Report to the Environmental Protection Agency

Maine Healthy Beaches Program Annual Beach Grant Report 2020 Season

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MAINE
Healthy Beaches

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I. Program Accomplishments

Maine Healthy Beaches (MHB) is managed by the Maine Department of Environmental Protection (ME DEP). In 2020, MHB staff worked with 28 local management entities to conduct routine monitoring, assessment, and public notification of water quality conditions for 61 beach management areas spanning Kittery to Mount Desert Island. MHB staff continued to build local capacity to make well-informed beach management decisions and to address pollution issues when they arose.

The MHB program accomplished the following in 2020:

- Processed 1424 enterococci samples at 133 routine and enhanced monitoring locations.
- Trained approximately 200 beach managers, local staff, and volunteers to collect water samples, conducted technical trainings for local staff and volunteers, and facilitated planning/problem-solving meetings.
- Implemented precautionary rainfall advisories at 15 beaches impacted by non-point source pollution.
- Analyzed 264 samples for optical brightener levels to target human-sourced fecal contamination at 50 enhanced monitoring locations.
- Implemented objectives of the program's MHB Quality Assurance Project Plan (QAPP, 2016-2021) approved by ME DEP and EPA.
- Supported enhanced monitoring and pollution remediation efforts for: Ogunquit River watershed, Wells Harbor, Goose Rocks Beach watershed, Kennebunk River watershed, Biddeford Pool, Crescent Beach State Park, Willard Beach stormwater system, Town Landing (Cumberland), and MDIBL efforts in Acadia.
- Continued partnering with the University of New Hampshire (UNH) to support testing for human and non-human DNA markers using microbial source tracking (MST) techniques.
- Continued updates to the MHB Risk Assessment Matrix (RAM), an evaluation of water quality trends and potential sources of fecal bacteria impacting coastal beaches.
- Continued implementing measures outlined in the EPA approved beach action value (BAV) justification.
- Transformed data to action items and served on several working groups for improving water quality and ecosystem health.
- Provided expertise and advised towns/groups interested in monitoring freshwater recreation areas as well other areas along the coast.
- Presented to local and regional audiences.

II. Program Deliverables/Appendices

Appendix A MHB 2020 Budget Summary
Appendix B MHB 2020 Beach Mgt. Area Classification/Tiered Monitoring Plan
Appendix C MHB 2020 Notification Activity

III. Budget Information

Program Activities

The US EPA sponsored MHB program 2020 budget (Appendix A) supported all routine monitoring, assessment, notification, education/outreach, and enhanced monitoring and source-tracking efforts including:

- Salaries for three staff including two DEP staff and a Maine Conservation Corps (AmeriCorps) Environmental Steward. DEP staff included one full-time Program Coordinator position and one half-time Program Data Manager position. This team of personnel provided extensive support to 28 local management entities (towns, state parks, a national park, and private beach associations) including program coordination, quality-assured protocols and structure, field/lab trainings, technical assistance, volunteer recruitment, education/outreach, etc.
- Program Data Manager provided data management services, transferred MHB data to DEP's Environmental and Geographic Analysis Database (EGAD) system, managed the submission of MHB data into the US EPA databases (STORET and PRAWN), and fulfilled data requests as needed.
- Planning and problem-solving meetings with diverse partners including local beach managers, conservation commissions, consultants, researchers, etc.
- Field monitoring supplies, equipment, volunteer training packets, and quality-assurance including annual field, database, and observational trainings for nearly 200 citizen volunteers and local staff.
- Laboratory equipment, supplies, labor, sample transport (courier), training, and quality assurance support for four laboratories processing enterococci samples for 61 beach management areas spanning a large geographic area (approximately 200 mi.).
- Enhanced monitoring and pollution identification efforts as well as numerous planning and problem-solving meetings with diverse partners.
- Education and outreach efforts including delivering presentations to local and regional audiences, development and distribution of numerous resources, etc.
- A contract with Relyon Solutions to host the MHB database and public interface.
- Miscellaneous expenses including travel, telephone, computer services, postage, office support and supplies, photocopying, etc.

Volunteer Contribution

MHB program participation is voluntary, and towns/parks designate local beach managers and field monitors to collect samples. Beach managers are typically town administrators, health nurses, fire chiefs, state park managers, and others who participate as an add-on to full-time jobs and schedules. Towns and state parks utilize citizen volunteers or devote paid staff time to sample collection, transport, and data entry. All volunteer monitors attend a pre-season field training and contribute an average of three hours of time per week during the monitoring season.

IV. Performance Criteria

In 2020, the MHB program continued to provide a unified structure and quality-assured tools to implement an adaptive monitoring regime, assess the risk of pollution, notify the public of water quality conditions, and promote best practices on the beach and surrounding drainage areas. In 2020, MHB staff also provided ongoing daily training and technical support including responding in real-time to water quality data, assessing pollution/risk of illness, and notifying the public of conditions on coastal beaches.

The COVID-19 pandemic affected some aspects of the MHB program, however the MHB program continued to implement a successful monitoring season in 2020. In 2020, the MHB monitoring season start date was delayed for the majority of participating beaches. This was done in order to assess the capacity of management entities and volunteers to participate, to provide time for beaches to reopen following State-required closures, and to allow for increased numbers of training sessions, including the development of online training sessions, and equipment deliveries to accommodate smaller group sizes. Despite these challenges, just one management entity (representing 2 beach management areas) declined to participate in 2020, leaving 61 beach management areas successfully conducting the monitoring and notification season.

Monitoring

There are more than 29 miles of public access beaches along Maine's coast. The MHB program is voluntary and monitoring coastal water quality for swimming and other water contact is the responsibility of local jurisdictions and is not mandated by state law. US EPA funding supports monitoring of moderate to high use beaches with adequate public access. Maine law allows public use of private beaches for "fishing, fowling and navigation" only. Participating beaches must have a management entity capable of meeting objectives and requirements outlined in the MHB program QAPP and MHB Program Town/Park Agreement. New beaches will be recruited over time as resources and funding allow and/or circumstances change eligibility for program participation.

In 2020, MHB staff successfully worked with 28 diverse local management entities to conduct routine monitoring for 61 beach management areas (Appendix B), 46 were classified as "Tier-1" (monitored weekly or more frequently), 15 were classified as "Tier-2" (reduced monitoring effort), and "Tier-4"[1] beaches were not monitored (i.e. did not participate in the program). Through the 2016 BAV selection process, Maine's participating beaches were evaluated and reclassified where necessary in order to reallocate resources to support increased monitoring efforts for beaches categorized as "high-risk". For beaches considered "low-risk", reclassification resulted in a reduced monitoring frequency, typically to a bi-weekly or monthly routine.

The monitoring season lasted approximately three months, extending from Memorial Day to Labor Day. Monitoring activities began the week after Memorial Day (as originally planned) at nine BMAs located in the Portland and Mount Desert Island regions. For the remaining BMAs, monitoring activities began once pre-season requirements were met for regional laboratories, equipment was issued to towns/parks, and volunteers/staff were trained. Table 1. details the specific monitoring week and start date for each participating BMA in 2020.

Table 1. Monitoring week and start date for monitoring activities at participating beach management areas (BMAs) in 2020.

Management Entity	Beach Management Areas	Monitoring Week (Start Date)
KITTERY	CRESCENT BEACH, FORT FOSTER-HORN POINT, FORT FOSTER-PIER BEACH, FORT FOSTER-SCUBA BEACH, SEA POINT BEACH	Week 5 (6/30/2020)
YORK	CAPE NEDDICK BEACH, LONG SANDS BEACH-NORTH, LONG SANDS BEACH-SOUTH, SHORT SANDS BEACH, YORK HARBOR BEACH	Week 4 (6/23/2020)

[1] MHB does not have any beaches with a status equivalent to EPA's Tier-3 beach designation.

Management Entity	Beach Management Areas	Monitoring Week (Start Date)
OGUNQUIT	FOOTBRIDGE, LITTLE BEACH, MAIN, MOODY, RIVERSIDE	Week 3 (6/16/2020)
WELLS	CASINO SQUARE, CRESCENT BEACH, DRAKES ISL BEACH, WELLS BEACH, WELLS HARBOR	Week 3 (6/16/2020)
Wells Reserve	LAUDHOLM BEACH	Week 5 (6/30/2020)
Kennebunk	GOOCHS BEACH, MOTHERS BEACH	Week 3 (6/17/2020)
Kennebunkport	COLONY BEACH, GOOSE ROCKS	Week 3 (6/17/2020)
Biddeford	FORTUNES ROCKS BEACH, GIL BOUCHE PARK-BIDDEFORD POOL, MIDDLE BEACH, HILLS BEACH	Week 4 (6/22/2020)
Ferry Beach State Park	FERRY BEACH	Week 6 (7/7/2020)
Saco	BAY VIEW, KINNEY SHORES	Week 4 (6/23/2020)
Old Orchard Beach	OOB-CENTRAL, OOB-NORTH END, OOB-OCEAN PARK	Week 4 (6/23/2020)
Town of Scarborough	FERRY BEACH, PINE POINT	Did not participate
Scarborough Beach State Park	SCARBOROUGH BEACH	Week 4 (6/23/2020)
Scarborough – Higgins	HIGGINS BEACH	Week 4 (6/23/2020)
Crescent Beach State Park	CRESCENT BEACH, KETTLE COVE BEACH	Week 4 (6/22/2020)
South Portland	WILLARD BEACH	Week 3 (6/15/2020)
Portland	EAST END BEACH	Week 1 (6/2/2020)
Cumberland	BROAD COVE RESERVE	Week 1 (6/3/2020)
Harpswell	MACKEREL COVE, MITCHELL FIELD BEACH, STOVERS POINT PRESERVE	Week 1 (6/3/2020)
Popham Beach State Park	POPHAM -CENTER BEACH, POPHAM-EAST BEACH, POPHAM-WEST BEACH/ MORSE RIVER	Week 6 (7/6/2020)
Reid State Park	HALF MILE BEACH, LAGOON BEACH, MILE BEACH	Week 6 (7/6/2020)
Bristol	PEMAQUID BEACH	Week 6 (7/7/2020)
Rockland	SANDY BEACH	Week 3 (6/16/2020)
Rockport	GOODIES BEACH	Week 3 (6/16/2020)
Camden	LAITE BEACH	Week 3 (6/16/2020)
Lincolnville	LINCOLNVILLE BEACH	Week 3 (6/16/2020)
Mount Desert	SEAL HARBOR	Week 2 (6/10/2020)
Acadia National Park	SAND BEACH	Week 1 (6/3/2020)
Bar Harbor	HADLEY POINT, HULLS COVE, TOWN BEACH	Week 1 (6/3/2020)

Approximately 1424 samples were collected at 133 routine and enhanced monitoring locations spanning Kittery to MDI. Monitoring sites for each beach were based on where people swim, at freshwater inputs (rivers, streams, storm drains), and near other high-risk features, wildlife areas, etc. Samples were collected in two to three feet of water at six to eight inches below the surface. For areas experiencing chronic bacterial pollution, additional monitoring sites were added in suspect areas to help determine contributing pollution sources and/or the worst-case scenario for water quality.

Parameters included: enterococci bacteria, air and water temperature, salinity, tidal stage, rainfall, and additional weather/field conditions that may affect beach water quality. Monitoring sites were resampled as soon as possible following an exceedance and the monitoring frequency increased until results were within acceptable limits. Samples were transported to the laboratory (four regional – Maine Environmental Lab, Portland Water District, Rockland Wastewater Treatment Facility, Mount Desert Island Biological Laboratory) for analysis within six hours of collection. Samples were analyzed using the IDEXX Enterolert ® Most Probable Number enumeration method. All samples and parameters were collected and analyzed according to the US EPA-approved QAPP.

Assessment

In addition to routine beach monitoring, MHB staff evaluated the risk of pollution and potential/actual sources via a Risk Assessment Matrix (RAM), and in some cases, through GIS mapping and analysis, enhanced monitoring, and other pollution source-tracking efforts. MHB staff continued updates to the RAM for each Beach Management Area (BMA) in 2020, and these preliminary assessments of shoreline characteristics, non-point and point sources of pollution (on and offshore) and water quality, inform local beach management decisions. This risk-based ranking system also guides the program's beach classification and monitoring regime and determines the need for more in-depth monitoring and sanitary surveys.

In an effort to assess water quality and pollution sources in 2020, the program supported enhanced monitoring and source-tracking efforts for: Ogunquit River watershed, Wells Harbor, Goose Rocks Beach watershed, Kennebunk River watershed, Biddeford Pool, Crescent Beach State Park, Willard Beach stormwater system, Town Landing (Cumberland), and MDIBL efforts in Acadia.

Notification

In 2020, beach monitoring results were recorded in the MHB program internal database that automatically updated the program website www.MaineHealthyBeaches.org. Maine's US EPA-approved single sample maximum safety threshold or Beach Action Value (BAV) for enterococci in marine waters was 104 most probable number (MPN[2])/100mL. Once a decision was made to post the beach, the information was made publicly available via the website and signage at beach access points. When results exceeded the safety limit, and/or a beach status change occurred, an automatic email alert was sent to local beach managers, MHB staff, and partners. In some cases, towns provided supplemental information by providing educational signage (e.g. risk following rainfall, stagnant tide pools), content on local websites, Facebook pages, and hotlines. All beaches attributes, monitoring, and notification data was transferred to DEP's database for final submission into EPA's databases. The MHB program continued to make local beach information (site locations, monitoring and notification data, contact information, etc.) more easily accessible to the public via the program's website.

Beach postings fall under local jurisdiction authority and are not mandated by state law. The program made recommendations to local beach managers based on the best and most current

[2] EPA's 2012 Recreational Water Quality Criteria (RWQC) recommends using EPA Method 1600 (resulting in colony forming units (CFUs)) to measure culturable enterococci, or another equivalent culturable method. MHB utilizes the equivalent IDEXX Enterolert ® method (resulting in most probable number (MPN) per 100mL).

information available. In some cases, local managers waited for resample results before posting contamination advisories. Typically, this was for “low-risk” beaches, and the decision was based on the results of neighboring sites, the magnitude of bacteria results, similarity of environmental conditions between sample collection day and results, historical water quality, risk of pollution, known pollution events, etc. Many towns/parks continued posting precautionary rainfall advisories (PRAs) (based on local precipitation levels rather than elevated bacteria) in 2020. An extensive Communication Plan of local beach managers and field monitors was updated for re-sampling efforts and beach status notification in 2020. Following each exceedance, MHB staff contacted local jurisdictions to ensure that program protocols were followed in a timely manner according to the QAPP. On a daily basis, MHB staff quality-checked the database for accurate entry of field, laboratory, and notification data.

Additionally, MHB staff responded to numerous data and information requests from program participants, state agency partners, non-profits, researchers, students, etc. The MHB program routine and enhanced monitoring data was used by partners to inform ongoing efforts to address impaired water quality including funding proposals to support pollution source identification and elimination projects, ongoing research initiatives, as well as watershed management, stormwater management, and comprehensive and water resource protection plans.

Education and Outreach

In 2020, MHB staff continued efforts to educate beach managers regarding program and notification protocols as needed and routinely shared research findings, program updates, etc. with local staff and volunteers. Additional support was provided as needed regarding local implementation of the program, issues of concern, etc. MHB staff delivered presentations to diverse audiences and provided extensive support to communities and organizations tackling bacterial pollution issues within and outside of Maine.

V. Data Summaries

- 1424 enterococci samples (including field and laboratory duplicates) were processed.
- 133 sites (83 routine beach sites and 50 enhanced monitoring sites[3]) were monitored.
- 61 beach management areas (BMAs) (routine beach sites) were monitored in 28 towns/state parks (Figure 3.).
- 9.5% routine samples exceeded Maine’s beach action value (BAV) of 104 MPN/100mL.
- 182 beach action days were reported including 66 actions at 30 beach management areas. The majority of reported action days (150) were for contamination advisories and closures (45 advisories and 1 closure).
- Precautionary rainfall advisories accounted for 32 action days (20 advisories). These were based on local precipitation levels rather than recorded bacteria levels (Appendix C).
- 97.2% of total beach days (beach season length x beach management areas) were free of beach advisories or closures.

[3] Sites located in close proximity to BMAs or in enhanced monitoring locations to help identify pollution sources.

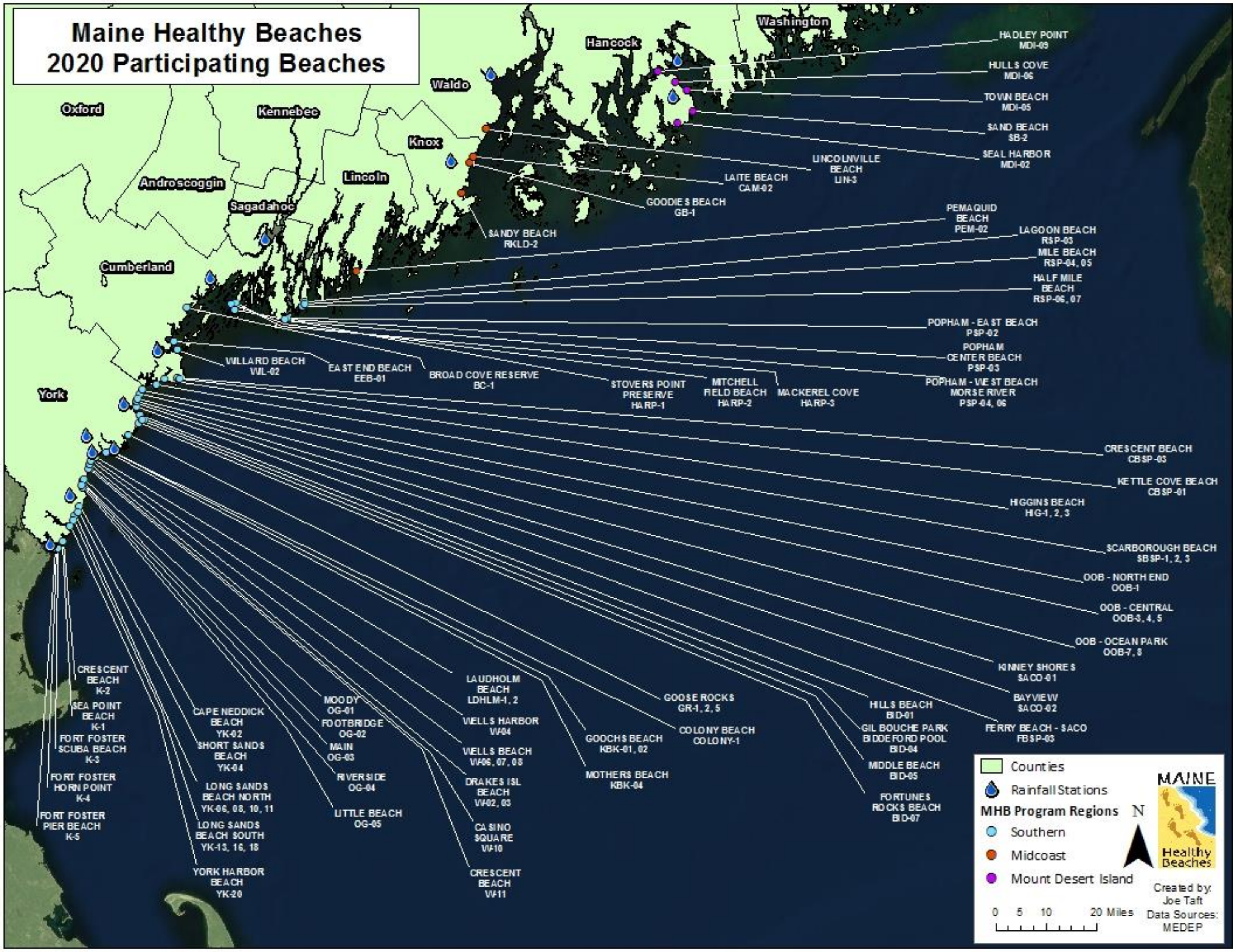
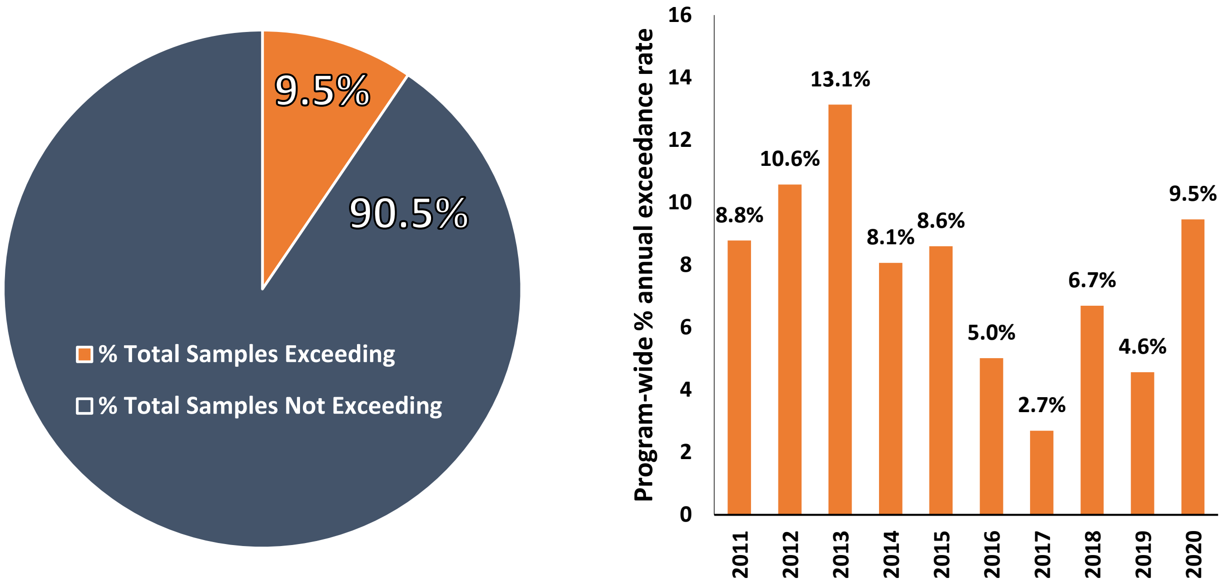


Figure 3. MHB's 2020 participating BMAs (Southern, Midcoast, and Mount Desert Island (MDI) regions) and NCDC rainfall stations.

Exceedances

Maine's US EPA-approved single sample maximum safety threshold or Beach Action Value (BAV) for enterococci in marine waters is 104 MPN/100mL. The 2020 overall program exceedance rate of Maine's BAV was 9.5%, representing 89 total exceedances at 24 beach management areas (Figure 1, Table 2). This represents an increase in the exceedance rate compared to 2019 and is the highest exceedance rate observed since 2013 (Figure 2).



Figures 1-2. The 2020 total % annual exceedance rate of Maine's BAV (104 MPN/100mL) and MHB's program-wide annual exceedance rate for the past ten seasons (2011-2020).

Maine's beaches span a wide geographic area and, as a result, average precipitation levels observed at 13 coastal rainfall stations located in close proximity to participating BMAs[4] varied distinctly (5.40-13.70 inches) (Figure 3). Typically, the pattern of yearly exceedance rates (shown in Figure 2) corresponds with the amount of average precipitation during the beach season. In 2020, less average precipitation (8.66 inches) was observed compared to the past 2 seasons (2019: 13.21; 2018: 10.16 in;), but the exceedance rate was greater in 2020 compared to both of those years. The reasons for this are not immediately clear. Some potential theories include, higher summer temperatures, timing of precipitation, and amount of precipitation per event. In general, lower precipitation accumulations were observed for the southern Maine region compared to the midcoast and MDI regions. Like many areas of the Northeast, Maine was affected by widespread drought conditions in 2020. This resulted in regions of the state, experiencing much smaller precipitation totals than the past several monitoring seasons.

Inter-annual variability of the total program percent exceedance rate is due to multiple factors including but not limited to: precipitation levels, beach and watershed characteristics (e.g. impervious surfaces, pollution sources), sample collection day/time, the number of monitoring sites and beach management areas, etc.

[4] Precipitation data source: NOAA NCDC (www.ncdc.noaa.gov). For stations with incomplete datasets, local rainfall from nearby weather stations was used.

Table 2. All BMAs with exceedances of Maine's single sample maximum BAV for enterococci in marine waters (104 MPN/100mL). Summaries include total number of samples, number of samples ≥104 MPN/100mL, and % samples ≥104 MPN/100mL.

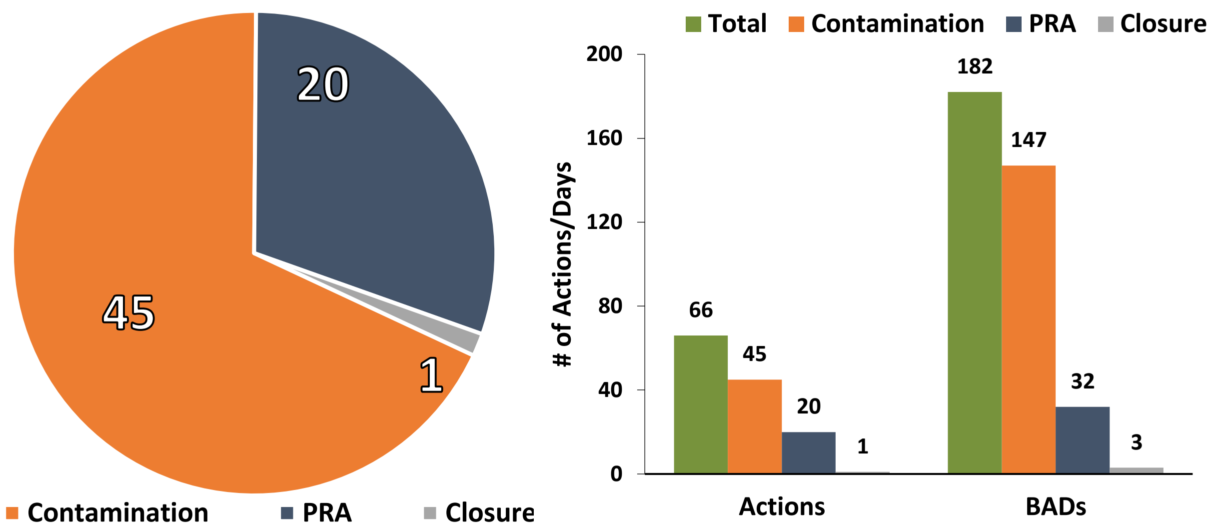
Beach Management Area	Site Name(s)	# Samples	# Samples ≥104	% Samples ≥104
RIVERSIDE (OGUNQUIT)	OG-04	19	9	47.4%
LITTLE BEACH	OG-05	17	7	41.2%
CAPE NEDDICK BEACH	YK-02	13	4	30.8%
GOOSE ROCKS	GR-1, GR-2, GR-5	75	23	30.7%
WILLARD BEACH	WIL-02	24	6	25.0%
LAITE BEACH	CAM-02	17	4	23.5%
LINCOLNVILLE BEACH	LIN-3	18	4	22.2%
MAIN (OGUNQUIT)	OG-03	14	3	21.4%
MACKEREL COVE	HARP-3	15	3	20.0%
KETTLE COVE BEACH	CBSP-01	13	2	15.4%
BROAD COVE RESERVE	BC-01	14	2	14.3%
HILLS BEACH	BID-01	7	1	14.3%
EAST END BEACH	EEB-01	22	3	13.6%
LAUDHOLM BEACH	LDHLM-1, LDHLM-2	21	2	9.5%
LONG SANDS BEACH - NORTH	YK-06, YK-08, YK-10, YK-11	43	4	9.3%
CRESCENT BEACH (KITTERY)	K-2	11	1	9.1%
KINNEY SHORES	SACO-01	12	1	8.3%
MOODY (OGUNQUIT)	OG-01	12	1	8.3%
HIGGINS BEACH	HIG-1, HIG-2, HIG-3	37	3	8.1%
MOTHERS BEACH	KBK-04	13	1	7.7%
GOOCHS BEACH	KBK-01, KBK-02	27	2	7.4%
GOODIES BEACH	GB-1	15	1	6.7%
MITCHELL FIELD BEACH	HARP-2	15	1	6.7%
OOB - CENTRAL	OOB-3, OOB-4, OOB-5	34	1	2.9%

Beach Actions

In Maine, beach actions include advisories (Contamination or Precautionary Rainfall) and closures. Contamination advisories represent those issued in response to elevated bacteria results, while Precautionary Rainfall Advisories (PRAs) are issued pre-emptively based on local precipitation levels (typically following 1 inch of rainfall or more in a 24-hour period). A Beach Action Day (BAD) represents the amount of time a beach is under an advisory or closure. This distinction is used as the duration of actions varies depending on the conditions under which they were posted. BADs are calculated for each beach as the number of days where the beach was under an action for any part of a day. This may over-estimate the length of BADs in some cases.

The MHB program provides beach management recommendations to local beach managers, but the decision to post an action at a beach falls under local jurisdiction. For that reason, the number of beach actions does not always align with the number bacteria exceedances as action posting protocols vary locally.

Overall, 97.2% of total beach days (beach season length x beach management areas) were free of beach actions. There were fewer total beach actions and beach action days in 2020 compared to 2019 (combining contamination advisories, precautionary rainfall advisories, and closures). There were 182 recorded BADs in 2020, including 147 contamination BADs (45 actions), 32 rainfall BADs (20 actions), and 3 closure days (1 closure)[5]. Although there were fewer total beach actions/days, the total number of contamination BADs (including contamination advisories and closures) in 2020 **(**150) was greater than those reported in 2019 (80), and the highest observed since 2013. Three beach management areas (Riverside Beach - Ogunquit, Little Beach - Ogunquit, and Goose Rocks Beach - Kennebunkport) collectively accounted for 43% of the reported contamination BADs in 2020 (Table 3).



Figures 4-5. The 2020 total number of beach actions (contamination, PRAs, closures) and BADs for all participating program beaches.

The decrease in total beach actions and total BADs for 2020 compared to 2019 is due, in-part, to decreased levels of precipitation in 2020 as compared to 2019, and therefore, fewer precautionary rainfall advisories. In 2020, there were a quarter as many PRAs posted (20 actions) as there were in 2019 (80 actions). Rainfall advisories accounted for just 18% of the total 182 recorded action days as well as 30% of the total number of actions in 2020 (Figures 4-5).

Depending on the timing of results and the availability of monitors/laboratories, resampling did not always occur the same day results were available. Additionally, beach managers sometimes kept an advisory in place until the next routine monitoring day indicated acceptable enterococci levels, rather than collecting a resample. There were also some "running" advisories where PRAs blended with contamination advisories and vice versa. PRAs often preceded contamination advisories and once bacteria results were available, PRAs were lifted, and contamination advisories were put in place until routine results indicated safe levels. These factors, as well as the practice of counting any part of one day as an action day, inflated the duration and number of beach action days in 2020.

[5] Total BADs include all action types (Contamination, Closure, and Precautionary Rainfall).

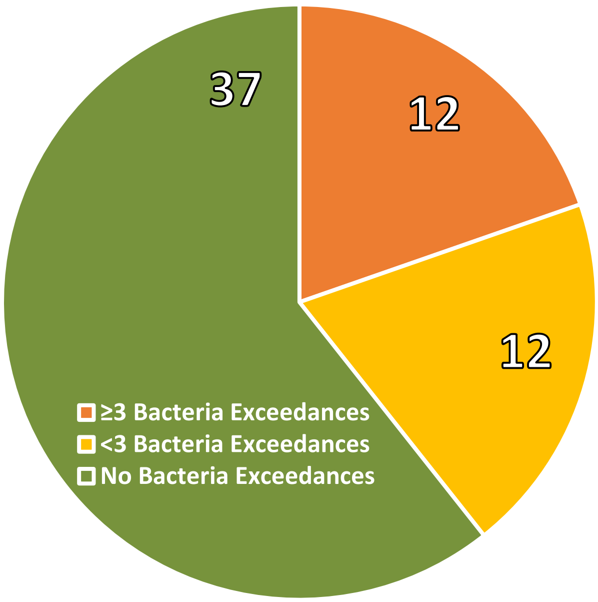
Table 3. All BMAs with contamination actions (contamination advisories and closures) in 2020. Summaries include the total number of contamination actions, number of contamination BADs, and the % of total contamination BADs the number of contamination BADs represents for each beach.

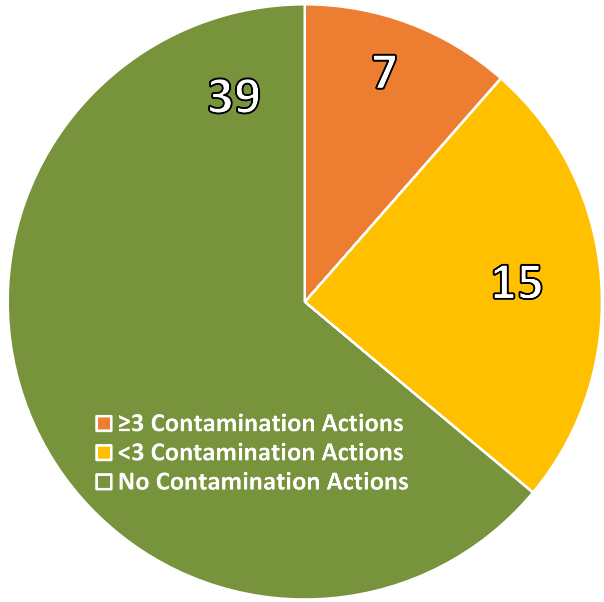
Beach Management Area	Site Name	# Contamination Actions	# Contamination BADs	% Total Contamination BADs
GOOSE ROCKS BEACH	GR-1, GR-2, GR-5	7	26	17.3%
RIVERSIDE BEACH	OG-04	3	19	12.7%
LITTLE BEACH	OG-05	3	18	12.0%
EAST END BEACH	EEB-01	3	10	6.7%
LAITE BEACH	CAM-02	2	10	6.7%
WILLARD BEACH	WIL-02	5	9	6.0%
MAIN (OGUNQUIT)	OG-03	1	8	5.3%
LINCOLNVILLE BEACH	LIN-3	3	7	4.7%
MACKEREL COVE	HARP-3	2	6	4.0%
BROAD COVE RESERVE	BC-01	3	5	3.3%
GOOCHS BEACH	KBK-1, KBK-2	2	5	3.3%
HIGGINS BEACH	HIG-1, HIG-2, HIG-3	1	3	2.0%
KETTLE COVE BEACH	CBSP-01	2	3	2.0%
CAPE NEDDICK BEACH	YK-02	1	3	2.0%
MOODY (OGUNQUIT)	OG-01	1	3	2.0%
LAUDHOLM BEACH	LDHLM-1, LDHLM-2	1	3	2.0%
GOODIES BEACH	GB-1	1	2	1.3%
LONG SANDS BEACH-NORTH	YK-06, YK-08, YK-10, YK-11	1	2	1.3%
LONG SANDS BEACH-SOUTH	YK-13, YK-16, YK-18	1	2	1.3%
COLONY BEACH	COLONY-1	1	2	1.3%
HILLS BEACH	BID-01	1	2	1.3%
MOTHERS BEACH	KBK-04	1	2	1.3%

High Risk Beaches

In 2020, 61% of BMAs (37/61 BMAs) were free of bacteria exceedances (Table 2, Figure 5). For the remaining 24 BMAs, 12 were observed to have <3 exceedances, while the majority of exceedances (BMAs with ≥3 exceedances) were observed at just 12 BMAs (Tables 1, 3; Figure 5). These 12 BMAs accounted for 82% or 73 out of the total 89 observed exceedances. Similarly, 64% of BMAs were free of contamination beach actions in 2020 with 59% of the contamination actions (BMAs with ≥3 actions) observed at just 7 BMAs (Table 3, Figure 6.).

Overall, most of MHBs participating BMAs experience either very few or no exceedances each monitoring season. Typically, only a handful of beaches contribute to the majority of exceedances for a season and, as a consequence, the majority of beach actions. MHB considers these BMAs with persistent bacterial contamination issues to be “higher-risk” due to various non-point and point sources of pollution impacting those beaches. In 2020, there were 13 BMAs for which ≥10% of samples exceeded Maine’s BAV, many of which were also among the top beaches with exceedances for the past several years. At 9 of these 13 BMAs, sample exceedances were associated with antecedent precipitation 50% or more of the time, and for 6 of those, sample exceedances were associated with antecedent precipitation 75% or more of the time (Table 4, Figure 7).





Figures 5-6. The number of BMAs with ≥3, <3, or no bacteria exceedances and the number of BMAs with ≥3, <3, or no contamination actions for the 2020 beaches season.

Table 4. BMAs for which ≥10% of enterococci samples exceeded Maine's BAV. Summaries include total number of samples, number of samples ≥104 MPN, % samples ≥104 MPN, and % exceedances associated with antecedent precipitation.

Beach Management Area	Site Name	# Samples	# Samples ≥104	% Samples ≥104	% Exceedances Antecedent Precipitation
RIVERSIDE BEACH	OG-04	19	9	47.4%	33.3%
LITTLE BEACH	OG-05	17	7	41.2%	28.6%
CAPE NEDDICK BEACH	YK-02	13	4	30.8%	50.0%
GOOSE ROCKS BEACH	GR-1, GR-2, GR-5	75	23	30.7%	91.3%
WILLARD BEACH	WIL-02	24	6	25.0%	83.3%
LAITE BEACH	CAM-02	17	4	23.5%	50.0%
LINCOLNVILLE BEACH	LIN-3	18	4	22.2%	75.0%
MAIN (OGUNQUIT)	OG-03	14	3	21.4%	0.0%
MACKEREL COVE	HARP-3	15	3	20.0%	66.7%
KETTLE COVE BEACH	CBSP-01	13	2	15.4%	100%
BROAD COVE RESERVE	BC-01	14	2	14.3%	100%
HILLS BEACH	BID-01	7	1	14.3%	0.0%
EAST END BEACH	EEB-01	22	3	13.6%	100%

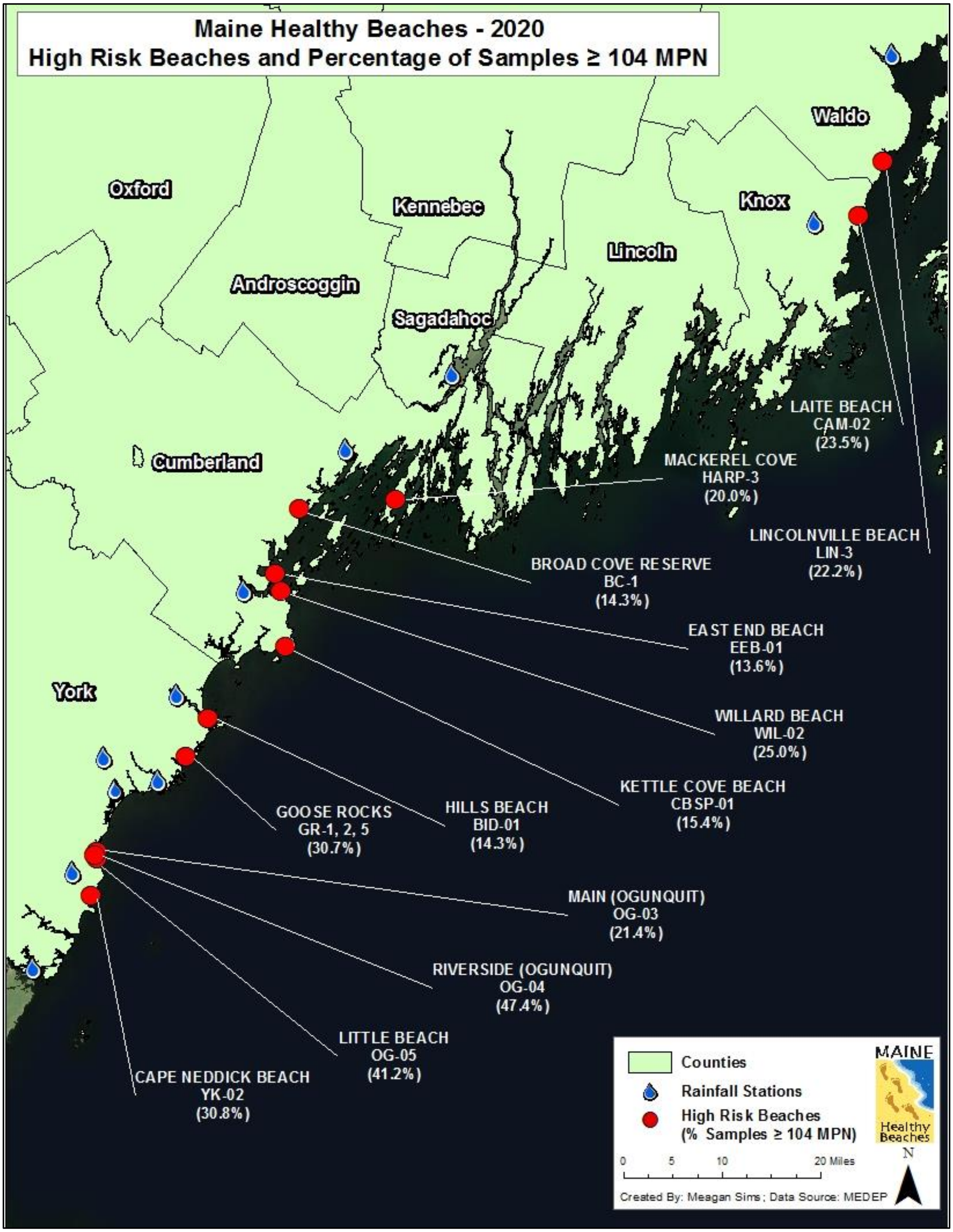


Figure 7. BMAs for which ≥10% of samples exceeded Maine's single sample maximum BAV for enterococci in marine waters (104 MPN/100mL) in 2020.

Antecedent precipitation calculations include any precipitation concentrations observed 48 hours prior to the monitoring date as well as any precipitation observed the day of sample collections because rainfall often occurred overnight and in the early pre-monitoring morning hours. Including the precipitation levels from the day of sample collection may over-estimate the % exceedances with antecedent precipitation as it includes a portion of the day after samples have been collected; however, a reliable dataset with the precision for hourly measurements is not available at this time.

Non-point source pollution likely contributed to fecal indicator bacteria (FIB) loading at BMAs with the greatest exceedance rates in 2020, as the majority of them are impacted by freshwater inputs (rivers, streams, storm drains). As a result, pollutants are transported from upland areas during all weather conditions, but especially when it rains. MHB's historical data demonstrates a relationship between antecedent precipitation and observed bacteria exceedances. In response, many of Maine's participating towns/state parks have begun implementing preemptive PRAs during and following moderate/heavy rainfall. Given the limited 1-2x per week sampling frequency for Tier 1 beaches, this preemptive advisory protocol allows beach managers to be more protective of public health at these BMAs when bacteria results are not available.

When feasible, MHB partners with towns/state parks managing high-risk BMAs to support ongoing efforts to find, fix, and prevent bacterial pollution sources (see VI. Collaborative Efforts).

VI. Collaborative Efforts

Maine's coastal tourism and recreation industry contribute billions of dollars annually to Maine's economy and clean coastal waters are a major priority. Results from a 2015 survey of Maine residents and visitors revealed reducing coastal pollution as the first of 13 possible priority actions, and clean waters and sandy beaches were the two most important factors when planning visits to coastal areas. Improving coastal water quality can be challenging as sources are typically difficult to find, often requiring intensive investigations beyond the immediate shoreline. For instance, the majority of Maine's beaches are impacted by freshwater inputs that transport pollutants from upland areas. Once sources are verified, solutions are often complex and expensive. Investing in improvements to coastal water quality can confer significant benefits to local economies largely sustained by revenue from coastal beach recreation activities by decreasing potential bacteria sources at beaches and in turn, costly beach advisories and closures (Lyon et al., 2018)[6].

The MHB program plays a critical role in keeping coastal waters healthy. Since 2003, the program has provided extensive support to communities experiencing bacterial pollution issues with a focus on sharing resources and solving problems. Some examples include: circulation studies, sanitary surveys, GIS mapping/analysis, stakeholder workshops, outreach campaigns, applying pollution source tracking tools like optical brighteners and DNA markers, etc. This work has built the foundation for historical and current local actions to identify, remove, and prevent pollution sources. For example, this work includes surveys of the shoreline and watershed, investigations of and improvements to wastewater/stormwater infrastructure, septic/cesspool removal, boat pump

[6] Lyon, Sarina F.; Merrill, Nathaniel H.; Mulvaney, Kate K.; and Mazzotta, Marisa J. (2018) "Valuing Coastal Beaches and Closures Using Benefit Transfer: An Application to Barnstable, Massachusetts," Journal of Ocean and Coastal Economics: Vol. 5: Iss. 1, Article 1.

out installation, beach and watershed management plans, protective ordinances, local monitoring efforts and outreach campaigns, etc.

Enhanced monitoring

The MHB program has supported enhanced monitoring of multiple parameters (toolbox approach) targeting human sourced fecal contamination for areas demonstrating persistent bacterial pollution issues. Typically, as the number of parameters that exceed a threshold (or detectable) limit increases, so does the confidence that human sources are impacting water quality. The focus areas have changed over time with the primary targets being freshwater inputs to the shoreline. However, program data and support (historical and current) has raised awareness regarding water quality issues and has helped make addressing them a priority. Although limited resources and staff has reduced the number of toolbox parameters monitored for the past several years, MHB staff continued an applied research partnership with researchers at UNH in 2020 to incorporate microbial source tracking (MST) tools into ongoing pollution source identification and remediation efforts.

In an effort to improve water quality at participating BMAs, MHB supported efforts beyond routine beach monitoring in the Wells Harbor, Goose Rocks Beach watershed, Kennebunk River watershed, Biddeford Pool watershed, Crescent Beach State Park, Willard Beach stormwater system, Town Landing (Cumberland), and MDIBL efforts in Acadia in 2020.

These efforts included the collection and analysis of 295 samples for enterococci bacteria at 50 enhanced monitoring locations in 2020. Samples were collected upland in freshwater inputs to the beach on designated dates throughout the season or were collected on a routine basis in “high-risk” areas such as the mouths of rivers and streams, storm drains, stagnant tide pools, etc. MHB also supported assessment of intermittent, suspected sources such as seepages and runoff typically associated with heavy rainfall. Additionally, MHB staff analyzed 264 samples for optical brightener (OB) levels at 50 enhanced monitoring locations in 2020. Optical brighteners are commonly used in commercial/retail products and are typically flushed down the drain. Therefore, when optical brightener concentrations are coupled with elevated fecal bacteria levels, it can be indicative of human-sourced fecal contamination.

Working groups and applied research partnerships

In 2020, MHB staff actively participated in numerous working groups, as well as applied research partnerships that have been instrumental in improving decision-making, addressing pollution issues, reaching diverse audiences, and supporting student advancement in Maine and beyond. For example, MHB staff continued to seek feedback from local participants for the 2020 implementation of the EPA approved BAV plan (approved in 2016). MHB staff will continue to collaborate with EPA, consulting their expertise on the latest research and development of new guidance, and to seek the expertise of its advisory committee, the research community, and other partners when necessary in establishing important program policies as well as addressing challenges.

Coastal beaches are complex systems and the regrowth and persistence of enterococci in sand, seaweed and sediments confounds our understanding of recorded bacteria levels, especially because these “naturalized” contributions have not been linked to human illness. However, studies in Maine and elsewhere have indicated extremely elevated bacteria levels in seaweed that has been cast and warmed on the beach, as well as in neighboring beach water that has rinsed previously stranded algal mats. In response to concerns, MHB staff continued to consult experts in 2020 to guide information shared with beach managers, the public, press, etc. MHB staff also worked with local and state agency partners to inform strategies that would allow communities to better and more quickly respond to episodic events that pose safety and other concerns. More research is needed to understand any health risks posed by fecal indicator bacteria (FIB) levels generated from seaweed that's been "seeded" with fecal material from birds, pets, stormwater, etc. The MHB program will continue to consider FIB levels sourced from seaweed as a potential health risk until further research and guidance develops.

Additionally, Program staff served on the Goosefare Brook Restoration and Outreach Committees, Casco Bay Working Group, Ogunquit River Watershed Restoration Committee, Kennebunk River 319 Steering and TAC committees, and Coastal Watersheds Working Group. As part of MHB's ongoing efforts to improve the program and its effectiveness, MHB staff will continue to seek opportunities for collaboration in 2021.

The MHB program would like to thank EPA for their continued support.