreational water is a risk factor for gastrointestinal illness, including serious health problems such as infection with *Shigellasonneri*, *Escherichia coli O157*, protozoan parasites and enteric viruses, mainly derived from human sewage or animal sources (Pruss, 1998; Pond, 2005; Nichols, 2006). The groups at highest risk for disease are children, who tend to play for longer periods in

recreational waters and may swallow more water than adults, either intentionally or accidentally, and tourists, who lack immunity against local endemic pathogens (Guidelines for safe recreational water environments, 2003). In 1986, the United States Environmental Protection Agency (USEPA) recommended that *Escherichia coli* and enterococci monitoring replace faecal coliform monitoring in ensuring State Water Quality Standards (USEPA, 1986). The recommendation was based upon a study that demonstrated a statistically significant relationship between the rate of swimming-related illnesses and the concentrations of *Escherichia coli* and enterococci at freshwater beaches (Dufour, 1984; Edberg et al., 1997).
Bathing water quality is an important issue in the Abruzzo region (Fig.1). The region's coast extends 125.8 kilometres, stretching between the Tronto river and the Trigno river, which forms the eastern boundary of the region. About 75% of the coastal belt is typical of the Adriatic coastline, characterised by shallow and sandy waters, while the remaining 25 % is represented by low coast with beaches and gravel and high coast interspersed with small bays.
The quality of bathing water is fundamental, not only from an environmental point of view but also given the economic importance of tourism.

2. Materials and Methods

2.1 Sampling conditions

Over a period of six months, from April to September, natural water samples were collected from 15 near shore beach zones (Table 1) in the province of Pescara (Italy, Central Adriatic Sea). The Abruzzo Regional Environmental Prevention and Protection Agency (ARTA) is the institutional body responsible for environmental monitoring and controls.
All samples were collected in sterile bottles and were immediately transported to the laboratory and processed within 2–3 h of collection. Samples were analysed for two parameters: *Escherichia coli* (EC) and intestinal enterococci (ENT) using International Organization for Standardization (ISO) methods.
Data produced are available from the Regional Environmental Informative System and were extracted and elaborated for the period of interest (2010−2013).

2.2 Methods

These samples were examined, simultaneously and in parallel in according with the official Italian method (APAT, 2003), ISO 9308-2:1990 and ISO 9308-2:2012 for EC, using the miniaturised most probable number method (MMPN), and for ENT according to the official Italian method (APAT, 2003), ISO 7899-2:2003 using the miniaturised most probable number method (MMPN). Directive 2006/7/EC provides that bathing water can be classified according to the quality of water as excellent, good, fair and poor, based on the density of the indicators (the 95th percentile derived from the data of the last three/four years, Table 2).
The first classification according to the requirements of this Directive shall be completed by the end of the 2015 bathing season. In addition by the end of the 2015 bathing season Member States shall ensure that all bathing waters are at least 'Sufficient'. Also, they shall take such realistic and proportionate measures as considered appropriate with a view to increasing the number of bathing waters classified as 'Excellent' or 'Good'.
Bathing Waters may temporarily be classified as 'Poor' and still remain in compliance with this Directive. In such case the following conditions shall be are satisfied: adequate management measures to prevent, reduce or eliminate the causes of pollution must be adopted, including a bathing prohibition or advice against bathing, with a view to preventing bathers' exposure to pollution.

If a bathing water is classified as ‘Poor’ for five consecutive years, a permanent bathing prohibition or permanent advice against bathing shall be introduced. However, a permanent bathing prohibition or permanent advice against bathing may be introduced before the end of the five-year period if it is considered that the achievement of ‘Sufficient’ quality would be infeasible or disproportionately expensive.

2.3 Statistical analysis

Statistical analysis was performed using Graph Pad Prism 4 (Graph Pad Software Inc., San Diego, USA). Parametrical methods were used after having verified the existence of the required assumptions. In particular, the normality of the distribution and the equality of variances were assessed by the Shapiro-Wilk and Levene’s tests, respectively.
Data were expressed as means and standard deviations of the recorded bacteria concentrations values. The main effect (and any possible interaction) of the two factors under investigation (time elapsed and place) on the mean values of the dependent variable (bacteria concentrations) was assessed by using two-way ANOVA tests for each bacteria concentrations. A Tukey test was applied for pairwise comparisons.
The level of statistical significance was assessed as follows: $p > 0.05$ – no statistically significant differences; $p < 0.05$ – statistically significant differences; $p < 0.01$ – highly statistically significant differences; $p < 0.001$ – very highly statistically significant differences.

3. Results and discussion

3.1 Classification and quality status of bathing waters

The monitoring of bathing water enables local institutions and operators involved in the management of the sector for the recovery of critical areas to identify the quality of recreational bathing water and make informed decisions to protect public health.
The integration of environmental information, together with monitoring and a knowledge of the characteristics and specificities of the territory as well as enhancement of information processes and public participation are all essential factors to ensure a continuous improvement of water quality and consequently optimal use for bathers.
In the six-month period under study (2010-2013), natural water samples were collected from 15 near shore beach zones in the province of Pescara (Pescara, Città Sant’Angelo and Montesilvano). These zones were identified based on resort population density, the presence of structures used for bathing, the accessibility of bathing areas from the land, the bathing habits of the population and the possible pollution sources from land.
On the basis of the parameters referred to EC relating to quality, regarding the municipality of Pescara for the years 2010-2011 we note a level between good and excellent. However, for the year 2012 the monitoring point 1 showed poor quality, a result confirmed in the following year. Furthermore, while in 2012 the sampling point 9 showed an excellent quality level, in 2013 the level was poor (Table 3) .
Potential pollution sources could be attributed to the Pescara River that delimits the southern boundary of the town. As regards ENT, in 2010 and in 2011 we can identify a level between good and excellent. In 2012, we may note a deterioration of the points 1,4,6,9, confirmed in 2013 for the point 1,9 (Table 3).We may deduce that over several years the local institutions of Pescara have failed to intervene effectively with the various remediation and improvement activities of the water out of the depurator and of the transparency system on the part of the riparian collectors.
As far as the municipality of Montesilvano is concerned there was, over the period considered, a positive trend for the two parameters with a level of water quality between good and excellent.

The municipality of Città Sant'Angelo over the years 2010-2011-2012 shows the reference values for EC between good and excellent. In 2013, we note a critical point (14). As regards ENT, this critical point 14 is present as early as 2012 (Table 4).
The protection and safeguarding of the water quality are crucial objectives of the European Union and all governmental authorities due to the important implications it has on human health and the environment (Cabelli, 1983).
Moreover, the origins of marine pollution must be investigated in the river basin (Miglioranza et al., 2004). The control and monitoring of the quality of the coastal marine waters are particularly important in the Province of Pescara, where significant tourist centres are located.
Furthermore, the economic and urban development of the province produces significant discharges, both into the rivers and into the marine waters, with the need for efficient wastewater treatment plants (WWTPs).
Numerous epidemiological studies have assessed the relationship among point source or nonpoint source pollution and human health outcomes (Wade et al., 2003; Zmirou et al., 2003). More recent studies have focused on the effect of nonpoint source contamination on human health (Colford et al., 2007; Fleisher et al., 2010; Soller et al., 2010a, Wade et al., 2010).
According to these study, gastroenteritis, skin rash and respiratory illness were significantly more frequent in bathers compared to nonbathers (Boehm et al., 2012; McQuaig et al., 2012). In particulary, the incidence of illness was consistently correlated with the age and significantly higher among children and elderly persons (Harwood et al., 2014).
Although more information is needed, the analysis offers a static outlook of the environmental biological contamination of waters with mean data; the ANOVA statistical assessment was used to confirm the aspects deduced from mean values of monitoring and control data for each stretch.

3.2 Statistical assessment of monitoring and control data

The analysis of the obtained data shows the EC and ENT water concentrations in the different zones under investigation during four years of study.
No statistically significant differences in the EC and ENT concentrations were found among the places at Città Sant'Angelo and the different years respectively (Figs. 2A and 2B).
No statistically significant differences in the ENT concentrations were found among the places at Montesilvano and the different years respectively (Fig. 3B).
However, in Montesilvano two point zones (100 mt south of the Saline mouth and Zone in front of Via Leopardi) showed a significantly high mean EC concentration values when compared with the other point zones. In particular in zone called 100 mt south of the Saline mouth data analysis displayed a statistically significant difference between years 2010 and 2012 ($p < 0.05$), and between years 2012 and 2013 ($p < 0.01$) (Fig. 3A).
In Pescara EC concentration values were significantly high in two point zones (300 mt north of the Pescara river quay and Zone in front of Via Balilla). In particular at 300 mt north of the Pescara river quay the EC concentration showed the mean values significant increase related with time, statistically significant differences were showed between 2010 and 2012 ($p < 0.01$), moreover most statistically significant differences were found between 2011 and 2013 ($p < 0.001$) (Fig. 4A).
In Pescara ENT concentrations were high in two zones (300 mt north of the Pescara river quay and Zone in front of Vallelunga stream). In particular at Zone in front of Vallelunga stream the concentration showed a significative increase mean values related with time (Fig. 4B).
The problem may be attributed to the white waters that are poured into the sea (Piomba and Saline rivers) from an open channel that empties near the bathing area.
Increasing population and rapid urban development along the coastline have caused a dramatic increase of sewage discharge into rivers and the sea. Most of this sewage has undergone no more than primary treatment and threatens the health of aquatic ecosystems and directly and indirectly affects human health and recreational opportunities along the coast (Greiner et al., 2000). Tertiary

sewage treatment is necessary as a precautionary measure to achieve a high level of discharge quality and reduce these risks and other uncertain consequences of sewage pollution with long-term effect. For example, a treatment for decontamination could be the combination of Advanced Oxidation Processes (AOP) and biological treatment (Oller et al., 2011, Liberatore et al., 2012).
In comparison to primary treatment, tertiary systems require expensive investments and have higher running costs. In order to achieve a significant improvement of water quality and coastal conditions, it is essential that all of them are implemented and further supported by other incentives, for example adequate zoning regulations for coastal development and a range of educational measures.
In conclusion we consider the statistical differences of each bacteria concentrations in every city under investigation, we compared the EC and ENT concentration in every city area for every year respectivel. In particular the most criticism areas are placed in municipalities of Montesilvano and Pescara. EC concentration between years 2010-2012 showed a high statistically significant differences in municipality of Montesilvano in point 10 (100 mt south of the Saline mouth) and 11 (Zone in front of Via Leopardi). EC concentration between years 2010-2012 showed a very high statistically significant differences in municipality of Pescara in point 1 (300 mt north of the Pescara river quay). ENT concentration between years 2010-2013 showed a high statistically significant differences in municipality of Pescara in point 9 (Zone in front of Vallelunga stream).

Conclusion

The problem of bathing water quality is not a recent issue. Local governments have considered it from as far back as 1800. Nowadays institutional bodies provide regular controls for constant protection during recreational activities.
The control of coastal water bathing is important because pollution may threaten marine ecosystems and consequently the development of fisheries and aquaculture. At the same time, it is necessary to guarantee the quality of life for people and the growth of the tourism industry. Bathing waters and recreational activities are a resource of great economic and environmental importance and their safety is a primary goal in the management of the coastal area.
In Italy, a major control programme is undertaken every year. Italian bathing sites are the most strictly tested in Europe as for over twenty years Italy has adopted criteria that are more restrictive than those of the European Directive governing the sector. The data highlight critical situations in various parts of the coast in the province of Pescara, with the result that bathing has been prohibited at different points. These problems can be attributed to river pollution, mainly due to the malfunctioning of the treatment plants for urban wastewater. These plants are undersized and overloaded, especially in summer.
Sewerage works and pollution control measures must be implemented in the coming years and these actions will have substantial implications for investment in the province.

Figures and tables

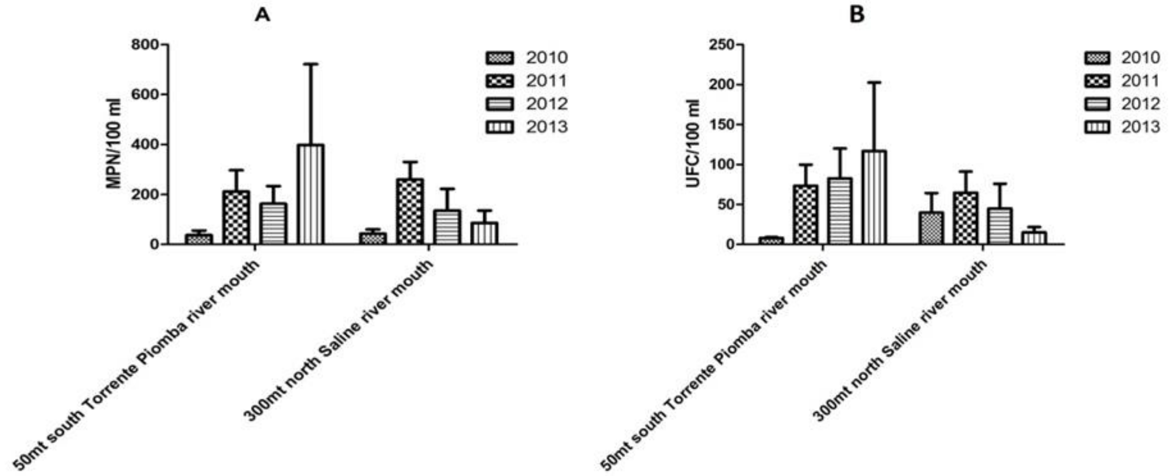


Fig. 1. Data were expressed as means and standard deviations of the recorded bacteria concentrations values and assessed by using two-way ANOVA tests. A Tukey test was applied for pairwise comparisons. Città Sant'Angelo municipality, EC (A) and ENT (B).

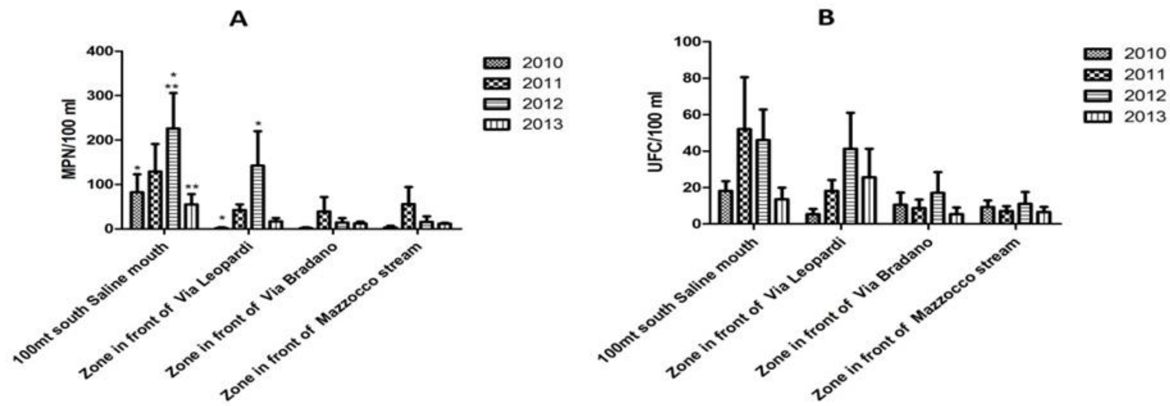
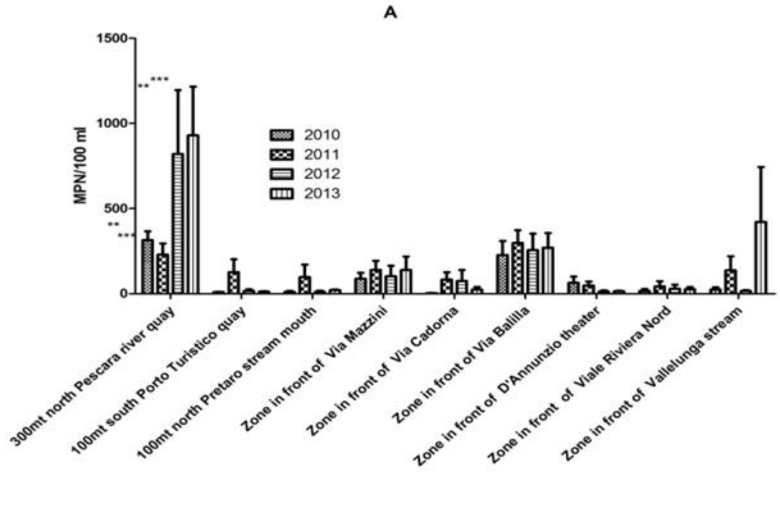


Fig. 2. Data were expressed as means and standard deviations of the recorded bacteria concentrations values and assessed by using two-way ANOVA tests. A Tukey test was applied for pairwise comparisons. Montesilvano municipality, EC (A) and ENT (B).



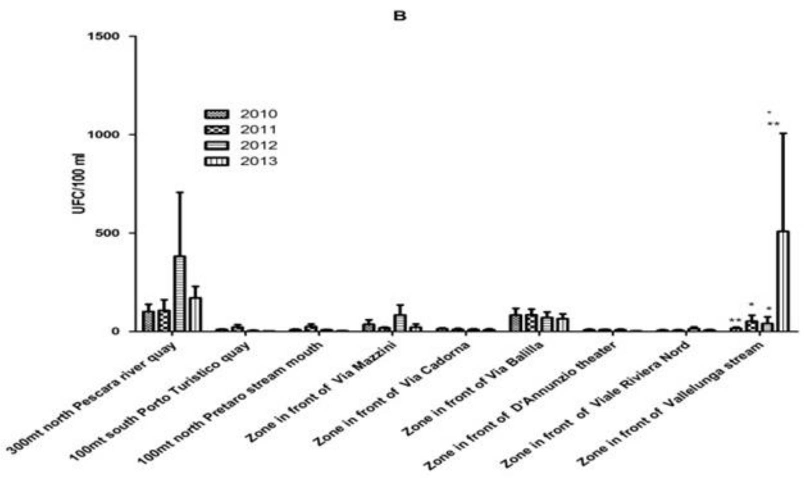


Fig. 3. Data were expressed as means and standard deviations of the recorded bacteria concentrations values and assessed by using two-way ANOVA tests. A Tukey test was applied for pairwise comparisons. Pescara municipality, EC (A) and ENT (B).

Table 1
Monitoring points

Number of monitoring points	Monitoring areas
	Municipality of Pescara
1	300 metres north of the Pescara river quay
2	100 metres south of the Porto Turistico quay
3	100 metres north of the Pretaro stream mouth
4	Zone in front of Via Mazzini
5	Zone in front of Via Cadorna
6	Zone in front of Via Balilla
7	Zone in front of D'Annunzio theater
8	Zone in front of Viale Riviera Nord
9	Zone in front of Vallelunga stream
	Municipality of Montesilvano
10	100 metres south of the Saline mouth
11	Zone in front of Via Leopardi
12	Zone in front of Via Bradano
13	Zone in front of Mazzocco stream
	Municipality of Città Sant'Angelo
14	50 metres south of the Torrente Piomba river mouth
15	300 metres north of the Saline river mouth

Table 2
Table of the proposed requirements for coastal waters and transitional waters

Requirement	Parameters	Level of quality			
		A Excellent quality	B Good quality	C Sufficient quality	D Poor quality
1	Intestinal Enterococci (CFU/100ml)	100*	200*	185**	>185**
2	Escherichia coli (CFU/100ml)	250*	500*	500**	>500**

(taken from Directive 2006/7/EC).
* Based upon a 95-percentile evaluation.
** Based upon a 90-percentile evaluation.

Table 3
Municipality of Pescara

Monitoring points	Parameters	Year						Avg	Ds	95th percentile	90th percentile	Quality
		Sept	Aug	July	June	May	April					
2012												
1	ENT	300	2500	1	80	100	40	503,5	983,56	1950	1400	D
	EC	1184	306	271	0	659	2500	820	918,57	2171	1660	D
2	ENT	12	0	0	1	0	10	3,83	5,6	11,5	11	A
	EC	0	0	0	53	0	42	15,83	24,77	50,25	47,5	A
3	ENT	7	16	8	1	14	0	7,67	6,53	15,5	15	A
	EC	100	453	10	0	0	20	97,17	178,36	364,75	275,08	B
4	ENT	155	12	2	6	310	12	82,83	125,92	271,25	232,5	D
	EC	31	31	0	0	164	384	101,67	151,17	329	274	B
5	ENT	13	80	4	0	0	30	21,17	30,97	67,5	55	A
	EC	0	20	20	0	0	400	73,33	160,33	305	236,67	B
6	ENT	450	198	12	39	20	100	136,5	168,51	387	324	D
	EC	478	99	0	31	478	450	256	235,38	478	464	B
7	ENT	7	30	0	0	0	5	7	11,66	24,25	18,5	A
	EC	0	31	0	0	0	40	11,83	18,55	37,75	35,5	A
8	ENT	2	3	8	5	0	60	13	23,19	47	34	A
	EC	0	20	0	0	0	150	28,33	60,14	117,5	89,17	A
9	ENT	9	0	600	210	20	7	141	238,89	502,5	405	D
	EC	0	20	31	0	10	31	15,33	14,22	31	31	A
2013												
1	ENT	80	24	380	280	210	50	170,67	142,56	355	330	D
	EC	1184	10	2005	1184	831	364	929,67	701,6	1799,75	1594,5	D
2	ENT	1	1	4	2	2	1	1,83	1,17	3,5	3	A
	EC	10	10	20	10	10	10	11,67	4,08	17,5	15,83	A
3	ENT	1	2	3	10	1	1	3	3,52	8,25	6,5	A
	EC	10	20	10	31	20	31	20,33	9,4	31	31	A
4	ENT	1	5	8	10	100	8	22	38,34	77,5	55	A
	EC	10	10	10	53	478	271	138,67	194,76	426,25	374,4	B
5	ENT	1	4	3	3	35	1	7,83	13,36	27,25	19,5	A
	EC	10	10	10	10	99	10	24,83	36,33	76,75	61,92	A
6	ENT	25	15	60	30	78	180	64,67	61,23	154,5	129	B
	EC	87	10	406	150	478	490	270,17	212,44	487	484	B
7	ENT	1	1	6	1	3	1	2,17	2,04	5,25	4,5	A
	EC	10	10	10	10	31	10	13,5	8,57	25,75	22,25	A
8	ENT	1	2	2	15	17	1	6,33	7,53	16,5	16	A
	EC	10	10	10	31	87	10	26,33	30,88	73	59	A
9	ENT	1	3	6	36	3	3000	508,17	1220,82	2259	1518	D
	EC	10	10	31	406	64	2005	421	790,78	1605,25	1213	D

Table 4
Municipality of Città Sant'Angelo

Monitoring points	Parameters	Year						Avg	Ds	95th percentile	90th percentile	Quality
		Sept	Aug	July	June	May	April					
2012												
14	ENT	198	85	20	2	1	190	82,67	83,6	195,6	193,2	D
	EC	271	99	150	0	10	450	163,33	172,21	405,25	360,5	B
15	ENT	196	6	10	3	4	50	44,83	69,54	152,2	108,4	B
	EC	324	0	0	0	10	480	135,67	212,15	441	402	B
2013												
14	ENT	9	1	17	540	100	34	116,83	210,35	413,05	286,1	D
	EC	10	10	20	2005	222	124	398,5	791,51	1559,25	1113,5	D
15	ENT	6	1	10	40	32	1	15	16,8	37,6	35,2	A
	EC	31	10	42	324	99	10	86	121,1	267,75	211,5	B

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