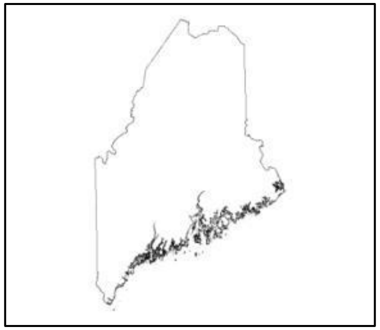
Geologic Site of the Month

July, 1999

The Variety of Maine's Changing Shoreline



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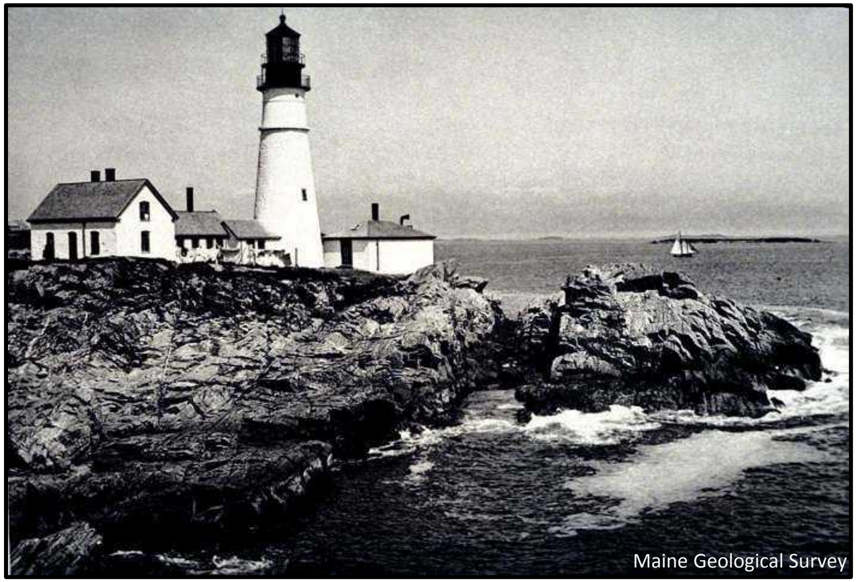
Introduction

Maine is famous for its "rockbound coast" buttressed by rugged, unchanging cliffs of stone. Rocky points such as Portland Head, photographed a century ago, show little change after a hundred years of storms (Figure 1). This is because Maine's bedrock is very strong and consolidated, hence it resists erosion from waves and weather.



Photos from Maine Geological Survey

Figure 1. Portland Head Light photographed around 1900 (Left), and in 1998 (Right). Though the photographs are at slightly different angles, it is apparent that only the lighthouse keeper's dwelling has changed in the time interval.

Shoreline Change

Other parts of Maine, however, have a "soft coast" of loose or unconsolidated materials that are subject to erosion. A landslide this year in Argyle, Maine (Figure 2), illustrates that shoreline changes are ongoing. Although a slow, steady rise in sea-level is the underlying reason for erosion along the coast, the most noticeable erosion occurs quickly during individual storms or landslide events.

Photo by Joe Kelley

Figure 2. May 3, 1999 landslide along the Penobscot River at Argyle, Maine.

Shoreline Change: Rockland Landslide

A vivid example of profound shoreline change occurred during a large landslide in Rockland in April, 1996. Photographs taken during the course of the event, which lasted for several days, document the geologically rapid retreat of the bluff through two houses (Figure 3).

Photos by Joe Kelley

Figure 3. The progressive retreat of the coastal bluff in Rockland during the April, 1996, event. On the 23rd of April (Left), it appeared that conditions might have stabilized, but on the 24th of April (Right) more blocks tumbled into the sea and the two houses were lost.

Shoreline Change: Rockland Landslide

The movement of a large mass of material onto the tidal flat extended the shoreline seaward for a time (Figure 4), but the sea immediately began to erode the landslide material from the tidal flat.

Photo by Joe Kelley

Figure 4. Landslide debris from the Rockland event extended far out onto the tidal flat.

Shoreline Change: Rockland Landslide

People began trying to stabilize the landslide mass (Figure 5). The building debris was removed, and the surface of the landslide was graded and planted with grass. Waves have continued to erode the outer area, but there are plans to contain the landslide deposit by engineering its seaward edge.

Figure 5. Views of the Rockland coast before and after the 1996 landslide. November, 1994 aerial view prior to the landslide (left). October 10, 1998 view of the landslide area after it has been re-vegetated (right).

Shoreline Change: Jonesport

In other locations along Maine's "soft coast" where the bluffs are clearly eroding, some property owners have taken measures to prevent damage to their buildings. One such place is a stretch of the Jonesport coast (Figure 6).

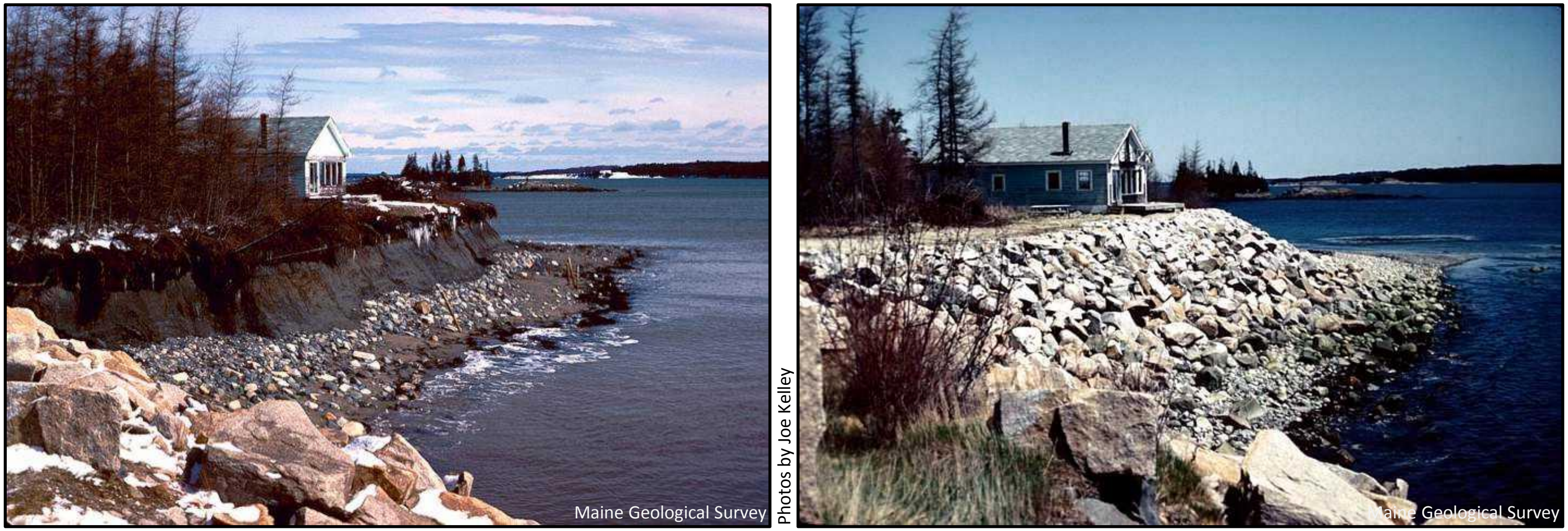


Figure 6. Human-made shoreline changes in Jonesport, Maine. April, 1983, view of house on eroding bluff (Left). May, 1992, view of the same property (Right). The large granite blocks have protected the house, which has been moved as far landward as possible.

Shoreline Change: Jonesport

Jonesport is underlain by peat bogs and Ice Age mud. These materials succumb easily to wave attack. As the bluff has eroded through the years, some houses in the area have been moved back from the edge. Unfortunately, coastal roads limit the places to which many of the dwellings can be moved. For other properties, the owners have tried to protect buildings by forestalling bluff erosion (Figure 6). Over the long run, this strategy can prove to be expensive, in some cases exceeding the value of the structure being protected. In addition, for regions with rising sea level, attempts to "permanently" fix the shoreline position with a wall will cause unintended problems such as eliminating the intertidal clam flats or salt marshes in the adjacent areas.

Shoreline Change: Sand Beach

Beaches make up another part of the "soft coast." They respond to rising sea level by eroding or by moving landward. Sometimes, during large storms, the breaking waves cut an erosional notch in the lower part of the beach (Figure 7).

Photos by Joe Kelley

Figure 7. At Sand Beach, Mount Desert Island, shoreline changes are benign. The left view shows a gently inclined beach surface. October, 1983, view (Right) depicts an erosion scarp 1.5 meters high following an early fall storm. This beach, which is largely made of shell fragments, changes in appearance but remains in the same place over time.

Shoreline Change: Sand Beach

Normally these erosional notches heal by the following summer as smaller waves wash sand back onto the beach. In the early spring of 1997, erosion of the beach at Reid State Park uncovered buried rockets from World War II. During the summer, they were again covered by sand. In November and early December, after fall storms had eroded the beach again, the rockets were removed in a cleanup effort. By mid-December, sand had moved back onto the beach again, burying the cleanup area beneath two feet of sand. In this example, careful measurements demonstrated the movement of sand on the beach. Where beaches are undeveloped or have not been carefully surveyed, however, it is more difficult to see how the beach changes from one time to another. Summer visitors may see the same image of the beach year after year, not knowing that dramatic changes have occurred during the rest of the year.

Shoreline Change: Camp Ellis

Beaches with artificial structures cannot respond so easily to natural forces because the presence of buildings in the sand dunes, or seaward of them, inhibits the beach from adjusting to storms and rising sea level. Many houses in Maine built too close to the shore have been claimed by the sea during winter storms (Figure 8), and many more properties are at risk to changes in the shoreline position. For this reason, the State of Maine does not allow new buildings to be located in frontal dune settings, and discourages enlargement of existing structures in this dynamic environment.

Photos by Stephen M. Dickson, MGS

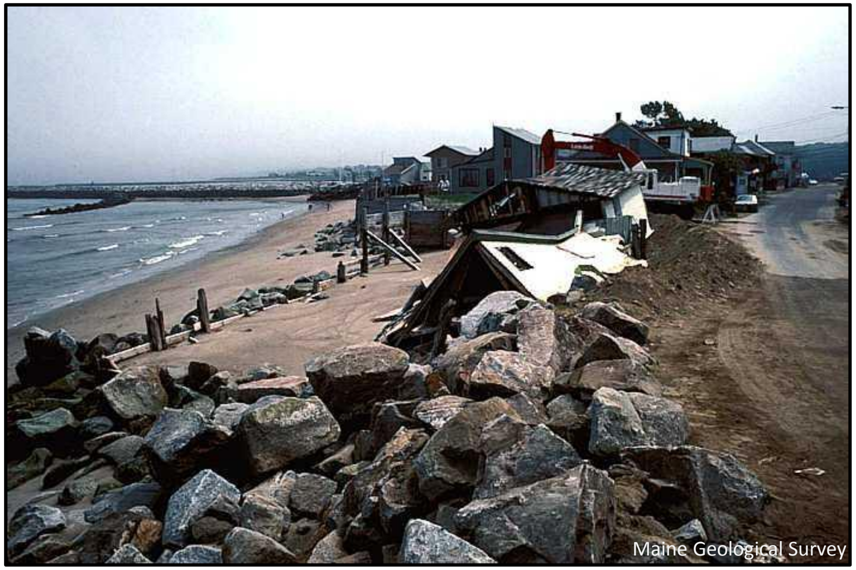


Figure 8. Effects of shoreline changes on a built-up coast, Camp Ellis, Maine. Winter storms batter houses (Left). Following 1991 storms (Right) houses have been knocked down by wave attack.