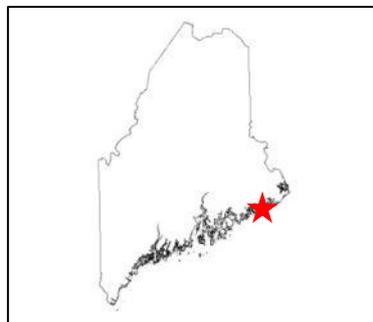


Geologic Site of the Month  
December, 2013

***Coastal Change in Holmes Bay, Whiting, Maine***



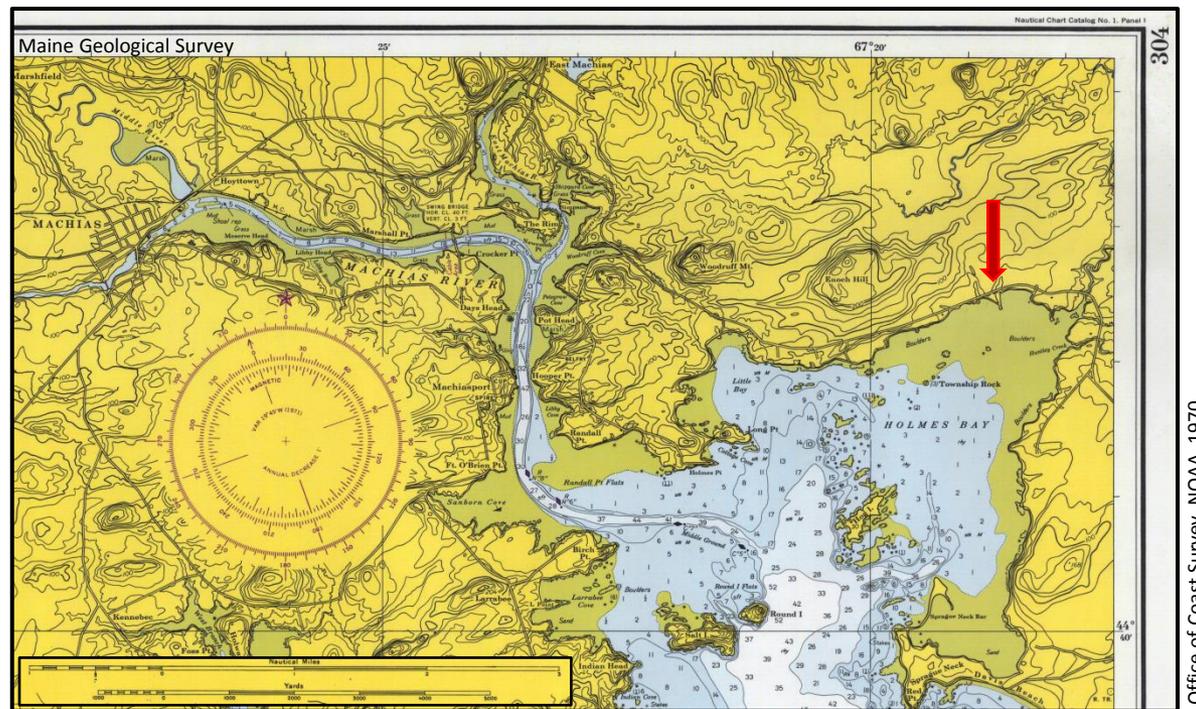
44° 42' N, 67° 19' W

Text by  
Stephen M. Dickson



## Introduction to Holmes Bay

Holmes Bay is a shallow and sheltered embayment in Washington County. The bay forms the northeast corner of the larger Machias Bay that opens south to the Gulf of Maine. The bay is bordered by the towns of Machias to the west, Whiting to the north, and Cutler to the east.



Office of Coast Survey, NOAA, 1970

**Figure 1.** Holmes Bay as charted in 1970 by the U.S. Coast and Geodetic Survey on nautical chart No. 304. A small peninsula (red arrow) extends south off the mainland in this chart (and subsequent charts). Water depth soundings are in feet Mean Low Water (blue) and land (yellow) elevations are in contour intervals of 20 feet. The green color illustrates the intertidal area that becomes exposed at low tide. To view the entire chart or more recent ones, see link to the Office of Coast Survey (2013) in the references.



### Coastal Bluff Retreat

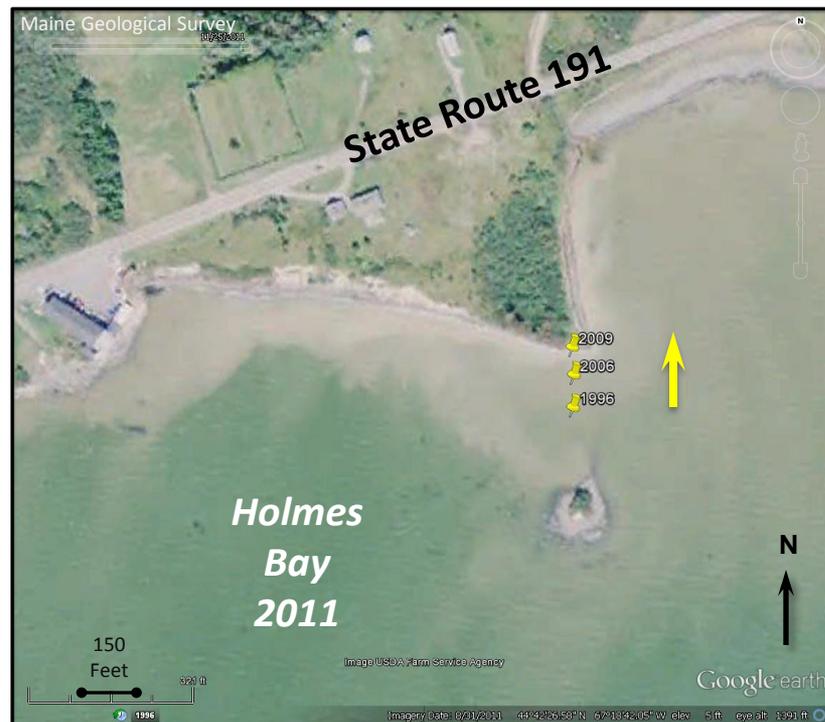
Coastal bluffs can erode several ways. Most coastal bluffs experience wave action along the base of the bluff. This erosion removes sediment and steepens the face of the bluff. Sometimes the bluff is so steep (as in the left photo below) that vegetation cannot grow before more sediment is removed. Vegetation overhangs the top of the bluff and also indicates sediment loss. Groundwater can seep out the face of a bluff and lead to additional erosion. Surface water runoff can also lead to erosion hot spots along a bluff as water flows down to the ocean. Seasonal freeze-thaw cycles can also dislodge sediment on a bluff and lead to erosion.



**Figure 2.** These two photographs were taken on December 3, 2013. The one on the left shows an eroding bluff of glaciomarine mud. On the right is a small island created by bluff erosion and shoreline retreat. Views are looking east toward the Town of Cutler. To learn more about evaluating coastal bluff erosion visit the MGS [web pages](#) or Maine Sea Grant's [Property Owner's Guide](#).

Shoreline Change from 1996 to 2011

Over a period of 15 years, the shoreline along Route 191 in Holmes Bay has retreated north approximately 150 feet (46 meters). The erosion rate at the point is about 10 feet per year. The yellow pins mark the high tide position at the southern point on the bluff in 1996, 2006, and 2009. Notice that the retreat (yellow arrow) has been primarily along the southwest facing shore and not the eastern one.



Background image 1996 courtesy of the USGS and Google Earth.

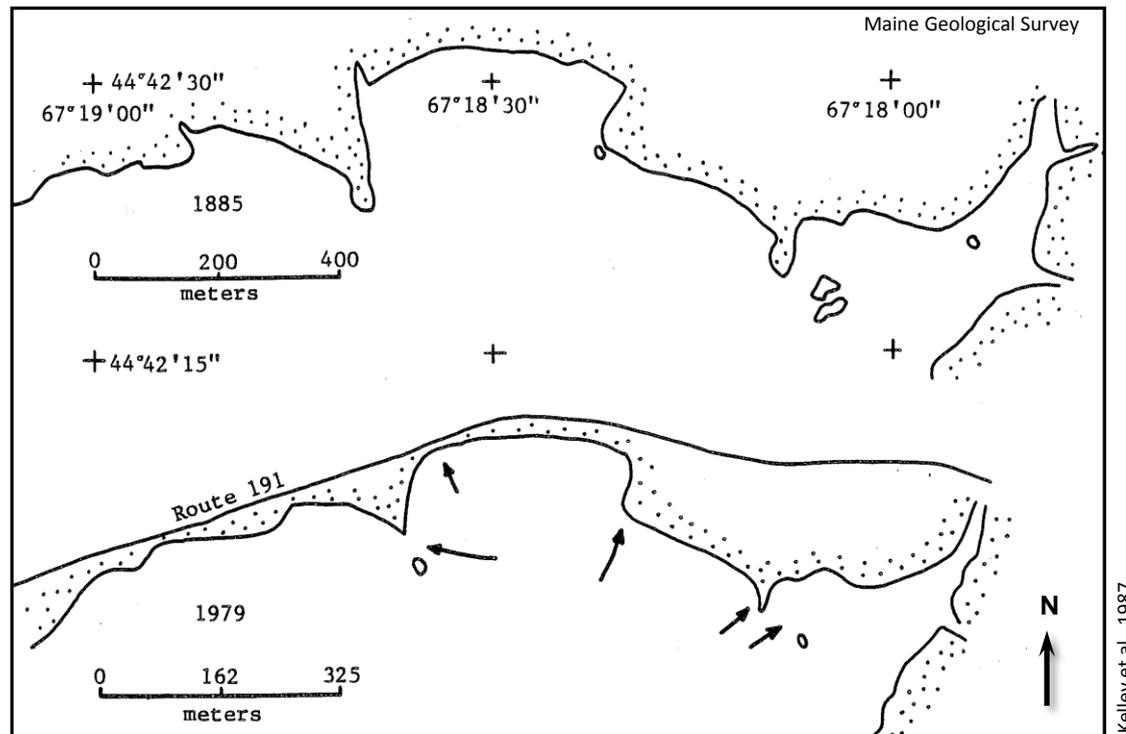
Background image 2011 courtesy of the USDA and Google Earth.

**Figure 3.** Compare these two historical photographs. The one on the left was taken on May 14, 1996 and the one on the right on August 31, 2011. The small island is still intact but appears smaller. The bluff shoreline has retreated north. Maine DOT installed riprap along the bluff (upper right corner) to protect Route 191. This area by the road has experienced both bluff retreat and a landslide in August 1962 (Ault and Bigelow, 1966).



Shoreline Change Since 1885

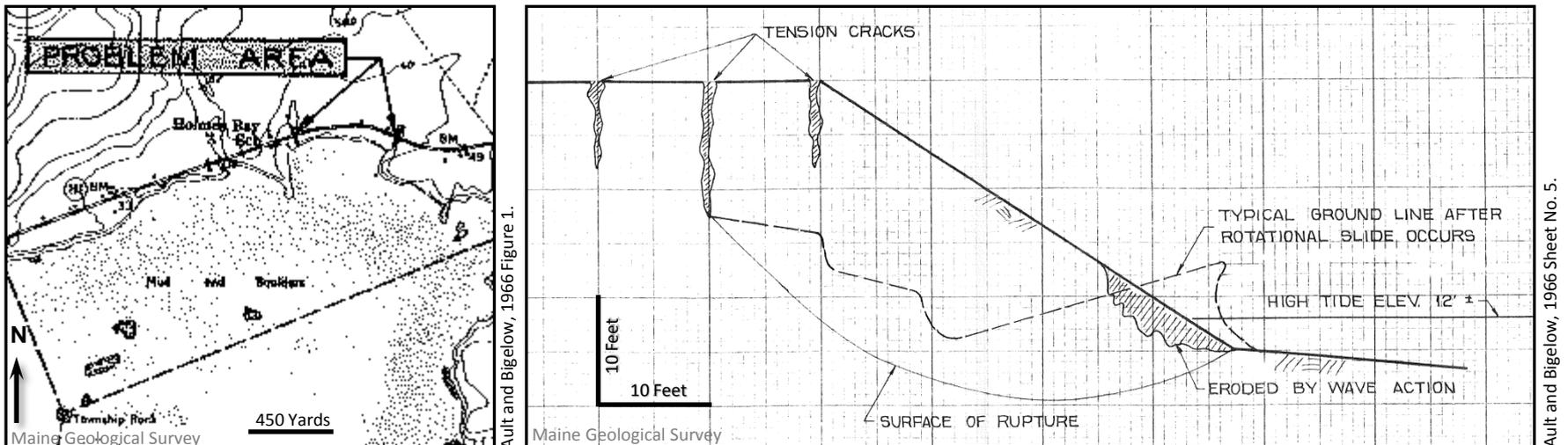
Early charting of the Maine coast can be compared to more recent charts and air photos to identify areas of significant shoreline change in the last 125 years. Where the ocean regularly reworks glacial sediment, shoreline peninsulas can retreat and form islands and islands can become smaller or disappear.



**Figure 4.** In 1885 the U. S. Coast and Geodetic Survey Chart No. 1687 (top) showed a peninsula that would retreat and leave an island (lower left arrow). In the east of the bay it appears that two islands disappeared, although they may have been too small to map in 1979 (right arrows) (From Kelley et al., 1987). See also Figure 1 for a 1970 chart.

August 1962 Coastal Landslide

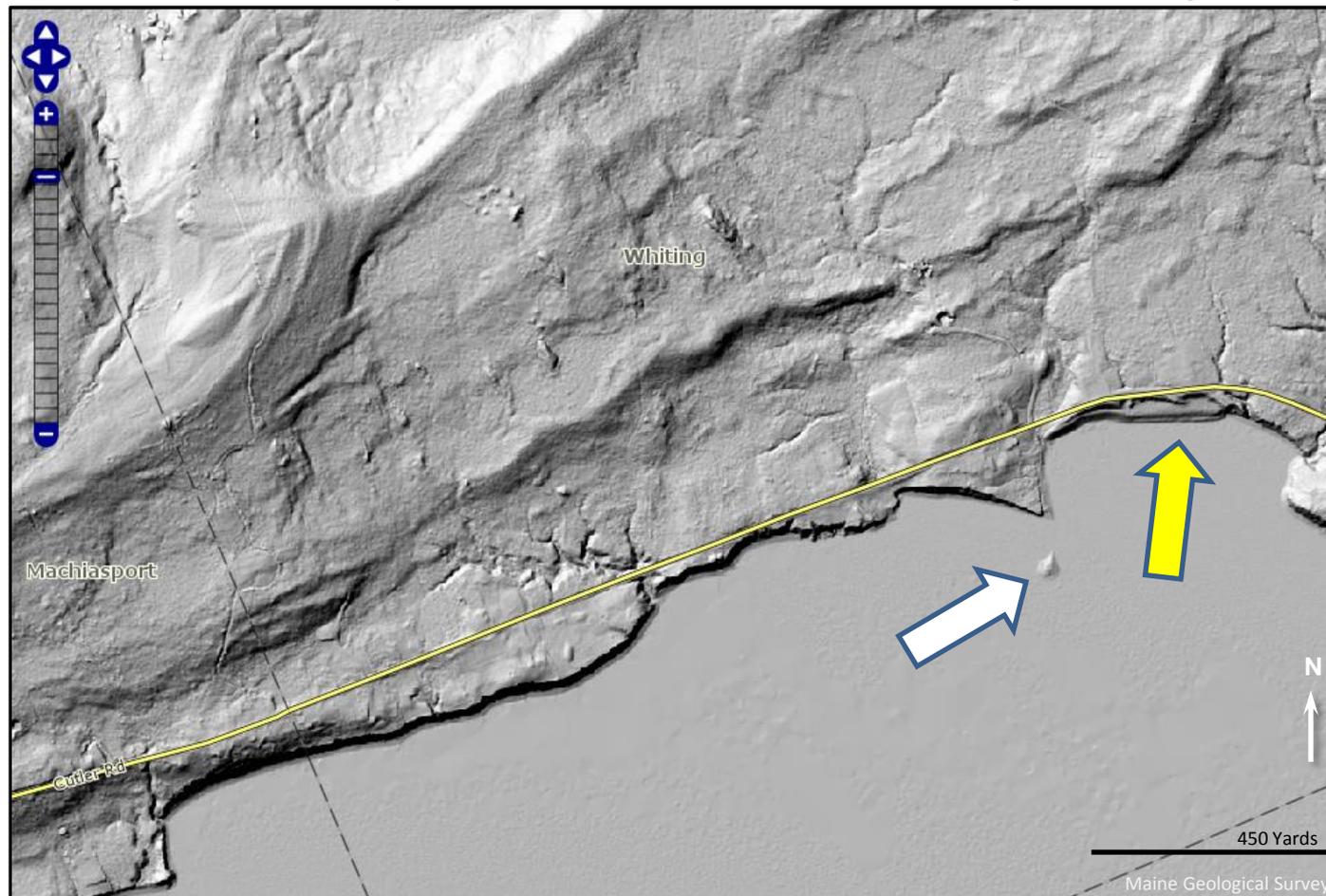
Landslides have occurred in many [locations](#) in Maine where the ground is underlain by glaciomarine clay called the [Presumpscot Formation](#) (Novak, 1987). In August 1962 a rotational slide occurred in Holmes Bay east of the eroding peninsula and island described here. The landslide resulted in down-dropped blocks of intact soil with trees leaning in a shoreward direction (Ault and Bigelow, 1966). The slide left a vertical headwall scarp about 20 feet high about 40 feet from State Route 191. Borings just landward of the slide headwall determined that the Presumpscot Formation was as much as 65 feet thick (Ault and Bigelow, 1966), so the soft silt and clay extended well below the low-tide elevation.



**Figure 5.** The “Problem Area” (left) shows the shoreline of existing and potential landslides identified by Ault and Bigelow (1966). Their study illustrated a typical cross-section of the rotational failure (right). This movement is similar to that in the 1973 and 1996 Rockland landslides (Berry et al., 1996). For more information on landslides visit the MGS [Coastal Landslide web pages](#).

Landforms Revealed by Light Detection and Ranging (LiDAR)

Topography illustrated with shaded relief. The island remnant shown by the white arrow. Former landslide area shown above the yellow arrow. Glacial moraines form ridges trending ENE-WSW.



Shaded Relief Courtesy of Maine Office of GIS Orthoviewer

**Figure 6.** Holmes Bay relief imaged in 2010 with LiDAR (aircraft-borne laser). For more interesting examples of Maine landscapes revealed by LiDAR see Thompson (2011).





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