NORTH HAMPTON SALT MARSH STUDY

Part I: Assessment of Little River Marsh and Bass Beach Marsh

Part II: The problem, recommended solutions, and projected outcomes

by

Frederick T. Short, Ph.D.
Jackson Estuarine Laboratory
University of New Hampshire
RFD #2 Adams Point Road
Durham, New Hampshire 03824

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Coastline of North Hampton, New Hampshire, showing the two salt marshes; Bass Beach Marsh on the right and Little River Marsh on the left.

PART I: Assessment of Little River Marsh and Bass Beach Marsh

INTRODUCTION

All salt marsh is intertidal. That is, at some time during the year, salt marsh is flooded with salty ocean water. Little River Marsh and Bass Beach Marsh are both examples of "high marsh," marsh area that forms between mean high water and the upper limits of the high spring tides. Much of the classic work on marshes focused on low, regularly flooded marsh areas, but recent authors have recognized the importance of the high marsh to understanding and managing marshland ecosystems generally.

New Hampshire tidal marshes, including those in North Hampton, are typical of what is called the "New England type." These marshes developed during post-glacial submergence of land and concurrent rise in sea level. Sediments, primarily of marine origin, were deposited in tidal lagoons and built up because of protection by sand bars or barrier beaches from direct impact by the sea. The sediments increased in depth until they reached the mid-tide level. At that point, the marsh area was free of tidal waters for approximately half the day and vegetation was established in the form of salt water cordgrass (Spartina alterniflora).

As stands of cordgrass spread and thickened, the plants themselves trapped sediments and the level of the marsh rose as these trapped particles combined with decaying plant material to form marsh peat. This process, which began approximately 10,000 years ago after the last glaciation, continues today.

When the marsh reaches the level of mean high tide, cordgrass is replaced by salt meadow grass (Spartina patens), the familiar salt hay of North Hampton's marshes that was so valuable to the early settlers. Salt hay is the dominant plant of the high salt marsh. High marsh may, as noticeably in North Hampton's

Little River Marsh, take over all the marsh area until the entire lagoon consists of high marsh except for the channels carrying fresh upland water and tidal ocean water.

Salt marshes of the New England type comprise only 2% of the marshland along the Atlantic coast of the United States. High marsh accounts for at most 50% of that 2%, or 1% of the total marsh area of the eastern seaboard. Of the approximately 7500 acres of marsh in New Hampshire, North Hampton's marshes represent about 200 acres. New England type marsh represents the highest ratio of people to marshland area in the United States, and the pressure on these marshes is therefore arguably the greatest.

"In the 17th century, these marshes were so valuable that armed men from Massachusetts came to take hay from the New Hampshire marshes, about which the New Hampshire citizens complained bitterly."[1] But the obvious value of the marshland to the colonists as cattle fodder no longer exists. No direct commercial use is made of New Hampshire's saltmarsh today.

However, the marsh that remains has great value, economic and otherwise, to the towns it occupies and to the vitality of the land/sea margin as a whole. Primary production, the conversion of light energy and mineral elements into plant material, occurs abundantly in marshes. It is estimated that tidal marsh ecosystems may produce 10 tons of organic matter per acre per year, comparing favorably with modern wheat production, and providing a basis for the entire marsh-related ecosystem including off-shore fisheries.

This plant material decomposes and is then available directly as food both within the marsh and offshore. The marsh is a hatchery and a nursery for oysters, crabs, snails, shrimp, commercially valuable fish, and insects. (These last, especially mosquitoes, have been the object of man's attention and the

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1. Teal, J. & M. 1969. Life and death of the salt marsh. p. 240.

Little River Marsh (top) and Bass Beach Marsh (bottom).

cause of considerable alteration of the marsh because of ditching to drain mosquito breeding pools. However, insects remain a crucial part of the food web.) The creatures in the marsh are attracted to it by its abundant food supply and the protection it affords.

Marshes provide a nesting ground and feeding ground for marine and other birds. Wildlife is drawn to the marsh to browse or to hunt the small mammals and reptiles that thrive there.

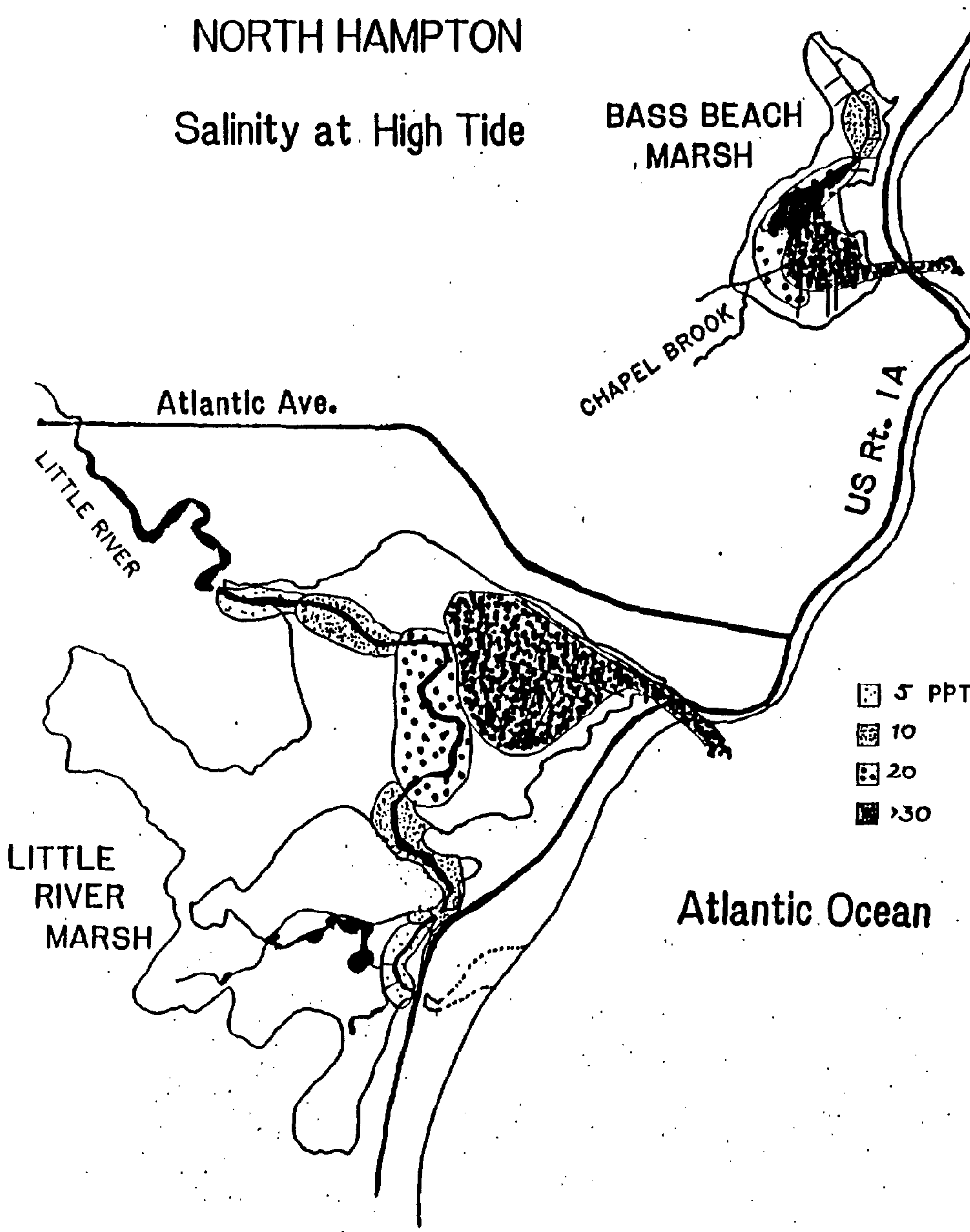
Marshes absorb flood waters, trap sediments, and improve water quality by assimilating nutrients of upland origin, whether agricultural or industrial. Lastly, marshes provide open space in crowded seashore environments, an asset that cannot be measured perhaps, but one that benefits residents and passers-by alike.

PHYSICAL DESCRIPTION

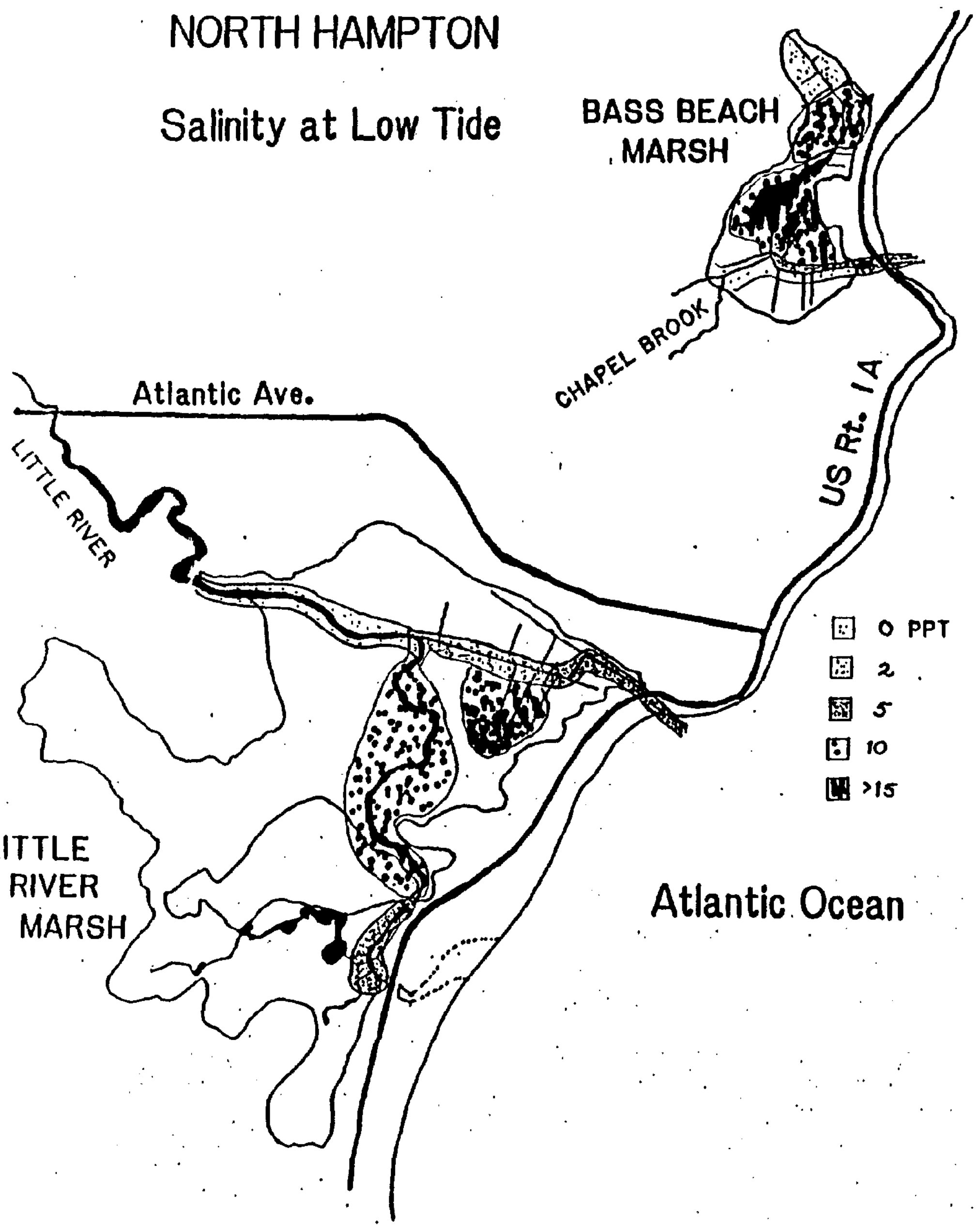
Little River Marsh

Little River Marsh represents the drainage of a post-glacial valley cut off at the mouth by a barrier beach. The major freshwater inflow to the marsh is the Little River, which derives its drainage from swamps and upland ponds in the town of North Hampton. The upper extent of the tidal, or saltwater, influence is a concrete dam located east of Woodland Road and behind the Fuller Farm.

The drainage of the Little River Marsh to the ocean is blocked with sand at the bridge on U.S. Rt. 1A on the Hampton-North Hampton line. The only open connection between the marsh and the ocean is a culvert under Rt. 1A at the northeast end of the marsh. Both the flood of tidal water and the flow from the Little River are restricted to this culvert.



Salinity distribution at high tide (parts per thousand) in the two North Hampton marshes. Ocean water extends into the marsh, pushing the fresh upland water back, and mixing with it in the upper reaches. The dam on the Little River and the blocked channel under Rt. 1A are the upper extents of tidal effects in the Little River Marsh. At the Bass Beach Marsh, ocean water extends into the salt pond, elevating the salinity.



Salinity distribution at low tide (parts per thousand) in the two North Hampton marshes. At low tide, ocean water drains from the marsh and fresh creek water reinvades the lower reaches. Note that the scales of the low tide and high tide figures are different. At low tide, significant portions of the creeks and pannes are not saline. At both marshes, salt water is left behind on the marsh surface as the tide drains, leaving saline pockets, while fresh water from the upland creeks mixes with the receding tidal water in the main channels, diluting the outflow.

The main channel into the marsh parallels Sea Road, doglegs to the south and continues west to join the Little River at a major bend in the stream. The channel of the Little River continues south around Fifield Island where it terminates in stagnant pools at the closed breachway at the Hampton-North Hampton line.

Bass Beach Marsh

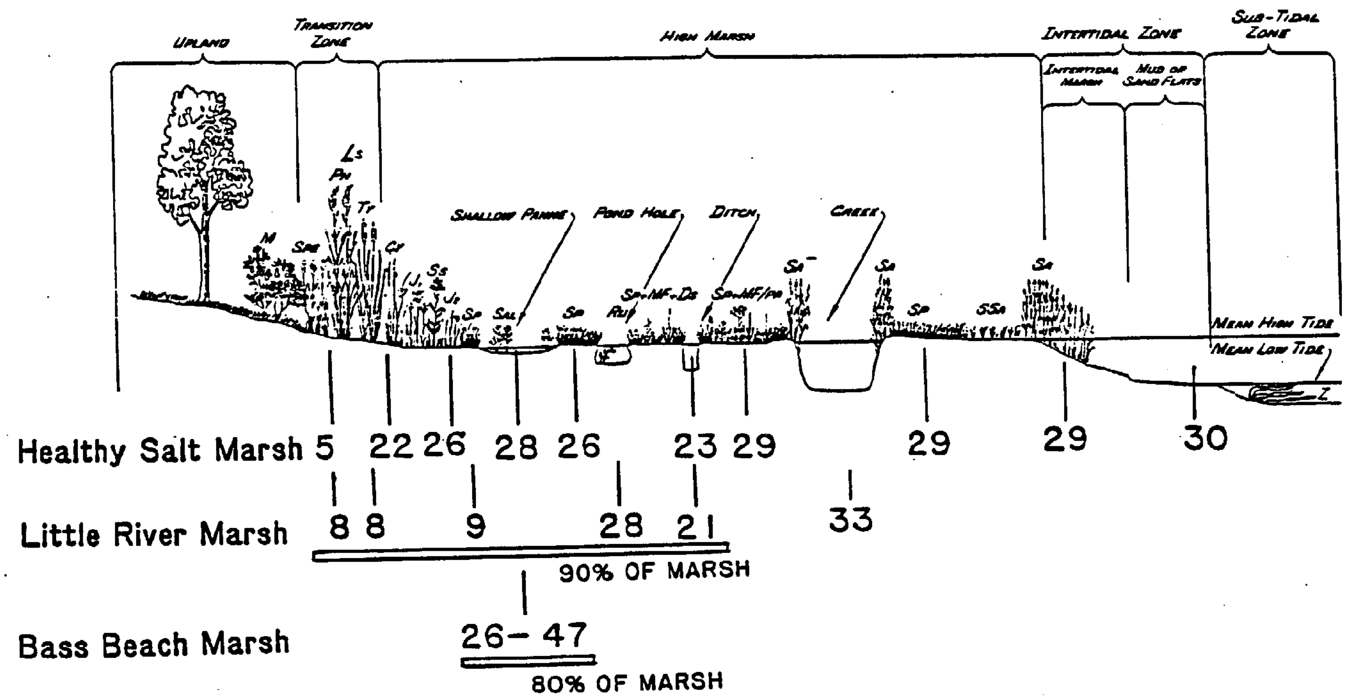
The marsh at Bass Beach represents the area of confluence of several small drainage brooks from North Hampton. Four to five brooks, including Chapel Brook, empty into the southwest end of Philbrick Pond, a salt pond at the center of Bass Beach Marsh. The brook running through the adjacent golf course no longer drains into the Bass Beach Marsh, but has been diverted to a point further north.

Philbrick Pond has an outflow at its southern end connected to the ocean by its flowing through a culvert under the old electric railway bed, continuing as a stretch of open water, and then flowing through a culvert under Rt. 1A. The latter culvert has had a floodgate, or clapper valve, employed in previous years.

Vegetation

The dominant salt marsh plant in the Little River Marsh is salt meadow grass, or salt hay (Spartina patens). Salt water cordgrass (Spartina alterniflora) occurs in only one patch. Broadleaf and narrowleaf cattail (Typha latifolia and Typha angustifolia) and phragmites (Phragmites communis), all indicators of fresh water, grow around the margins of Little River Marsh. Purple loosestrife (Lythrum salicaria), an introduced plant which has invaded many freshwater and terrestrial areas of New England, is now the most abundant plant in the Little River Marsh, covering 60% of the marsh surface area.

SALINITY OF SEDIMENTS, ppt



Generalized cross-section of a New England salt marsh. Typical salt content of sediment water for a healthy salt marsh with salinity values indicated for specific points across the marsh. Salinity values at the Little River Marsh are lower throughout the Transition Zone and High Marsh, allowing invasion of loosestrife, phragmites and cattail. At Bass Beach Marsh, sediment water salinity values in the predominant pannes are as high or higher than the healthy marsh. Plant identification: SP - Spartina patens, SA - Spartina alterniflora, M - Myrica pensylvanica, J_1 - Juncus spp., SPE - Spartina pectinata, Ss - Solidago sempervirens, Z - Zostera marina, Ty - Typha spp., J_2 - Juncus gerardii, MF - Mixed forbs, SSa - Stunted Sa, Ru - Ruppia maritima, Cr - Sedges (mostly Scirpus spp.), Ph - Phragmites communis, Ls - Lythrum salicaria, SAL - Salicornia spp., DS - Distichlis spicata.

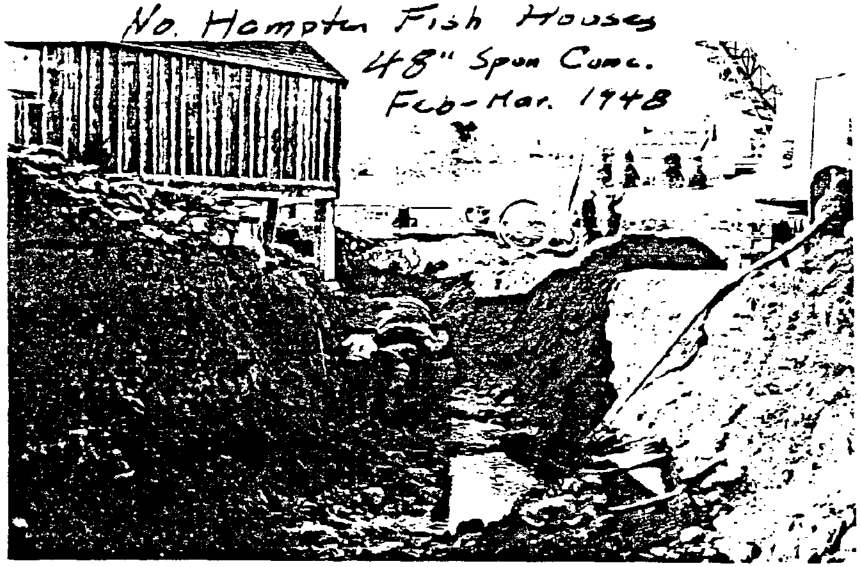
Decreased salt content in the sediments of Little River Marsh has greatly reduced the area of high marsh and allows an invasion of Transition Zone (freshwater/terrestrial) plants.

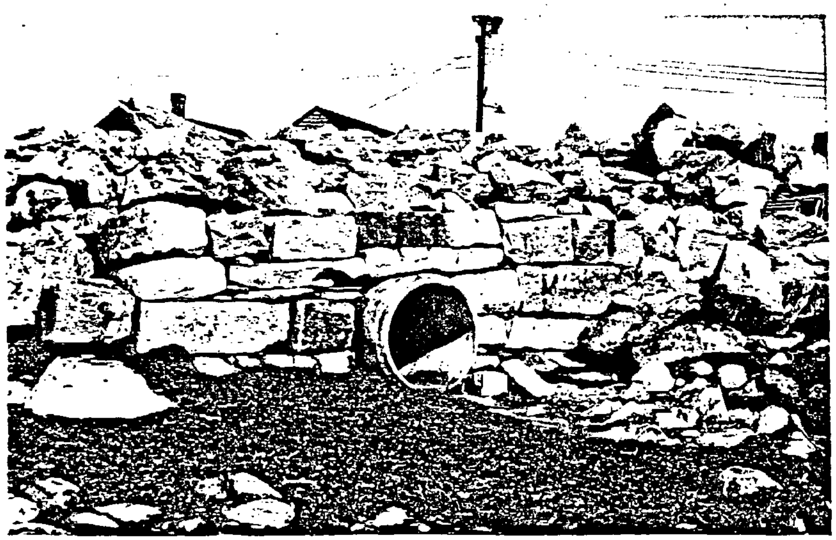
Both forms of Spartina occur at the Bass Beach Marsh. Cordgrass (S. alterniflora) is found along some channel edges, at the upper end of the pond, and typically, in its short form is found in the dead pannes of standing water. When all of Bass Beach Marsh was true high marsh, its predominant plant was salt hay (S. patens). But as the dead pannes formed, cordgrass, which is more salt tolerant, re-invaded. Salt hay (S. patens) remains along the higher channel and ditch edges and as high marsh meadow along the outflow from Philbrick Pond. Phragmites occurs at the marsh margins. Samphire (Salicornia europaea) is found in the pannes, as is blue-green algae.

HISTORY OF NORTH HAMPTON MARSHES

The marshes in North Hampton have a long history of alteration by man. Ditching, diking, road construction, dredging, and development of upland areas have all played their part in changing marsh hydrology. Human intervention compounded itself: to improve drainage of the Little River Marsh without the bothersome dredging of the channel to the ocean at the southern end of town, a 29" culvert was installed under the fish houses. And when the 29" culvert proved too small to do much good, it was replaced with a 48" culvert early in 1948.

Conversations about the marshes with residents of North Hampton were useful for gaining perspective on changes taking place over the course of many years. William Fowler said that in 1850 and again in 1870, ditches were opened into





Photos of Little River Marsh and the 48" culvert installed under the fish houses in 1948. Photo at upper right shows the marsh under flood conditions. Photos from the New Hampshire Department of Public Works and Highways.

Little River Marsh. And in 1950, approximately, the trunk, or culvert, was installed at the north end of Little River Marsh. He first noticed purple loosestrife growing in the marsh about 20 years ago.

Morris Lamprey has seen fox and deer on the marsh. His father mowed salt hay on Little River Marsh until 1915. According to Mr. Lamprey, the dam on the Little River that is the limit of salt water inflow was installed before 1950. He first saw purple loosestrife 10-15 years ago.

Vivian Brown's father plowed out the channel at the Hampton/North Hampton line with his horses every spring from 1920 to 1950. Until 1960, Leonard Knowles reditched and oiled the Little River Marsh for mosquito control. Vivian Brown remembers bobbing for eels and ice skating on the pond that formed over Little River Marsh in winter, but not being allowed on the main ditch or the opening to the trunk. She thinks purple loosestrife has come in within the last 10 years or 15 at most.

Vince and Lucy Palmer say that the Little River Marsh floods "to look like a lake" about 3 times a year, mostly in winter and spring.

Mary Russell remembers rafting on Philbrick Pond at Bass Beach Marsh, and says that the area of open water has grown smaller. She says that several people, including William Fowler, experimented with aquaculture by seeding clams in the area between the trunk to the ocean and the trunk under the old electric railway. There is less samphire now, she says, and some loosestrife has come in on her land, upland from the marsh, during the past 5 years.

Frank Richardson, scientist with the New Hampshire State Wetlands Board, says that the excellent birding in Bass Beach Marsh is related to the extensive open water areas. And he confirms that in the last 10 years there has been a dramatic invasion of purple loosestrife in Little River Marsh, especially at the southern end.

These conversations confirm that the marshes used to flood with tidal water more extensively and more often than they do now, and that purple loosestrife is a relatively new phenomenon of the last 10 to 15 years.

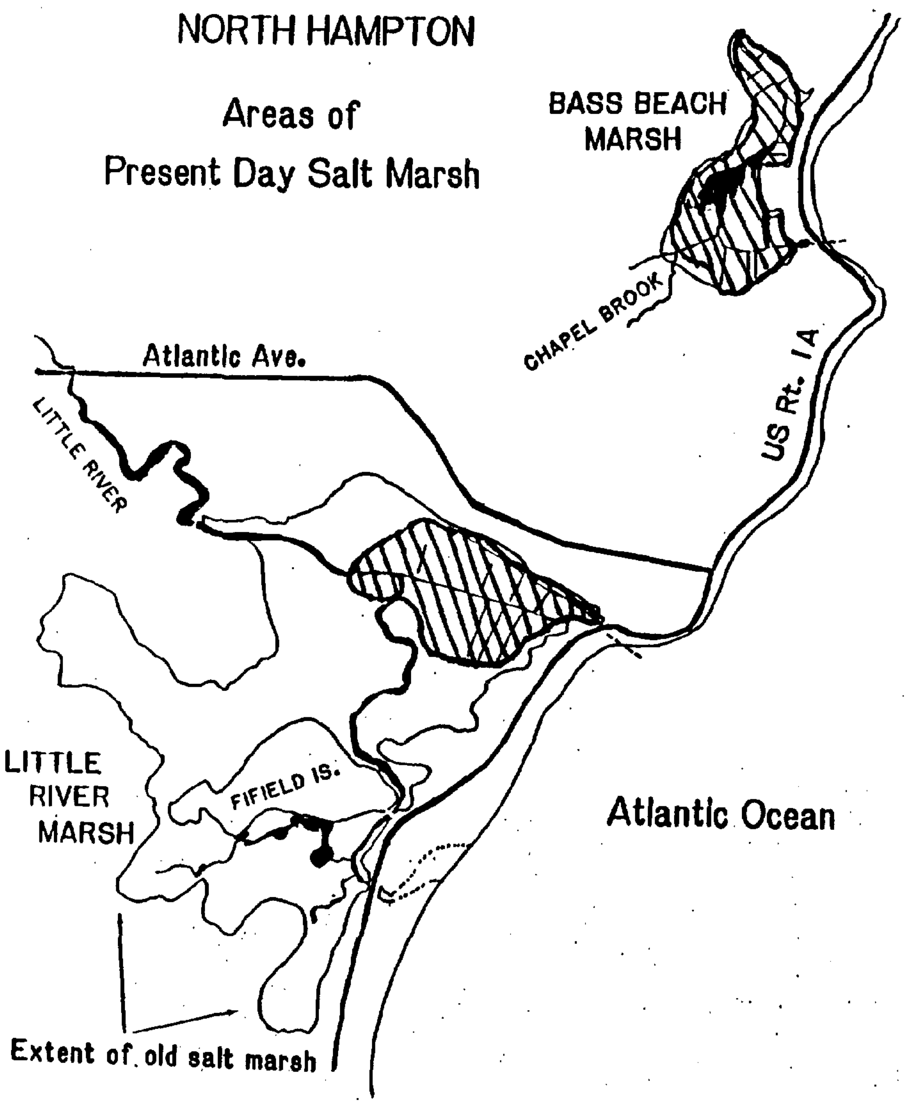
PART II: The problem, recommended solutions, and projected outcomes

THE PROBLEM

Both of the salt marshes in the town of North Hampton are in serious trouble. And in both cases, the cause of these problems is hydrological. That is, the changes in the Little River Marsh and Bass Beach Marsh are caused by and related to the way water, both fresh and salt, interacts with the surface of the marsh. In both marshes, these changes are tending toward a loss of true salt marsh and the substitution of something else. Hydrological changes are typical causes of marsh loss along the East Coast of the United States. And in most cases, the changes in the water/land interface are caused by man. This is the case in North Hampton.

It would be a mistake, however, to think that the same process is occurring in Little River Marsh and Bass Beach Marsh. Despite their common root in hydrology, the changes leading to loss of high salt marsh are quite different in the two marshes and must be explained separately. This report will do that and will then recommend solutions and predict the results that can be anticipated if the solutions are instituted.

The town of North Hampton is outstanding in its interest in the salt marshes within its borders. A significant portion of New Hampshire's marshland has disappeared over the past few years with very little concern or even notice on the part of the locales involved. It must be understood that the study presented here to the Selectmen of North Hampton is not long-term or intensive scientific research, but rather a broad overview of conditions familiar to the author from work in similar areas, backed up with two months of research and



Hatched areas represent the extent of present day salt marsh at Little River Marsh and Bass Beach Marsh in North Hampton, New Hampshire. Actual salt marsh at Little River Marsh is reduced 70% from its former extent. At Bass Beach the salt marsh remains the same size as previously, although 80% of the marsh is dead panne.

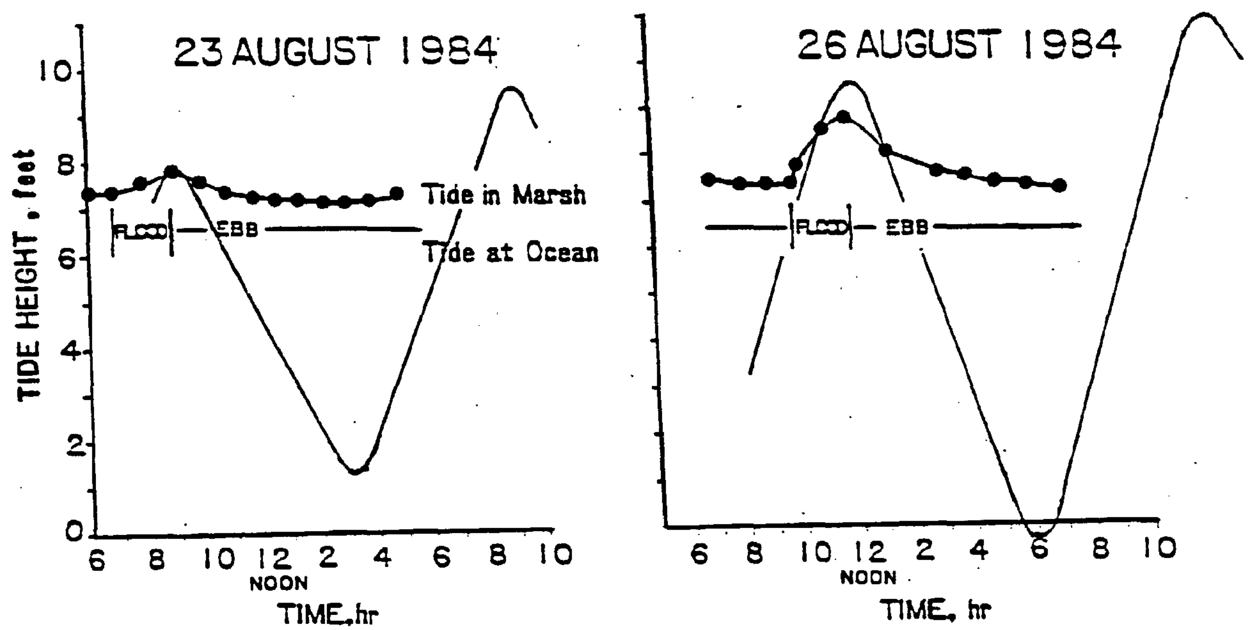
investigation of local conditions plus a literature review. Other, more detailed, work could be done to document current conditions and to track the changes that will occur if and when efforts are made to restore the hydrology of both marshes. From what I now know, I make the following assessment of the North Hampton marshes.

Little River Marsh

The problem at the Little River Marsh is that there is not enough flushing of saline tidal ocean water up into and then back out of the marsh. During a normal tidal cycle of 12 hours, ocean water cannot reach the far end of Little River Marsh and drain back out. It is this flooding and draining of salt water that creates the characteristic salt marsh flora and fauna, from the smallest benthic alga and crustacea to the more noticeable cordgrass and racoon. At Little River Marsh, the single culvert under the fish houses at the north end of the marsh currently carries all the salt water it can into the marsh. It is full of inflowing water throughout flood tide.

The lack of tidal flushing is exacerbated by the channel under the bridge on Route 1A being blocked. It is doubtful whether this channel carried much ocean water into the marsh except when newly reditched, as it was annually before 1950. But it certainly drained the freshwater from the Little River into the ocean, thereby allowing more salt water originating at the culvert under the fish houses to penetrate the upper reaches of the marsh by simple displacement.

There are other culverts and bridges within the marsh that restrict flushing. The development of Fifield Island and the associated roads have all wrought hydrological changes. Each of these culverts and other "improvements" must, at the time it was built, have seemed to be a minor undertaking unlikely to have any significant impact. But the long-term cumulative effect is great.



Tide sequences for two days of varying tidal amplitude, showing tide height at the ocean (above mean low water) and in the marsh. Tide heights are always much reduced inside the marsh because of the restricted inflow. Ocean tide height strongly affects the amount of ocean water entering the marsh. Additionally, ebb from the marsh lasts longer than flood because of the relation of the culvert to ocean water level.

As explained in the first part of my report, salt marsh forms precisely because land areas are flooded during the tidal cycle with salt water. If an area no longer receives this periodic flushing, "the resulting loss of tidal energy, an essential driving force in salt-marsh ecosystems, alters the role of these coastal wetlands."[2] This is what has happened, and what continues to happen, in the Little River Marsh.

Since much of what was formerly true marsh in the Little River Marsh is now no longer subject to tidal flushing, terrestrial and freshwater marsh plants have begun to invade. The most obvious and aggressive of these is purple loosestrife (Lythrum salicaria) which now covers approximately 60% of former marsh area. Loosestrife is not productive of the detrital material so essential to the food web of the marsh. It doesn't attract birds or animals since it constitutes a barrier rather than a protective habitat for wildlife. The invasion of purple loosestrife is a sure indicator of degradation and loss of salt marsh area.

Bass Beach Marsh

The Bass Beach Marsh has, to explain it in simplest terms, the opposite problem from the Little River Marsh. That is, too much water sits on the marsh surface and doesn't drain out. Because large areas of the marsh are permanently covered with saline water, the typical marsh plants have died out and dead panne areas have formed. The dead pannes represent an area of dead saltwater hay (Spartina patens) covered by a thick mat of blue/green algae.

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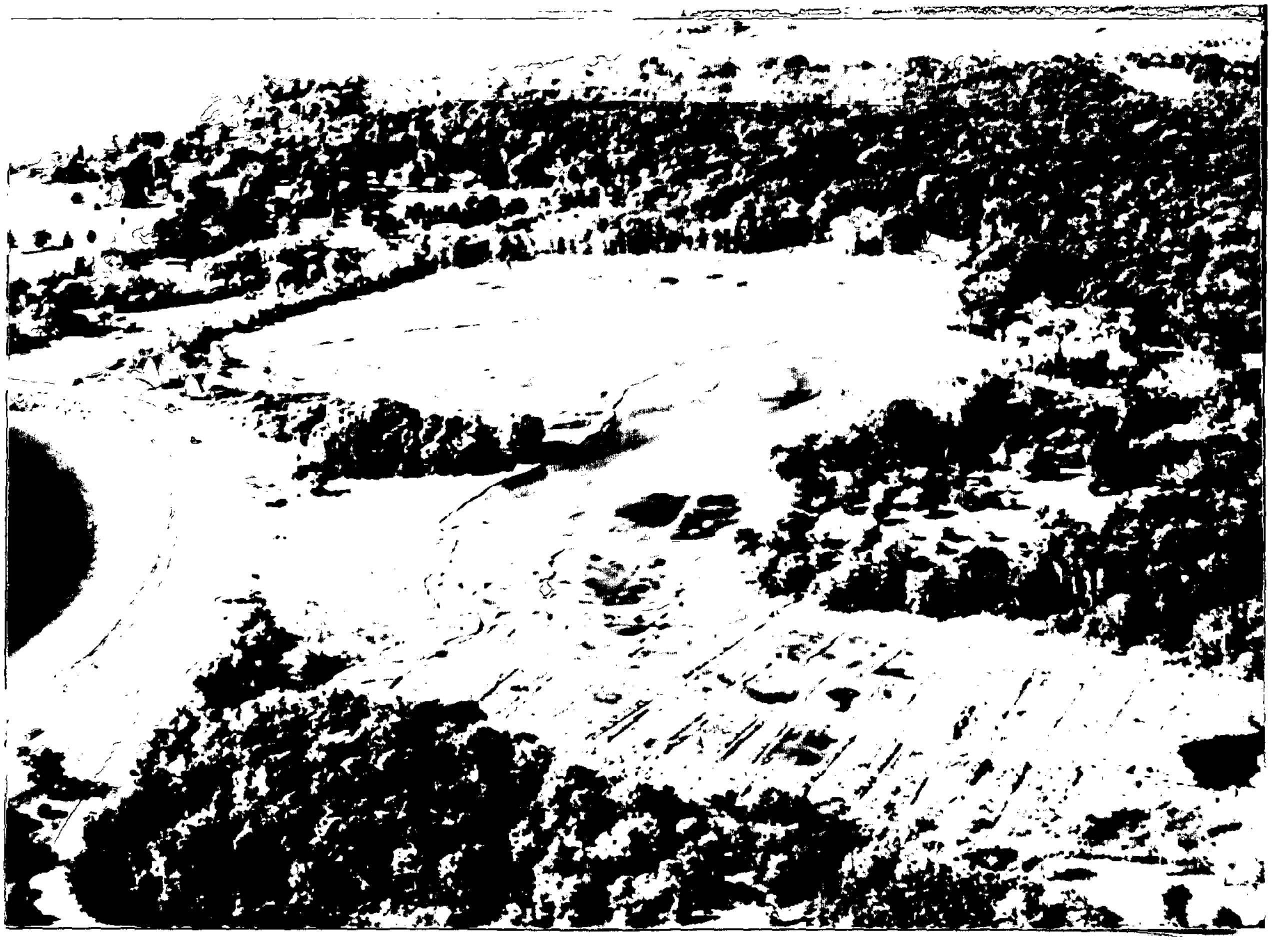
[2]Roman, C.T., W.A. Niering and R.S. Warren. 1984. P. 141. Salt Marsh Vegetation Change in Response to Tidal Restriction. Environmental Management. Vol. 8, No. 2, pp. 141-150.

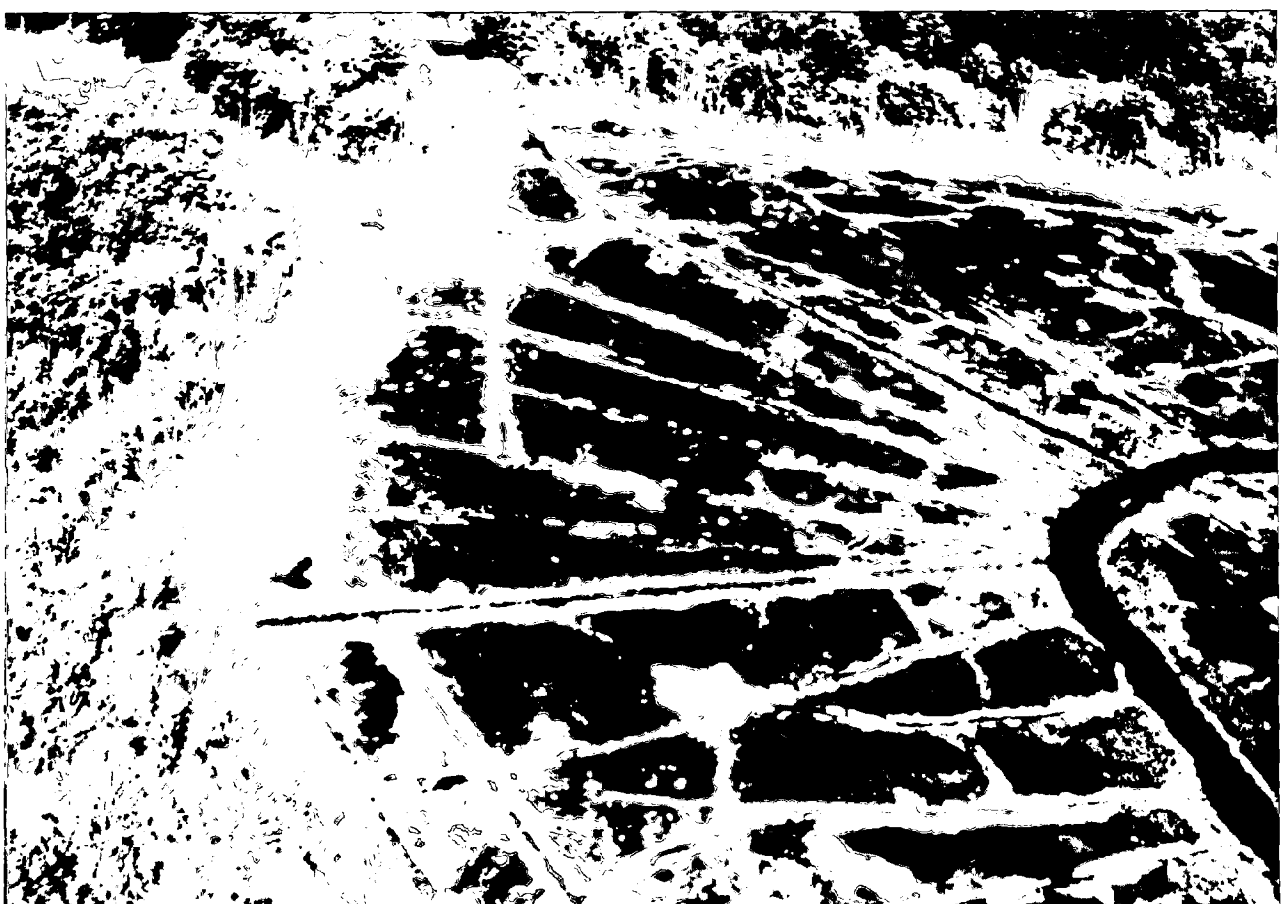
Little River Marsh showing the invading non-saltmarsh plants.

It is hard to say in retrospect exactly what the cause of the dead pannes might have been. However, it seems certain that it is related to the mosquito ditches which rib the marsh surface, creating high margins along the ditches where the earth was thrown when the ditches were dug. These levees may have trapped water between the ditches and made it hard for it to drain. There is some indication in the literature that standing water on the marsh peat causes the peat itself to rot, compact, and subside. That process would tend to speed up the formation of dead pannes. Or the ditch margins, like dikes, may have simply held the tidal water in the salt hay areas longer than the plants could handle, and the stress eventually caused the death and decay of the typical high marsh meadow vegetation. Salt marsh plants can tolerate a twice daily saltwater bath, but not a continual soaking in salt water. Purple loosestrife has not invaded the Bass Beach Marsh because the soil there is too salty and too constantly submerged. It exists only along some of the upper margins of the marsh and is not abundant.

The dead pannes are not totally dead. As mentioned above, they support thriving colonies of blue/green algae and also many insects and, at least in the deeper ones, crustaceans and small fish. The fish and insects attract many shore birds making Bass Beach Marsh one of the best birding marshes along the New Hampshire coast.

Because Bass Beach Marsh is full of birds and free of purple loosestrife, it is possible to conclude that the marsh is healthy. This is simply not the case. First, Bass Beach Marsh is no longer true high marsh any more than much of Little River Marsh is. Second, Bass Beach Marsh is not a stable ecosystem. The size and extent of the dead pannes has increased rapidly in the past 10 years and, without intervention, can be expected to continue to expand. If the process of dead panne formation goes unchecked, the marsh will eventually degrade and become inhospitable to birds and animals. In other words, the





Bass Beach Marsh showing extensive nonproductive dead panne areas.

current abundance of birds and fish at the Bass Beach Marsh represents a step in the gradual decline of the marsh into a stable but non-ecologically productive flooded area.

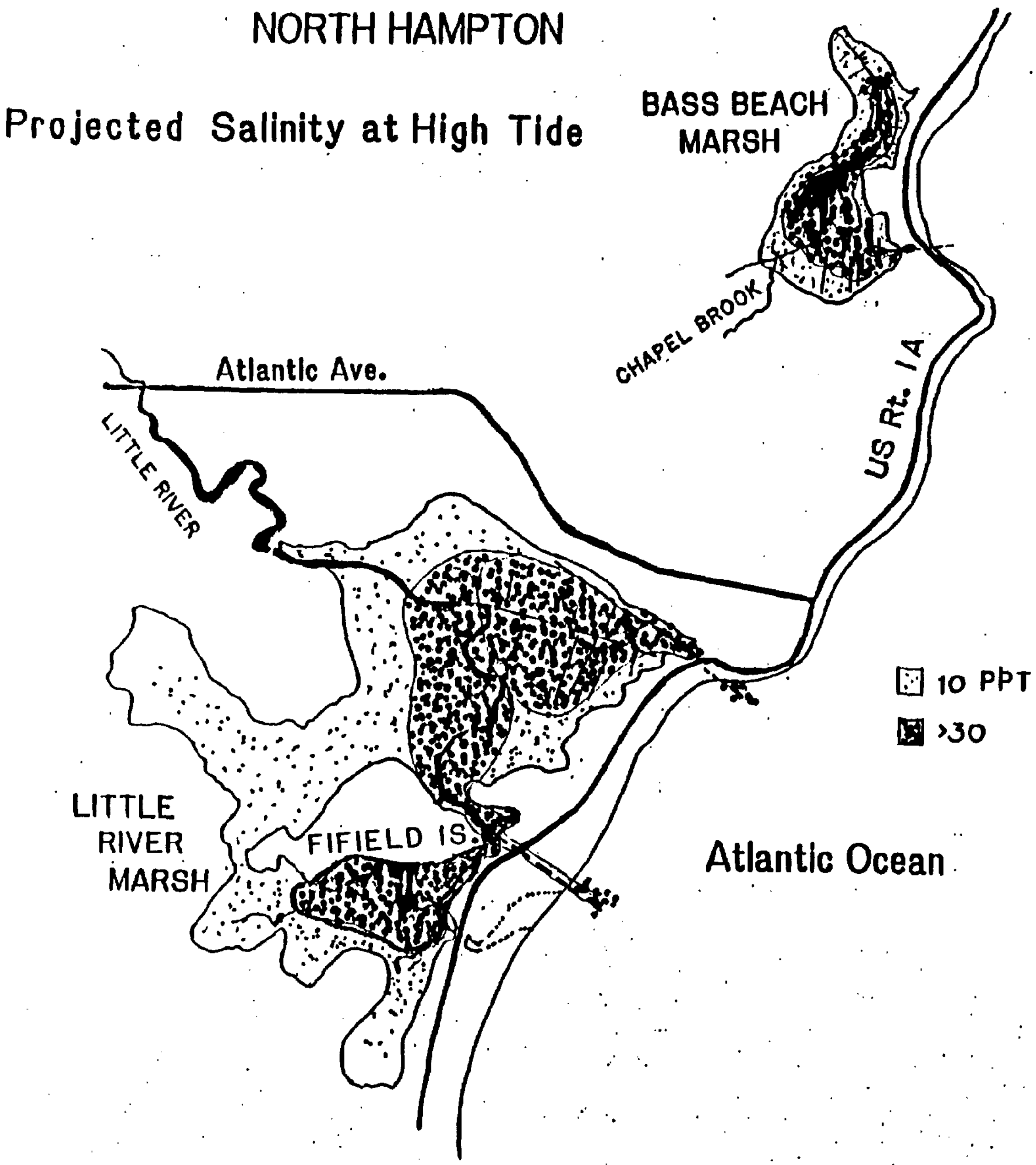
RECOMMENDED SOLUTIONS

Given that both Little River and Bass Beach Marshes are seriously disrupted high marsh ecosystems, what, if anything, can be done to restore them to true marsh? The solution, like the problem, lies in hydrology. To revitalize each marsh, more movement of both fresh and salt water across the marshes' surfaces is required. But just as the two marshes have rather different problems, so their cures , though hydrological, will occur quite differently and must be looked at separately.

Little River Marsh

My recommendation for increasing water flow in the Little River Marsh is to install a 48" culvert under Route 1A, running from the Little River as it passes the north side of Fifield Island, under Route 1A and the beach beyond it, out into the ocean, and terminating on the rock ledge found off the beach at that point.

What will this culvert do? First, it will increase flow in the Little River and allow it to drain. Draining the Little River will permit increased salt water flow into the marsh from the northern culvert under the fish houses by displacement. Draining the Little River will flush accumulated sediment now deposited on the river and marsh channel bottoms out to the ocean. As the sediment is flushed, the various channels within the marsh will become deeper



Salt Water Intrusion After Recommended Changes

Projected salinity distributions at the Little River Marsh and Bass Beach Marsh after recommended changes in hydrology are instituted. Note the extension of high salinity water into the southern and northern ends of Little River Marsh, the projected result of a second culvert installed near Fifield Island. At Bass Beach Marsh the extent and level of salinity is projected to increase throughout the marsh.

and the tidal flooding and draining of the marsh all the more effective. Seawater will circulate around Fifield Island once again. Salinity of the water on the marsh surface and the water in its sediments will increase.

It should be noted also that installation of the recommended culvert will not increase the winter and spring flooding of Little River Marsh. If anything, flooding will decrease because of better drainage of the marsh. Placing the ocean end of the culvert on the rock ledge off the beach should circumvent another potential problem, the filling of the seaward end of the culvert with sand.

In sum, the proposed additional culvert at the south end of the marsh will help, over time, to create more truly high marsh conditions. Saline tidal water and fresh upland water will be exchanged over the marsh surface twice daily, and something near to the hydrological pattern of the millenia before major roads, dams, and their consequent water restrictions were installed will occur. The ebb and flow of salt water, a virtual necessity for the existence of true salt marsh, will exist again at the Little River Marsh in North Hampton, and will permit the re-establishment of genuine salt marsh flora and fauna.

There is another possible, but less desirable, alternative to the construction of a culvert under Route 1A near the North Hampton/Hampton line as a way of improving the situation at the Little River Marsh. This second alternative would involve running a ditch from near the fish house culvert approximately parallel to the shore and over to the Little River at the north side of Fifield Island. Such a ditch would improve the flow of salt water to the far reaches of the marsh currently being invaded by purple loosestrife. To be effective, however, I think this method would require a second culvert, or trunk, out to the ocean under the fish houses. Otherwise, the single trunk now in place would probably operate as a barrier to the sufficient tidal flushing that is the ultimate aim of these changes.

Bass Beach Marsh

At the Bass Beach Marsh, rather than installing a culvert, a culvert needs to be removed. The culvert under the old electric railway bed, along with the bridge running over it, creates too great a restriction of water flow and will have to be disassembled if the Bass Beach Marsh is to be restored. Instead of the culvert/bridge under the old electric railway, an open channel should be established. The culvert under Route 1A appears to allow an adequate flow of water and does not require any changes, except that use of the floodgate should be discontinued.

Additionally, ditching should be done to drain some of the dead panne areas of standing water. Although the ditches are the probable cause of the dead pannes, only breaking through their higher rims with drainage ditches will alleviate the conditions that have produced these dead panne areas. Such ditching, when combined with the creation of an open channel, except under Route 1A, should provide enough flooding and drainage of the Bass Beach Marsh to restore it to high marsh over a period of time.

Since the excellent birding at Bass Beach Marsh is related to the dead pannes, some dead panne areas can be maintained by not ditching and draining them. The birds will continue to be attracted by these pannes' insect and fish populations.

To reduce the mosquito population currently breeding in the dead pannes, deep center areas, or pot holes, should be dug in the pannes. Then, at low tide, the small larvae-eating fish that live in the pannes will congregate in these pot holes and survive to eat more larvae. Currently, during particularly low tides, the entire panne probably becomes dry enough or saline enough so that fish do not survive, leaving mosquito and other insect larvae to thrive. This and other methods of Open Marsh Water Management show great potential for controlling mosquitoes in New Hampshire marshes.

PROJECTED OUTCOMES

The eventual results of implementing the above recommendations would be great, if not complete, restoration of the Little River Marsh and the Bass Beach Marsh to true New England salt marsh, or high marsh, ecology. It is impossible to give a time frame for these changes. I have been able to find only one follow-up study on marsh restoration, and it covered a period of only two years after changes were made to the marsh. To examine the specifics, let me once again talk about the marshes separately.

At Little River Marsh, adding a culvert under Route 1A at the south end of the marsh is, as I said, the preferred solution. Doubling culvert access to the marsh will double the amount of salt water flowing onto the marsh. Currently, salt water flows through the culvert under the fish houses at near maximum capacity during the two hours that flood tide occurs on the marsh. Ebb tide lasts for 10 hours on the marsh. Its flow is determined by the volume of water on the marsh at high tide. If more salt water enters the marsh, more will leave during ebb tide. The present culvert does not restrict ebb flow. An additional culvert will not, either; it will drain the marsh more completely.

The increased ebb and flow in the marsh channels and the Little River will have an immediate self-dredging effect on these waterways. And the increased intrusion of ocean water into former marsh areas will allow a gradual return to the high marsh environment. Salt hay (Spartina patens) will grow in and purple loosestrife (Lythrum salicaria), phragmites (Phragmites communis), and cattail (Typha latifolia) will retreat. It should be understood that increasing the salinity of the water flowing in the channels of the Little River Marsh also increases the salinity of the water held in the marsh peat, or interstitial water. The salt water bath to the roots of loosestrife, phragmites, and cattail is what will cause their retreat and eventual demise.

I cannot say exactly what the effects would be of the second solution, an additional ditch from the main ditch at the north end of the marsh and over to Fifield Island, would be. There would be some increased salinity at the far end of the marsh, but it would not be accompanied by increased flow overall.

At Bass Beach Marsh, improved hydrology will improve marsh health. Removing the bridge and culvert will allow more ocean water into the marsh, and, most importantly, will allow better drainage of the marsh. The same sediment flushing mechanism will apply and will self-dredge the channels and ditches. Salt hay (Spartina patens) will regrow over ditched dead pannes, and up into areas now covered by phragmites.

As mentioned before, some dead panne areas could be kept to attract birds. Bass Beach Marsh will probably always have some dead panne areas, and as the currently preserved areas grow in, others will occur through natural flooding and subsiding of marsh peat. These new pannes should then be pot-holed. Eventually, most of the marsh will be high marsh, with a few dead pannes in low, frequently flooded places.

I can find only one report of marsh restoration in the literature. The effort was undertaken by the Fairfield Conservation Commission in 1974, to restore salt marshes in Connecticut that had been invaded by phragmites. "With this reintroduction of tidal exchange, significant reduction in Phragmites were noted within one growing season."[3] The report does not constitute a scientific follow-up of marsh restoration procedures. It merely mentions word-of-mouth reports that measures to improve tidal flow seem to have reduced phragmites populations.

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[3] Roman, C.T., W.A. Niering, and R.S. Warren. 1984. P. 149. "Salt Marsh Vegetation Change in Response to Tidal Restriction." Environmental Management Vol. 8, No. 2, pp. 141-150.

If the Town of North Hampton undertakes the restoration of its marshes by instituting the recommendations made above, it will be exemplary in its environmental concern. If the town additionally undertakes to document and scientifically monitor the changes in the marshes, it would establish itself as a unique textbook example of marsh restoration certain to be of interest to scientists, coastal wetlands managers, and students of ecology throughout the United States.

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