

Geologic Site of the Month
July, 2013

Taking the Pulse of a Beach



Photo by Mark Sladen

Maine Geological Survey

Text and imagery by
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What Are Beaches and How Do We Measure Change

The favorite summer destination we know as a beach is only one part of a much larger, dynamic system. The beach system includes everything from the marsh, dunes, across the berm (the “recreational beach” as we know it), down the beach face and extending underwater out past the breakers. The 2-D cross sectional image below is a “textbook” example of a beach system.

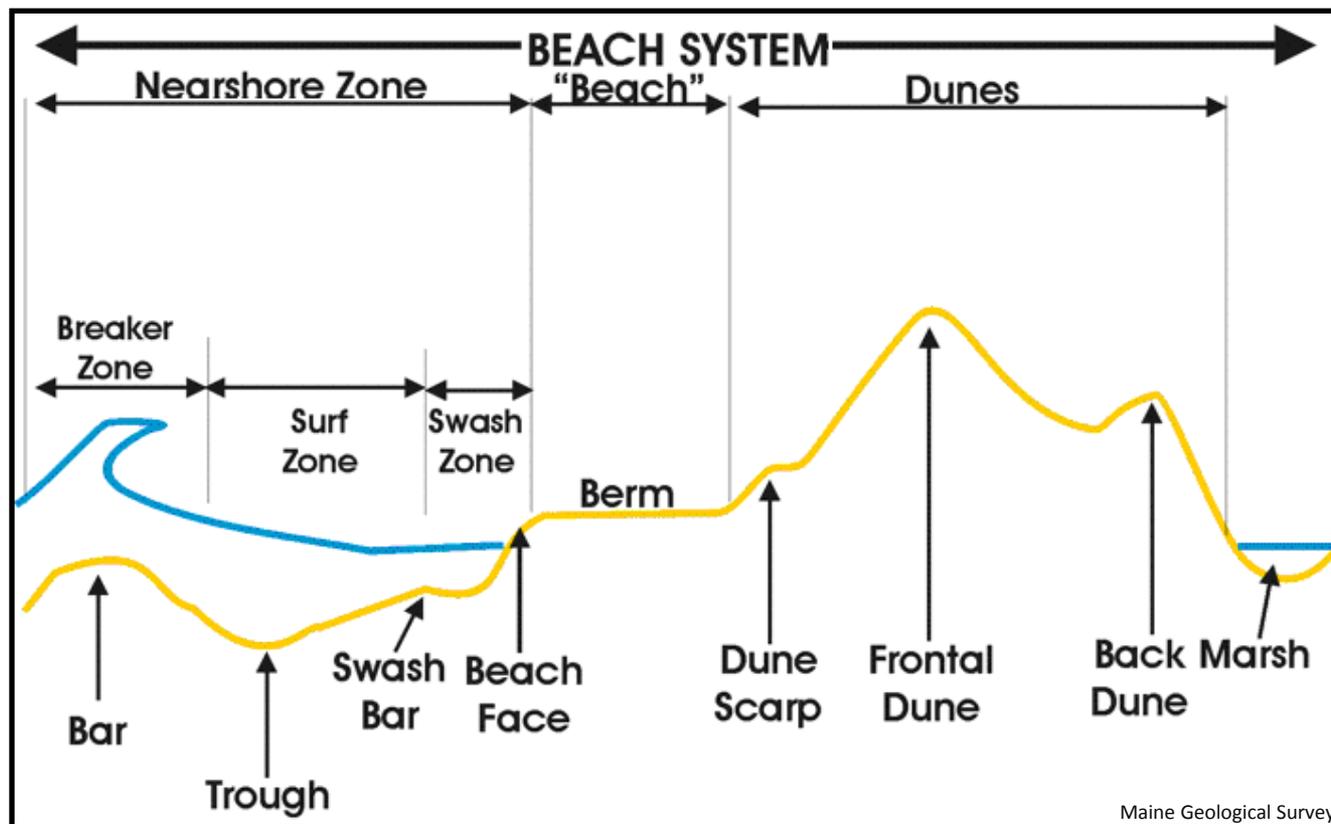


Image by Peter A. Slovinsky
(adapted from Komar, 1998)

Figure 1. Two-dimensional schematic of the beach system (not to scale).



Beach System Features

The image below, of Small Point Beach (also known as Seawall Beach) in Phippsburg, shows the dominant features of the beach system in plan, or overhead view. Each beach system in Maine generally has these same features, whether they are developed or undeveloped.



Figure 2. Aerial image of Small Point Beach, Phippsburg, ME, showing the beach system components.

How Do Beaches Change During the Year?

Beaches have different shapes, especially during the winter and summer months. Beach shapes are influenced during the late fall and winter by storms which erode the upper part of the beach and move sand offshore into bars. During the late spring and summer, relatively calm weather allows sand to move back up onto the beach, building it up by accretion, especially in the berm area where people like to sit.

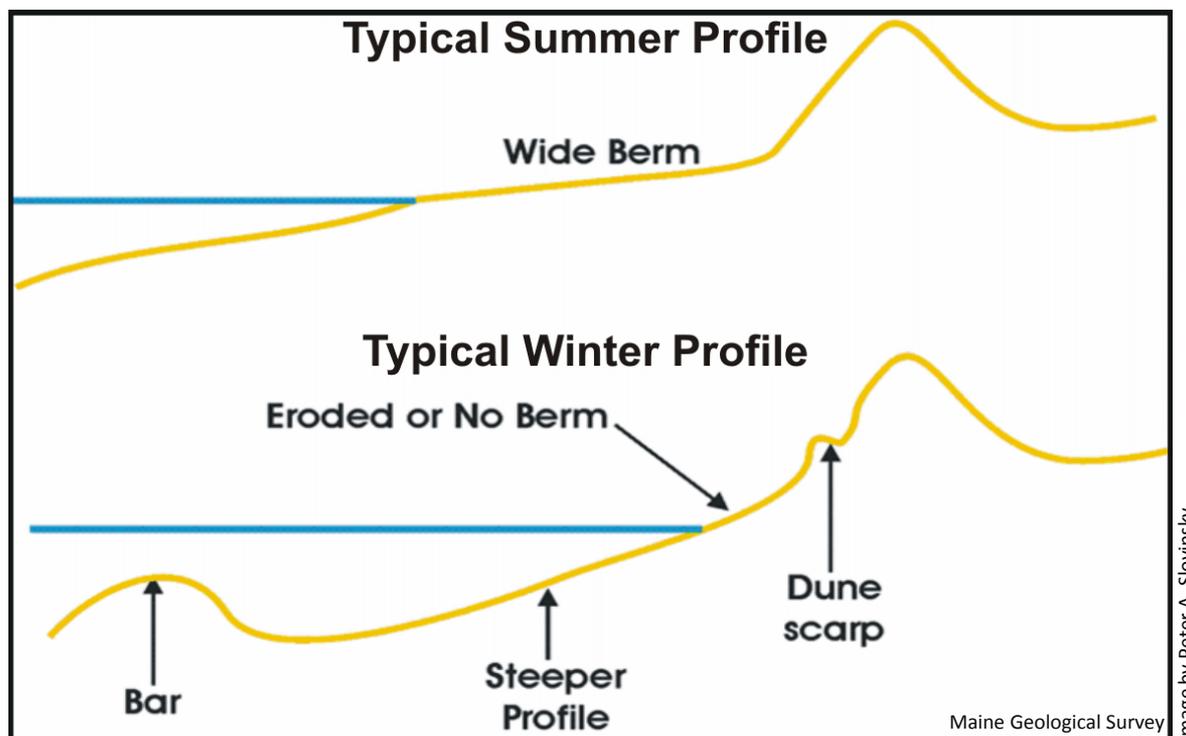


Figure 3. Seasonal variation in beach profile shape. The wave climate during the winter is much more energetic. Large, short-period waves associated with storms tend to erode the beach and berm and move sediment seaward into an offshore bar. The winter beach profile is typically steeper with a much smaller or non-existent berm. Smaller, longer-period waves during the summer tend to move sediment back onto the upper portion of the beach system, rebuilding the berm and creating a less steep beach profile.

How Do We Measure Change on Beaches?

In Maine, we measure changes using two different projects: the Southern Maine Beach Profiling Program, or SMBPP, and the Maine Beach Mapping Program, or MBMAP. The first project, which has a [website run by Maine Sea Grant](#), uses the help of volunteers who measure changes perpendicular to the beach on a monthly basis at several different southern Maine beaches using what's called the "Emery method" of profiling (Emery, 1961). This method uses three volunteers – two "profilers" who use two stakes with vertical marks and the horizon to measure vertical changes horizontally along the beach, and one "recorder" who records each reading.

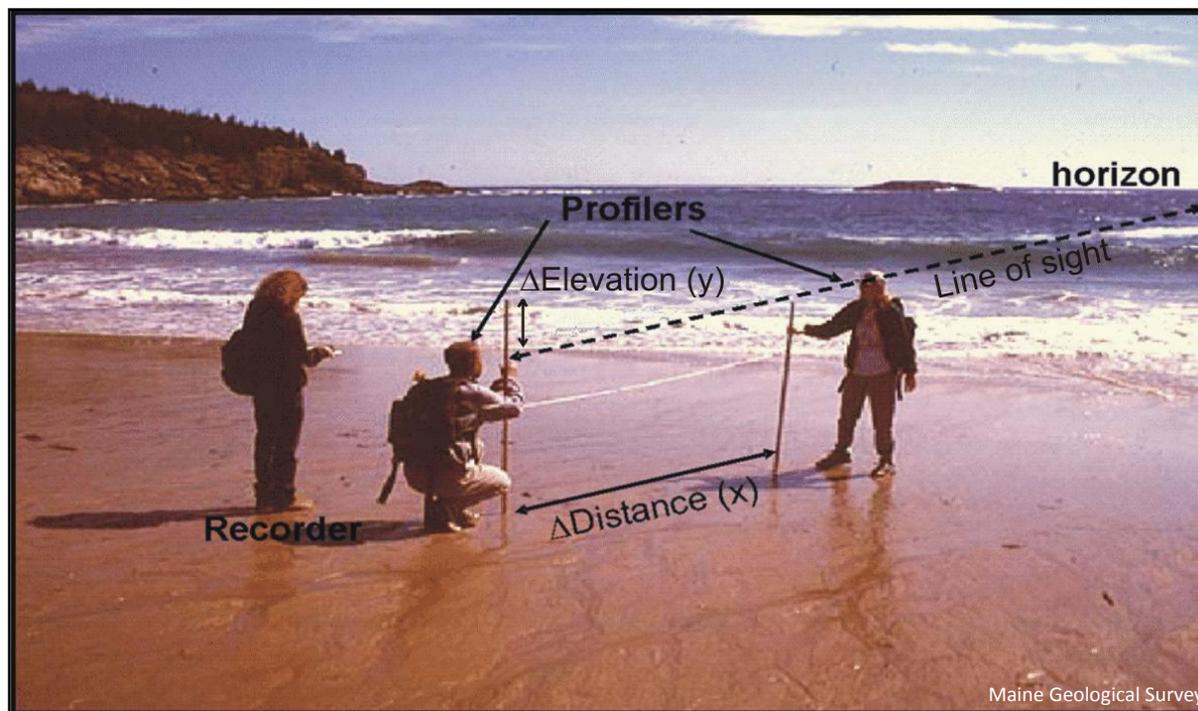


Image by Peter A. Slovinsky

Figure 4. The Emery Method of beach profiling for data collection (Emery, 1961). The horizon and the lower of two graduated poles are used as a level to intersect the second pole to make a reading in the change in elevation (y) over a known distance (x). Field readings are taken and entered into a booklet.



How Do We Measure Change on Beaches? (continued)

Beach profile data is collected across the beach, from a starting point (benchmark) somewhere in the dune or on the seawall, and extending down to the low water mark. The result, when the x (horizontal) and y (vertical) data are plotted into a chart, is what is called a “beach profile”, and looks like the image below. The profile captures the important features of the beach shape.

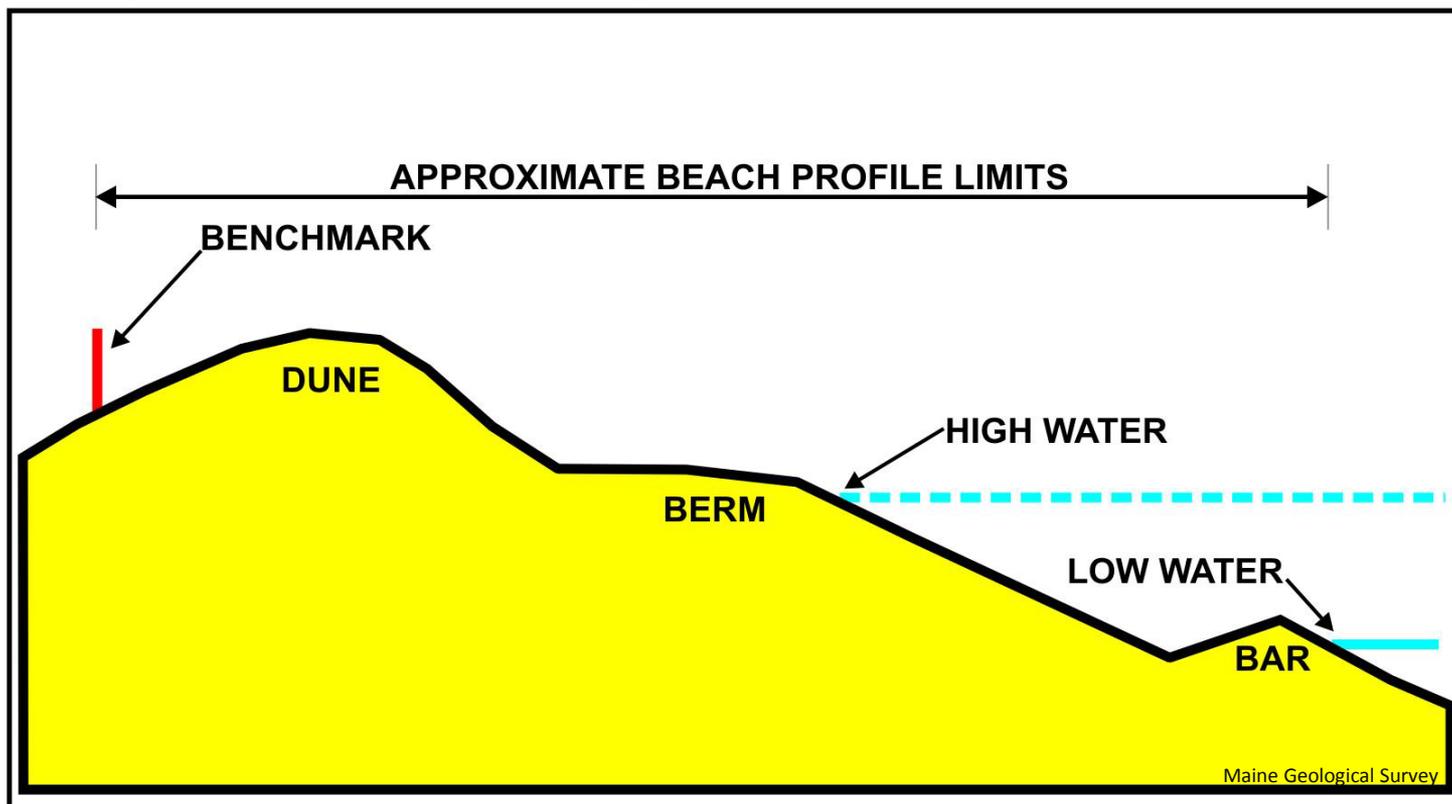


Image by Peter A. Slovinsky

Figure 5. Data collected using the Emery Method is used to construct a beach profile. The profile is a transect from the benchmark (a metal pin, post, or other fixed mark) on a dune or seawall toward the ocean. The profile measurements extend to the water line at the time of the survey and are usually made at low tide.



How Do We Share Information on Changes Observed?

Beach profile data is available for viewing, download, and graphing for participating beach areas via the Maine Shore Stewards [online data collaborative](#). Beach profile data can be graphed through a special user interface, resulting in the comparison of beach profiles from different times of the year, as shown below in Figure 6. In this example, from Scarborough Beach, note how the beach profile gains height as we go from spring (May, yellow line) to summer (August, red line), especially at the “berm”, the hump that is clearly seen in the August profile.

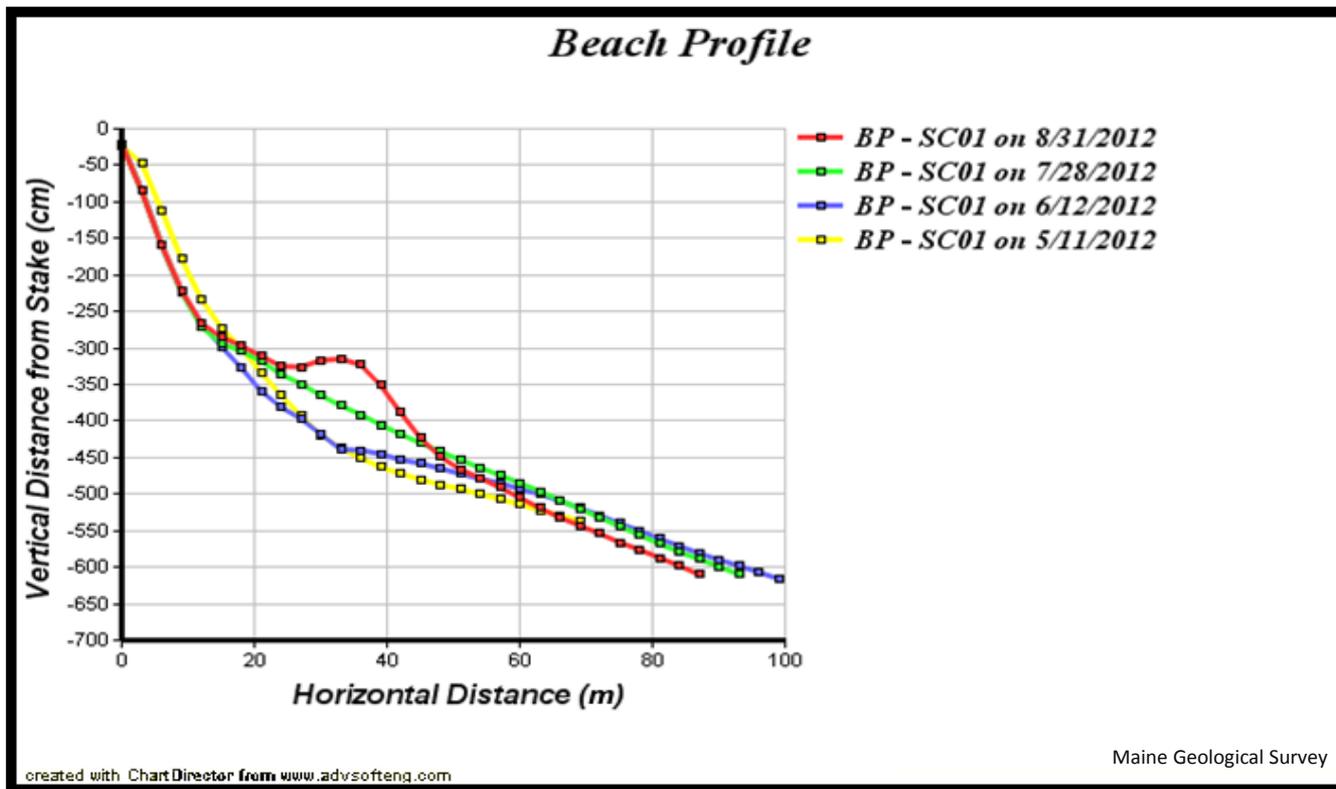


Figure 6. An example of beach profiles, from Scarborough Beach profile SC01 showing changes from May through August 2012.



What about the Maine Beach Mapping Program?

The Maine Beach Mapping Program, or MBMAP, collects annual alongshore positions of the shoreline, typically the high water mark or the edge of dune vegetation. A very precise GPS is used, which can measure positions accurately within an inch or two. Data is collected each year at beaches at about the same time of year (usually in June, July, August, and September) so that shoreline positions can be compared with previous years.



Photo by Peter A. Slovinsky

Figure 7. 2013 Geology Technician Rachael Dye measuring the position of the edge of vegetation using a precise GPS as part of the Maine Beach Mapping Program.



What about the Maine Beach Mapping Program? (continued)

Once we have several years of data, we use a Geographic Information System (GIS) to analyze shoreline changes using the USGS [Digital Shoreline Analysis System \(DSAS\)](#). This allows us to calculate the rate of shoreline change at closely spaced transect points. Results are displayed by color-coded lines that show the amount and direction of shoreline changes. This helps us put changes we see in beach profiles into a larger geographic context.

Figure 8. Shoreline change for the Saco beaches from 2007-2013. Green lines show accretion and migration toward the ocean. Red, orange, and yellow lines show erosion and migration inland. Linear regression rate (LRR) is calculated in meters per year (m/yr) using DSAS. Individual SMBPP profile locations are shown by black dots. MBMAP gives a regional and alongshore picture of the changes seen in the individual profiles.

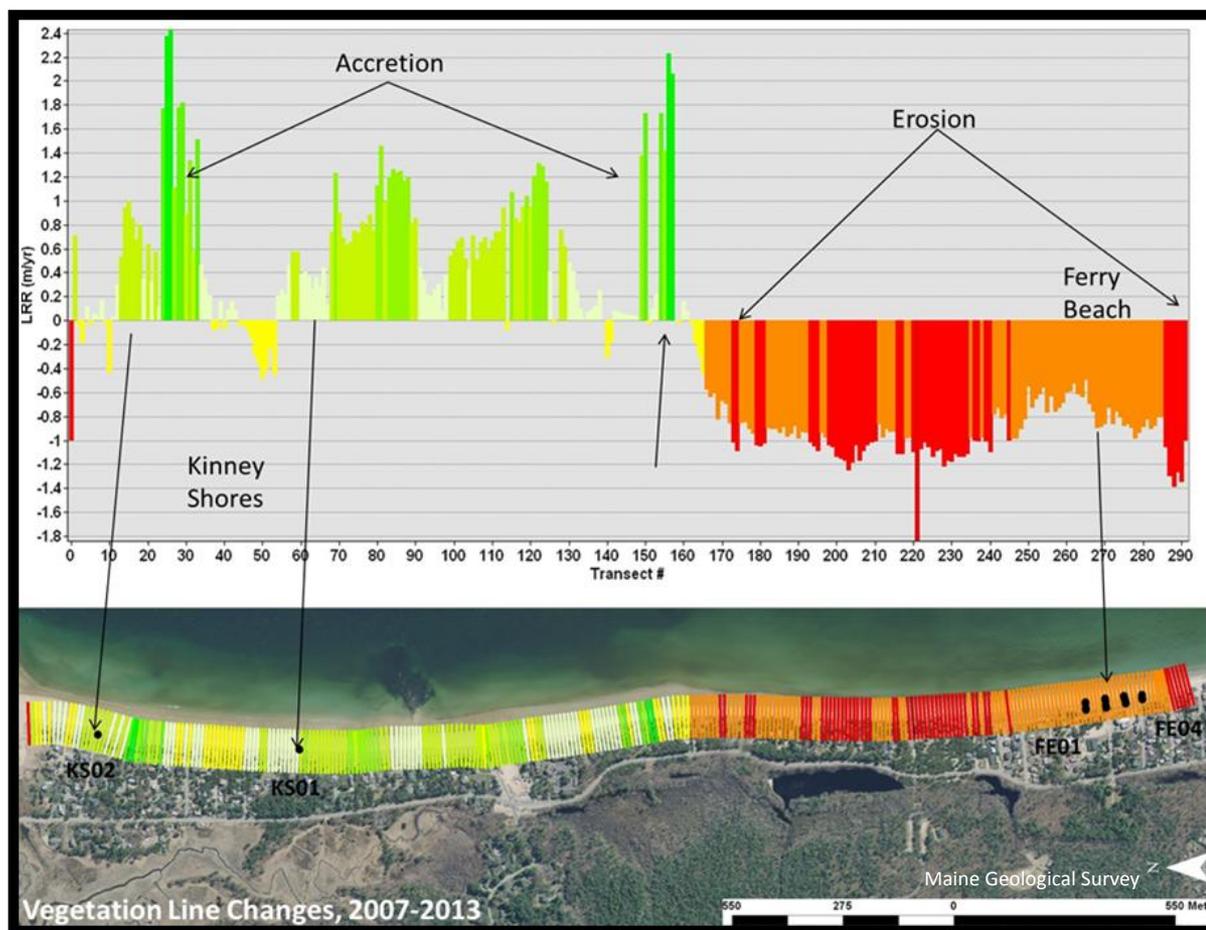


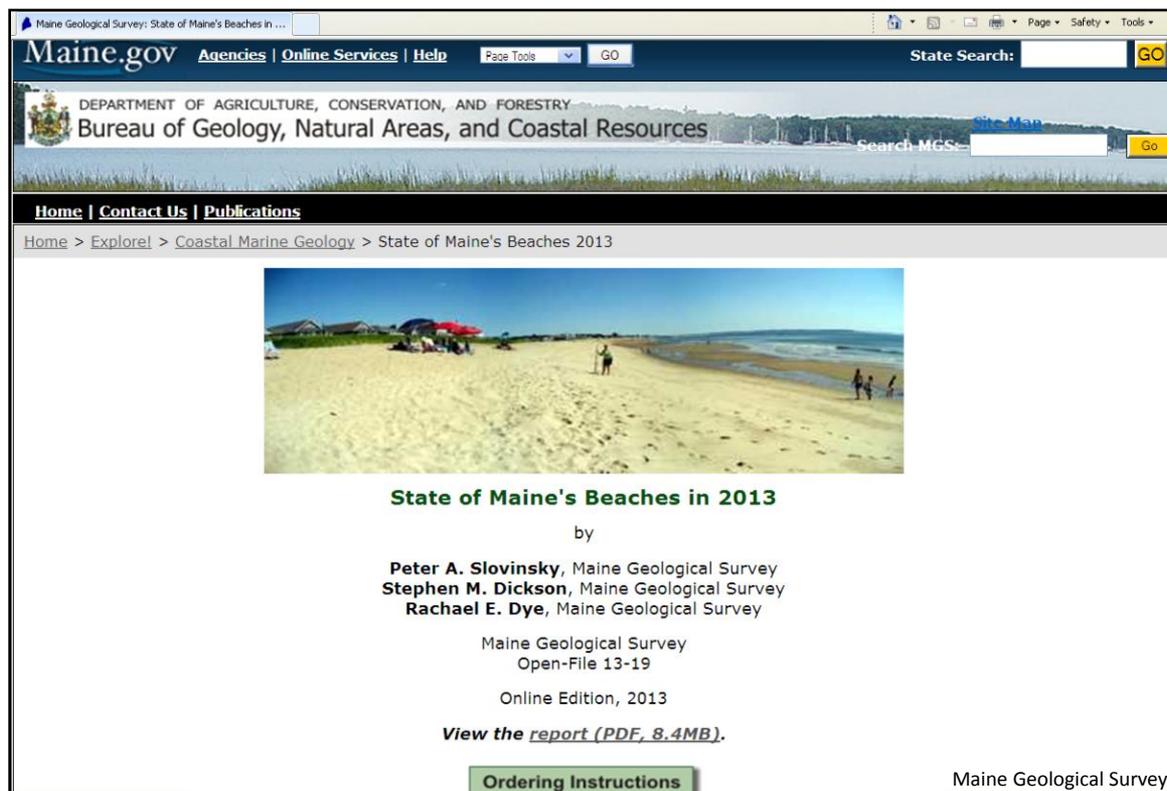
Image by Peter A. Slovinsky



Maine Beaches Conference

The Maine Beaches Conference is held every two years. This conference brings together volunteers, coastal property owners, local, regional, and state decision-makers, and others, to share information on the status of Maine's beaches. Coinciding with each of these conferences, since 2007, the Maine Geological Survey has released the *State of Maine's Beaches* report, which summarizes beach changes observed since the previous report. These reports are available for online viewing, download, and hard-copy purchase from the [Maine Geological Survey website](#).

Figure 9. Each of the *State of Maine's Beaches* reports is available from the Maine Geological Survey website. The page for the most recent report, from 2013, is shown here.



The screenshot shows a web browser window displaying the Maine Geological Survey website. The page title is "State of Maine's Beaches in 2013". The header includes the Maine.gov logo, navigation links for Agencies, Online Services, and Help, and a search bar. The main content area features a large photograph of a sandy beach with people and umbrellas. Below the image, the title "State of Maine's Beaches in 2013" is displayed, followed by the authors: Peter A. Slovinsky, Stephen M. Dickson, and Rachael E. Dye. The page also includes the text "Maine Geological Survey Open-File 13-19 Online Edition, 2013" and a link to "View the report (PDF, 8.4MB)". A green button labeled "Ordering Instructions" is visible at the bottom of the page.



References and More Information

- Emery, K.O., 1961, A simple method of measuring beach profiles: *Limnology and Oceanography*, v. 6, p. 90-93.
- Komar, P.D., 1998, *Beach processes and sedimentation* (2nd edition): Prentice-Hall, Upper Saddle River, New Jersey, 544 p.
- Slovinsky, P.A., Dickson, S.M., and Dye, Rachael E., 2013, [State of Maine's Beaches in 2013](#), Maine Geological Survey, online report.
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