

ASSATEAGUE ISLAND NATIONAL SEASHORE

BEACH WATER QUALITY REPORT 2006



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ABSTRACT:

National Park Service staff monitored the presence of bacterial indicators of fecal contamination at six ocean beach locations within Assateague Island National Seashore weekly from 22 May to 5 September, 2006. Using guidelines developed by the Environmental Protection Agency (EPA), water samples were collected from high-use public bathing beaches, and analyzed for the presence of enterococci bacteria. Assay results were compared to EPA-recommended numeric standards on a weekly basis and used to assess risk to swimmer health from contaminants. Sample results ranged from < 10 to 42 Most Probable Number (MPN) of colonies of enterococci bacteria per 100 ml, and were all within the range of values considered indicative of safe conditions for water contact.

INTRODUCTION:

Water contact recreational activities (e.g. swimming, surfing) in marine waters contaminated with human fecal material can result in swimmer gastroenteritis and other related illnesses, with viruses being the probable causal agent. As the number of people living in the coastal zone continues to increase, so too do the risks to public health from inadequately treated sanitary wastes. Bathing beach closures due to fecal contamination during the late 1980's in New Jersey and Delaware escalated concerns over bathing beach water quality at Assateague Island National Seashore, Maryland and Virginia.

Beach water quality monitoring at Assateague's ocean bathing beaches began in 1990, as part of a Maryland Department of the Environment (MDE) bathing beaches bacterial monitoring program. This cooperative effort, which was continued in 1991, consisted of monthly fecal coliform bacteria determinations at Maryland's ocean beaches. While this program provided useful background information, it was not considered to provide an adequate level of monitoring to assure the protection of public health at heavily used marine bathing beaches located on Assateague Island (ASIS 1992). This was due to the once a month sampling frequency and a sole reliance on fecal coliform bacteria as an indicator organism.

In 1991 the National Park Service conducted a two-year pilot program to evaluate the efficacy of bacterial water quality monitoring at Assateague Island. This program provided for the weekly monitoring of enterococci bacteria, which is a public health related bacterial indicator group recommended for marine and brackish waters by the Environmental Protection Agency (EPA), (US Environmental Protection Agency, 1986).

Protocols proposed in 1992 outlined procedures for sampling, analysis, data interpretation and management response using the EPA's recommended guidelines. These protocols were developed in part by the Water Resources Division of the National Park Service, the US Office of Public Health and the NPS staff at Assateague. The Beach Water Quality Monitoring Program was designed from information contained in the 1992 protocols and data collected from the 1991-1992 two-year pilot program.

High levels of bacteria, which can indicate the presence of pathogens from human or animal waste, are responsible for the overwhelming majority of beach closings and advisories. The major causes of high bacteria levels in beach water are: inadequate and overloaded sewage treatment plants, raw sewage discharges from combined or sanitary sewers, polluted storm water run-off, faulty septic systems, and boating wastes (Natural Resources Defense Council, 1993).

The wide range of diseases associated with sewage contaminated waters includes gastroenteritis, dysentery, and hepatitis. The consequences of contracting swimming-associated illnesses can be greater for children, elderly people, and others with weaker immune systems (Natural Resources Defense Council, 1993).

The analysis of beach water samples for enterococci using the Enterolert analytical technique provides a method to assess the potential presence of contaminants in the water, but does not pinpoint the specific cause of illnesses. Assays designed to find the specific bacterial/viral causes of swimmer associated illnesses are expensive and time consuming. At this time the enterococci indicator is considered by the EPA to be the most reliable test to protect public health in ocean bathing waters.

Assateague Island National Seashore compared results from the 2000, 2001 and 2002 swimming seasons between the membrane filtration (MF) analytical method and the Enterolert analytical method employed by the Maryland Department of Health and Mental Hygiene's (MD DHMH) Eastern Shore Regional Laboratory (ESRL). This method employed by the MD DHMH laboratory still uses enterococci bacteria as an indicator; however the Enterolert method provides results in 24 hours instead of 48 hours required by the membrane filtration technique. After consultation with the EPA, Assateague Island National Seashore switched over to the Enterolert analytical technique and selected the MD DHMH Eastern Shore Regional laboratory as the new contract lab in April 2003. The Enterolert method was chosen to reduce analytical costs and cut response time and travel costs in half.

METHODS:

Assateague Island National Seashore Natural Resource Management staff monitored water off ocean beaches weekly for enterococci bacteria. This sampling was performed from May through September. Six National Park Service (NPS) sites were sampled weekly for enterococci. These sites are located from the Assateague State Park boundary, south through the National Seashore and Chincoteague National Wildlife Refuge to Toms Cove in Virginia at the southern end of the Island (figure 1). In cooperation with the state of Maryland and Worcester County, ASIS staff also collected water samples every week for enterococci bacterial analysis at Assateague State Park. All samples were analyzed for enterococci bacteria using the Enterolert technique.

Site 1A Concession Building: Located across from the Concession building in the State Park, samples are collected for Worcester County. No NPS samples are collected here. [Life-guarded beach]

Site 1B F Loop: Located across from the F Loop campground in the State Park, samples are

collected for Worcester County. No NPS samples are collected here. [Unguarded beach]

Site 1 State Park Boundary (STB1): Located at the boundary between the State Park and National Seashore. NPS and Worcester County samples are collected. [Unguarded beach]

Site 2 Ranger Station (RST2): Located across from the Ranger Station dune crossing. NPS and Worcester County samples are collected. [Life-guarded beach]

Site 3 Oceanside (OCS3): Located approximately 0.6 miles south of RST2, across from the ocean-side campground. NPS and Worcester County samples are collected. [Unguarded beach]

Site 4 South Beach (SBE4): Located across from the South Beach parking lot and approximately 0.5 miles south of OCS3. NPS and Worcester County samples are collected. [Unguarded beach]

Site 5 Toms Cove North (TCN5): Located at the Toms cove district in Virginia, north of the traffic circle and across from the northern boundary of the beach parking area. Only NPS samples are collected. [Unguarded beach]

Site 6 Toms Cove South (TCS6): Located at the Toms cove district in Virginia, south of the life guard stand and in front of the Southern boundary of the guarded beach area. Only NPS samples are collected. [Life-guarded beach]

Sample collection was performed by staff and volunteers trained in aseptic procedures and sample bottle handling. Sterile 125 ml sample bottles, provided by MD DHMH lab in Salisbury, were properly handled to avoid contamination and placed upright in an ice filled cooler. At each sample site the technicians would wade into the surf to about mid-thigh depth with a 1000 ml plastic sampling ladle. This ladle was rinsed in seawater at least two times after an in-coming wave passed, then filled with seawater. On the beach, this sample water was poured into the sterile, pre-labeled sample bottle, capped and stored on ice for transport. The remaining water in the ladle was used to measure water temperature and salinity.

Data collected in the field included site number, bottle number, and time that sample was taken, air temperature in the shade, water temperature and salinity. Temperature measurements in °C were collected using VWR Scientific Digital Thermometers (1% accuracy). Salinity concentrations were determined using an SPER Scientific model 300011 salinity refractometer which was calibrated at 0 parts per thousand (ppt) with distilled water before sampling. Weather conditions were noted in the field and checked off on the data sheet as either: sunny, cloudy, overcast, raining, windy, calm or other. Rainfall amounts were determined using a rain gauge located at Assateague Island National Seashore headquarters. Tide predictions were obtained from the National Oceanic and Atmospheric Administration's National Ocean Service website for Ocean City, MD and for Toms Cove, VA. Lastly, field comments were noted at the bottom of each data sheet.

The Maryland DHMH Eastern Shore Regional Laboratory in Salisbury, Maryland performed laboratory analysis of all NPS and Worcester county beach water samples for enterococci

bacteria. Assateague staff transported samples on ice within 6 hours of the first sampling event. Laboratory personnel received the water samples for processing, measured the temperature of the cooler and Assateague staff picked up new sterile sample bottles and MD DHMH data sheets for the next week.

The Enterolert analytical method employed by the Eastern Shore Regional Laboratory provides results in just 24 hours instead of 48 hours required by the MF technique. The laboratory reported the results to the Park by fax and mailed hard copies of the results within two weeks. Laboratory results and field data were entered into an Access/Excel database. This database was also used to store and calculate the geometric mean (geomean) of the enterococci counts for the year.

The geomean of sample results is used to evaluate bacteria levels over consecutive sampling periods. The geomean is calculated using the present lab counts plus the previous four sample results. The formula used to calculate the geometric mean is as follows: $GMy = \text{antilog } 1/N \sum \log y$. The geomean, GMy, is the antilogarithm of the mean of the natural logarithms of the sample counts (y). This formula is programmed into the database to automatically calculate the geomean of the water samples.

The Enterolert protocol for marine waters requires 10ml of the collected sample be diluted in a 90ml sterile blank for a total volume of 100ml. As a result tests producing zero colonies / 100ml are reported as <10 (0-9) to give a more accurate representation of this sub-sample. For the purpose of calculating the geomean all results reported as <10 were entered into the database as 9 (Table 2). The results of this calculation provide a pre-programmed margin of safety by delivering a calculated value that is most likely higher than the actual geomean.

Assateague's Beach Water Quality program follows guidelines and management actions recommended by the EPA. These guidelines include the following:

A: exceedance of the recommended criteria will be signaled when the geometric mean of a minimum of five samples, taken within a 30-day period, at any location, equals or exceeds 35 enterococci colonies/100ml. (US EPA)

B: exceedance of the recommended criteria will be signaled when any single sample taken at any location along a designated guarded beach equals or exceeds 104 colonies/100ml. (US EPA)

C: exceedance of the recommended criteria will be signaled when any single sample at any location not designated a guarded beach equals or exceeds 158 colonies/100ml. (US EPA)

Management actions include notification of Assateague's Superintendent and the Chincoteague Wildlife Refuge Manager by the Chief of Resource Management at ASIS when any of the above listed criteria are exceeded. Further actions require the consultation of the National Park Service US Public Health Service representative. After the consultation further responses, which include re-sampling and/or beach closures may be necessary. Local officials will be notified if a decision

is made to post a public health advisory or to prohibit swimming. In addition, the Chief of Resource Management will advise the Head Lifeguard at any time enterococci counts exceed 75 colonies/100ml at a designated guarded beach. This precautionary notification will be made in order that the Head Life Guard may evaluate the need to modify lifeguard training drills to minimize full body contact and the unintentional swallowing of water.

RESULTS AND DISCUSSION:

The 2006 Beach Water sampling season began on 22 May and continued weekly until 5 September for a total of 16 weeks of routine sampling sessions (Table 1). No beaches were closed in 2006 and no NPS samples exceeded EPA guidelines. On 7 Aug the highest single bacterial count of the year, 42 colonies/100ml, was measured at Oceanside Campground (OCS) (figure 4). All Bacterial counts reported as <10 (0-9) are graphically represented as 1. Sampling took place during a light rain and the tide was at early ebb. It is likely that the rain in addition to the recent high tide contributed to the slightly elevated counts. This single bacterial count was well below the EPA guideline of 158 colonies/100ml for a non life-guarded beach. The next highest single bacterial count of 31 colonies/100ml was also measured at Oceanside Campground (OCS) on 30 May (figure 4). No precipitation was recorded within 24 hours of sampling but 0.38 inches were recorded within the past 72 hours. Horse feces were observed on the beach near the sampling site and the tide was at max flood. It is likely that the presence of horse feces on the beach at the time of sampling contributed to the slightly elevated bacterial counts however no exceedance of EPA guidelines was measured and no further action was taken. The highest calculated geometric mean for the 2006 sampling season was 14.67 MPN which is well below the EPA guideline of 35 colonies/100ml (Table 2).

Ocean water temperatures ranged from 13.7°C (56.66° F) in late May and rose to a high of 25.7°C (78.26°F) in early August (figure 8). The average ocean water temperature for the 2006 season was 20.2° C (°F) which was slightly cooler than the 2005 average of 20.4° C (°F). Although the 2006 average temperature was below the 2005 average temperature, it remained consistent with the long term average ocean temperature for the majority of the season (figure 9). Rainfall amounts from the Remote Automated Weather Station (RAWS) located on the island showed the summer of 2006 to be wetter than the previous year with 17.60 inches of rain during the sampling period and 10.90 inches for the same time period in 2005. However, total rainfall was much closer to the long term average of 15.11 inches for the sampling period. Salinity measurements ranged from a minimum of 28 ppt to a maximum of 34 ppt. The temperatures and salinity recorded during this sampling season indicate a normal range of variation for the area and time of year.

The Assateague Island National Seashore Beach Water Quality monitoring program did not detect any exceedance of EPA guidelines in 2006. Assateague Island National Seashore and the National Park Service will continue to use enterococci bacteria as an indicator and employ the Enterolert analytical method. At the present level, the program is believed to be effective in monitoring the water quality of Assateague's beaches and in helping protect the visiting public from possible health risks.

ACKNOWLEDGEMENTS:

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TABLE 1
2006 Enterococci Colony Counts
MPN/100MLS

Date	STB	RST	OCS	SBE	TCN	TCS
22-May	9	9	9	10	9	10
30-May	9	9	31	10	9	9
5-Jun	9	9	9	9	9	9
12-Jun	9	9	9	10	10	9
19-Jun	20	9	9	9	9	9
26-Jun	9	10	9	10	9	9
5-Jul	9	9	9	9	9	9
10-Jul	9	9	9	9	9	10
17-Jul	9	9	9	9	9	9
24-Jul	9	9	9	9	9	9
31-Jul	9	9	10	9	9	9
7-Aug	9	10	42	10	9	9
14-Aug	10	10	9	9	9	9
21-Aug	9	9	9	20	9	9
28-Aug	9	9	10	9	9	9
5-Sep	9	9	20	9	9	9

TABLE 2
2006 Enterococci Geometric Mean

Date	STB	RST	OCS	SBE	TCN	TCS
19-Jun	10.56	9.00	11.53	9.59	9.19	9.19
26-Jun	10.56	9.19	11.53	9.59	9.19	9.00
5-Jul	10.56	9.19	9.00	9.39	9.19	9.00
10-Jul	10.56	9.19	9.00	9.39	9.19	9.19
17-Jul	10.56	9.19	9.00	9.19	9.00	9.19
24-Jul	9.00	9.19	9.00	9.19	9.00	9.19
31-Jul	9.00	9.00	9.19	9.00	9.00	9.19
7-Aug	9.00	9.19	12.51	9.19	9.00	9.19
14-Aug	9.19	9.39	12.51	9.19	9.00	9.00
21-Aug	9.19	9.39	12.51	10.78	9.00	9.00
28-Aug	9.19	9.39	12.77	10.78	9.00	9.00
5-Sep	9.19	9.39	14.67	10.78	9.00	9.00

*Geometric Mean for results reported as <10 calculated as 9

Key: STB=State Park Boundary, RST=Ranger Station, OCS=Oceanside, SBE=South Beach, TCN=Toms Cove North, TCS=Toms Cove South

Figure 1

2006 Beach Water Quality Monitoring Sites

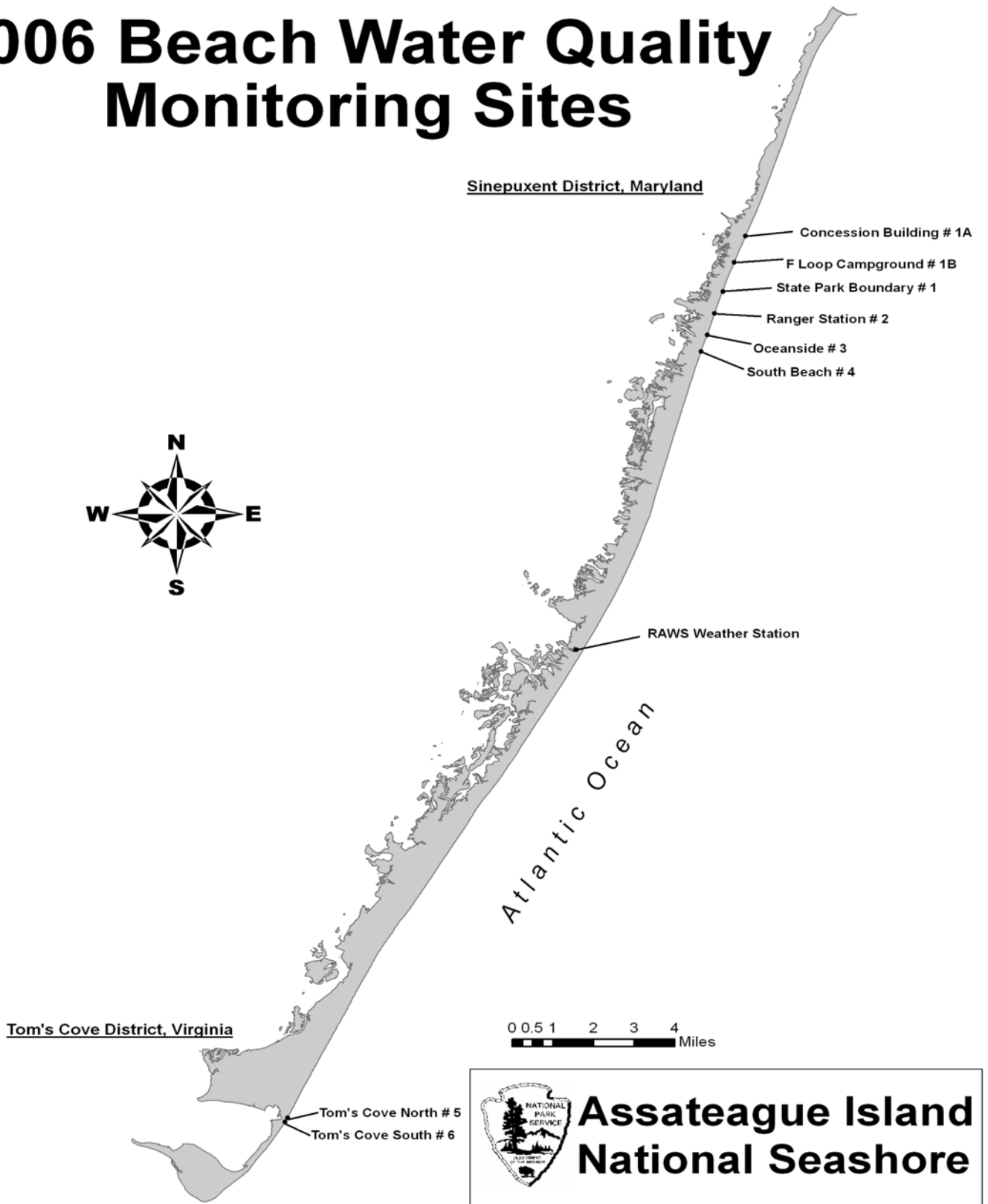


Figure 2: State Park Boundary (STB 1) Enterococci Counts

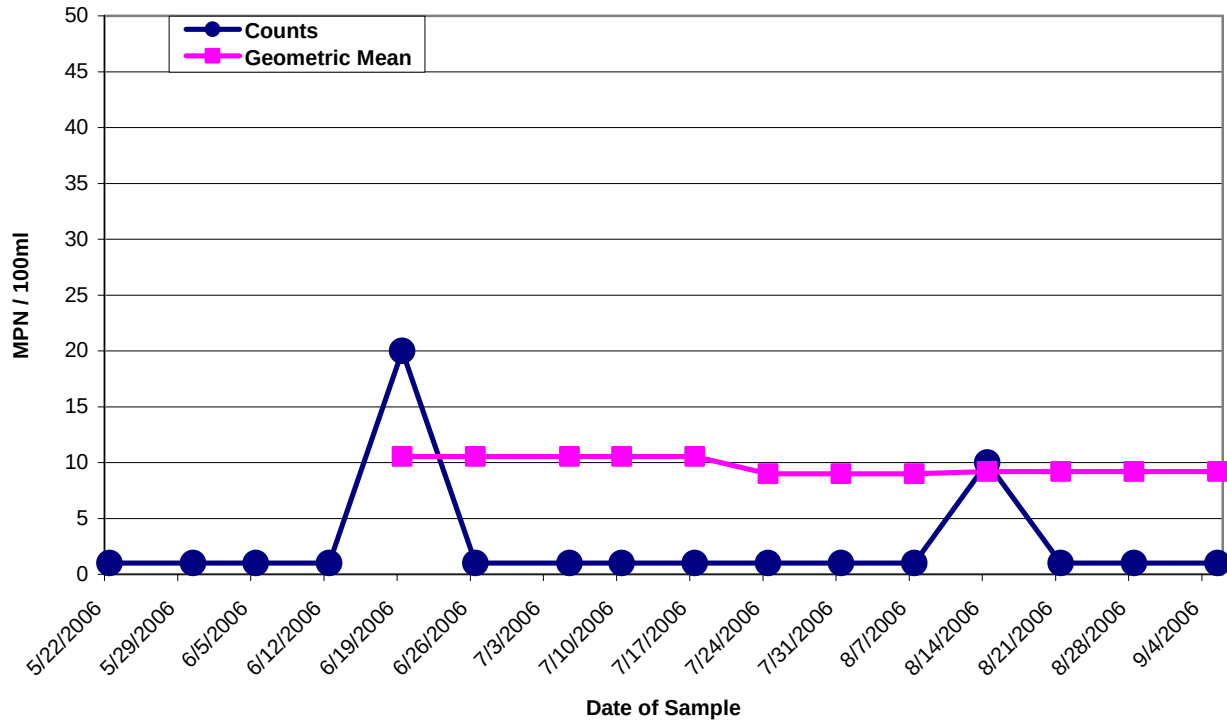


Figure 3: Ranger Station (RST 2) Enterococci Counts

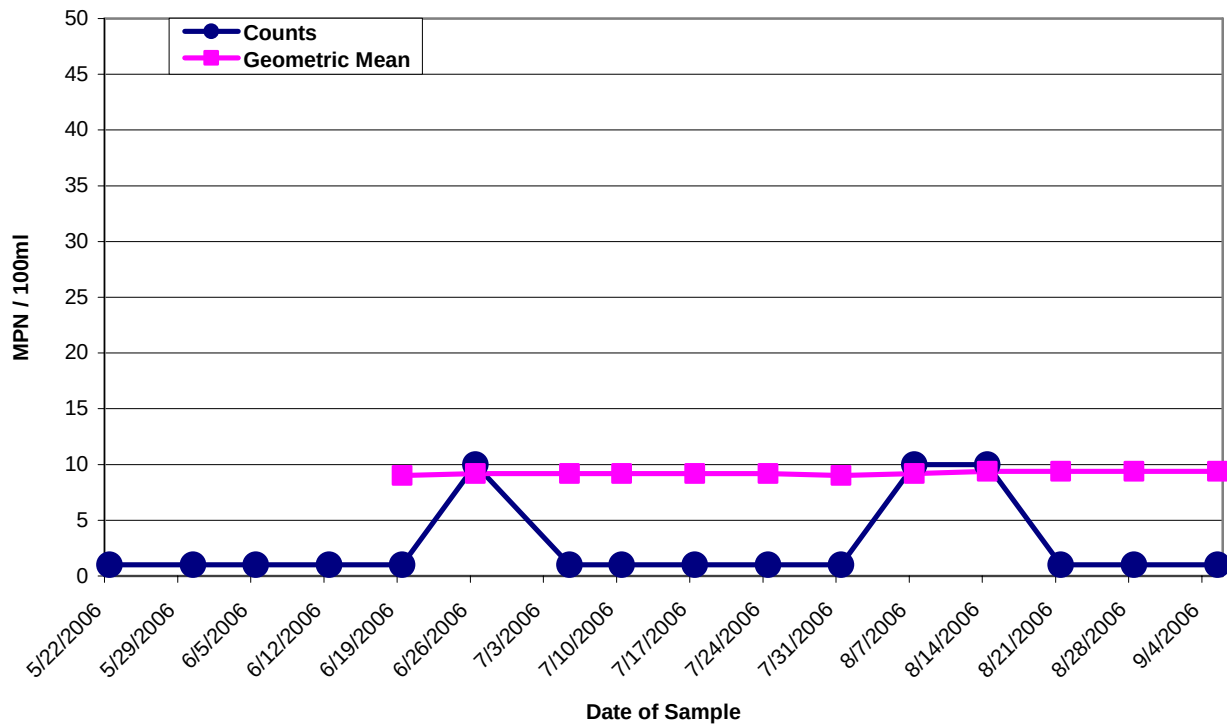


Figure 4: Oceanside Campground (OCS 3) Enterococci Counts

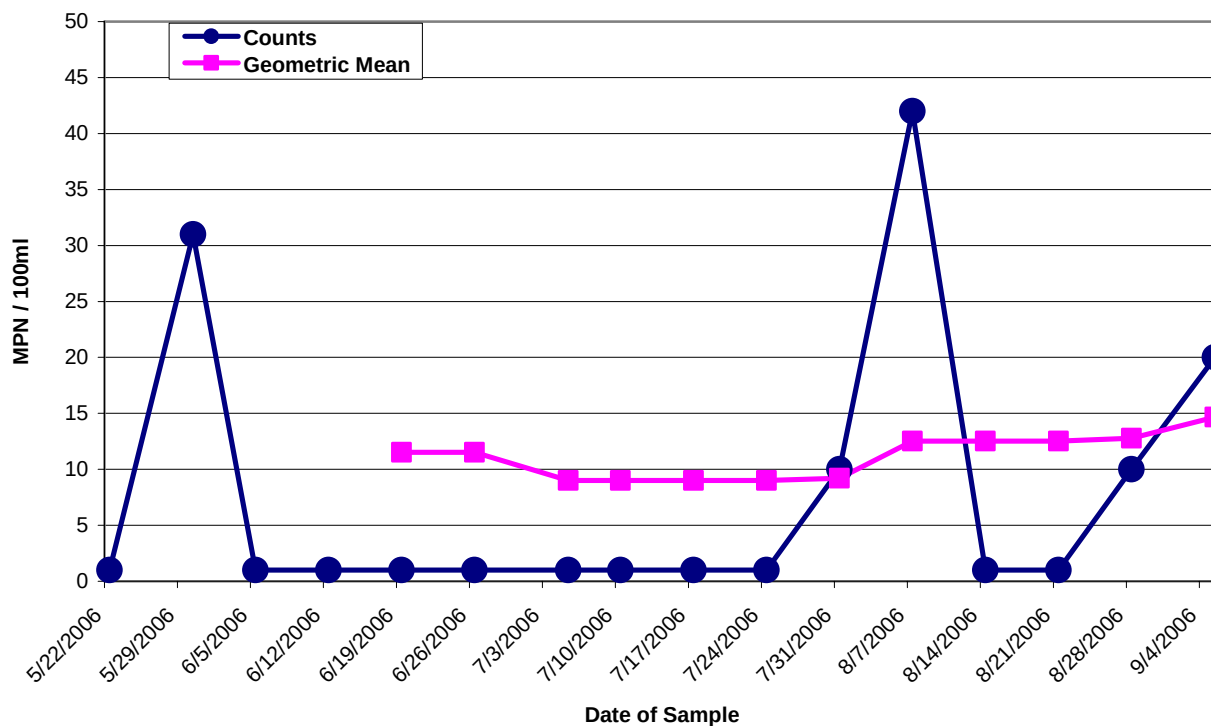


Figure 5: South Beach (SBE 4) Enterococci Counts

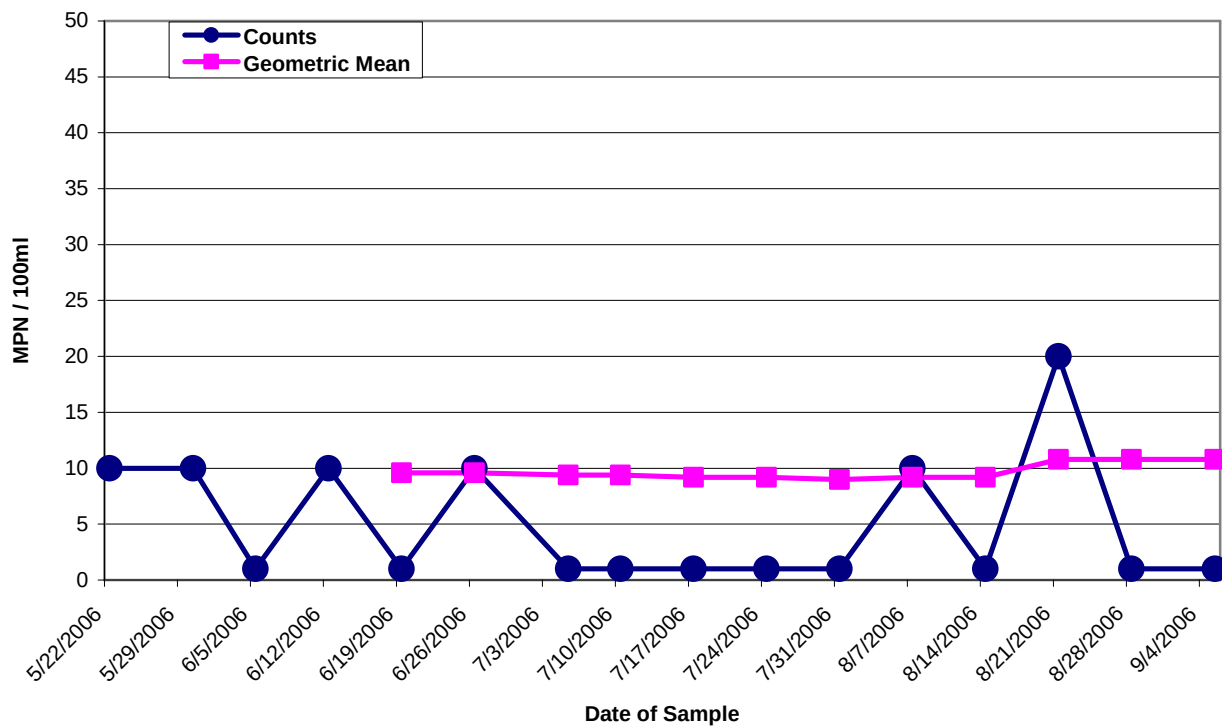


Figure 6: Tom's Cove North (TCN 5) Enterococci Counts

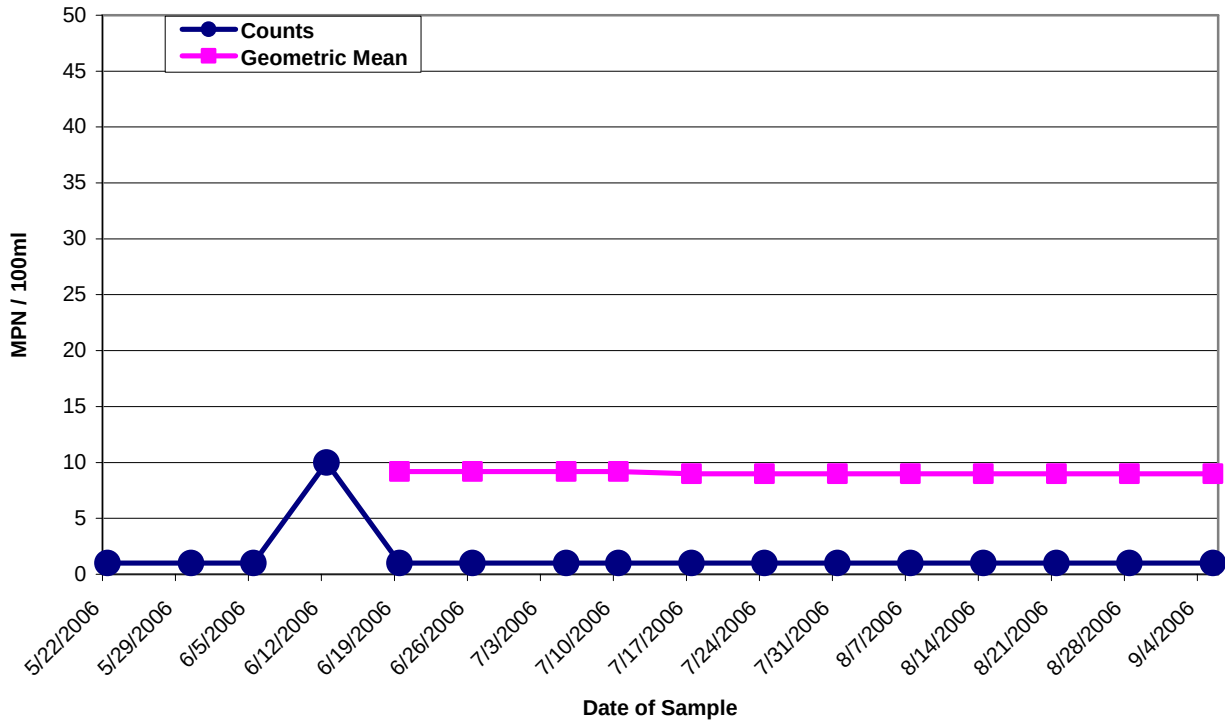


Figure 7: Tom's Cove South (TCS 6) Enterococci Counts

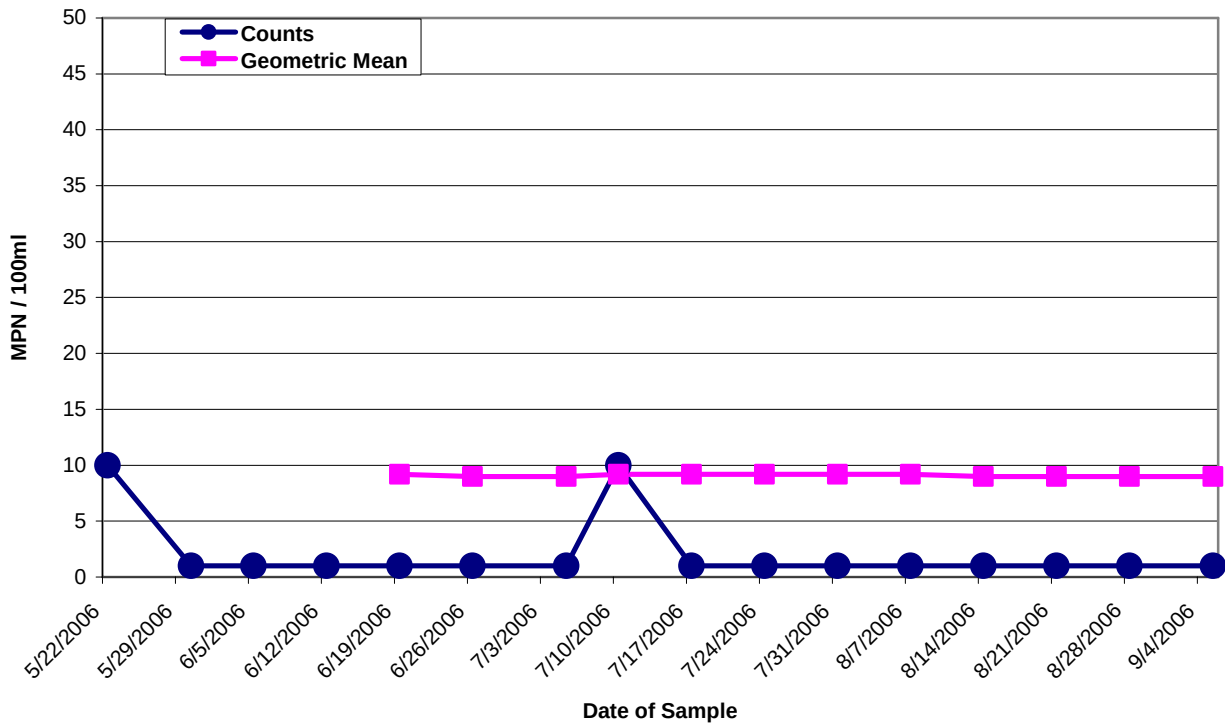


Figure 8: Comparison of Ocean Water Temperatures

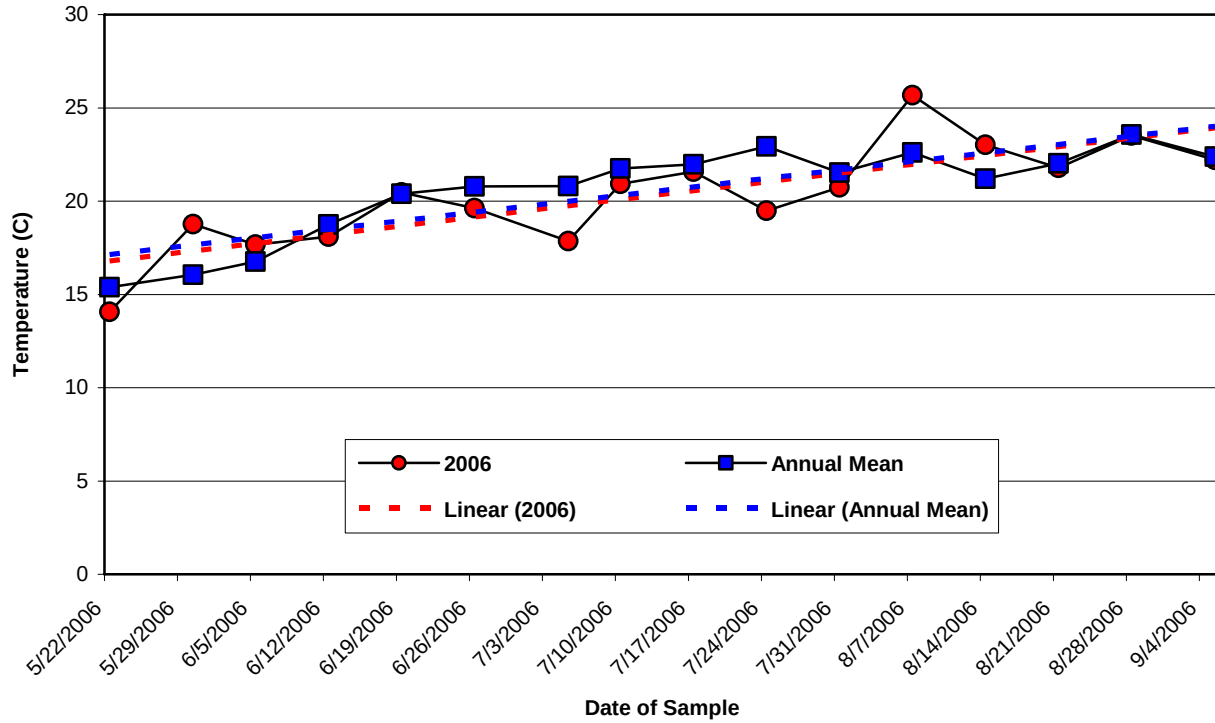


Figure 9: Comparison of Ocean Water Salinities

