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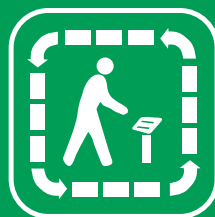
U.S. Fish & Wildlife Service

# Rachel Carson

## *National Wildlife Refuge*

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## *Trail Guide*



## Welcome

Welcome to Rachel Carson National Wildlife Refuge. We hope you will take time to walk this 1 mile trail and explore deciduous & pine forests and an environment that is very important in Maine — salt marsh.

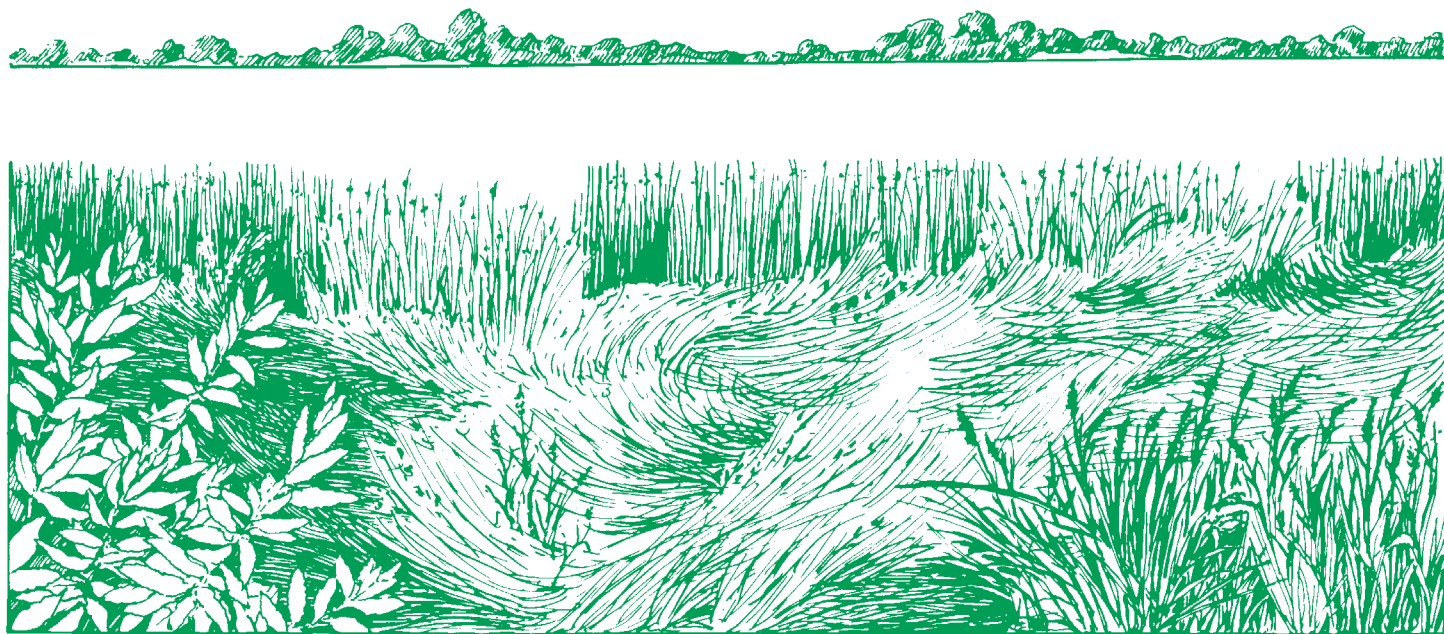
While most salt marshes in Maine are small and scattered along the entire coastline, there are a few sheltered bays where waves slow to ripples and cordgrass can take root to build a meadow-like marsh. Large, meadow marshes occur mostly along the southern coast, including the fine example protected here.

The Rachel Carson Trail is a one-mile walk along forested upland edge that offers vistas and close-up views of one of southern Maine's most valuable ecosystems.

## The Edge of the Marsh

1

Salt marshes, like barrier beaches, are fragile and dynamic ecosystems. When we build on or dig into these habitats, we can adversely affect them in dramatic ways. The upland edge along marshes now seems to be more important than once thought. Undisturbed coastal wetlands that have natural vegetation along their edges produce dense meadows of grasses and other plants that support abundant wildlife. When marsh edges are cleared for buildings or otherwise disturbed, use of the marsh by wildlife declines.



## The Edge of the Sea

2

Here you can see all the parts of this coastal Maine salt marsh. From critical edge through creeks, salt pannes, marsh grass, beach and ocean, it is a system of soils, water, plants and wildlife that functions as a whole forming a unique and fragile community.

## Run-off

3

The intermittent stream below is one of the obvious links between the forested upland and the salt marsh. Clean water from the woodland seeps into the ground and then emerges in the stream. Fresh water flows into the marsh, mixes nutrients with seawater and helps keep the marsh productive.

## The Critical Edge

4

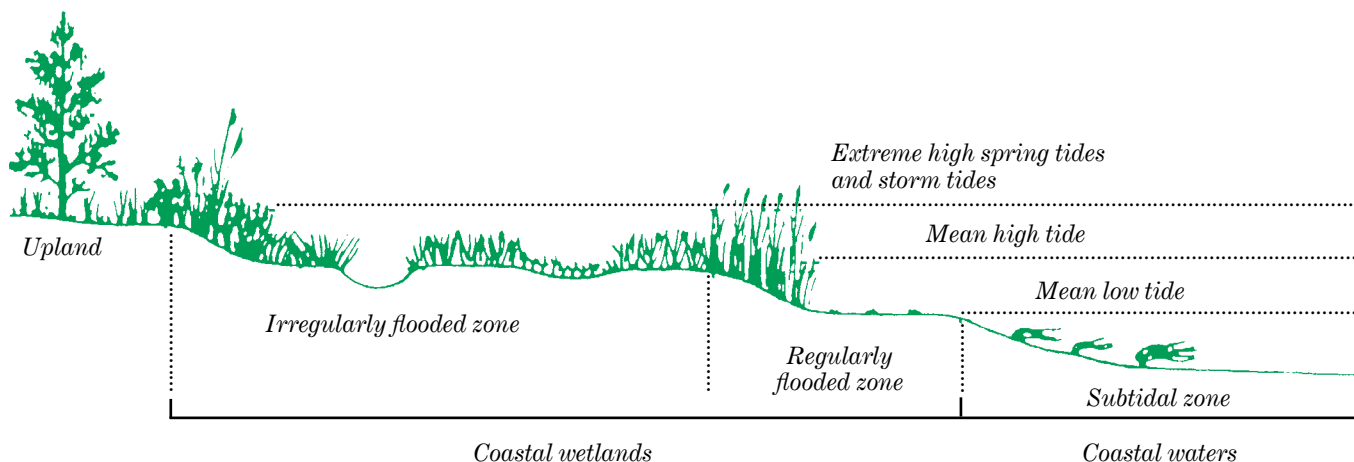
Critical edge is that portion of upland that runs along the border of the marsh. This transition zone is part of the salt marsh system in that it sends fresh water into the marsh, provides food, cover, breeding habitat and travel corridors for wildlife that live in the coastal zone, and protects the marsh from the adverse impacts of human activities.

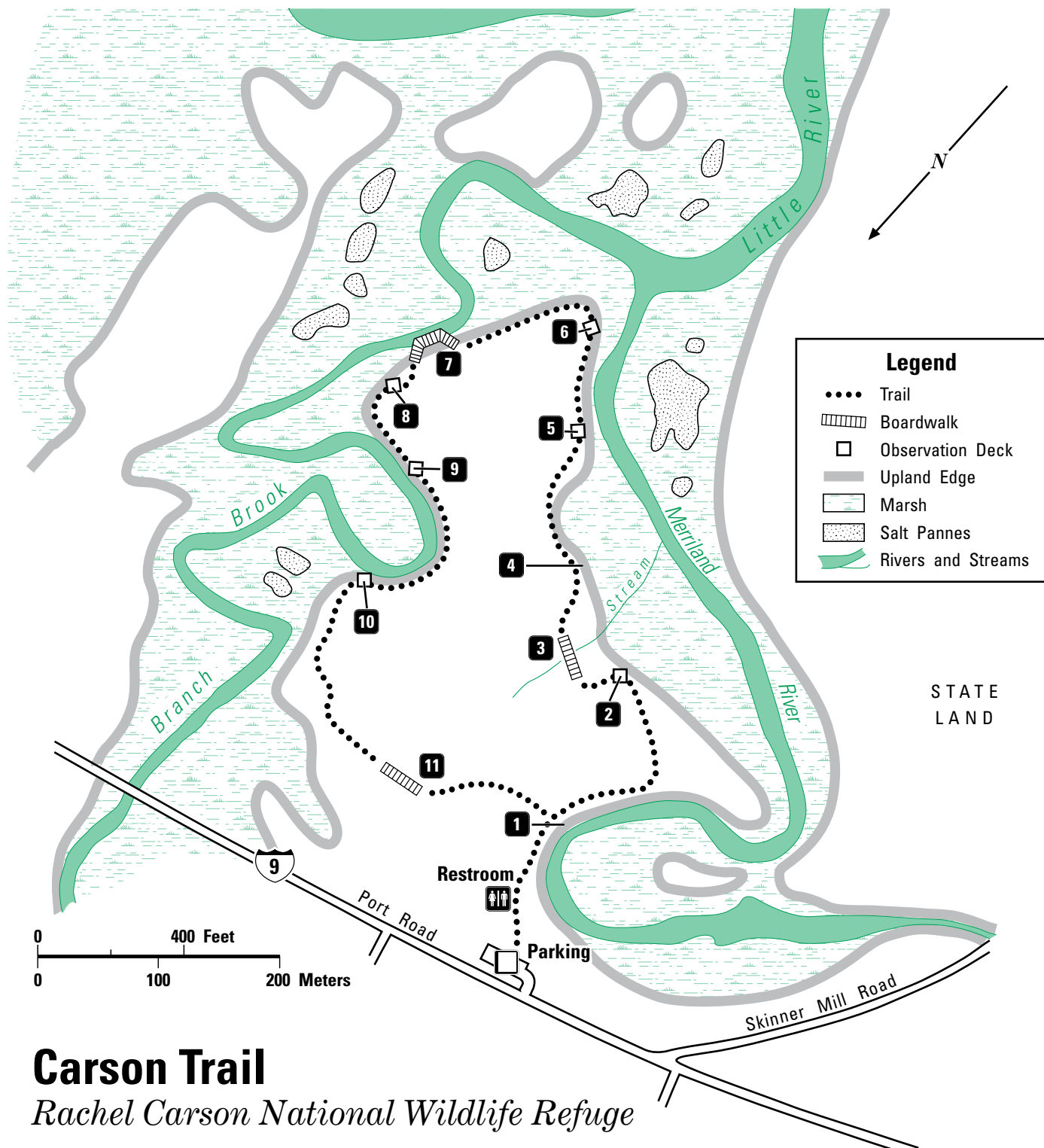
## Dedication Site

5

Rachel Carson worked for the U.S. Fish & Wildlife Service from 1936 to 1952, first as a biologist, then as a writer-editor. She spent summers in West Southport, Maine. Through her books, Rachel Carson alerted the public to the link between human actions and their environmental effect.

From her books about the coast—*Under the Sea Wind* (1941), *The Sea Around Us* (1951), and *Edge of the Sea* (1955)—to *Silent Spring* (1962), which challenged the widespread use of pesticides, her writings fundamentally changed society's outlook on the environment.



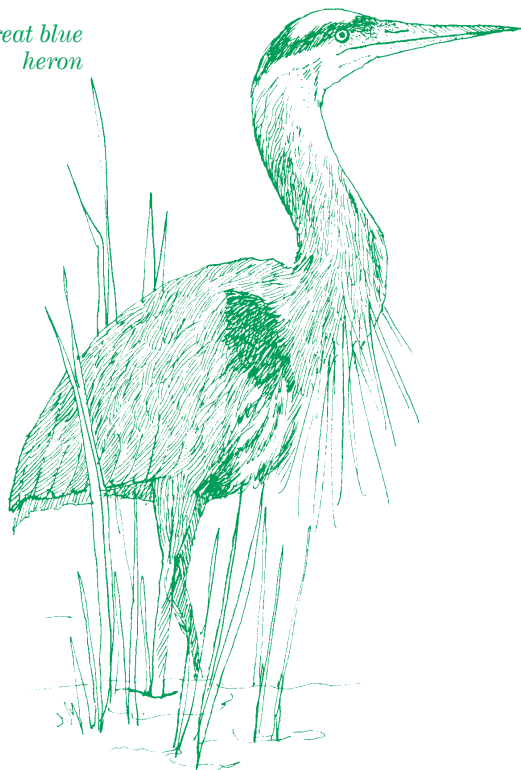


## Joining Rivers

6

Here Branch Brook merges with the Merriland River, creating the Little River, which flows to the ocean and reverses on incoming tides. The tranquil, nutrient-rich waters of the tidal rivers and marshes are nurseries for many of our shellfish and finfish. Mussels, soft-shelled clams, flounder, bluefish and striped bass all depend on this habitat during part of their life cycle. Abundant insects, worms, clams and fish in the marsh in turn attract flocks of feeding waterfowl, shorebirds and wading birds.

Great blue heron



## Carbon Sequestration

7

Two grasses are responsible for both building a coastal salt marsh and making it one of the most productive ecosystems in the world. Smooth cordgrass (*Spartina alterniflora*), a tall plant with stiff, pointed leaves, grows along the creek banks and in the low marsh. It has special adaptations to get oxygen to its roots when flooded during high tide. The shorter saltmeadow cordgrass or salt hay (*Spartina patens*) generally grows above mean high tide and forms the broad “cowlicked” meadows of the high marsh. These grasses can produce up to ten tons of organic (plant) matter per acre per year — as much as a prime Midwestern corn field. When plants convert sunlight and carbon dioxide into plant material, they lock up (sequester) that carbon dioxide so it is unable to contribute to greenhouse gasses that drive accelerated climate change.



Salt hay grass or salt meadow grass  
*Spartina patens*  
(Alt.) Muhl



Smooth cordgrass or saltwater cordgrass  
*Spartina alterniflora*  
Loiseleur

## Salt Pannes

8

The small, ponded areas before you are another feature of the marsh: salt pannes. These low spots in the marsh hold salt water as the tide falls. The water evaporates, concentrating salt in the pannes. Only specialized, salt-tolerant plants like glassworts and sea-blite can grow here. The pannes nevertheless support populations of small invertebrate animals which make these ponds important feeding areas for waterfowl and shorebirds.

## Meanderings

# 9

Tidal creeks twist and turn as they wander through a salt marsh. At any wide turn, or meander, tidal currents erode the outside bank as they build up the inside bank. Here the outside bank has cut into the upland edge, causing soil to slump into the creekbed. The creek will slowly carry the soil away, spreading it through the marsh.

## The Tidal Flux

# 10

Marshes are flooded and drained twice a day by meandering tidal creeks like the one before you. The tides bring sea water into the marsh, mix in fresh water from the upland, and carry organic nutrients from decaying marsh grasses back into the bay. This continual exchange of water and nutrients among the upland, marsh and ocean keeps the marsh thriving and helps support a complex marine food web.

Salt marshes exist in a dynamic equilibrium with sea level. As sea level gently increases, salt marshes can keep pace through plant growth, peat formation and sediment deposition. With global climate change, the concern is about accelerated sea level rise and whether plants can survive longer periods of time under water. At Rachel Carson NWR, we're studying ways to give salt marsh plants the best possible opportunity to keep pace with sea level rise. We're doing this by reducing non-climate stressors like ditching and diking and increasing natural salt marsh resilience.

## Hemlock Hollow

# 11

The coastal upland along this stretch of Maine's shore is evergreen. White pines and hemlocks dominate, with oaks and maples intermingled and a ground cover of ferns. Though out of sight of the marsh, this woodland is directly linked to it. Ground water carries nutrients from the forest's decaying leaves and needles out to the marsh. Many species of mammals and birds rely on both the marsh and upland for food, cover and breeding habitat. As Rachel Carson wrote, "All the life of the planet is interrelated... each species has its own ties to others, and...all are related to the earth." (*The Sea Around Us*)

As you leave the Carson Trail, consider the activities you see every day and how they may affect the area around you and the salt marshes downstream. Watch the coast line as well. Will salt marshes be able to migrate inland as sea levels rise or will they be challenged by sea walls, roads and other structures? Working together, we can ensure the future of these magnificent, productive and inspiring ecosystems.



*Common  
goldeneye*