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DEPARTMENT OF CONSERVATION
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Title: Investigation of Salt Marsh Stratigraphy as an Indicator of Sea Level Rise in Coastal Maine

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Field and lab work conducted during the summer and fall of 1979 as part of the investigation of evidence for Holocene and Contemporary crustal warping along the Maine coast is described in this report. Our segment of the investigation consisted of identifying thick (about 3 m), undisturbed salt marshes and obtaining cores from suitable marshes. This work represents an initial step in deducing a sea level curve for the Maine coast by examining the sediment core stratigraphy for type of peat and microfossil, primarily foraminiferal, content.

Salt marshes form and grow when the rate of deposition of silts and clays is sufficient to keep pace with the rise in sea level (Thompson, 1973). Salt marsh accumulation can only exist in a rising sea level regime. Terrestrial vegetation will begin to encroach upon the salt marsh in a situation in which sea level is falling.

Miller and Egler (1950) outlined the vertical and horizontal distribution of plant species inhabiting Connecticut salt marshes. Our observations from the Maine marshes substantiate their conclusions. The dominant vascular plant is Spartina alterniflora from an area somewhat below mean high water to just above half-tide level. These plants are completely submerged during each high-tide cycle. Spartina patens dominates at a slightly higher elevation in the tidal range. The boundary between these two communities is very sharp and may be related to salinity differences and interspecific competition. The Spartina patens zone is flooded for approximately one hour during each high tide. Thus, this elevation represents mean high water ± several centimeters. Other species which commonly occur in this "middle marsh" in Maine salt marshes include Salicornia europaea, Suaeda maritima, Triglochin maritima, Plantago juncoides, Limonium nashii, Atriplex patula, Glaux maritima among many others.

Above the Spartina patens zone and mean high water is a zone most often dominated by the rush Juncus gerardii. Plants in this "high marsh" zone can withstand periodic salt water intrusion and are flooded only occasionally. This is termed the zone of highest high water (HHW) and often contains driftwood and mats of organic material pushed up into the zone and deposited during times of very high water. The Juncus zone grades vertically into an area dominated by semi-aquatic or terrestrial plants.

The theoretical stratigraphy of a core from a typical salt marsh, growing upward and landward, consists of an inorganic stratum (bedrock, till, clay, etc.) overlain by peat of terrestrial plants (often absent). This, in turn, is successively overlain by high-marsh peat (characterized by Juncus gerardii) and middle-marsh peat (primarily Spartina patens). The latter two types of peat are often difficult to differentiate on a macroscopic scale. An ideal salt marsh, for our purposes, contains no fresh water peat at the base of the stratigraphic section but consists of salt peat lying directly on top of a non-compactible, inorganic stratum. All peat exhibits autocompaction due to overlying weight during upward growth. Therefore, as a salt marsh accretes over a former fresh marsh, the first appearance of salt peat becomes artifically lower with respect to present sea level as compaction by the more recent, overlying salt peat proceeds.

METHODS

The procedure consisted of three phases. First, marshes were identified from USGS topographic maps of the Maine coast. Second, these marshes were probed for depth of sediment accumulation and cored for type of sediment. Third, samples for radiocarbon dating were obtained. Cores were taken with either a Davis peat corer, a McCauley peat corer, or by cutting samples with a knife off of an exposed marsh face. Several historic coastal structures were also investigated for possible recent encroachment of salt marsh upon them.

RESULTS AND DISCUSSION

A total of 33 marshes (Table 1) were investigated and can be classified in the following four groups:

1) Fresh marshes. Fresh marshes include those formed by either terrestrial or semi-aquatic plants. Four of the marshes identified on topographic maps were in this category. These marshes were rejected for obvious reasons.

2) Salt marshes with underlying freshwater peat, no visible bedrock lip. Test probings and corings showed that 13 or our marshes were in this category. These marshes were rejected because of substantial amounts of compactible fresh peat underlying the salt peat.

3) Salt marshes with underlying freshwater peat, bedrock lip present. These sites were considered because a date on the basal salt peat signifies the time of overtopping of the bedrock lip by the ocean. The occurrence of fresh peat in this case is unimportant because the measurement of interest is the depth of the bedrock lip below high tide. A total of 5 marshes fell into this category. Three of these were rejected because the salt peat was very shallow (less than 1 m) (Mitchell Marsh, Bass Harbor Marsh, and Tenants Harbor III Marsh). Weskeag Marsh, 3.1 m, and Friendship Marsh, about 2 m, are the deepest in this category.

4) Salt marshes underlain by non-compactible material. Eleven marshes fell into this category, 7 of which were rejected for various reasons (too shallow, no distinct contact, possibility of gross human disturbance, etc.). Four were selected for detailed analysis and include Addison I (in Addison), Addison II (also in Addison), Holt Pond (on the Stonington-Deer Isle town boundary), and Cunningham Island Marsh (S. Newcastle) (Figure 1). Detailed locations are given in the Appendix. We now have cores from all of these sites (Addison I, 5 cores; Addison II, 5 cores; Holt Pond, 4 cores; and Cunningham Island, 4 cores).

TABLE I

LOCALITY	TOWNSHIP	MARSH TYPE
Addison I	Addison	4
Addison II	Addison	4
Beaver Brook	Milbridge	2
Franklin	Franklin	2
Grand	Gouldsboro	2
Jones	Bar Harbor	2
Pretty	Mt. Desert	1
Bass Harbor	Bass Harbor	3
Mitchell	Tremont	3
Sedgwick (2)	Sedgwick	1
Little Deer Isle	Deer Isle	1
Holt Pond	Stonington	4
Branch	Frankfort	2
Castine Canal	Castine	2
Horseshoe Cove	Brookville	4
South Warren I and II	Warren	4
Weskeag	South Thomaston	3
Tenants Harbor I and II	Tenants Harbor	2
Tenants Harbor III	Tenants Harbor	3
Friendship	Friendship	3
Montsweag	Wiscasset	2
Chewonki	Wiscasset	2
Parsons Creek (2)	Edgecomb	4
Squam Creek	Edgecomb	4
Marsh River	South Newcastle	4
Cunningham Island	South Newcastle	4
Damariscotta River	Damariscotta	2
E. Branch Johns River (2)	Bristol	2

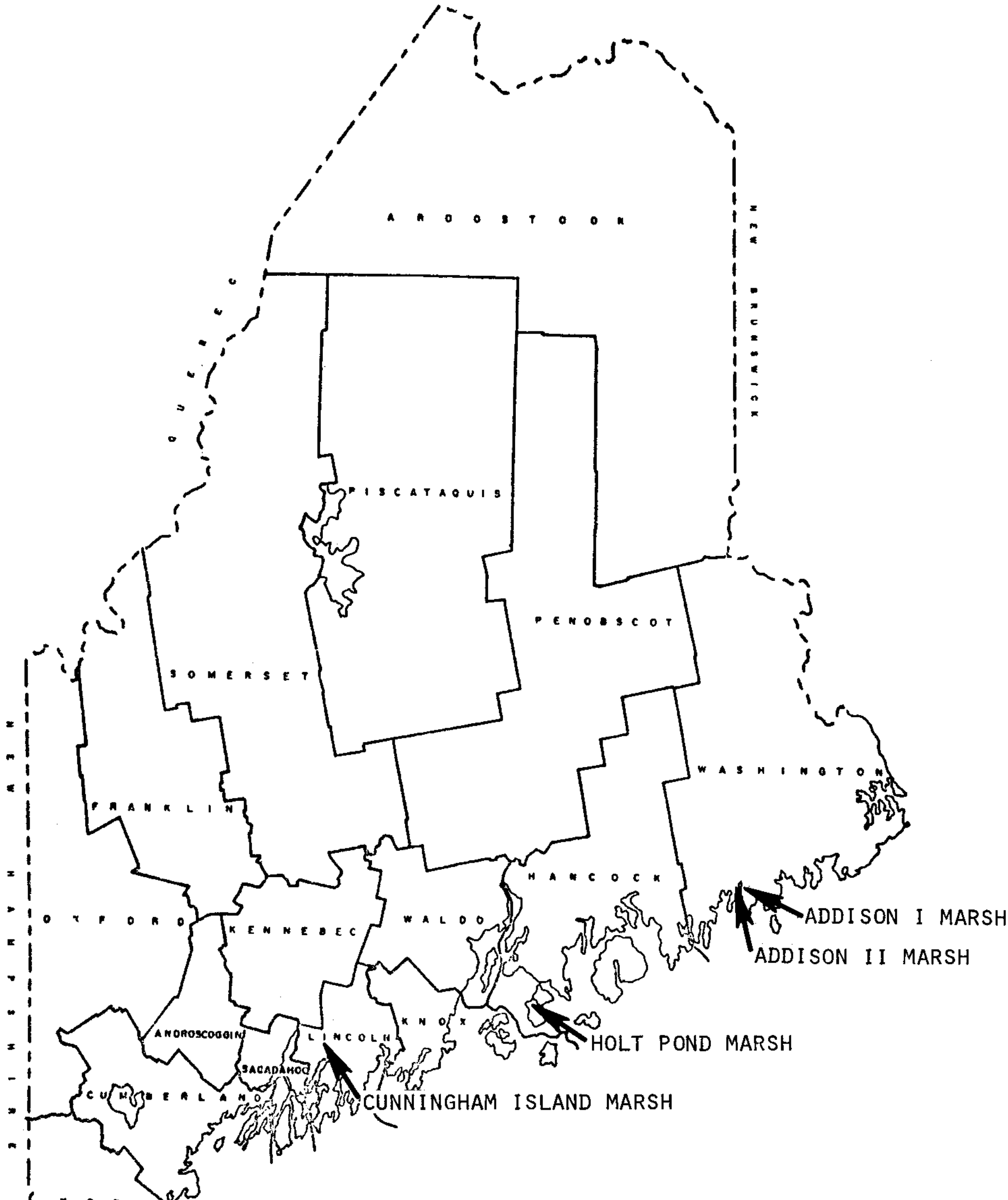


FIGURE 1

Index Map Showing Locations of Salt Marshes that were Cored

Working in conjunction with Dr. David Smith and Anne Bridges of the Department of History at the University of Maine, we have investigated several historical structures which are lowering with respect to present sea level. These structures include the shipyard and wharf at Shipbuilding Cove in East Machias, Machias Harbor Wharf in Machias, Addison Wharf in Addison, and the Franklin Marsh Corduroy Road in Franklin. The shipyard in Shipbuilding Cove was most probably built during the 1820's (D. Smith and A. Bridges, pers. comm.). While it is obvious that the shipyard is regularly flooded by the sea at the present time, the structure has been subsequently modified, so that conclusions as to the exact amount of inundation would be tenuous without detailed excavation. We found the same problem with obtaining any reliable information at the Machias Harbor Wharf and the Addison Wharf. However, one promising area of study appears to be the Franklin Marsh in Franklin where we found, quite by accident, a corduroy road (built with timbers) overlain with sand and gravel and being overridden by salt marsh at the present time.

CONTINUING STUDIES

Identifying the first occurrence of salt marsh in a core, as an indicator of initial salt water encroachment, could be a difficult task. Basal salt marsh peat, by itself, cannot be reliably differentiated from fresh marsh peat at a precise enough level to relocate past sea levels. However, the presence or absence of microfossils of Foraminifera has proven useful in differentiating marine from non-marine peat deposits (Scott, 1977; Scott and Medioli, 1978). Foraminifera are found in the marsh seaward from the highest high water (HHW) mark, often characterized by the aforementioned row of driftwood and thatch in the _Juncus_ zone. Starting from basal sediments in a core, the dramatic upcore increase in foraminiferal numbers, primarily those of _Trochammina macrescens_ with minor amounts of _Tiphotrocha comprimata_ signifies the HHW datum $\pm$ 5 cm (D. Scott, pers. comm.). Peat above this level can then be radiocarbon dated to give a point on a date-depth curve of sea level for the location of that marsh. Identification of the level of the abrupt increase in foram numbers and the composition of the fossil assemblages (which has bearing on the significance of the HHW datum) from cores from the Addison II locality has begun. Studies of Addison I, Holt Pond and Cunningham Island marshes are continuing at the present time.

APPENDIX

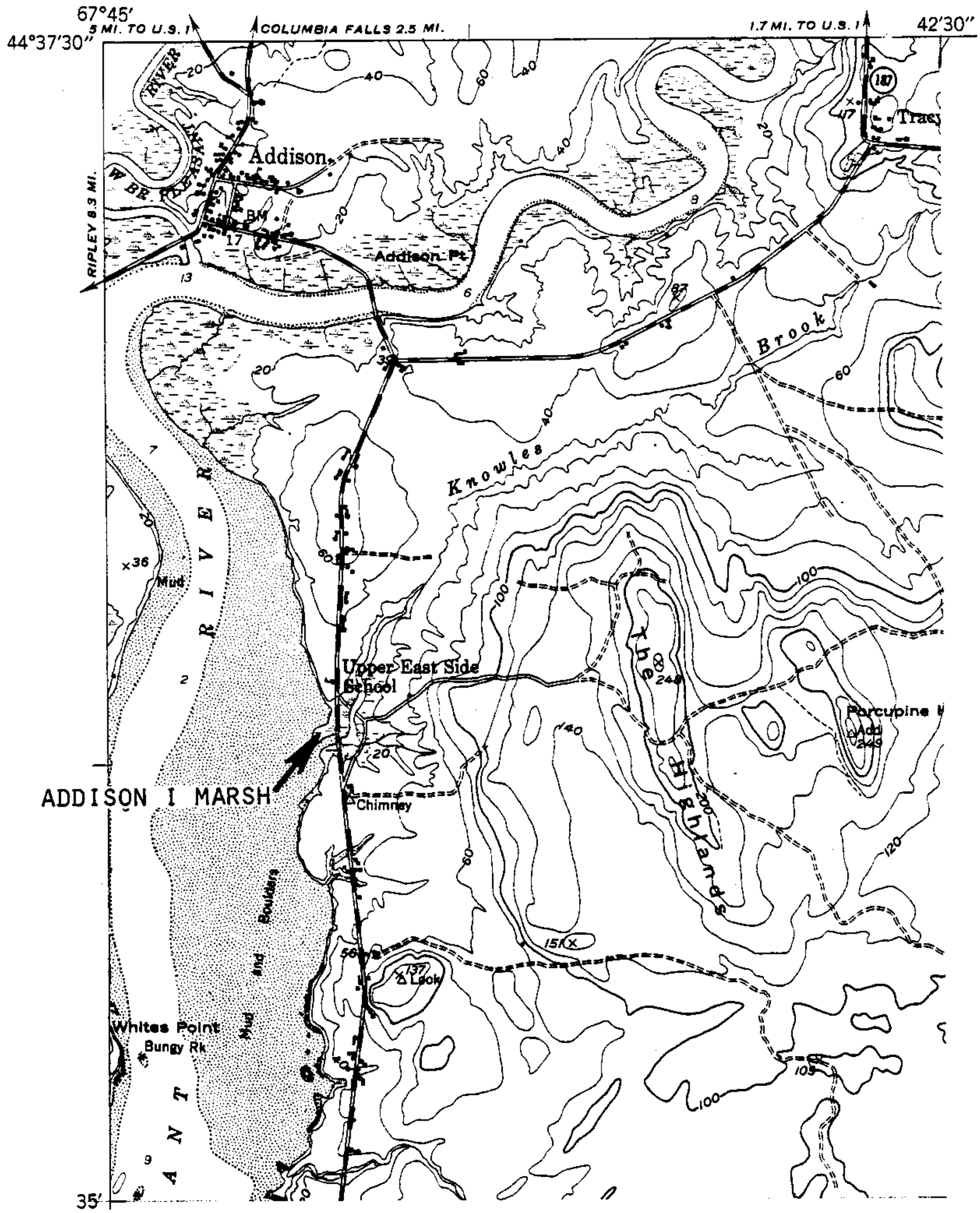
Locations of deep salt marsh cores used for radiocarbon dating.

ADDISON I

ADDISON II

HOLT POND

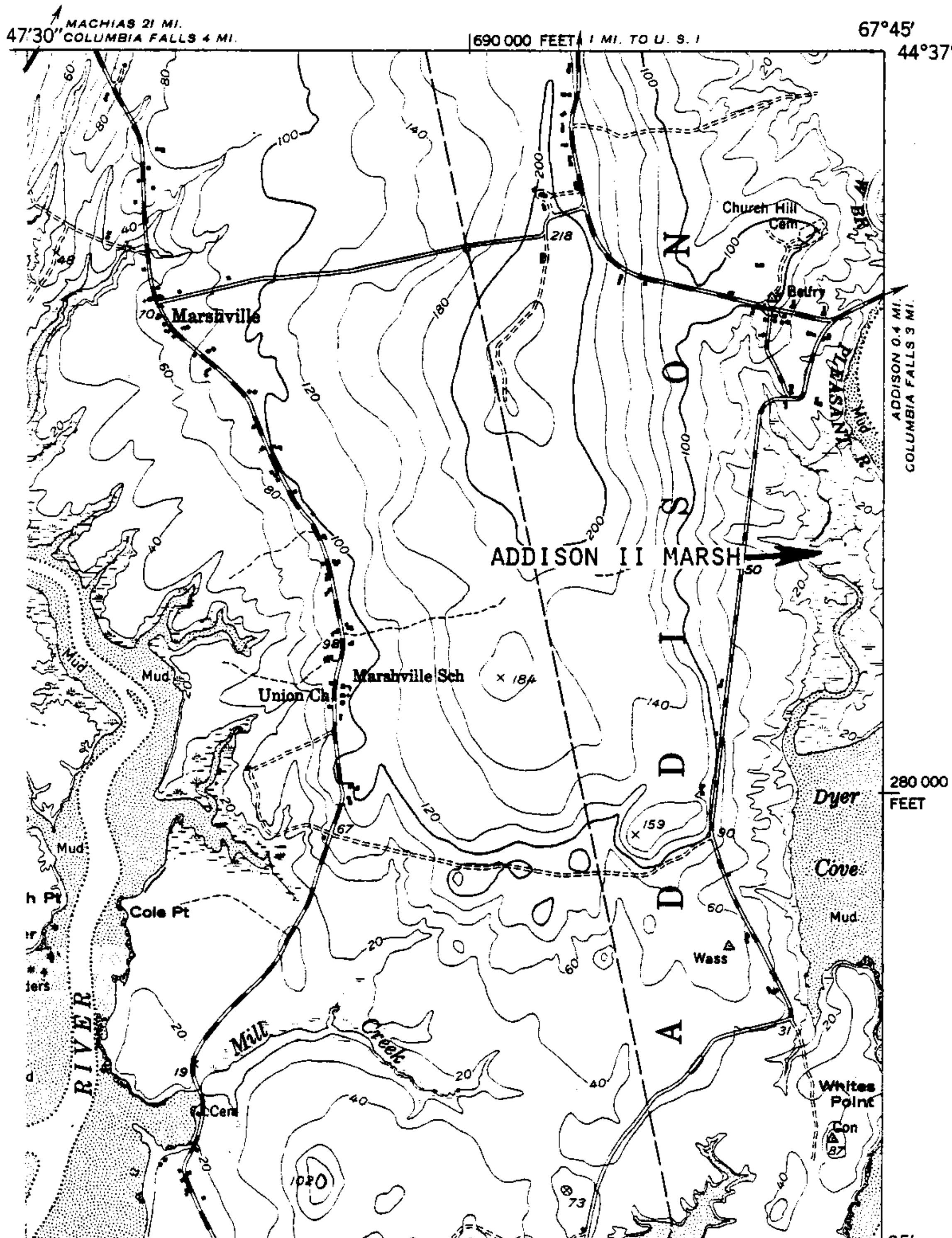
CUNNINGHAM ISLAND



ADDISON QUADRANGLE
MAINE-WASHINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 COLUMBIA FALLS 15' QUADRANGLE

SCALE 1:24000

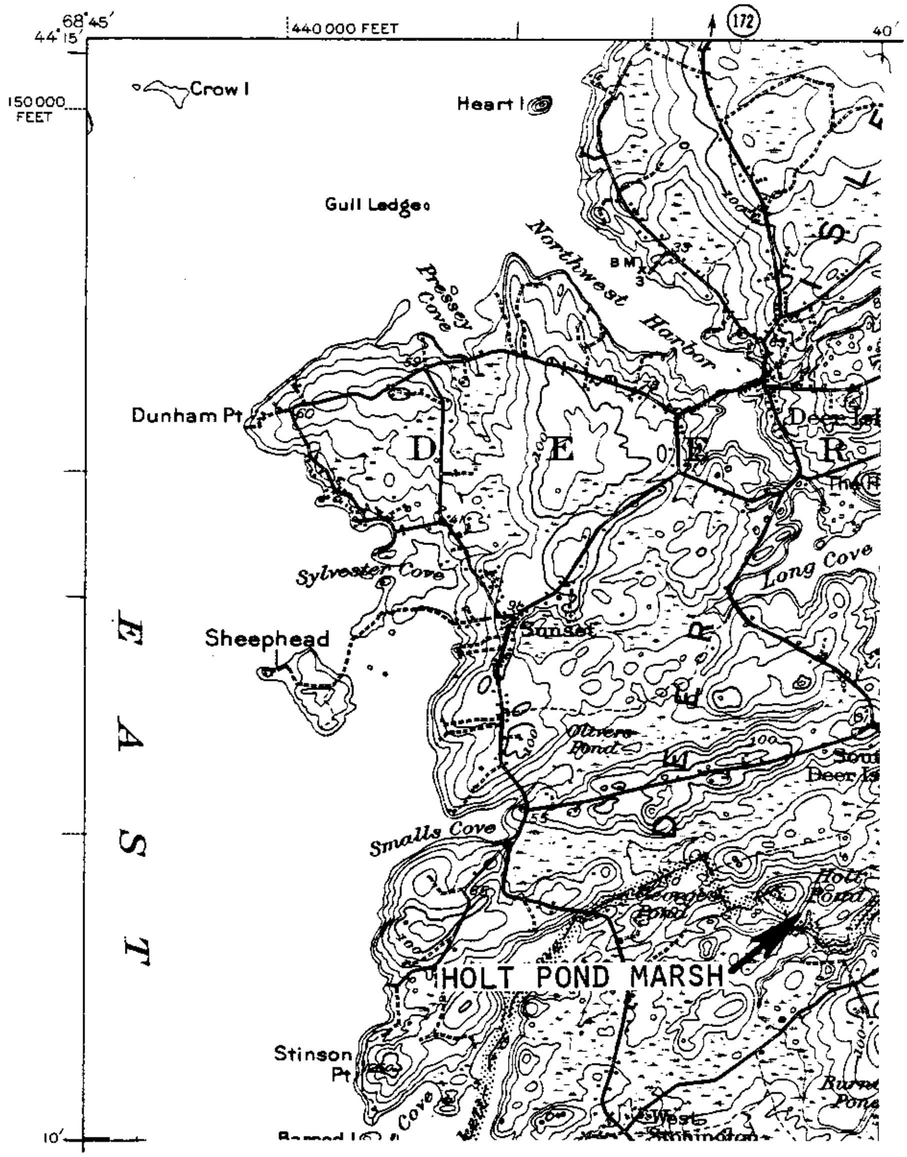
1 ½ 0 1 MILE



HARRINGTON QUADRANGLE
MAINE-WASHINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 CHERRYFIELD 15' QUADRANGLE

SCALE 1:24000

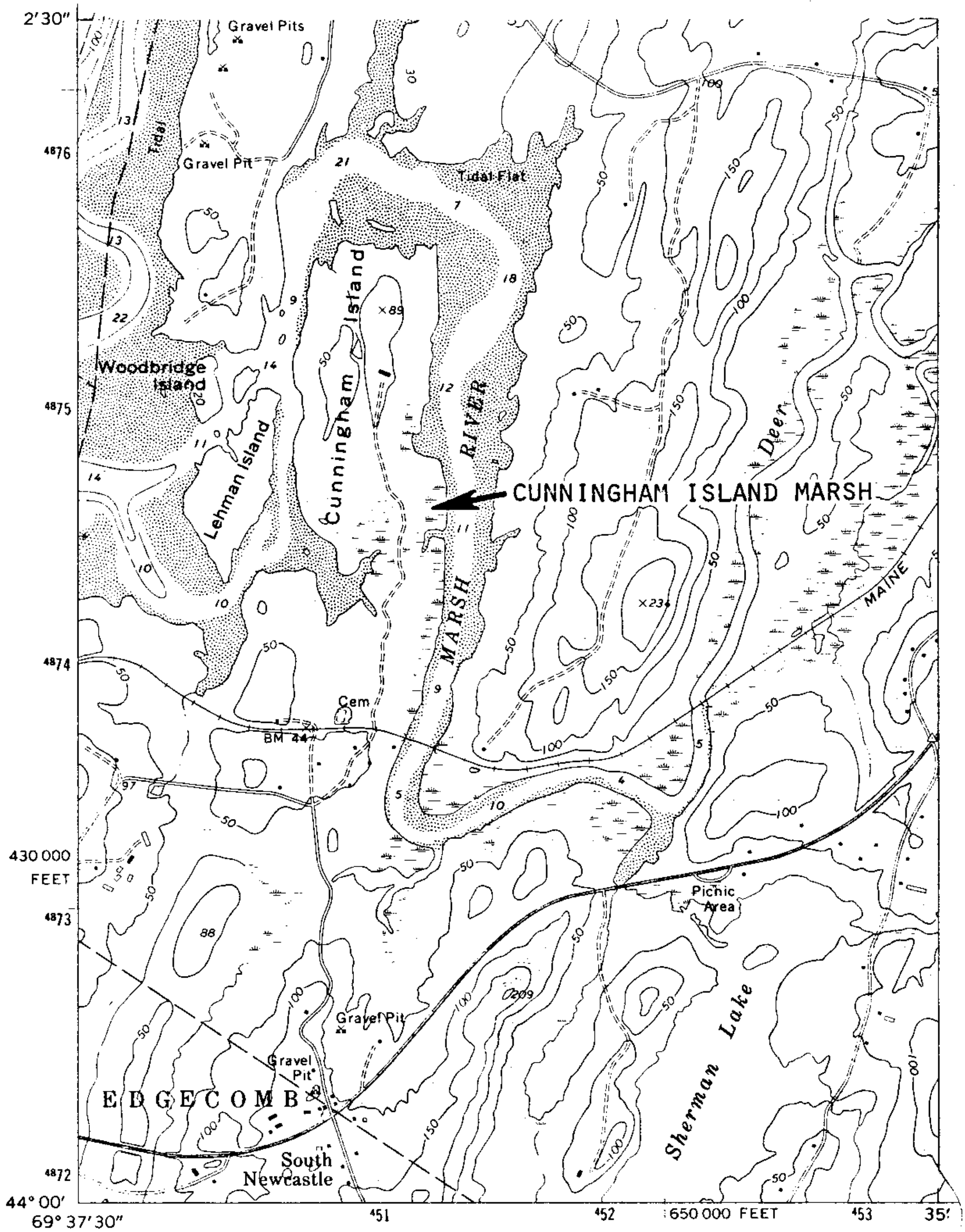
1 ½ 0 1 MILE



MAINE
DEER ISLE QUADRANGLE
15-MINUTE SERIES

Scale $\frac{1}{62500}$

1 ½ 0 1 2 3 4 Miles



DAMARISCOTTA QUADRANGLE
MAINE—LINCOLN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 WISCASSET 15′ QUADRANGLE

SCALE 1:24 000

1 ½ 0 1 MILE

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