

Supplementary Information

Indicator L: Swimming Beaches & Shellfish Beds

State of Casco Bay 6th Edition

References

No references were cited in this chapter.

Further Reading

Maine Department of Environmental Protection. (n.d.). *Maine Healthy Beaches*. Retrieved from <https://www.maine.gov/dep/water/beaches/index.html>.

Maine Healthy Beaches is funded by the Environmental Protection Agency through the Beaches Environmental Assessment and Coastal Health Act of 2000. Here you can find beach closure information and bacteria levels in participating beaches.

Maine Department of Marine Resources. (n.d.). *Shellfish Sanitation and Management*. Shellfish Sanitation and Management: . Retrieved from <https://www.maine.gov/dmr/shellfish-sanitation-management/>.

The Bureau of Public Health oversees the National Shellfish Sanitation Program to ensure shellfish are safe for human consumption. Here you can find shellfish closure information and maps, biotoxin monitoring, volunteer programs, and shellfish dealer certification information.

Methods and Data Sources

Data for bacteria levels in Casco Bay beaches was provided to CBEP by staff at the Maine Beaches program. Similar data is also available directly from the Maine Beaches Program website, but historical data for sites in Casco Bay that are no longer monitored are not available there.

Data on bacteria levels at shellfish harvesting areas was provided to CBEP by Maine Department of Marine Resources (DMR) staff. DMR makes summary data (medians and P90 scores) available on-line annually. The public datasets provide a synopsis of recent observations, usually from the most recent 30 observations collected from any particular location. The summary data includes median and 90th percentiles of those observations. These summary values relate directly to Maine and National Shellfish Sanitation Program safety standards. However, we needed the underlying observations to allow more robust statistical modelling. Raw data was especially important to evaluate relationships to rainfall, season and temperature, and to develop error bars for estimates of summary statistics.

Both *E. coli* (shellfish data) and enterococci (beaches data) tests quantify groups of bacteria that are common in vertebrate digestive systems, especially the digestive systems of warm-blooded organisms. These bacteria are less common in aquatic environments. Thus, elevated levels of these bacteria (as documented by either test) indicate a higher likelihood of recent contamination of surface waters by fecal material. However, the tests measure different bacteria, and thus numbers for the shellfish data are not comparable to numbers from the beaches data. It is important to remember that either test

provides an indirect indicator of pathogen risk, as fecal contamination is associated with many different pathogens, not just the bacteria directly quantified.

Data presentation for the beaches data focuses on presentation of data distributions by showing all data points, along with geometric means. The primary data display for the shellfish data displays medians and P90 scores. Error bars around the median and P90 scores are bootstrapped 95% confidence intervals, based on 1000 bootstrap samples at each sampling location.

Statistical analyses behind the scenes used GLMs to model absolute bacteria levels and probability of exceeding thresholds. We used these models to evaluate relationships between bacteria levels (or exceedances) and several predictors, including year, water temperatures, time of year, rainfall, and location. Highly skewed data and large numbers of non-detects complicate analysis of absolute numbers, making binomial and proportional odds models related to regulatory thresholds often a more robust approach.

Access to data and summary of data analysis can be found at <https://github.com/CBEP-SoCB>. For a full archive of data and all analyses steps head to <https://github.com/CBEP-SoCB-Details>.