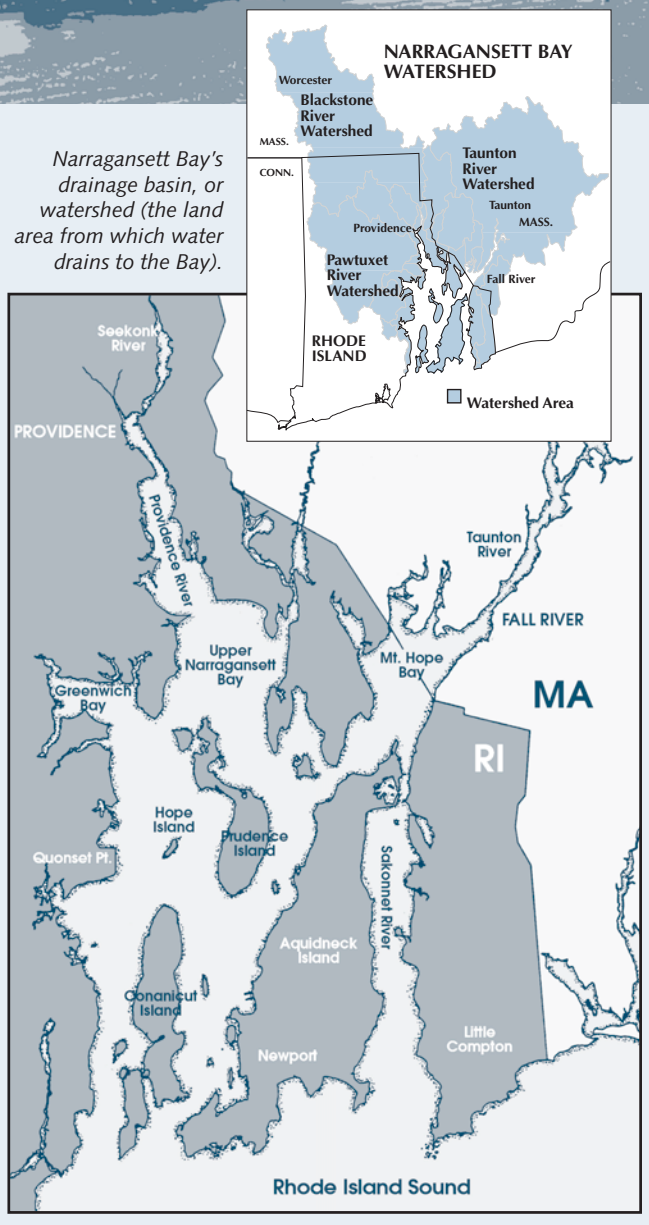
AN OVERVIEW OF

NARRAGANSETT BAY

Narragansett Bay is an estuary–that is, a semi-enclosed inlet of the sea in which seawater is diluted by freshwater. Compared to other estuaries, Narragansett Bay is small-to-medium-sized. Chesapeake Bay, the largest estuary in the United States, covers more than 30 times as much area as Narragansett Bay. Still, Narragansett Bay is big enough to take a good-sized bite out of little Rhode Island. It reaches two-thirds of the way up the state—with the result that no Rhode Islander is more than half an hour's drive from a shoreline—and covers about 10 percent of the state's area.



Narragansett Bay's drainage basin, or watershed (the land area from which water drains to the Bay).

- About 61% of Narragansett Bay's drainage basin—but only 7% of its area—is in Massachusetts.

- The major rivers draining into the Bay are the Blackstone, Taunton, and Pawtuxet.

There are three entrances to Narragansett Bay: the West Passage, the East Passage, and the so-called Sakonnet River, which is really not a river but an arm of the sea. Only the East Passage, with an average depth of 44 feet, is deep enough for large ships.

The Bay's three largest islands are Aquidneck (the Indian name means "longest island"), Conanicut, and Prudence. Some 30 smaller islands, many of them little more than large rocks, also dot the Bay.

As estuaries go, Narragansett Bay is relatively salty: the salinity does not fall below 20 parts per thousand (ppt), except in the Providence River, which represents only a very small portion of the Bay. By contrast, many other estuaries include a wide range of salinities, with large areas in the range of 10 to 15 ppt. (For comparison, seawater has a salinity of 35 ppt.) Like all estuaries, the Bay has a salinity gradient from the head (Upper Bay) to the mouth, with the lowest salinity at the head, where the major rivers flow in.

- The reason for the Bay's high salinity is that the average daily input of freshwater from all sources (rivers, rainfall, and treated sewage) is fairly small, amounting to less than 0.5% of the Bay's total volume.

Life in the Bay

One-celled floating algae called phytoplankton are the basis of the Bay's food chain—or, more accurately, food web. Like land plants, these microscopic plants use photosynthesis to convert carbon dioxide into organic material that ultimately nourishes all other life in the Bay. In spring, summer, and fall, the phytoplankton population can rise ("bloom") and fall rapidly, within a period of weeks. Historically the Bay experienced a major bloom in late winter or early spring nearly every year; but in the past several years this bloom has either not occurred or been reduced. Some scientists hypothesize that this change in the long-term algal bloom pattern may be related to warming of the Bay (the mean surface winter-spring water temperature has risen 1.4 C, or nearly 4 F, over the past 30 years).

- During a bloom, Narragansett Bay's phytoplankton population can double in a single day, and one drop of water may contain up to 4,500 individual cells.

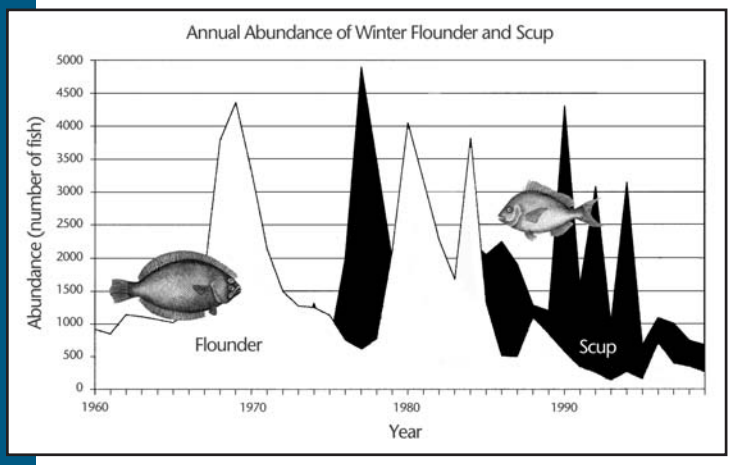
- More than 250 species of phytoplankton have been identified in the Bay.

Narragansett Bay, like any estuary, provides a variety of different habitats for living things. Certain plants and animals are concentrated in particular areas where salinity and other conditions are best suited to their needs. For example, the most productive quahog (hard clam) beds are in the less salty, more nutrient-rich waters of the Upper Bay. On the other hand, lobster and blue mussel prefer the more oceanlike conditions of the Lower Bay.

Fisheries population changes. Two long-term bottom trawl surveys track population fluctuations of Bay fish, squid, and crustaceans. Since 1959, University of Rhode Island (URI) researchers have collected samples from two stations, one in the upper West Passage and one at the mouth of the Bay. The R.I. Department of Environmental Management (RIDEM) has conducted spring and fall surveys since 1979 throughout the Bay and in Rhode Island and Block Island sounds.

These surveys reveal some dramatic changes. For the first three decades of the URI survey, winter flounder was the dominant bottom-dwelling fish species in the Bay. Starting in the late 1980s, a shift occurred: Year-round resident bottom-dwelling fish, especially winter flounder, declined sharply while migratory pelagic species like scup, butterfish, and squid became much more abundant. During the same time period, lobster and crab increased in abundance and quahog populations declined.

Reasons for the downward trend in demersal fish species are not well understood, but other factors in addition to overfishing must be at play because declines have persisted in spite of more than a decade of catch restrictions. Factors that may have a role in the declines include the warming of the Bay's waters (most pronounced in winter and spring) and a trend toward increased levels of nutrients and lower dissolved oxygen concentrations during the summer months.



Over the past two decades, Narragansett Bay has experienced a shift from resident cold-water fish species, such as winter flounder, to migratory warm-water species, such as scup. Source: Jeffries (2000).

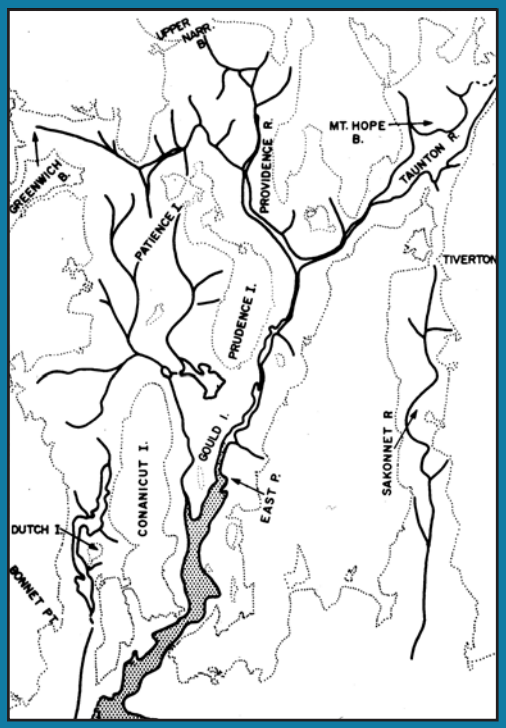
Geological History of Narragansett Bay

25,000 years ago: With the Pleistocene Ice Age in full force, and sea level 300 feet lower than today, Rhode Island lay buried under a sheet of ice 400 feet thick. The glacier extended as far as Block Island. Southward from there, some 70 miles of frozen tundra led finally to the Atlantic coast.

10,000 years ago: Earth was warming. The glacier had receded from Rhode Island, and the ocean was rising but had not yet reached its present level. Prehistoric humans lived in the valleys that today are the passages of Narragansett Bay. They could walk all the way across Rhode Island simply by crossing the small streams that ran through these valleys.

9,000 years ago: As sea level continued to rise, the Atlantic Ocean entered the East Passage of the Bay.

5,000 years ago: Narragansett Bay was filled to almost its present level.



Narragansett Bay 9,000 years ago. Source: McMaster (1984).

Shipping

Maritime commerce, based on the infamous rum-slaves-sugar "triangle trade" and centered in Newport, was Rhode Island's first major commercial enterprise. By the early 19th century, manufacturing along the Bay's major rivers had replaced shipping as the basis for Rhode Island's economy. To accommodate the manufacturers, the shipping industry followed them up the Bay to Providence and Fall River, Mass.

Today, Narragansett Bay has three public ports: Providence, Quonset Point-Davisville, and Fall River. Several dredged channels allow large vessels to reach these ports. The longest and deepest channel runs 17 miles from the southeast side of Prudence Island up to the Port of Providence, the most active of the three ports. This channel is authorized to be maintained at 40 feet deep, but because of the difficulty of finding acceptable sites for disposal of contaminated dredge spoils it has not been dredged since 1976. Currently the channel is as shallow as 30 feet in some places, making it impassable for deep-draft vessels. However, the U.S. Army Corps of Engineers recently completed an environmental impact study, and a permit to dredge the ship channel back to a depth of 40 feet has been issued.

- The total cargo brought into Rhode Island ports exceeds 8 million tons annually.
- In 1999, 84% by weight of the total cargo delivered to Narragansett Bay ports consisted of petroleum products (gasoline, heating oil, diesel, kerosene, and natural gas).
- Most commercial vessels using the Bay are barges, tugs, and tow vessels.

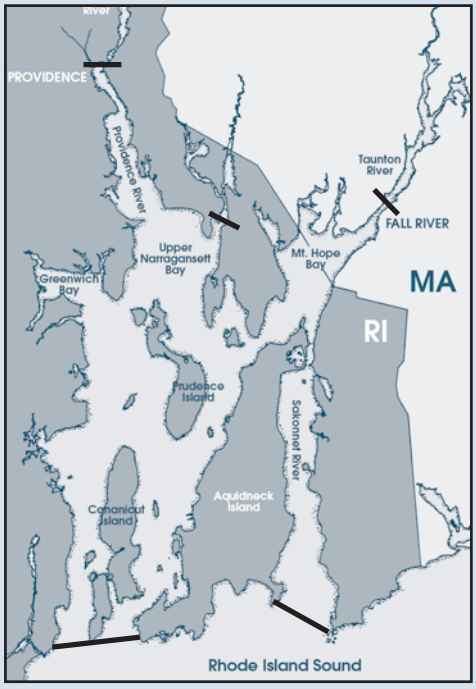
The heavy commerce in petroleum products puts the Bay at risk for oil spills. The largest have been the June 1989 *World Prodigy* spill, which released 392,724 gallons at the Bay's entrance, and the January 1996 *North Cape* spill, which released 828,469 gallons off Point Judith in South Kingstown.

Physical Characteristics of Narragansett Bay

Measurements for area, volume, depth, and shoreline are based on the Bay area bounded by the **black bars,** shown on the map at right.

- **Length:** 25 miles (40 kilometers)
- **Width:** about 10 miles (16 kilometers)
- **Surface area:** 132 square miles (342 square kilometers), not including Taunton River.[1]
- **Volume:** 706 billion gallons (2.7 billion cubic meters) at mid-tide
- **Average depth:** 26 feet (7.8 meters)
- **Deepest point:** 184 feet (56 meters) in East Passage off Castle Hill
- **Shoreline:** 256 miles (412 kilometers), including island shorelines
- **Drainage basin (watershed):** 1,853 square miles (4,801 square kilometers)
- **Average salinity:** 29 to 31 ppt
- **Daily freshwater input, all sources:** 2.4 billion gallons (9.1 million cubic meters)
- **Temperature range, mid-Bay:** from 32 F (0 C) in winter to 73F (23 C) in summer
- **Flushing time:** 10 to 40 days; mean = 26 days
- **Tides:** 3 to 4 feet (0.9 to 1.2 meters) every 12.5 hours; tide takes about 20 minutes to move up the Bay from Newport to Providence
- **Prevailing winds:** from the southwest in summer; northwest in winter

[1]Area is 143 square miles (370 square kilometers) when lower portion of Taunton River is included (Ries, 1990).



Note: Various estimates for these characteristics have been published. Disagreement is due to differences in (1) choice of boundaries for Narragansett Bay and (2) techniques used to obtain the measurements.

Sources: Pilson (1985); Chinman and Nixon (1985).

Commercial Fisheries

The Bay's commercially important species include the following:

- Demersal (bottom-dwelling) fish: winter flounder, summer flounder, tautog, black sea bass
- Pelagic fish (fish that feed in the water column): bluefish, striped bass, scup, squeteague (weakfish), menhaden, Atlantic herring, and alewife (for use as lobster bait)
- Shellfish: quahog, oyster
- Lobster
- Squid

The demersal fish, as well as quahog and oyster, are Bay residents that are able to live in the Bay year-round and during all stages of their life cycle. Most of the commercially important pelagic fish—as well as squid, which is a pelagic invertebrate—migrate to Narragansett Bay in May or June. Each year, representatives of about 100 different fish species may visit the Bay at one time or another.

Because of Narragansett Bay's small size, and its crucial role both as a feeding area for the young of many species and as a spawning ground, the Bay's resources need to be carefully managed. Restrictions govern fishing methods, size of fish or shellfish that may be kept, amount of catch, and where and when fishing is permitted.

Shellfishing. At the beginning of the last century, the Narragansett Bay oyster—highly prized by gourmets—was the most important commercial species in the Bay. The oyster industry started shortly after the Civil War, peaked in 1910 at 15 million pounds harvested, and continued to flourish through the 1920s. Up to 20,000 acres—about one-fifth of the Bay—were leased for oyster farming (aquaculture) during the industry's heyday. But subsequently the oyster business declined for a variety of reasons. Predators, hurricane damage, poaching, and pollution have all been blamed. The last Narragansett Bay oyster company closed its doors in 1957. Landings remained below 10,000 pounds from the mid-1950s through 1995. A resurgence began in 1996 and peaked the following two years with annual landings in the neighborhood of 200,000 pounds (meat weight). However, after 1998 landings declined, dropping to about 40,000 pounds in 2001. The temporary "boom" was apparently caused by unusually favorable conditions leading to a couple of years of exceptionally good sets; but recently few juveniles have been seen in harvestable waters.

During the 20th century, the Bay's quahog harvest went through two cycles of abundance and decline. Commercial landings peaked at 5 million pounds of meats in 1955—the last year that power dredging was permitted—then fell to a low of 840,000 pounds in 1974. By 1983 landings had climbed again to 4.3 million pounds, only to drop back down to 880,000 pounds in 1998. In 1999 and 2000 landings were around 1.3 million pounds. Recent low harvests are primarily due to three factors: pollution-related closures, lower quahog populations, and fewer quahoggers.

The Bay presently supports shellfish aquaculture on a very small scale, with 30 acres under lease. In 2000 the wholesale value of farmed shellfish (primarily oysters) was $300,000.

Lobstering. For the state of Rhode Island as a whole, the lobster is the most economically important species. In the 1990s, Rhode Island landings held fairly stable at about 6 to 7 million pounds per year, with a value at the dock of around $20 million. While there are no firm data regarding where these lobsters were taken, probably no more than 10 to 20 percent of the catch came from Narragansett Bay.

Finfishing. The great majority of Rhode Island's commercial catch of finfish and squid comes from outside the Bay, in Rhode Island Sound and the Atlantic Ocean, up to 100 miles offshore. Currently, about a dozen small commercial trawlers fish in the Bay, primarily for summer flounder, scup, squid, lobster, and butterfish. At present, fishing for winter flounder is prohibited inside the Bay.

Recreation and Tourism

Visitors and residents alike treasure Narragansett Bay's waters, beaches, and parks for fishing, boating, swimming, diving, sunbathing, picnicking, and other recreational activities. The total annual economic value of all Bay-related recreational activities is estimated at $2 billion.

Recreational fishing. Recreational fishing on the Bay, whether from a boat, a dock, a bridge, or the shore, is very popular.

- According to federal survey statistics, about 300,000 anglers—of whom 60% were nonresidents—participated in recreational saltwater fishing in Rhode Island waters in 2000, landing an estimated 3.8 million pounds of fish.

These statistics are for the state as a whole. No separate data exist for the Bay, but RIDEM's "best guess" is that one-third to one-half of recreational fishing takes place inside the Bay, and most of the rest occurs in state waters—that is, within 3 miles of shore.

The state's total commercial landings for finfish—close to 82 million pounds in 2000—dwarf the recreational landings, but about 95% of this catch is taken in federal waters. For Rhode Island state waters, the recreational catch is about the same as the commercial catch; and inside the Bay the recreational catch is greater, though specific numbers are not available. For bluefish, striped bass, and tautog, all of which are mainly caught in the Bay or in nearshore waters, total recreational landings exceeded total commercial landings in 2000.

Boating. The Bay is considered one of the best sailing locations in the world. Its safe, sheltered waters, with few shoal areas, are rarely too rough for small boats during the summer months, and sailors can generally count on an afternoon sea breeze of 12 to 15 knots.

- In 2000, 36,522 boats were registered in Rhode Island (up from an average of about 33,000 for the years 1995–1999).

- 91% of all boating facilities (marinas, boatyards, and yacht clubs) in Rhode Island are on the Bay.

Diving and swimming. Recreational scuba divers are drawn to the Bay by the warm water temperature, the diversity of marine life, and an estimated 100 shipwreck sites. Near shore, the water can reach a surface temperature of 74 F—ideal for swimmers at town and state beaches along the Bay and island shores. Of the Bay's parks and beaches, Colt State Park is the most visited, followed by Scarborough Beach and Goddard State Park.

Tourism. Situated at the center of the Washington, D.C.-Boston "megalopolis," Rhode Island attracts many visitors. The tourism industry is the state's second-largest employer, surpassed only by the health services sector.

- In 2000, an estimated 15.7 million people visited Rhode Island for business or leisure. About 5.1 million of them stayed overnight.

- In 2000, tourism brought an estimated $3.2 billion to the state, of which approximately $800 million could be attributed to Bay-related activities.