Spring 2000 ISSUE # 16

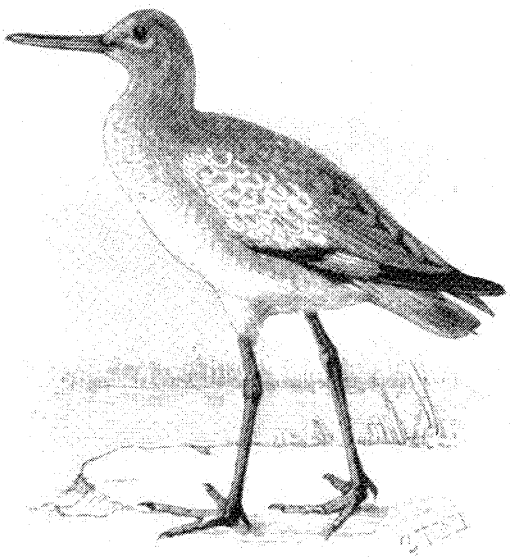
FUNDY ISSUES

Salt Marsh Saga

Conserving Fundy's Marine Meadows

Salt Marsh Swan Song

The dump truck, labouring under its load of boulders and gravel, edges back onto the rough, rocky peninsula jutting out into the Annapolis Basin in south-western Nova Scotia; a peninsula formed from many earlier loads. With back-up alarm ululating a shrill warning that echoes across the Basin, it tentatively eases to the edge of the rocky precipice and stops. Its cargo box slowly rears upward and the contents tumble, with thundering rattle and billowing dust, down the bank and onto the narrow, muddy fringe of grass. Over several days, this barren outcrop has crept steadily out over the coastal salt marsh flat. With a final backward glance, the driver gives the box a vigorous shake to dislodge a few remaining stones and then slowly lowers it as he eases back onto the road and roars off in search of one final load. Silence, save for the rhythmic lap of rising wavelets against the base of the intrusive rockpile, returns. Another valuable piece of prime waterfront property has replaced a useless plot of muddy, waterlogged coastal wasteland. Moments later, a small flock of hungry Willets swoop in from the Basin, their wings flashing black and white in the sun. They come to forage for marine worms, snails and insects among the grasses of the familiar muddy flat that countless generations of their kind have visited for a meal. At the last minute, recognizing that something is amiss, they veer in consternation up and away from the stark, sterile rocky pile. Sharp "kip…kip...kip" alarm notes reverberate across the Basin as they hasten away in search of other, increasingly scarce, foraging grounds. Yet another fragment of their ancient salt marsh heritage has been sacrificed to the march of progress.



A Willet in search of a meal on a salt marsh

FMESP Fundy Marine Ecosystem Science Project

BOFEP Bay of Fundy Ecosystem Partnership

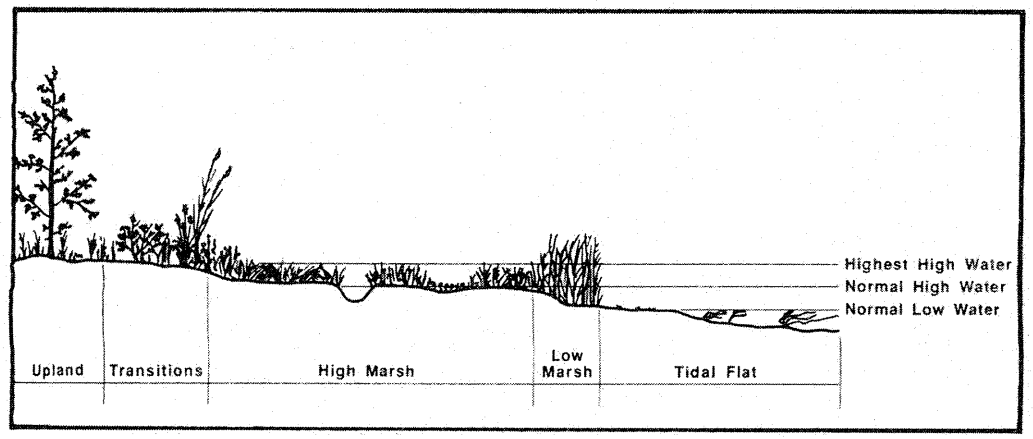
Salt Marsh Saga

But what are these salt marshes? What are they good for? Why should we care if they are buried, diked or drained? These are questions that residents of coastal communities around the Bay of Fundy and Gulf of Maine are going to have to come to grips with. The saga of the salt marsh is a long and dispiriting one. There are still many words, sentences, paragraphs and even whole chapters missing, including the final one that has yet to be penned. How the story ends will very much depend on how we as coastal dwellers respond to these pressing questions. To focus our thoughts on this matter, let's review what we know about salt marshes, what we have done to them and why they should matter to us.

"What are these salt marshes? What are they good for? Why should we care if they are buried, diked or drained?"

Salt marshes develop in that narrow band between the land and the sea called the intertidal zone, where the habitat is alternately salty subsea and dry exposed land. John and Mildred Teal, spent a lifetime studying salt marshes and distilled their experience into a highly readable and evocative book *"Life and Death of the Salt Marsh"*. They describe salt marshes as "a ribbon of soft, salty, wet and low lying land." Adopting a more scientific tone, Paul Adam, author of "*Saltmarsh Ecology*" defines salt marshes as "areas, vegetated by herbs, grasses or low shrubs, bordering saline water bodies… subjected to periodic flooding as a result of fluctuations in the level of the adjacent water body". But salt marshes don't occur everywhere along the coast. They develop best in sheltered areas on soft-bottomed tidal mud flats, where fine sediments have accumulated in thick layers, such as along the shores of estuaries. Salt marshes are scattered along the eastern seaboard of North America from southern Labrador to the Gulf of Mexico. In the Gulf of Maine the most extensive ones are found in the northern and southern regions, largely because of the ready availability of sediments there. Southward, around Cape Cod and New Hampshire, sediments were bulldozed into the region by the advancing glaciers that only withdrew about ten-thousand years ago. Towards the centre of the Gulf coast, the hard, granitic glacier-scraped, rocky shores of Maine are poor sediment providers. Thus, salt marshes there are smaller, more scattered and mostly fringe the estuaries of larger rivers. Northward, an abundant supply of sediment is easily eroded from the soft red sandstones, siltstones and shales that rim the upper Bay of Fundy.

The gently sloping shores, the very high tidal amplitudes and the easily eroded rocks of the surrounding landscape make the upper reaches of the Bay of Fundy a particularly good place for very large salt marshes to form. The tidal waters, bearing huge quantities of reddish brown sediments, flood over vast areas of coastal flats twice each day. Much of



A salt marsh is a zone of transition between the land and the sea.
Adapted from Hatcher and Patriquin, 1981

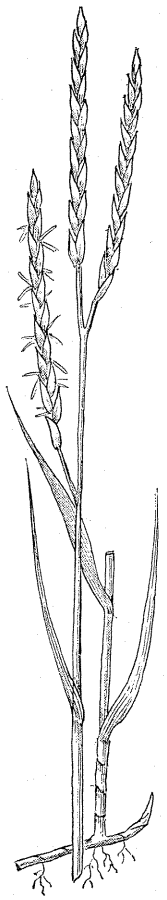
this sediment is deposited in sheltered areas along the shoreline forming the thick red mudflats for which the upper Fundy landscape is world famous. As the initially soupy mud settles and firms, marsh grasses from surrounding areas gradually creep out onto the flats, thrusting their tangled roots deep in the nutrient rich mud. The fibrous roots anchor the mud even more securely, while the waving stalks slow the currents of the incoming tide and like a myriad miniature snow fences causes the water to deposit much of its sediment load in their lee. The grasses thus both stabilize the mud and hasten its accumulation. Building their habitat as they go the marsh plants steadily creep outward toward the sea.

"The high marsh is dominated by Spartina patens and the low marsh by Spartina alterniflora. These two grasses give the salt marsh its unique character and are responsible for its remarkable productivity."

The intertidal zone can be a harsh habitat, submerged in icy, salty water one minute and subject to hot withering winds the next. Most marine plants and animals can't tolerate long exposure to the air and most terrestrial ones don't like being submerged in salt water. However, a few organisms, both marine and terrestrial, can not only tolerate these conditions but thrive, particularly as food is plentiful and there is little competition for it. But even these salt tolerant species have preferences and tend to favour particular parts of the intertidal zone. They are especially influenced by how often an area is submerged and for how long each time. The amount of land that flooded and exposed by tides changes according to complex daily, monthly and annual cycles of the moon and sun. Some areas are submerged and exposed twice every day, while higher land above the normal tide line is flooded only a couple of times each month or each year, and the seabed below normal low tide is similarly exposed only infrequently. Thus there are differing conditions of exposure duration and frequency, water depth, temperature and salinity across the intertidal marsh and the different plants and animals choose their preferred places accordingly. In most marshes there is a distinct division between the "high marsh" above the mean high water level and the "low marsh" below it. Around the inner Basins of Fundy, the area of high marsh is slightly greater (53%) than that of low marsh (47%), although very large tracts of the original high marsh were diked centuries ago and converted to farm land. The high marsh is dominated by *Spartina patens* and the low marsh by *Spartina alterniflora*. These two grasses give the salt marsh its unique character and are responsible for its remarkable productivity.

Salty *Spartina*

Spartina grasses are adapted both in form and physiology to thrive in the harsh intertidal habitat. They evolved from dry land species and thus ecologists usually think of salt marshes as terrestrial ecosystems with a distinctive maritime flavour. These plants are perennial and live for many years, although the above ground portion dies each autumn. However, the rhizomes and roots survive the winter in the mud and push up new growth each spring. They are better able to absorb water and excrete excess salts than other land plants. In addition, hollow ducts in their stems allow air to diffuse to the roots buried deep in gooey mud that is largely devoid of oxygen. Flexible stems, small size and tough, fibrous roots enable them to stand firm against current and wind. But in adapting themselves to salt water they have had to give up some of their ability to succeed in fresh water. Thus in parts of the marsh where there is a large inflow of freshwater they may

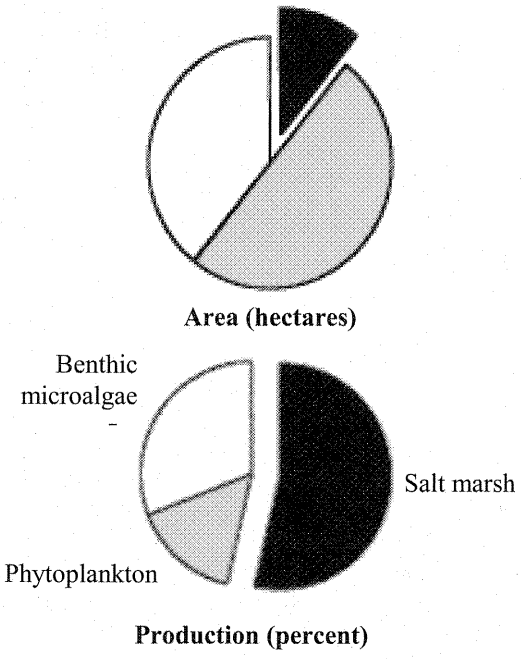


Spartina Cordgrass

be muscled out by more vigorous wetland plants such as cattails or the common reed, *Phragmites*.

The two species of *Spartina* common to Fundy marshes look different and have somewhat different habitat preferences, and thus grow best in specific areas of the marsh. *Spartina alterniflora,* or cord grass, is the larger, coarser and more pioneering of the two. It grows on the lowest parts of the marsh which are flooded more often and where tidal currents are stronger. It can grow over 3 metres tall, although 1 to 2 metres is more usual. Winter killed stalks break off and are quickly washed away by currents, leaving only dense stubble projecting from the bare mud. The plants creep outwards over adjacent mudflats, continually trying to colonize new areas. Once the mud is stabilized by the plants, accumulating sediment gradually raises the height of the marsh making it more suitable for the other type of *Spartina* grass which eventually moves in and takes over. Meanwhile, the *Spartina alterniflora* continues its pioneering slow spread outwards, conquering new mudflats for the salt marsh realm. The less adventurous *Spartina patens*, or salt hay grass, prefers the higher, landward portions of the marsh that are only occasionally flooded by the tides and where currents are much weaker. It is shorter and more finely textured that its relative and typically forms a dense, uniform half-metre high carpet. In these parts of the marsh dead and decaying plant material is not as readily washed away by currents and it accumulates on the surface and keeps the mud moist and rich in organic matter.

"The Spartina plants absorb these and grow lush and luxuriant. The leaves eventually die, fall off and slowly decay into fragments of the rich organic 'detritus' that is the principal currency of the salt marsh economy."

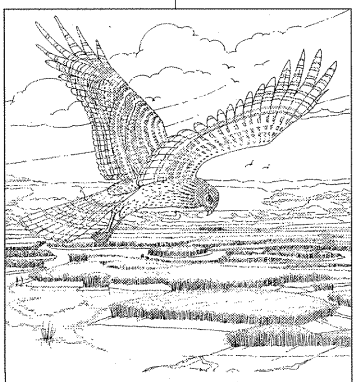


Relative production of organic matter in the upper basins of the Bay of Fundy by phytoplankton, benthic microalgae and salt marshes. The top pie shows proportion of area available for each type of production.
(Data from Gordon and Cranford, 1994)

Significance of Salt Marshes

Some salt marshes are among the most productive habitats on earth in terms of the quantity of vegetation produced each year. Costly cultivation and fertilization are needed to achieve comparable agricultural yields in upland areas, services that the tides freely provide to salt marshes. Although Fundy marshes are not as productive as those in warmer more southerly regions they may, nevertheless, be of even greater importance to their local marine ecosystem. In the upper Bay, production of microscopic floating plants (phytoplankton) is very low because sunlight cannot penetrate far in the muddy water. Mats of benthic microalgae growing on the surface of mudflats are more important primary producers. However, the coastal salt marshes, although occupying only a fraction of the area, are the principal source of food for sea creatures in the region. Their efficient production process has been aptly called a "nutrient pump". The incoming tides deposit sediments rich in inorganic nutrients (fertilizers) onto the marshes. The *Spartina* plants absorb these and grow lush and luxuriant. The leaves eventually die, fall off and slowly decay into fragments of the rich organic "detritus" that is the principal currency of the salt marsh economy. Some of this is eaten by the abundant organisms that live

in the marsh mud, but even larger quantities are "pumped" into the sea on the outgoing tides. In the memorable words of the Teals, "The tide giveth and the tide taketh away."



A soaring hawk surveys its salt marsh hunting ground.

In both the marsh and coastal waters the nutritious detritus is food for swarms of bacteria, microscopic protozoans, small invertebrates and larger filter feeders such as clams. These in turn are eaten by an array of large invertebrates, fish, birds and mammals; a food chain ultimately fuelled by marsh grass. The permanent residents of the marsh include a variety of crustaceans, molluscs and marine worms, most of which stay buried in the mud much of the time. Visitors from the land, such as shorebirds, hawks, songbirds, insects and a few mammals such as racoons, foxes and field mice, invade the exposed flat in search of food when the tide recedes. Other hungry visitors, such as crabs and fish move in from the sea as the tide once again covers the flat. For many of these marine fish and shellfish the grassy flats, pools and marsh creeks also serve as important spawning and nursery habitats. Waterfowl, such as Green-winged Teal, American Black Ducks and American Widgeon also heavily use them during the breeding season.

Although some animals spend their whole life within or near a particular salt marsh there are many birds and fish, that migrate along the coast each year visiting a number of estuaries and marsh areas in their travels. Fundy's saltmarshes are important internationally as staging, feeding and resting areas for many types of migratory shorebirds and waterfowl that rely on a chain of such wetland habitats scattered up and down the east coast of the Americas to get from their summer breeding grounds to winter feeding grounds. Their migratory patterns have evolved over many millennia and are based on the assurance of finding suitable marsh habitat at regular intervals along the route. A major break in this slender and fragile chain could have disastrous consequences for them. This is a crucially important point in assessing the overall ecological value of salt marshes. Protecting one salt marsh may suffice to ensure the survival of the stay-at-home species, but the well being of the long-distance wanderers is largely dependent on the availability of a network of suitably spaced habitats throughout their range. The Teals pointedly observe that "The preservation of a few marshes here and there, will not serve for their existence".

"Fundy's saltmarshes are important internationally as staging, feeding and resting areas for many types of migratory shorebirds and waterfowl that rely on a chain of such wetland habitats scattered up and down the east coast of the Americas."

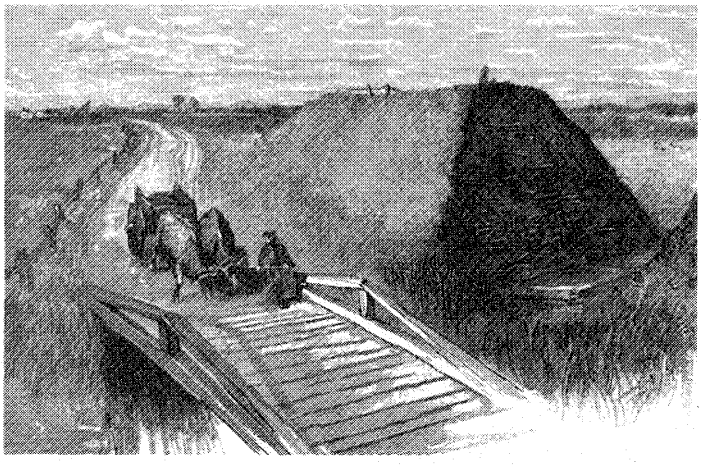
Attempts are often made to put a dollar value on the benefits of salt marshes to a region and then to make decisions about their conservation or destruction in purely economic terms. This is an overly simplistic approach, as many of the important marsh functions cannot be easily expressed in monetary terms; some because of their very intangible nature, but most because we simply don't have the necessary measurements. It is also likely that there are other ecological roles that marshes play in coastal and estuarine ecosystems that we are not even aware of. There is growing evidence that healthy coastal marshes are crucial to the continued well-being of many commercially important finfish and shellfish stocks. In recent decades, salt marshes have also attracted considerable interest from the rising tide of ecotourism and outdoor recreation. Hunters and fishermen have long recognized the plenty that coastal marshes offer. Increasingly bird watchers and other nature enthusiasts are learning to appreciate the rich diversity and unique ecological vistas provided by undisturbed salt marshes. Many Maritime schools and universities are even tailoring their science programs to include more wetland ecology.

In many areas salt marshes also play an important role in protecting coastlines from the periodic fury of the sea. The yielding mud and thickly entangled vegetation can absorb a great deal of the wave energy that would otherwise pound on exposed rocky coast and erode them. Although large amounts of mud and marsh vegetation may be washed away in the process, the damage is only temporary. Once calmer conditions prevail the marsh begins a slow process of healing itself, accumulating new sediments and regrowing. Unlike expensive seawalls, groins and other man-made structures, this living buffer has the ability to recover without our costly intervention. Marshes have the added benefit of automatically adjusting their relative position on the shore to accommodate rising and falling sea levels, something that no seawall can do. As we learn more about salt marshes and how they interact with the coastal marine ecosystem we shall undoubtedly find that their ecological and economic value is far more than we have ever imagined.

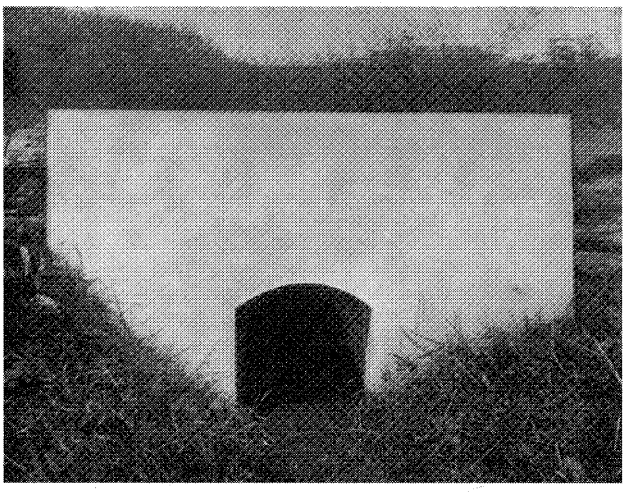
"In the Fundy region salt marsh loss and degradation began on a massive scale soon after the first European settlers moved into the region almost four centuries ago and continues right up to this day."

Siege on Salt Marshes

And yet, over the centuries we have treated salt marshes as something to be despised and "reclaimed", not something to be nurtured and treasured. Man's assault on these precious wetlands has been unrelenting. Three decades ago, John and Mildred Teal warned "the dangers to salt marshes stem from human activities, not natural processes". Although natural processes, such as sea level change or winter storms can alter their relative position on the shore or superficially damage them, they seldom obliterate marshes completely, except perhaps over long geological time scales. The effects of human activities are quite another thing altogether. In the Fundy region salt marsh loss and degradation began on a massive scale soon after the first European settlers moved into the region almost four centuries ago and continues right up to this day. The story of the conversion of vast tracts of salt marsh into diked and drained agricultural lands is told in more detail in Fundy Issues Fact Sheet number 9 *"Dykes, Dams and Dynamos: The Impacts of Coastal Structures"*. The ongoing degradation and loss of other large areas of marsh habitat because of interference with river flow and tidal exchange is discussed at length in Fundy Issues Fact Sheet number *11 "Whither the Waters? Tidal and Riverine Restrictions in the Bay of Fundy"*. The worrisome verdict of both these reviews is that since the arrival of Champlain in 1604, between 75 and 85% of the original Fundy marshes has been destroyed or converted into something else. Furthermore, a large proportion of what remains is severely degraded because of impeded tidal exchange. For example, in some areas salt marshes are being overgrown by invasive alien plants that crowd out *Spartina* and other plants This creates a much less diverse habitat, provides less food and shelter for wildlife and is less supportive of coastal marine production. Cattails, the Common Reed, *Phragmites*, and Purple Loosestrife are the main freshwater invaders in the Maritimes. However, these are a symptom of problems in a marsh, and not the underling cause. They are largely freshwater plants, and as long as the flooding tide keeps the marsh salinity high they are held at bay at the periphery. However, anything that interferes with the tidal exchange, or increases runoff from rivers or the surrounding high-



Almost 400 years ago Acadian farmers began building large, earthen dikes to reclaim and drain extensive tracts of Fundy's salt marshes.



An undersized or improperly placed culvert hampers the tidal exchange in a salt marsh.

lands into the marsh, allows the poised invaders make their move and overrun freshened areas. Simply rooting out or otherwise eliminating the invaders is unlikely to be successful. The underlying hydrological problems responsible for freshening the marsh have to be fixed for the *Spartina* meadows to recover and thrive.

Salt marshes around the Gulf of Maine are particularly vulnerable to human activities because the majority of them are clustered around estuaries. Unfortunately, these same estuaries have historically been the preferred locations for the proliferation of human settlement as well. Protected harbours, fresh water, fertile land, hydropower and ready river access to inland areas made estuaries ideal locations in the eyes of early settlers. Today, most of our larger coastal cities and towns hug the shores of estuaries. Inevitably the steady growth of these urban centres increasingly impinged on adjacent salt marshes, resulting in their total destruction or gradual degradation. Networks of roadways and railroads criss-crossing the marshes and adjacent upland areas disrupted the flows of freshwater in the area, impeded tidal exchange and thus strangled the marsh by slow degrees. Understandably, a sick or dying marsh is not a very pleasant urban neighbour. Normal ecological processes and functions have gone completely awry. Marsh plants sicken and die, mud erodes and slumps and accumulating organic matter stagnates and decays, producing malodorous gases. Mosquitoes and other bothersome pests thrive in the degraded, stagnant wetland and make unwelcome forays into surrounding areas. In contrast, desirable species of waterfowl and wildlife find the habitat intolerable and move out. In very short order a pestilential eyesore of a waterlogged wasteland develops where garbage soon starts to accumulate. Is it any wonder that upset residents are only too pleased to see them filled in and converted to more useful playgrounds, subdivisions or strip malls. A dying marsh has few friends. The greatest impact of urban sprawl on salt marshes in the Gulf of Maine region has been in the southerly region, particularly around Boston, where population densities are particularly high. We are perhaps fortunate that around the Bay of Fundy, population numbers are much lower and there are few areas where urban development has had a devastating and irreversible impact on nearby salt marshes. But we shouldn't be complacent for, as we have seen, we have wantonly drained or harmed large tracts of salt marsh in other ways. Fortunately, in recent years the scale of this startling loss of healthy coastal wetlands and the likely ecological consequences are finally being publicly recognized. Concerned individuals and dedicated groups both within and outside of governments are now mobilizing to stop and perhaps even reverse the trend. But what can be done and, perhaps more importantly, what is being done to save salt marshes?

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Saving Salt Marshes

Efforts to protect and conserve salt marshes are now occurring all around the Gulf of Maine. However, salt marsh restoration is a relatively new science. There are few experts who have all the answers and no standard cookbook of tested methods.

Each salt marsh is somewhat different in origin, character and present condition; and these differences have to be carefully taken into account in any restoration efforts. What works in one marsh may spell disaster in another. A variety of conservation projects, ranging from the simple to the complex, have been attempted in several places around the Gulf of Maine, with varying degrees of success. In many of these cases there was little if any monitoring afterwards to see how successful the project was. This is slowly changing, with the growing realization that we can learn much from both our successes and failures. Nowadays, restoration projects are being better documented and there is more careful ongoing study of the site after the initial restoration phase is complete. Let's consider a few of the more promising of the approaches to protecting and restoring salt marshes

Cattails and other freshwater plants may overrun a salt marsh if tidal exchange is greatly impeded.

One of the most encouraging developments in the Fundy region is the recent designation of the Musquash Estuary and its complex of salt marshes as an Area of Interest under the Marine Protected Area provision of the 1996 Oceans Act. This designation is the first official step towards the eventual recognition of the area as a full-fledged Marine Protected Area. The Musquash is reportedly one of the "last ecologically intact estuaries in the Bay of Fundy", so its conservation and protection is of considerable importance, both ecologically and symbolically. It was largely through the concerted efforts of communities in the region, spearheaded by dynamic groups such as the New Brunswick Conservation Council and the Fundy North Fishermen's Association, that this groundbreaking step was finally taken. There are high hopes that once official protected status is attained, the implementation process developed will serve as a template for obtaining similar protection for other ecologically significant coastal wetlands around the Bay, as well as for highly vulnerable nearshore and offshore habitats. It is equally important that the governments of New Brunswick and Nova Scotia develop and rigorously implement coastal land use policies that recognize the importance of coastal wetlands and the urgent need for their protection. There is little point spending large sums restoring salt marshes if individuals can fill, drain or otherwise degrade other salt marshes with little or no restriction.

There is a growing realization that merely protecting what little marsh is left may not be nearly enough to sustain a healthy coastal ecosystem indefinitely. We must seriously consider expanding the area of salt marsh around the Gulf. What about the possibility of creating new marshes in areas where they haven't formerly existed? The practice of creating new habitat to replace that destroyed elsewhere, or "habitat substitution", is accepted as a viable option in some areas of the US. Where salt marshes have been destroyed or never existed before, it has been possible to create entirely new ones. This might simply involve removing a layer of fill that covers a former marsh and then allowing marsh plants to colonize the area. Sometimes it is possible to subtly change the slope of a low-lying coastal area to promote the accumulation of sediments that will eventually form a new marsh. This is a long-term process as sediment deposition and removal have to reach a new balance, the substrate has to become firm and marsh plants have to become established. Giving nature a hand can speed up the process. In New England, dredge spoils have been pumped onto low-lying coastal areas and the sediment beds artificially planted with marsh grasses to stabilize them. Eventually, these areas developed into more diverse, mature salt marsh communities.

"There is little point spending large sums restoring salt marshes if individuals can fill, drain or otherwise degrade other salt marshes with little or no restriction."

However, such large-scale marsh restoration projects often require extensive landforming and are expensive. They are thus unlikely in Fundy where there may be more feasible options such as improving unintentionally created marshes or restoring former ones that were diked as croplands generations ago.

"The ongoing saga of the Petitcodiac serves as a timely illustration of the complexity of the social, economic, political and ecological concerns that have to be addressed before any major habitat restoration initiatives can be carried out."

A certain amount of unintentional salt marsh creation or restoration is happening all the time. Often, it is the unexpected result of man's activity in the coastal zone. A good example is the huge mud flat that has developed downstream of a causeway built across the Avon River at Windsor, Nova Scotia. Over a few decades, soft muddy sediments accumulated just below the barrier and these have now firmed up enough to support pioneering *Spartina.* Today this mudflat is well on its way to becoming a luxuriant and productive salt marsh. In other instances of unplanned restoration the relentless forces of nature simply reclaim that which man had previously wrested from the sea. Long-neglected dikes near Kingsport and elsewhere eventually eroded, allowing waves and currents to break through, flooding abandoned fields and allowing salt marsh plants to slowly reestablish. Some oceanographers worry that rising sea levels may cause even more such dikes to fail and flood a great deal more reclaimed land. Thus far in the Maritimes there have only been a few attempts to purposely breach dikes and recreate lost salt marsh habitat. For example, the Canadian Wildlife Service has allowed some agricultural land to "go back out to sea" at the Chignecto National Wildlife Area. In many places this might not be a feasible option. Some protected dikelands now have a range of non-agricultural uses, such as residential or commercial developments, road and rail beds, or utility corridors that are vulnerable to flooding. However, there are areas of unused dikeland, where the upkeep of dikes is no longer economical and where there are no flood-prone structures, that could easily be flooded and restored as salt marsh.

In recent years, however, there has been a major effort to convert many such unwanted former salt marshes, not back to their former marine state, but to freshwater impoundments. Thousands of acres of such "constructed" freshwater wetlands have been created in recent years by groups such as Ducks Unlimited and the Canadian Wildlife Service to enhance waterfowl habitat and sustain recreational hunting. There are as yet no comparably powerful interest groups pressing for the restoration of true salt marshes.

Many species of waterfowl and shorebirds rely on salt marshes for food and refuge.

The need for the continuing upkeep of dikes protecting farmland along the shores of most of Fundy's larger tidal rivers, such as the Petitcodiac, Avon and Annapolis was eliminated almost four decades ago by the construction of protective tidal barrages or causeways across their lower reaches. These effectively blocked tidal exchange in the river and barred the passage of migrating fish. Recent studies have shown that these structures have had serious ecological impacts on the river, estuary and nearby coastal waters. There is a growing interest in attempting to undo some of the environmental damage by modifying the structures to allow more tidal flushing of the river. Efforts are now underway to do this with the causeway across the Petitcodiac River near Moncton, New Brunswick. The severe ecological impacts of this structure and the divisive debates

that have attended the attempts to arrange even an experimental opening of its tidal gates are outlined in Fundy Issues Number 11, *"Whither the Waters? Tidal and Riverine Restrictions in the Bay of Fundy"*. The ongoing saga of the Petitcodiac serves as a timely illustration of the complexity of the social, economic, political and ecological concerns that have to be addressed before any major habitat restoration initiatives can be carried out.

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But smaller, less controversial, marsh restoration projects are also ecologically important in the long run. Many constricted, degraded coastal marshes could be restored to a healthier state by improving the tidal exchange of seawater. This might simply involve enlarging a culvert to permit greater flow, or changing its position to allow the marsh to fill and drain more completely on each tidal cycle. Environmental groups in New England have found that often, bringing such a problem to the attention of the local highways department results in its correction as part of subsequent routine maintenance in the area. However, the first step in tackling this serious problem is locating and mapping all such restrictions, assessing their ecological impact on nearby salt marshes, and measuring the area of marsh affected. Such detailed inventories have been developed for many areas in New England, but little useable information has been collected in the Maritimes. An *ad hoc* working group of Environment Canada examined the issue of tidal restrictions and recommended that the creation of such an inventory be a priority. It also suggested that all remaining Fundy salt marshes be mapped and their ecological condition evaluated. This information could then be used to assess the benefits and costs of enhancing tidal exchange in selected marsh areas. However, undertaking such restoration projects will require the active involvement of various levels of government as well as coastal communities around the Bay. In an effort to "prime the pump" the Conservation council of New Brunswick sponsored a workshop in April 1999 on "*Tidal Barriers in the Inner Bay of Fundy*" that included participants from throughout the Maritimes. This workshop drafted and endorsed a "*Proposed Federal - Provincial Accord on Tidal Flow Restoration in the Bay of Fundy*". The early ratification of such an accord by the Federal, New Brunswick and Nova Scotia Governments would be an important first step in the uphill struggle to restore our coastal wetlands to health.

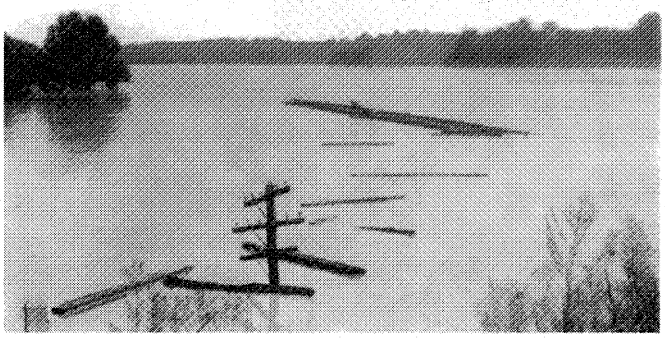
"It takes a lot to convince people that such pathetic ugly sloughs could, with a little thought and effort, be rejuvenated as dynamic thriving ecosystems that would be an asset to the community."

Selling Salt Marshes

However, all such efforts to conserve salt marshes will only be successful if people who live near them learn to appreciate their natural history and understand their importance to the ecology of estuaries and coastal seas. There has long been a widespread perception that "wetlands are wastelands" and their reclamation for other "productive" uses almost always regarded as a positive step. Mud flats and salt marshes lack the public appeal and natural mystique of tropical rain forests and coral reefs, even though in their own way they are every bit as interesting and ecologically valuable. Guided walks through healthy vibrant marshes can be a memorable and eye-opening experience. However, all too often salt marshes have been badly abused and the struggling remnants exhibit little of their former vigour, productivity and natural beauty. Regrettably, it is these ailing fragments that colour the public perception of a salt marsh. It takes a lot to convince people that such pathetic ugly sloughs could, with a little thought and effort, be rejuvenated as dynamic thriving ecosystems that would be an asset to the community.

Not only must community apathy and distaste be overcome, but valid community concerns about the

likely results of proposed restoration projects must also be addressed, preferably early in the planning process. One common concern is an increase in mosquitoes and other insects around a marsh. This is understandable given that many people's experience has been with stagnating marshes that are prime habitats for such pests. In healthy marshes, where tidal flushing is adequate and standing water minimal, this is not usually a significant problem. Studies in the US have shown that once a marsh becomes reestablished, usually within about two years, the mosquito populations fall drastically. Frequent tidal flushing makes it difficult for them to reproduce and the burgeoning fish population feeds on any larvae or adults that are present. Other people have concerns about the potential loss of agricultural productivity if dikelands are flooded as marsh habitat. This argument may be less compelling than it once was, given the general low value of much agricultural land and virtual abandonment of many unused tracts of dikeland. The cost of maintaining many dikes and other protective structures is becoming less and less economically viable. Such unused dikeland may provide the best, least disruptive and economically justifiable opportunities for restoring large areas of salt marsh. But here again, the co-operation and active involvement of land owners, nearby residents and the "marsh bodies" who manage this land is a prerequisite for success.



There is concern that poorly planned salt marsh restoration efforts may lead to flooding of agricultural land or utility corridors.

"can we mobilize enough community support and harness sufficient financial and other resources to protect and revitalize our diminishing network of salt marshes?"

An even more serious and widespread concern is the possibility of flooding if protective dykes and barrages are removed. In many areas roadways, railbeds, power lines, croplands and residential and commercial buildings are now present in the low-lying areas protected by these structures. If dikes were removed or altered then valuable properties might be vulnerable to damage during high tides or storm surges. Such problem areas would have to be reviewed on a case by case basis, using topographical and hydrological mapping to evaluate flooding risks. There may be other means of protecting such assets while allowing adequate flushing of the marsh. In some situations it will be necessary to accept that no feasible solution is available and therefore marsh rehabilitation or restoration is not possible. Proponents of restoration projects must be prepared to accept "no" for an answer if that is the consensus of the community. Community support is essential, for without it any conservation or restoration efforts are doomed to eventual failure. Outsiders may be catalysts or resources in the process, but the local people must guide it and make the final decision. The community must want the marshes. Enthusiastic support for a restoration project may unleash a wide range of invaluable volunteer effort. There are many ways of "animating" communities and many things that individuals and groups can do to support restoration projects. Some of these "actions" are detailed in *"Community and Social Considerations in Salt Marsh Restoration Work in Nova Scotia"* prepared by the Ecology Action Centre, based in Halifax N.S. *(*see Further Reading*)*. Contributions may include the land donation, conservation easements, stewardship agreements, loan and operation of heavy equipment, organizational and planning skills, specialized knowledge, monitoring, volunteer labour and financial support. The only question is can we mobilize enough community support and harness sufficient financial and other resources to protect and revitalize our diminishing network of salt marshes?

Whither the Willets?

Paul Adam in "*Saltmarsh Ecology*" strikes a rather sombre note when he concludes, "The future of the world's saltmarshes remains uncertain". He suggests that their future will only be assured if we begin now, in a major way, to protect what is left, restore to health what has been degraded and recreate some of what has been lost. Our tentative efforts thus far indicate that we have much of the know how and most of the technological ability to save a significant proportion of our productive and diverse salt marsh habitats. But do we have the courage and the will to do it? It will not be sufficient to save isolated, representative fragments here and there as living museums. They are critically important to the health of our coastal waters and are part of a complex, extended network of wetland habitats that are crucial to many species of fish and wildlife. The Teals are very emphatic that "The ribbon of green marshes along the eastern coast of North America … must be preserved almost in its entirety if its preservation is to have any real meaning". By doing our part to ensure that healthy, flourishing salt marshes continue to ring the Bay of Fundy we will be conserving for ourselves and for future generations an invaluable part of our rich natural heritage …… ...as well as that of the hapless Willets.

The Fundy Issues Series is an initiative of the Bay of Fundy Ecosystem Partnership. These publications describe our present scientific understanding of some of the environmental issues confronting the Bay. We hope that they will enhance your understanding of the biological richness and complexity of this unique marine area and the problems confronting it. Such awareness may encourage you to help in protecting it for the use and enjoyment of all, so that future generations may also share and appreciate its bounty and rare beauty.

Fundy Issues are available on the BoFEP Website at
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