Middle East Journal for Scientific Publishing

Vol. 2, Issue No. 3, 1-8 (2019)

# Bacteria in the coastal Environment

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**Received: 5 June 2019, Revised: 18 June 2019, Accepted: 26 June 2019**

**Published online: 6 Oct. 2019.**

## Abstract

The use of beaches for recreation is a widespread activity for many people globally. For many years there have been concerns over public health for those visiting beaches. Bathing in coastal waters polluted with fecal contamination is estimated to cause more than 120 million cases of gastrointestinal illness and 50 million cases of respiratory disease around the world. The variety of diseases associated with beaches contaminated with fecal pathogens can come from a large variety of pathogens. Pathogens include various types of bacteria, viruses, protozoan parasites, and other organisms. Pathogen sources are also numerous and complex. Sources can be defined as point and non-point (diffuse) sources. Known sources include wastewater treatment facilities, combined sewer overflow, agricultural runoff, leaky septic tanks, urban runoff, boat discharge, local animal populations, and others. The most common indicator bacteria in use today are E. coli and Enterococci. It is important to distinguish the use of these two bacteria from other bacterial groups that could be used(Bevers, 2015).

**Keywords:** FIB, Bacteria, E.coli, Enterococci, Coastal Environment, hydrocarbon-utilizing bacteria.

## Introduction

Coastal beach water quality is important to the public health and economic well-being of coastal communities. Recreational water is an important transmission route of water-borne pathogens and can result in large-scale disease out-breaks. To protect the public from health risks associated with contaminated recreational water, beach advisories and closures are frequently issued. The National Research Defense Council (NRDC) reported that in 2009 beach water pollutions caused beach closures and advisories to exceed 20000 for the fourth consecutive year in the U.S. A separate survey by the U.S. EPA indicated that 40% of 3762 beaches monitored in 2012 experienced at least one advisory or closure. Frequent beach advisories and closures can hurt the economy of coastal communities, which increasingly relies on tourism and recreation, and the impact can be very significant because about 75% of the world's unfrozen shorelines are sandy beaches(Zhang, He, & Yan, 2015).

## The study problem

This study discussed many topics relevant to the Bacterial especially Fecal Indicator Bacteria (FIB) and hydrocarbon-utilizing bacteria in the coastal environment. The study showed the factors that affect on FIB and what is the effect of temperature and seasonal changes in the bacteria levels? And how the fecal Microorganisms transported by Gulls?

The study also discussed the coastal sewage discharge and its impact on fish.

## What distinguishes this study from previous studies?

In this study, we talk about more than one type of bacteria in the coastal environments and more than one country like FIB in U.S. and hydrocarbon-utilizing bacteria in Oman.

# The study content

### 1.0 Fecal indicator bacteria (FIB)

Fecal indicator bacteria are a group of bacteria inhabiting the intestines of warm- blooded animals and are used in water quality assessments to indicate potential exposure risk from pathogens associated with fecal waste. The most practical way to circumvent the expense and difficulty of detecting true fecal pathogens is to use surrogates. The EPA recommends the fecal indicator bacteria (FIB) Escherichia coli and enterococci as two ideal proxies for fecal pathogens when monitoring or assessing water quality. Escherichia coli is a Gram negative, rod-shaped, motile, and facultative anaerobe that is classified as a thermotolerant coliform (fecal coliform) capable of lactose fermentation. Enterococci are Gram positive, spherical shaped (coccus), nonmotile, facultative anaerobes that can be grown at a wide range of conditions. The fecal indicator bacteria can be modulated by a number of factors, such as temperature, ultraviolet light, land use, and rainfall(Bailey, Farone, Fischer, Otter, & Wang, 2019).

### 2.0 Seasonal change in bacteria levels

A study on 32 sample sets were used to analyze the seasonal change in E. coli and Enterococci levels. Each sample set was taken on the same date and broken up into 6 categories; E. coli swash zone, E. coli up shore, E. coli water, Enterococci swash zone, Enterococci up shore, and Enterococci water. The date range was from April 3rd to August 21st, 2013. The bacteria count for the swash zone and up shore were recorded as MPN/100 grams of sand and the water samples were recorded as MPN/100 mL.

All of the samples showed increasingly higher bacteria counts as time passed from spring to summer(‘SEASONAL CHANGE IN BACTERIA LEVELS AND ELUENT COMPARISON FOR THE ENUMERATION OF E . COLI AND ENTEROCOCCI FROM RECREATIONAL BEACH SAND by Kyle Hines A

Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Engine', 2013).

### 3.0 Factors affecting fecal indicator bacteria

FIB is presented in three unique exposure pathways that could ultimately impact human health.

### 3.1 Surface waters

Elevation in the salinity and solar radiation have been shown to decrease fecal coliform survival. Cooler sediment temperatures in coastal waters were found to increase survival whereas E. coli concentrations were higher in warmer months in other studies.

### 3.2 Beach sand

Epidemiological studies have demonstrated that with beach sand can result in gastrointestinal illness and that enteric illnesses are associated with densities of fecal indicator organisms in beach sand. Recent research conducted by Heaney et al. (2014) reported that factors like sand-wetting, fecal indicator concentrations in adjacent water, and wave height had an influence on numbers of fecal indicators found in sand.

### 3.3 Pipe infrastructure

In one study, fixed bacterial biomass on cement coupons was found to be 2.6 times higher than on PVC coupons, and in another, heterotrophic plate counts of a biofilm were 100 times higher on galvanized steel coupons than PVC, copper, and stainless steel(Bailey et al., 2019).

### 4.0 Temperature and FIB levels

Florida Healthy Beaches Program (FHBP) has collected bacteria (enterococci and fecal coliform) and environmental data for coastal beaches throughout Florida, including Monroe County. FIB and temperature data were retrieved from the FHBP database for the 2000 to 2015 period of record. Each FIB data point in the database was paired with a temperature value.

Temperature data from the FHBP shows a correlation of increasing FIB levels with increasing air and water temperature between the temperature range of 15 to 28°C(Barreras, Kelly, Kumar, & Solo-Gabriele, 2019).

**5.0 Transporting fecal Microorganisms to the beach by Gulls**

Contamination of recreational beaches due to fecal waste from gulls complicates beach monitoring and may pose a risk to public health. Gulls that feed at human waste sites may ingest human fecal microorganisms associated with that waste. If these gulls also visit beaches, they may serve as vectors, transporting fecal microorganisms to the beach where they may subsequently contaminate sand and water(Alm et al., 2018).

**6.0 Coastal sewage discharge and its impact on fish**

Presence of antibiotic resistant bacteria as bio-indicators of pollution was monitored in fish (colons and gills) and in sewage treated effluent (STE) in two marine sites in the Gulf of Oman, Muscat. One site was polluted as the sewage effluent STE was directly discharged into the sea while the unpolluted site was 10 km away. A total of 42 water samples (250 mL each) were collected from both sites. In the polluted site, 14 samples were taken directly from the STE discharge point and 14 from the surrounding area near the STE discharging point (7–10 m). Water and fish samples were collected from polluted and unpolluted sites. Chlorine and nitrate levels were significantly higher in STE samples. A significant difference ($P < 0.005$) was found in total bacterial count of fish colon and gills in the two sites. Most probable number (MPN) was significantly higher in STE and polluted seawater over unpolluted. Coliforms were detected in the polluted site only. A total of 320 target enteric normal flora of animals and pathogenic species were isolated from 10 genera taken from water and fish samples. The isolates were exposed to 14 antibiotics. Most of the isolates were resistant to at least one antibiotic with ampicillin was the dominant antibiotic. This is a clear indication that sewage effluent causes contamination of marine wildlife along coastal lines(Al-bahry et al., 2009).

**7.0 Bioremediation potential of coastal materials for oil-polluted sea water& the numbers of hydrocarbon-utilizing bacteria they naturally harbor**

Inshore water of the Arabian Gulf was found to contain only about one thousand hydrocarbon-utilizing bacteria per ml. Coastal sand, cyanobacterial mats and epilithic biomass were much richer in these bacteria, with numbers ranging between several thousand-fold to several million-fold than in the water body. The predominant bacterium in all samples was Acinetobacter calcoaceticus, next in predominance were nocardioforms and Micrococcus sp. Inoculation, in batch cultures, of oily sea water or sea water containing pure hydrocarbons with fresh sea water, coastal sand, cyanobacterial mats or epilithic biomass harboring significantly different numbers of hydrocarbon-utilizing bacteria brought bioremediation effects that depended on fertilizing with KNO3. In the absence of KNO3, the bioremediation effect increased with numbers of hydrocarbon-utilizing bacteria in the inoculum. In the presence of KNO3 similar bioremediation effects were found irrespective of the inoculated materials. The reason may be that bacteria reproduce quickly in closed cultures provided with nitrogen, reaching equal maximum numbers, irrespective of the inoculum size(Al-awadhi, Al-hasan, & Radwan, 2002).

## The Results of the study

The effect of the FIB and other harmful bacteria is so dangerous on the life of human but there are useful bacteria like hydrocarbon-utilizing bacteria which save the marine life from oily materials.

## The suggestions

It is critically important to understand the followings:-

1- What factors and processes affect the fecal pollution in coastal areas?

2- Where and when the pollution events occur?

3- How we can calculate the FIB pollutant loadings from coastal marshes into the coastal waters?

## Conclusion

It is necessary to develop effective ways to protect coastal environments and minimize the potential pollution sources.

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