The Marsh at St. Paul's Inlet: Context, Significance, and Change

Julia Daly, Dept. of Natural Sciences, University of Maine at Farmington, Farmington, ME 04938 USA dalyj@maine.edu
Trevor Bell, Dept. of Geography, Memorial University of Newfoundland, St. John's, Newfoundland, A1B 3X9 tbell@mn.ca

What is a salt marsh?

Salt marshes are grass , rush, and sedge-dominated areas of the intertidal zone. The vegetation in a salt marsh thrives in a special ecological niche – they are able to withstand periodic inundation of the ocean. The salt marsh surface might be considered a patchwork or mosaic of different plants, responding to more or less frequent tidal or storm influences. Across the marsh, different species occupy slightly different areas – some species can withstand more frequent flooding while others grow best closer to the transition to freshwater vegetation.

Close up of seaside arrowgrass (tall) surrounded by spikerush (brown seedheads). The plants in this part of the marsh grow very densely.

View looking north toward the inlet. In the foreground is high marsh, characterized by saltmeadow rush. Low marsh, with the large seaside arrowgrass plants, can be seen in the background.

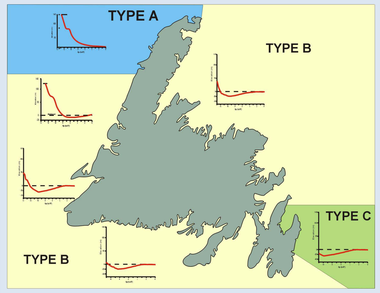
Low marsh vegetation. Seaside arrowgrass (*Triglochin maritima*) is the large plant easily seen in the photo above.

The marsh at St. Paul's Inlet can be divided into two zones, a rush-dominated high marsh that is flooded less frequently, and low marsh with mixed vegetation. The most unusual feature of the low marsh here is the large seaside arrowgrass (*Triglochin maritima*), shown above on the left and at the right. Other species include spikerush (*Eleocharis* sp.), sedge (*Carex* sp.) and saltmarsh rush (or saltmeadow rush, *Juncus gerardii).* The high marsh is shown in the center picture above; the seedheads of the rush give the marsh a brownish appearance.

How is sea level changing in western Newfoundland?

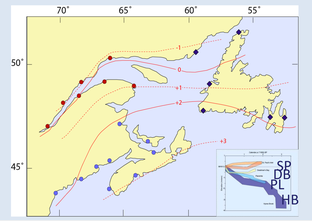
Reconstruction of Atlantic Canada 13,000 years ago, showing ice cover (white) and exposed land (from Shaw et al., 2006). At this time, large areas of the continental shelf (Grand Banks) are exposed above sea level. Note that some of the Long Range Mountains are ice-free by this time.

Newfoundland has experienced a complex pattern of sea-level change stemming from its glaciation during the last Ice Age. The complex interplay of changing ocean and land levels, which resulted in both rising and falling sea levels at different times and places, has altered the relative position of sea level by tens of metres or more over the last 10,000 years.



Sea level curves show the progressive change in the height of sea level relative to present sea level (dashed line) from the time of ice retreat (left side of graph) to today (right side of graph) around the coast of Newfoundland. Many of the coastal areas of Newfoundland experienced a period when sea level was lower than present and the present seabed was dry land. In contrast, the Northern Peninsula has always been higher than present sea level.

The history of sea level change preserved in the salt marsh at St. Paul's Inlet reveals only the most recent chapter of this extraordinary story of coastal change. The salt marsh lies near the modern boundary between rising sea level to the south and falling sea level to the north. The buried peat in the marsh preserves a record of slowly rising sea level over the last 1000 years and the gradual landward migration of the shoreline.

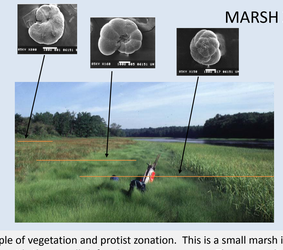


Red lines show the rate of modern sea level rise in mm/year, based on data from tide gauges. The inset on the lower right shows sea-level change at four Newfoundland locations over the past three thousand years (the present time is at the left). The record derived from St. Paul's Inlet is shown in orange.

How do salt marshes record sea level change?

Sea-level rise is an important and immediate challenge facing coastal communities.

Salt marshes provide an important archive of sea-level change over thousands of years. Salt marsh vegetation is closely tied to sea level – some species are more tolerant of tidal inundation than others. When sea level is rising, the salt marsh plants try to keep up by trapping sediment, slowly raising the marsh surface.



Example of vegetation and protist zonation. This is a small marsh in coastal Maine with three well-defined vegetation zones. The orange lines show the distribution of different protists (foraminifera). The tests (like shells) and plant material are preserved in peat, recording the history of the elevation of the marsh above sea level over time.

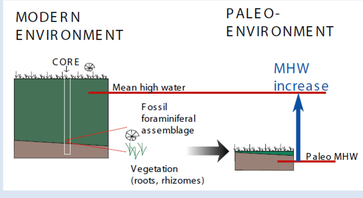
A core collected from the marsh at St. Paul's Inlet. The top of the core (most recent) shows a peat layer overlying a sandy layer. In the middle of the core (older) is another peat layer over a sand layer.

The sand layers are probably storm deposits of sand washed over the barrier, interrupting development of the salt marsh peat.

Small protists (amoebae) also live on the marsh surface (see images on the bottom left). When the plants and amoebae die, material is incorporated into and preserved as peat.

Cores collected from the marsh, such as the one shown at left, yield samples of ancient plant remains and microfossils. These samples are analyzed to determine sea level at the time the peat was deposited, and some material is radiocarbon dated.

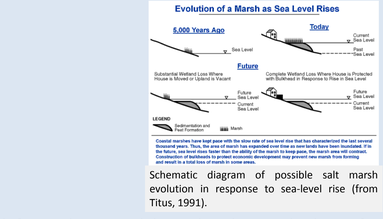
A series of these dated marsh samples are used to reconstruct sea-level change over time.



What is the geologic future of the St. Paul's Inlet marsh?

As the rate of sea-level rise increases in the next century, changes to the shoreline will occur. Sea-level rise forces salt marshes and barriers to migrate inland.

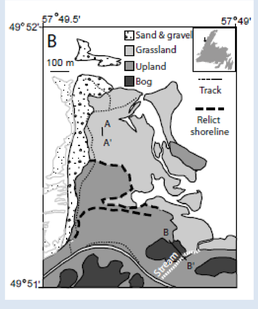
At St. Paul's inlet, it is likely that the barriers will continue to move landward on the north and south sides of the inlet. The salt marsh, which provides a buffer from storm energy and serves as an important habitat, will also migrate landward.



Schematic diagram of possible salt marsh evolution in response to sea-level rise (from Titus, 1991).

If enough fine sediment is delivered to the marsh, the surface may be able to keep pace with sea-level rise. The other key to successful migration of the marsh will be the free movement of the barrier. Other studies have shown that hard structures (walls, roads, buildings) located on these barriers may compromise the long-term health of the marsh.

BELOW: Surficial map of the marsh and adjacent area on the south side of St. Paul's Inlet. The relict shorelines record a sea level higher than present several thousand years ago. At present, the barrier is migrating east, leaving behind a shallow platform.



View toward the Long Range. The gravel of relict beach ridges is visible in the foreground.

SUGGESTED READING

2007 Daly, J.F., Belknap, D.F., Kelley, J.T. and Bell, T. Late Holocene sea-level change around Newfoundland. Canadian Journal of Earth Sciences, 44: 1453-1465.
2006 Shaw, J.; Piper, D.J.W.; Fader, G.B.J.; King, E.L.; Todd, B.J.; Bell, T.; Batterson, M.J.; and Liverman, D.G.E. A conceptual model of the deglaciation of Atlantic Canada, Quaternary Science Reviews, 25: 2059-2081
2005 Bell, T., Daly, J., Liverman, D.G.E., Shaw, J., Batterson, M.J., and Smith, I.R. Late Quaternary Relative Sea-Level Change on the West Coast of Newfoundland, Géographie physique et Quaternaire, 59: 129-140.
2005 Bell, T., Smith, I.R. and Renouf, M.A.P. Postglacial Sea-Level History and Coastline Change at Port au Choix, Great Northern Peninsula, Newfoundland. Newfoundland and Labrador Studies, 20: 9-31.
2005 Smith, I.R. and Bell, T. Testing a Proposed Late Holocene Sea-Level Oscillation using the 'Isolation Basin' Approach, Great Northern Peninsula, Newfoundland. Newfoundland and Labrador Studies, 20: 33-55.
2005 Bell, T. and Renouf, M.A.P. Humans on the Landscape: Interdisciplinary Studies at Port au Choix. Newfoundland and Labrador Studies, 20(1).
2003 Bell, T., Batterson, M.J., Liverman, D.G.E. and Shaw, J. A New Late-Glacial Sea-Level Record for St. George's Bay, Newfoundland. Canadian Journal of Earth Sciences, 40: 1053-1070.
2003 Bell, T., Macpherson, J.B. and Renouf, M.A.P. "Wish you were here..." a Thumbnail Portrait of the Great Northern Peninsula Environment 1000 AD. In Lewis-Simpson, S.M. ed. Vinland Revisited: The Norse World at the Turn of the First Millennium. Selected Papers from the Viking Millennium International Symposium 15-24 September 2000, Newfoundland and Labrador. St. John's, Newfoundland: Historic Sites Association of Newfoundland and Labrador.
1991 Titus, J.G. Greenhouse effect and Coastal Wetland Policy, Environmental Management, 15: 39-58.