

Geologic Site of the Month
November, 2008

***Seawall and Popham Beach Dynamics
Phippsburg, Maine***



43 43' 56.57" N, 69 48' 37.22" W

Text by
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Introduction

Beach dynamics and sand movement along the shoreline at Popham Beach State Park and Seawall Beach is a continuing saga of extreme shoreline change and dune erosion. Here we look at Seawall Beach, the Morse River, and the large sand spit (bar) connected to Seawall Beach that extends seaward of Popham Beach.

In fall 2008 an enormous beach spit was connected to Seawall Beach reflecting several years of growth and easterly extension. It currently blocks the Morse River from flowing directly south to the sea and has led to severe dune erosion and loss of mature pitch pine trees in the back dune maritime forest at [Popham Beach State Park](#). For more on the historical location of the Morse River and erosion at the park see the previous MGS web page, [Tombolo Breach at Popham Beach State Park, Phippsburg, Maine](#).



Hiking to Seawall Beach to Visit the Morse River

Access to the mouth of the Morse River can be from the east via Popham Beach State Park or from the west via Seawall Beach. In order to see the new beach spit first-hand or to walk out on it when the tide is low, a hike from Route 216 will lead to the beach and the spit (Figure 1).

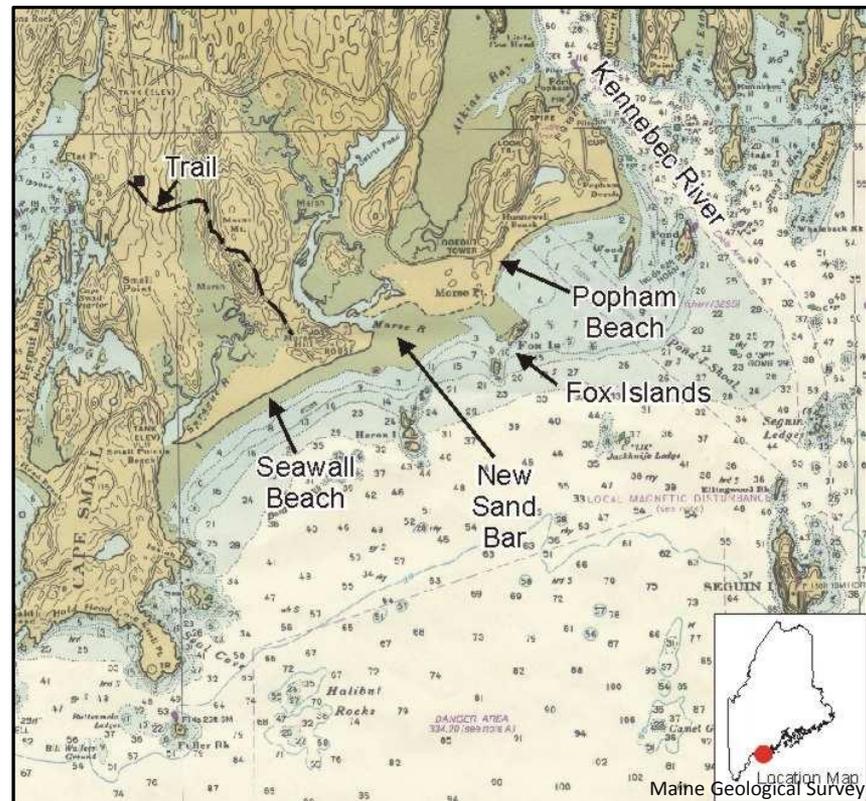


Figure 1. Nautical chart of mid-coast Maine with the locations of the mouth of the Kennebec River next to Popham Beach, Fox Islands just seaward of Popham Beach State Park, Morse River, and Seawall Beach adjacent to Small Point.

Hiking to Seawall Beach to Visit the Morse River

Seawall Beach is part of the Bates-Morse Mountain Conservation Area and has limited vehicle access. There is a small parking lot 12 miles south of Bath, Maine and 0.8 miles south of the split of routes 216 and 209 in Phippsburg and marked by a street sign labeled Morse Mountain Rd. This parking area is open during daylight hours and provides the starting point for a 2-mile hilly hike through woods and across lowlands adjacent to salt marshes. The conservation area does not allow bicycle access or pets but strollers are permitted. During hunting season it is advisable to wear orange; hunters and hikers share the area. In spring and summer prepare for insects. Note there are no restroom facilities, sources of drinking water, nor trash facilities, so please plan accordingly for a trip that could last two hours or more. For more information about the conservation area contact the [Harward Center for Community Partnerships](#), [The Nature Conservancy \(Maine Branch\)](#) or the Small Point Beach Association.



Hiking to Seawall Beach to Visit the Morse River

On the hike to the beach you will follow a wide gravel or asphalt path that winds through the woods (Figure 2), passes a small bedrock cliff (Figure 2), crosses two salt marshes with views of tidal channels and efforts at salt marsh restoration (Figure 3).



Photos by S. M. Dickson

Figure 2. (Left) A view of the hiking path. (Right) Vertical outcrop of bedrock along the trail.

Hiking to Seawall Beach to Visit the Morse River

Note that the marsh crossings are about at the level of the spring high tide (high salt marsh), so if tide predictions are over 10 feet (which happens only a few times a year) the path may be covered with salt water at the time of high tide.



Photos by S. M. Dickson

Figure 3. (Left) The path crosses the Sprague River and salt marsh. A culvert allows tidal currents to flow beneath the path. This is an area where Bates College, The Nature Conservancy, the Small Point Association, The Natural Resources Conservation service and others began a salt marsh restoration effort in 2002. (Right) A view of Sprague River channel.



Hiking to Seawall Beach to Visit the Morse River

Before reaching the beach it is possible to walk up Morse Mountain on a short side trail for an overlook to see the ocean, barrier dune system, and back-barrier salt marshes of Seawall Beach and the Sprague River (Figure 4). From Morse Mountain it is even possible to see Casco Bay on a clear day.



Photo by S. M. Dickson

Maine Geological Survey

Figure 4. A view from Morse Mountain of the Seawall coastal barrier system. Seawall Beach is on the far side of the dunes. The overlook also provides a panorama of low-lying hills and Casco Bay to the east



Hiking to Seawall Beach to Visit the Morse River

At the end of the main trail, the path crosses through mature back dunes and the frontal dune (Figure 5). Seawall Beach is one of Maine's finest beaches. The beach is important habitat for [piping plovers](#) and [least terns](#) and signs at the entrance to the beach will inform visitors of what they look like and how to avoid disturbing them in nesting season in the summer.



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Photo by S. M. Dickson

Figure 5. The path turns from gravel and asphalt to soft sand at the entrance to the beach. From the high point shown in the path it is possible to see the large frontal dune system of Seawall beach.



Seawall Beach

It is very linear and has a natural frontal dune ridge (Figure 6) and no seawalls as the name might suggest. Winter erosion can lead to dune loss and the formation of a vertical drop or scarp that runs along the frontal dune. As you approach the beach on the dune path look to the right (southwest) and note the change in dune elevations that are vegetated with [American beachgrass](#). See if you can see signs of fresh sand washed into the dune from recent ocean storms. This process, called overwash, leads to the dunes building in elevation and being more storm resistant.



Figure 6. The frontal dune ridge at Seawall Beach. The rise in the dune ridge to the right side of the photo is a relict dune scarp from the Blizzard of February 1978. The storm created coastal flooding, and large surf eroded the dune well inland of where it is today. This 100-year storm left a legacy in many of Maine's frontal dunes similar to that seen here.



Seawall Beach

The dune scarp that forms in winter can be "repaired" naturally by wind and wave action. Waves can push sand up from the beach during high tides or periods of surf all the way to the toe of the dune. Wind can blow dried beach sand up against the dune scarp and produce what geologists call an eolian ramp (Figure 7). These processes of accumulation on the seaward edge of the dune help repair winter storm damage and also provide sand for beach grass to grow in during the summer. The beach berm or relatively flat sand accumulation in front of the dune also collects seaweed, driftwood, shells, and litter.



Figure 7. The seaward edge of the frontal dune has a vertical drop to the beach created by storm wave erosion. Here a wind-blown sand ramp has formed up against the dune scarp.

Seawall Beach

A walk along the beach to the east (left from the path entrance) leads to the beach spit and the Morse River. The dune gives way to a bedrock outcrop that rises directly from the beach (Figure 8). At high tide it may be necessary to get around the outcrop either by wading or climbing over its steep slopes.



Photo by S. M. Dickson

Maine Geological Survey

Figure 8. A view east from the path entrance to a bedrock outcrop of Devonian granite on the beach. When the tide is high it may not be possible to walk on a dry beach around the outcrop to reach the beach spit in the distance.



Seawall Beach

Along the walk you may find stranded lobster traps among other items that have been pushed ashore by surf. Along with driftwood, lobster traps act as sand traps (Figure 9). At the end of the vegetated sand dune you will reach the beach spit and channel of the Morse River.



Photos by S. M. Dickson

Figure 9. (Left) Surf washes loose lobster traps ashore. Any obstacle on the beach profile will slow wind and lead to sand deposition. Here sand is infilling the traps. (Right) Two lobster traps are buried in the intertidal beach profile.

Morse River

The Morse River separates Seawall Beach from Popham Beach. In November 2008 the channel was located along its usual course next to a bedrock outcrop behind Seawall Beach. As it made its way to sea the river took a sharp bend to the east and flowed toward Popham Beach (Figure 10). Be cautious on the bank of the river. Sand can be soft and it is possible to slip off the bank and into the river. The Morse River flows out to sea during the ebbing (falling) tide and into the salt marsh on a flooding (rising) tide. At the mid-tide level (either ebb or flood) the currents will be the strongest and the most dangerous.



Photo by S. M. Dickson

Figure 10. A view of the south bank of the Morse River where the Seawall Beach dunes end.



Morse River

A walk along the beach spit to the east and adjacent to the Morse River offers a chance to examine the shape (morphology) of spit accretion. In November 2008 there were several lobate deposits on the landward side of the spit that mark times of sand accumulation and buildup (Figure 11).



Photo by S. M. Dickson

Maine Geological Survey

Figure 11. A second view of the south bank of the Morse River and Seawall Beach spit closer to the end than shown in Figure 10. The spit curves landward and diverts the Morse River toward Popham Beach State Park in the background. Note how the spit elevation changes where a lobe of sand projects to the left. This lobe is a former terminus of the spit that has since built eastward. At least two such spit lobes were present in November 2008.



Morse River

As you walk farther out on the spit (tide permitting) you will see a general lowering of the sand elevation and a variety of sand ripples on the surface (Figure 12-15). The eastern end of the spit has lower elevations and is overtopped by more of the tidal cycle (Figure 12). Across much of the spit at the eastern end, net sand transport is in a shoreward direction across the top of the spit. Close examination often shows that the crests of the ripples have a reversed asymmetry indicating seaward transport on the last phase of the ebbing current across the spit, just prior to their exposure in the air. In places the ripples appear "flat topped" due to flow reversal on a falling tide.



Figure 12. Linear-crested sand ripples shown in this photo are slightly asymmetrical. The steeper side faces the direction of net sand transport.

Morse River

As the tide falls across the spit, water drains through the troughs and carries sand in miniature channels where the smaller ripples form (Figure 13).



Photo by S. M. Dickson

Figure 13. Linear ripples in this photograph have a secondary set of smaller ripples in the troughs.



Morse River

Photo by S. M. Dickson

Figure 14. Three-dimensional ripples have sinuous crests and a more hummocky shape than linear ripples. These ripples can indicate faster currents than those that formed the linear ripples.



Morse River

Megaripples are troughs or deeper holes that also contain smaller ripples formed by waves and currents. When the tide covers these features, walking through them in a current can be challenging.



Photo by S. M. Dickson

Figure 15. A few places on the spit also have larger sand forms called megaripples.



Morse River

Compare this to the hummocky and sparsely vegetated axis of the spit that rises above the tides and is affected by wind action as well as waves (Figure 16).



Photo by S. M. Dickson

Maine Geological Survey

Figure 16. The highest portion of the spit is an area of sparse vegetation and hummocky topography. In addition to vegetation, driftwood and wrack (dried seaweed) trap sand on the spit surface. Smooth patches of sand are areas of wind-blown sand accumulation.

Popham Dune Loss

From the spit it is possible to look across the Morse River and see the loss of dunes caused by the undercutting by the river. As described in March 2008 ([Dickson, 2008](#)) the channel has scoured sand and led to shoreline migration into dunes that have existed for more than 50 years (Figure 17).



Figure 17. A view from the Seawall Beach spit across the Morse River to the west beach at Popham Beach State Park. Fallen trees and high dune scarps are common along most of this stretch of the park's shoreline.

Popham Dune Loss

Along Popham Beach State Parks' west beach, numerous trees are falling into the channel and across the beach (Figure 17-19) and entire trees are carried by the river currents elsewhere along the beach.



Maine Geological Survey

Photo by S. M. Dickson

Figure 18. Erosion of the dunes and maritime forest at Popham Beach State Park is visible from the Seawall Beach spit. Sand that is eroded from the park is swept by ebb currents (to the right) and flood currents (to the left) and redistributed to other parts of the beach and also onto the beach spit.



Popham Dune Loss

Figure 19. Loss of relict dunes at Popham Beach state park is severe along the bank of the Morse River. The pitch pine forest has been growing for at least 50 years based on historical aerial photographs. Near the eastern end of the Seawall Beach spit the Morse River channel is directed close to the state park beach in the background.

Popham Dune Loss

As of November 2008, the Morse River still had a channel that ebbed easterly across the Fox Island tombolo (Figure 20). See [Dickson \(2008\)](#) for additional discussion of the tombolo.

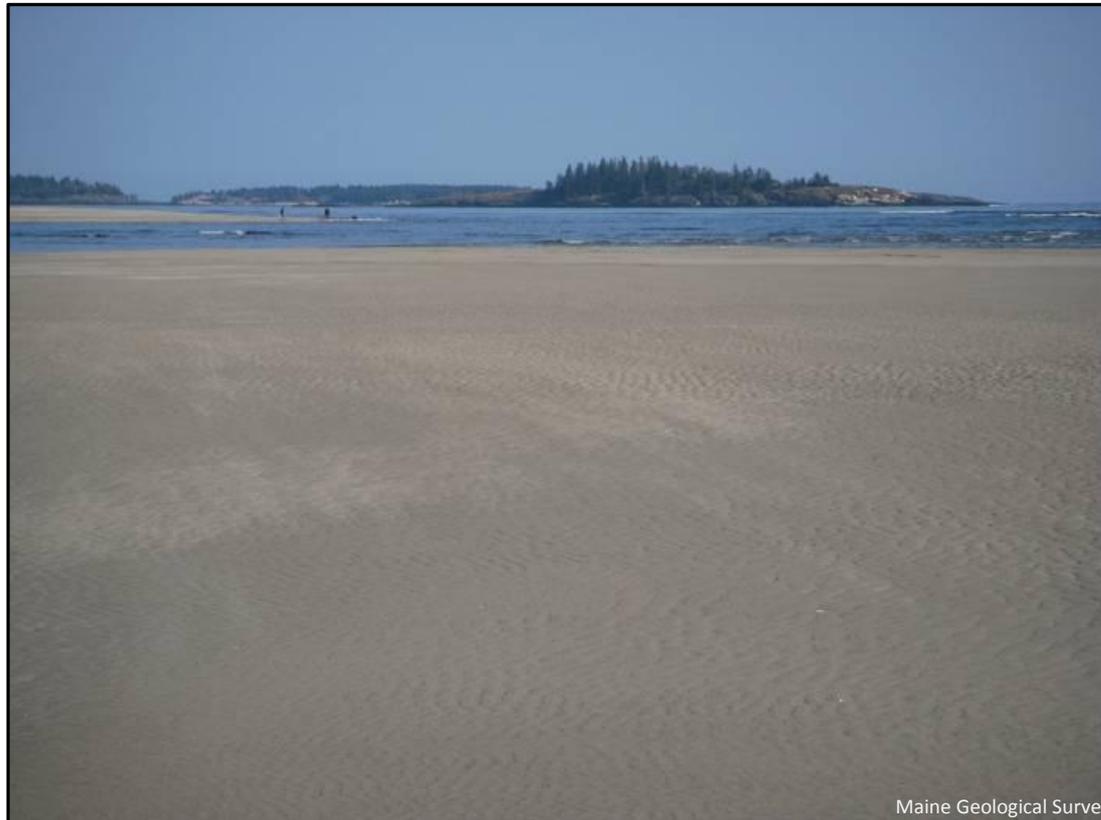


Photo by S. M. Dickson

Maine Geological Survey

Figure 20. The eastern end of the Seawall Beach spit gradually slopes into the Morse River channel. This photograph was taken at mid-tide looking east. It shows a rising tide submerging the Fox Island tombolo (where the people are standing). The forested Wood Island and Kennebec River mouth are in the background.



Spit Extension Across the Morse River

Shoreline change along Popham Beach in the last few years has been nothing less than dramatic. Figure 21 shows a vertical air photograph of the Morse River inlet, sand bars, and dunes on both beaches. The extensive loss of vegetated dunes at Popham Beach State Park is shown by a June 2007 shoreline surveyed by the Maine Geological Survey. A November 2008 survey of the extent of the beach spit above a recent tide (approximately 8 feet above mean lower low water) shows how the spit has prograded into the former channel of the Morse River.

A shaded relief map (Figure 22) was generated using high-resolution topographic data (LIDAR) acquired in 2004 by the NOAA Coastal Services Center for the Maine Geological Survey. In this map the Morse River channel shows up as a flat area that is now beneath the beach spit. Easterly growth of the spit has forced the Morse River north and against the beach and dunes at Popham Beach State Park.



Spit Extension Across the Morse River

Figure 21 is a map of the Seawall and Popham Beaches. The yellow line marks the November 2008 position of the last high tide swash line (elevation approximately 8 feet above mean lower low water) and serves as a contour to outline the spit as well as the berm edge along Seawall Beach. The blue line approximates the highest elevations on the beach spit where they could be mapped in November 4, 2008. The spit becomes very flat on the eastern end so a ridge could not be mapped. The red line is a June 7, 2007 shoreline survey along the seaward edge of the dune at Popham Beach State Park conducted by MGS.



Figure 21. Map of the Seawall Beach, Morse River, and Popham Beach in Phippsburg, Maine. The base air photo is from August 23, 2005, courtesy of the Maine Office of GIS and Seth Barker of the Maine Department of Marine Resources.



Spit Extension Across the Morse River

Figure 22 is a shaded relief map of Seawall and Popham Beaches. The yellow line marks the November 2008 position of the last high tide swash line (elevation approximately 8 feet above mean lower low water) and serves as a contour of the spit as well as the berm edge along the Seawall Beach dunes. The blue line approximates the highest elevations on the beach spit where they could be mapped in November 2008. The spit becomes very flat on the eastern end so a ridge could not be mapped. The red line is a June 7, 2007 shoreline survey along the seaward edge of the dune at Popham Beach State Park conducted by MGS.

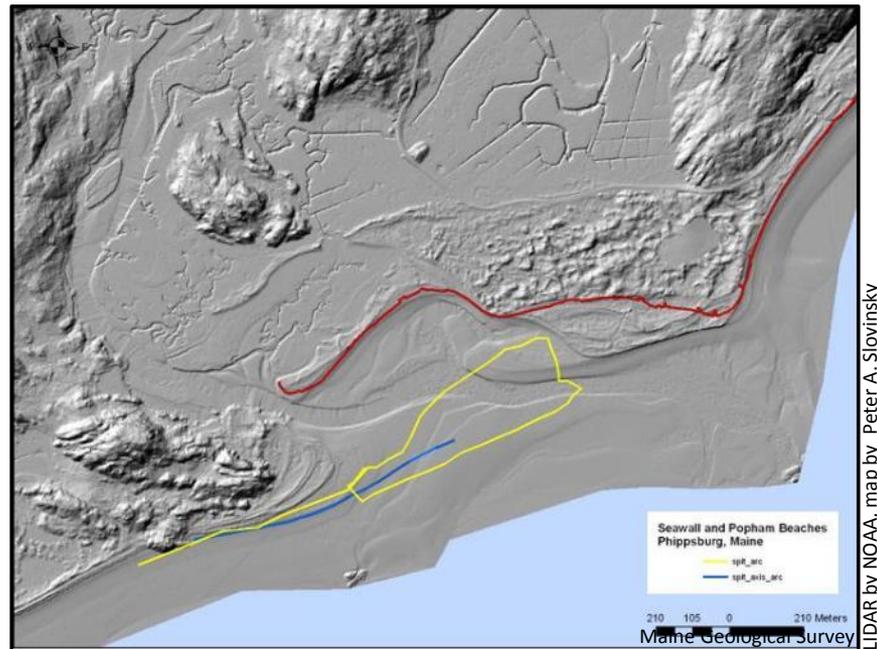


Figure 22. Shaded relief map of Seawall and Popham Beaches. The shaded relief image was generated by Peter A. Slovinsky of the Maine Geological Survey using NOAA Coastal Services Center LIDAR data acquired in 2004.

Future Change

Over time, the cut bank (outer bend in the channel shown in Figure 10) may erode more of the spit and allow the Morse River to cut a more direct and less sinuous path to the sea. It is hard to predict when this might happen. It may take a period of extremely high tides - and thus strong ebbing tidal currents - or a storm with flooding that covers the back-barrier salt marsh with a surplus of water that wants to exit directly to the sea on a falling tide. In any case, an extreme event may accelerate the natural cycle of channel migration.

When the day comes that the Morse River shifts its channel to a more southerly course, the beach spit will become an isolated and temporary sand bar (or if high enough a true barrier island) that is difficult to reach from either Seawall Beach or Popham Beach. As waves and tides rework the beach system, the bar should migrate ashore and "weld" onto Popham Beach State Park and lead to the end of the chronic erosion of the back dune pitch pine forest for at least a decade. As it does so, the beach at Popham Beach State Park will enlarge and the Fox Island tombolo will be wider and higher allowing better access to the islands.



References

[American beachgrass](#), US Department of Agriculture, Natural Resources Conservation Service, PLANTS Profile.

Bates-Morse Mountain Conservation Area, [The Harward Center for Community Partnerships](#), 161-163 Wood Street, Lewiston, Maine 04240, (207-786-6078)

[Least Terns](#), Maine Department of Inland Fisheries and Wildlife.

[Piping Plovers](#), Maine Department of Inland Fisheries and Wildlife.

Small Point Association, P.O. Box 7205, Portland, Maine, 04112 (207-791-7162).

[The Nature Conservancy, Maine Chapter](#), 14 Main Street, Brunswick, Maine 04011, (207-729-5181).



Related MGS Web Sites

MGS Virtual Tour of Maine's Coastal Marine Geology ([pdf format - 2.1 Mb](#))

Slovinsky, P.A. and Dickson, S. M., 2006, [Impacts of Future Sea Level Rise on the Coastal Floodplain](#): Maine Geological Survey, Open-File Report 06-14.

Erosion and flood maps - [Coastal Erosion Assessment for Maine FIRMs and Map Modernization Plan](#).

Seawall Beach is part of the [Maine Coastal Barrier Resources System](#).

[Bedrock Geology of the Bath 1:100,000 Quadrangle \(4.9 Mb PDF file\)](#), 2002, 36" x 44" color map. Includes radiometric age dates and photos describing rock types.

- [Bedrock geology of the Bath 1:100,000 map sheet, coastal Maine, Bulletin 42](#). Describes stratified rock sequences, intrusive rocks, structural geology, and metamorphism of the Bath 1:100,000 map sheet.

Dickson, S. M., 2008, [Tombolo Breach at Popham Beach State Park, Phippsburg, Maine](#).

