

Indicator #4200

Overall Assessment

| Status: | Mixed |
|------------|--|
| Trend: | Undetermined (due to the vast increase in reported U.S. beaches and excised Canadian beaches |
| | not directly on a Great Lake) |
| Rationale: | The 2004-2005 Great Lakes data included significantly more U.S. beaches reporting and fewer |
| | Canadian beaches than in previous years. Some beaches not directly on a Great Lake were |
| | included in the Canadian dataset prior to 2004, but they were excised from the 2004-2005 data. |
| | Therefore, analysis of trends may be uncertain. The percentage of beaches open the entire season |
| | remained nearly constant in the U.S. (72% average) during the period 1998-2005 and in Canada |
| | (76% average) from 1998-2003. During 2004-2005, however, only 36% of the Canadian beaches |
| | were reported to have no postings. The percentage of beaches posted more than 10% of the season |
| | averaged 13% in the U.S. and 52% in Canada during 2004-2005. Differences in the percentage |
| | of open and posted beaches between the U.S. and Canada may reflect differing posting criteria. |

Lake-by-Lake Assessment

| Lake Superior | | |
|---|---|--|
| Status: Trend: Rationale: | Good Undetermined (due to vast increase in number of U.S. reported beaches) During 2004 and 2005, 90% or more of Lake Superior beaches were open more than 95% of the time in the U.S. In Canada, during 2005, 5 of 9 beaches (56%) were open more than 95% of the time. | |
| Lake Michiga Status: Trend: Rationale: | n Fair Undetermined (due to vast increase in number of reported beaches) During 2001-2005, on average, 77% of Lake Michigan beaches were open more than 95% of the time. Increased monitoring has resulted in approximately twice as many postings since 2000. | |
| Lake Huron | | |
| Status: Trend: Rationale: | U.S Good Canada - Fair U.S Unchanging Canada - Undetermined During 2004-2005, on average, 96% of U.S. beaches and 27% of Canadian beaches in Lake Huron were open more than 95% of the beach season. More than 50% of Canadian beaches were posted for more than 10% of the season. | |
| Lake Erie | | |
| Status: Trend: Rationale: | Fair Undetermined During 2004-2005, on average, 67% of U.S. beaches and 41% of Canadian beaches in Lake Erie were open more than 95% of the beach season. 22% of U.S. beaches and 42% of Canadian beaches were posted for more than 10% of the season. | |
| Lake Ontario | | |
| Status: Trend: Rationale: | Fair Undetermined During 2004-2005, on average, 74% of U.S. beaches and 38% of Canadian beaches in Lake Ontario were open more than 95% of the beach season. 24% of U.S. beaches and 52% of Canadian beaches were posted for more than 10% of the season. | |

Purpose

• To assess the number of health-related swimming posting (advisories or closings) days for recreational areas (beaches) on the Great Lakes

Ecosystem Objective

Waters used for recreational activities involving body contact should be substantially free from pathogens that may harm human health, including bacteria, parasites, and viruses. As the surrogate indicator, *E. coli* levels should not exceed national, state or provincial standards set for recreational waters. This indicator supports Annexes 1, 2 and 13 of the Great Lakes Water Quality Agreement (United States and Canada 1987).

State of the Ecosystem

Background

A health-related posting day is one that is based upon elevated levels of *E. coli*, or other indicator organisms, as reported by county (U.S.), Public Health Units (Ontario), or municipal health departments in the Great Lakes basin. *E. coli* and other indicator organisms are measured in order to infer potential harm to human health through body contact with nearshore recreational waters because they act as indicators for the potential presence of pathogens.

The Ontario provincial standard is 100 *E. coli* colony forming units (cfu) per 100 mL, based on the geometric mean of a minimum of one sample per week from each of at least 5 sampling sites per beach (Ontario Ministry of Health 1998). It is recommended by the Ontario Ministry of Health and Long-Term Care that beaches of 1000 meters of length or greater require one sampling site per 200 meters. In some cases local Health Units in Ontario have implemented a more frequent sampling procedure than is outlined by the provincial government. When *E. coli* levels exceed the limit, the beach is posted as unsafe for the health of bathers. Each beach in Ontario has a different swimming season length, although the average season begins in early June and continues until the first weekend in September. The difference in the swimming season length may skew the final result of the percent of beaches posted throughout the season.

The bacteria criteria recommendations for *E. coli* from the U.S. Environmental Protection Agency (U.S. EPA) are a single sample maximum value of 235 cfu per 100 ml. For *Enterococci*, another indicator bacterium, the U.S. EPA recommended criterion is a single sample maximum value of 61 bacteria per 100 ml (U.S. EPA 1986). When levels of these indicator organisms exceed water quality standards, swimming at beaches is prohibited or advisories are issued to inform beachgoers that swimming may be unsafe.

The 2004-2005 Great Lakes data included significantly more U.S. beaches reporting and fewer Canadian beaches than in previous years. In the U.S., the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) amended the Clean Water Act in 2000 and required states and tribes that have coastal recreation waters, including the Great Lakes, to adopt new or revised water quality standards by April 10, 2004, for pathogens and pathogen indicators. The Act also authorizes U.S. EPA to award grants to states or local governments to develop and implement beach monitoring and notification programs, which now enables Great Lakes beach managers to regularly monitor beach water quality and advise bathers of potential risks to human health when water quality standards for bacteria are exceeded.

During an analysis of the Canadian beach dataset for 2004-2005, the authors realized that some of the reported beaches were within Public Health Units that bordered the Great Lakes but were not Great Lakes beaches, *per se.* Those beaches remain part of the Canadian datasets prior to 2004, but they were excised from the 2004-2005 data. Therefore, the applicability of trends in beach advisories prior to 2004 to just Great Lakes beaches is uncertain.

Status of Great Lakes Beach Advisories, Postings and Closures

The percentage of Great Lakes beaches open the entire season remained nearly constant in the U.S. during the period 1998-2005 (72% average), although the number of reporting beaches more than doubled between 2002 and 2004 (Figure 1). In Canada, the percentage of beaches open the entire season was similar to that in the U.S. from 1998-2003 (76% average), but during 2004-2005, only 36% of the Canadian beaches were reported to have no postings. Significantly fewer Canadian beaches were reported for the period 2004-2005 than for previous years because several non-Great Lakes beaches were included in the previous datasets (see Background above).

The percentage of beaches posted more than 10% of the beach season averaged 13% in the U.S. and 52% in Canada during 2004-2005. In the two reporting years prior to 2004, 12% of U.S. beaches and 24% of Canadian beaches were posted more than 10% of the season. Differences in the percentage of posted beaches between the U.S. and Canada might be due to the differing posting criteria (see Background above). Differences in the Canadian data between the periods 2002-2003 and 2004-2005 may be linked



Figure 1. Proportion of Great Lakes beaches with postings in the United States and Canada for the 1998-2005 bathing seasons.

Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003; Canadian data compiled by Environment Canada from Ontario Health Units

to the latter reduced dataset, but that has not been confirmed.

The U.S. *Great Lakes Strategy 2002* envisions that all Great Lakes beaches will be swimmable and sets a goal that by 2010, 90% of monitored, high priority Great Lakes beaches will meet bacteria standards more than 95% of the swimming season (U.S. EPA 2006). To help meet this goal, U.S. EPA will build local capacity for monitoring, assessment and information dissemination to help beach managers and public health officials comply with the National Beach Guidance (U.S. EPA 2002a) at 95% of high priority coastal beaches.

A new version of the Guideline for Canadian Recreational Water Quality (Health Canada 1999) is expected soon, focusing on implementing measures to reduce the risk of contamination (Robertson 2006). Beach surveys, barriers, and preventive measures due to certain weather conditions are some of the actions that will be taken to improve beach quality for the Canadian Great Lakes.

A brief assessment of the current status of beach postings for each Great Lake follows:

Lake Superior

During 2004 and 2005, 90% or more of Lake Superior beaches (green and blue - Figure 2a) were open more than 95% of the time in the U.S. This meets the key objective of the *Great Lakes Strategy 2002* goal. In Canada, during 2005, 5 of 9 beaches were open more than 95% of the time (green and blue - Figure 2b).

Lake Michigan

Since 2000, on average, 77% of Lake Michigan beaches were open more than 95% of the time (green and blue - Figure 3). Increased monitoring has resulted in approximately twice as many postings since 2000 (yellow and red - Figure 3). While the key objective of the *Great Lakes Strategy 2002* has not been met, several groups are collaborating to identify and remediate sources of beach contamination in Lake Michigan.

Lake Huron

Since 1998, on average, 94% of U.S. Lake Huron beaches were open more than 95% of the beach season. This meets the key objective of the *Great Lakes Strategy 2002* goal (except in 2002). However, in Ontario, an average of 27% of Lake Huron beaches were open more than 95% during the 2004-2005 beach seasons (green and blue - Figures 4a and 4b).

Lake Erie

From 1998 to 2005, on average, 75% of U.S. Lake Erie beaches were open more than 95% of the beach season. The key objective of the *Great Lakes Strategy 2002* has not been met, but efforts to identify sources of contamination are being conducted at Lake Erie beaches. During 2004-2005, in Ontario, an average of 41% of Lake Erie beaches were open more than 95% of the beach seasons (green and blue - Figures 5a and 5b).

Lake Ontario

From 1998 to 2005, on average, 84% of U.S. Lake Ontario beaches were open more than 95% of the beach season. The key objective of the *Great Lakes Strategy 2002* has not been met. During 2004-2005, in Ontario, an average of 38% of Lake Ontario beaches were open more than 95% of the beach season (green and blue - Figures 6a and 6b).

Pressures

Current pressures

Due to the nature of the laboratory analysis, each set of beach water samples requires an average of one to two days before the results are communicated to the beach manager. Therefore, there exists a lag time in posting beaches and in the lifting of any restrictions from the beach when safe levels are again reached. The delay in developing a rapid test protocol for *E. coli*, as well as the costs, training, and collection times associated with rapid methods, is lending support to the use of predictive models to estimate when bacterial levels may exceed water quality standards.

Unless contaminant sources are removed or new sources introduced, Great Lakes beach sample results generally contain similar bacteria levels after events with similar meteorological conditions (primarily wind direction and the volume and duration of rainfall). If episodes of poor recreational water quality can be associated with specific events (such as meteorological events of a certain threshold), then forecasting for episodes of elevated bacterial counts may become more accurate.

Future pressures

Additional point and non-point source pollution at coastal areas due to population growth and increased land use may result in additional beach postings, particularly during wet weather conditions.

There may be new indicators and new detection methods available through current research efforts occurring binationally in both public and private sectors and academia. Although currently a concern in recreational waters, viruses and parasites are difficult to isolate and quantify, and feasible measurement techniques have yet to be developed. Comparisons of the frequency of beach postings have typically been limited due to the use of different water quality criteria in different localities. In the U.S., all coastal states (including those along the Great Lakes) have criteria as protective as U.S. EPA's recommended bacteriological criteria (use of *E. coli* or *Enterococci* indicators) applied to their coastal waters. Conditions required to post Ontario beaches as unsafe have become more standardized due to the 1998 Beach Management Protocol, but the conditions required to remove the postings remain variable.

Management Implications

Recreational waters may become contaminated with animal and human feces from sources and conditions such as combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), malfunctioning septic systems, and poor livestock management practices. These potentially harmful inputs can become further emphasized in certain areas after heavy rains. States, provinces, and municipalities are continuing to identify point and non-point sources of pollution at their beaches to determine why beach areas are impaired. As some sources of contamination are identified, improved remediation measures can be taken to reduce the number of postings at beaches.

Continued BEACH Act funding for beach monitoring and notification programs should be encouraged. Grants have been issued to pilot beach sanitary surveys at 60 Great Lakes beaches for identification of beach water contamination sources. Provision of funding for remediation of sources of beach water contaminants and development of predictive models should be considered.

In Canada, a partnership between Environment Canada (Ontario Region) and the Ontario Ministry of Health and Long-Term Care have created the Seasonal Water Monitoring and Reporting System (SWMRS). This web-based application will provide local Health Units with a tool to manage beach sampling data, as well as link to the meteorological data archives of Environment Canada. The result will be a system that potentially can have some predictive modeling capability, as well as improving the interface for public use. The system, once running, will help identify areas of chronic beach postings and, as a result, will aid in improved targeting of programs to address the sources of bacterial contamination.

Many municipalities are in the process of developing long-term control plans that will result in the selection of CSO controls to meet water quality standards. For example, the City of Toronto has an advanced Wet Weather Flow Management Master Plan, which could serve as a model to other urban areas. Information on this initiative can be obtained at: http://www.city.toronto.on.ca/wes/techservices/involved/wws/wwfmmp/index.htm.

Creating wetlands around rivers or areas that are wet weather sources of pollution may help lower the levels of bacteria that cause beaches to be posted. The wetland area may reduce high bacterial levels that are typical after storm events by detaining and treating water in surface areas rather than releasing the bacteria-rich waters into the local lakes and recreational areas. Studies by the Lake Michigan Ecological Research Station show that wetlands could lower bacterial levels at state park beaches, but more work is needed (Mitchell 2002).

Comments from the author(s)

Variability in the data from year to year may reflect changing seasonal weather conditions, the process of monitoring, and variations in reporting, and may not be solely attributable to actual increases or decreases in levels of microbial contaminants. At this time, most of the beaches in the Great Lakes basin are monitored and have quality public notification programs in place. In addition, state beach managers are submitting their beach monitoring and advisory/closure data to the U.S. EPA annually. The state of Michigan has an online site http://www.michigan.gov/deq/1,1607,7-135-3313_3686_3730---CI,00.html where beach monitoring data are posted by Michigan beach managers.

To ensure accurate and timely posting of Great Lakes beaches, methods must be developed to deliver quicker results that focus not just on indicator organism levels but on water quality in general. This issue is being addressed. The BEACH Act requires U.S.

EPA to initiate studies for developing appropriate and effective indicators that will improve detection in a timely manner in coastal recreation waters. In connection with this requirement, the U.S. EPA and the Centers for Disease Control and Prevention are conducting the National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water study at various coastal freshwater and marine beaches across the country to evaluate new rapid and specific indicators of recreational water quality and to determine their relationships to health effects.

Until new indicators are available, predictive models and/or the experience of knowledgeable environmental or public health officers (who regularly collect the samples) can be used on both sides of the border. Each method takes a variety of factors into account, such as amount of rainfall, cloud coverage, wind (direction and speed), current, point and non-point source pollution inputs, and the presence of wildlife, to predict whether indicator organism levels will likely exceed established limits in recreational waters.

Acknowledgments

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Sources

Canadian beach data were obtained from Ontario Health Units along the Great Lakes.

U.S. beach data were obtained from U.S. EPA PRAWN database. PRAWN (Program Tracking database for Advisories, Water Quality Standards, and Nutrients) meets requirements listed in the Beaches Environmental Assessment and Coastal Health (BEACH) Act 2000, that required EPA to collect, store, and display a list of monitored waters, beach program monitoring and notification information, and pollution occurrence data.

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Figure 2. Proportion of Great Lakes beaches with postings for Lake Superior. Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003; Canadian data compiled by Environment Canada from Ontario Health Units



Figure 3. Proportion of Great Lakes beaches with postings for Lake Michigan. Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003.



Figure 4. Proportion of Great Lakes beaches with postings for Lake Huron. Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003; Canadian data compiled by Environment Canada from Ontario Health Units



Figure 5. Proportion of Great Lakes beaches with postings for Lake Erie. Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003; Canadian data compiled by Environment Canada from Ontario Health Units



Figure 6. Proportion of Great Lakes beaches with postings for Lake Ontario. Source: U.S. data: U.S. Environmental Protection Agency, Great Lakes National Programs Office and the National Resource Defense Council for 2003; Canadian data compiled by Environment Canada from Ontario Health Units