

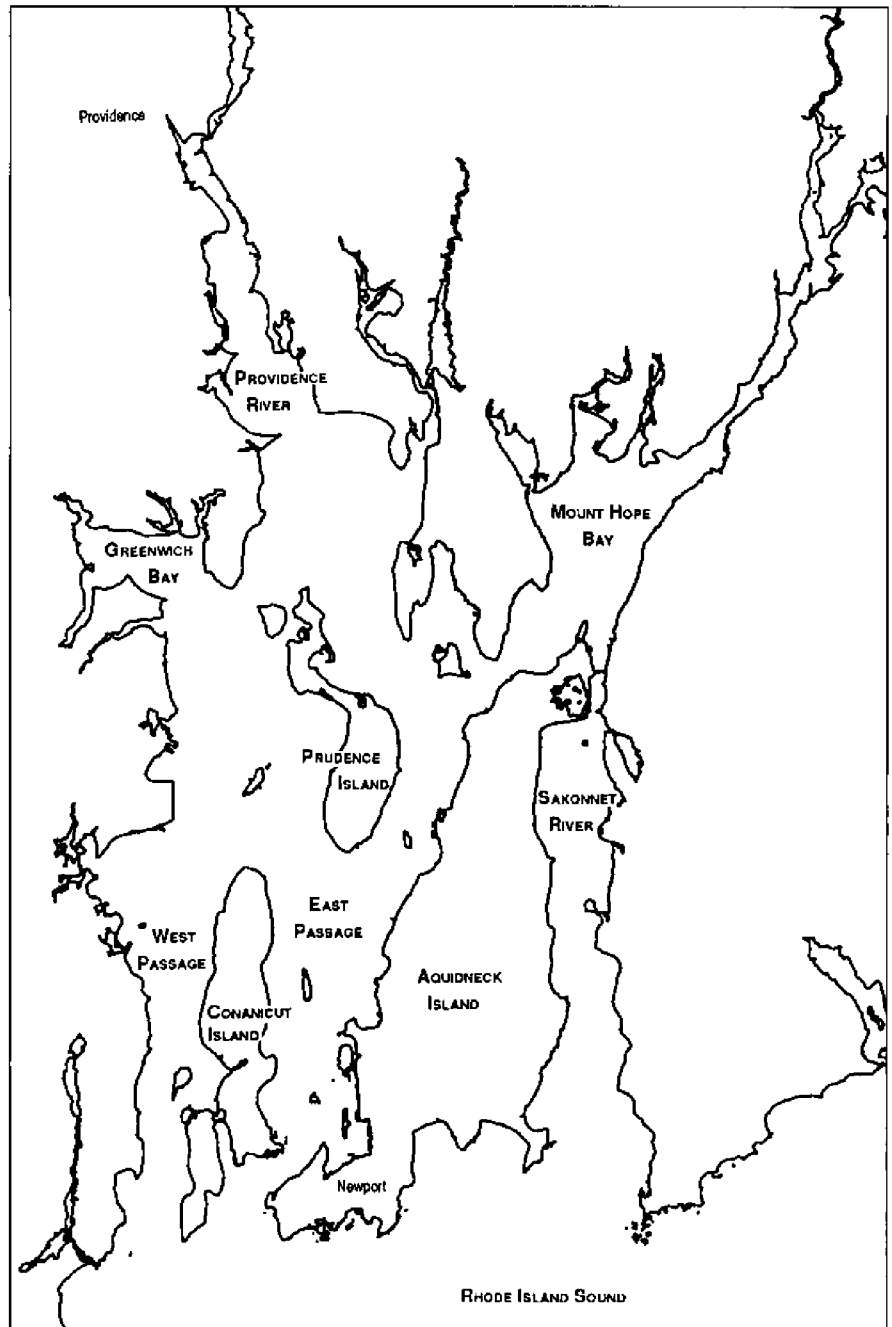
An Overview of Narragansett Bay

LOAN COPY ONLY

Narragansett Bay is an *estuary* — that is, a semi-enclosed inlet of the sea in which seawater is diluted by fresh water. As estuaries go, Narragansett Bay is relatively salty: the salinity never goes below 20 parts per thousand, even in the Providence River (which is actually an arm of the bay). By contrast, many other estuaries include a whole range of salinities, starting at zero (fresh water) and having large areas in the range of 10 to 15 parts per thousand.

- The average salinity of Narragansett Bay, 29 to 31 parts per thousand, is just slightly below the value of 35 parts per thousand for the open ocean.
- The reason for the bay's high salinity is that the average daily input of fresh water from all sources (rivers, rainfall, and treated sewage) is fairly small, amounting to less than one-half of one percent of the bay's total volume.
- The major rivers draining into the bay are the Blackstone, Taunton, and Pawtuxet.
- About 61% of Narragansett Bay's drainage basin — but only 7% of its area — is in Massachusetts.

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.



CIRCULATING COPY
See Grant Depository

Narragansett Bay

Physical characteristics of Narragansett Bay

Measurements for area, volume, depth, and shoreline are based on the shaded area 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)
- **Volume:** 706 billion gallons (2.7 billion cubic meters) at midtide
- **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:** 1,853 square miles (4,801 square kilometers)
- **Average salinity:** 29 to 31 parts per thousand
- **Daily freshwater input, rivers:** 2.1 billion gallons (8 million cubic meters)
- **Daily freshwater input, all sources:** 2.4 billion gallons (9.1 million cubic meters)
- **Temperature, midbay:** from 32°F (0°C) in winter to 68°F (20°C) in summer
- **Flushing time:** 10 to 40 days; mean = 26 days
- **Tidal range:** 3 to 4 feet every 12-1/2 hours; tide takes about 20 minutes to move up the bay from Newport to Providence
- **Prevailing winds:** from the southwest in summer; the northwest in winter

Note: Various estimates for these characteristics have been published. Disagreement among the estimates 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)

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. One group of minuscule islands just southeast of Conanicut Island is called "The Dumplings."

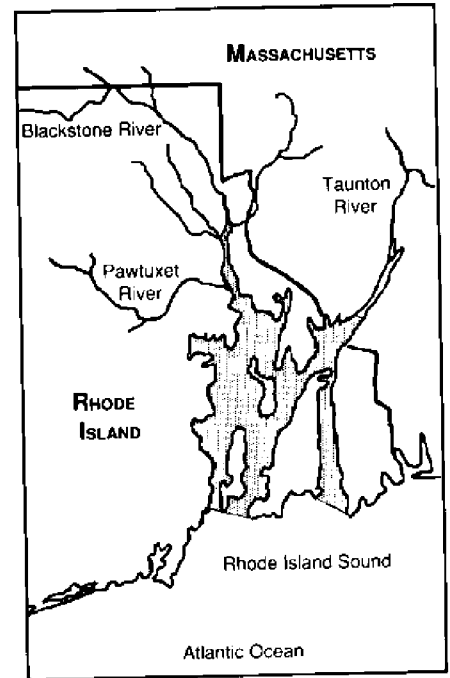
Life in the bay

The basis of the bay's food chain — or, more accurately, food web — are one-celled floating algae called phytoplankton. Like land plants, these tiny plants use photosynthesis to convert carbon dioxide into organic material that ultimately nourishes all other life in the bay. The phytoplankton population rises and falls several times each year, with an explosive growth period called a "bloom" occurring in late winter or early spring.

- **During the winter/spring 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, lobsters and blue mussels prefer the more oceanlike conditions of the lower bay, near Rhode Island Sound.

It is generally agreed that quahogs are the most abundant commercially important species in the bay, but obtaining reasonable estimates for the population sizes of the various fish and shellfish in the bay is more difficult than it might seem. Collecting truly representative samples poses many problems. One difficulty is that faster-swimming species can avoid a sampling net. Another complication is that populations fluctuate tre-



Major tributaries of Narragansett Bay

mendously from season to season and from year to year.

Since 1959, researchers at the University of Rhode Island have been collecting weekly samples of the bay's benthic (bottom-dwelling) fish by dragging a conical net, called an otter trawl, across the bottom. Among their findings:

- **The winter, or blackback, flounder is the dominant bottom-dwelling fish species in Narragansett Bay.**
- **There are large year-to-year variations in the winter flounder population, ranging from a high of 75% of the total yearly sample in 1968 to a low of 10% in 1976.**
- **Three species (winter flounder, scup, and sand flounder) account for 90% of the total bottom fish sample.**

The bay's commercially important species of pelagic fish (fish that feed in the water column, as opposed to bottom fish like flounder) include the bluefish, striped bass, tautog (blackfish), squeteague (weakfish), and menhaden. Most of these 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.

Commercial shellfishing and fishing

At the beginning of this 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 1908, and continued to flourish through the 1920s. But subsequently the oyster business declined for a variety of reasons: pollution, poaching, hurricane damage, predators, and over-fishing have all been blamed. The last Narragansett Bay oyster company closed its doors in 1952.

Today, in terms of both economic value and employment, quahogs are by far the most important resource harvested from Narragansett Bay. Each year the state of Rhode Island issues commercial quahogging licenses to approximately 3,000 people who make all or part of their living from this physically demanding job. Working from small open boats, the quahoggers harvest the clams by hand, using a heavy bullrake whose handle can be up to 70 feet long.

- In 1986, 3.6 million pounds of quahog meats, with a value of \$15.7 million at the dock, were harvested from the bay.
- Since 1980, Rhode Island's yearly quahog catch has accounted for about 25% of the United States total.

Lobstering is the bay's second most important commercial fishery. Annually, about one million pounds of lobsters — worth about \$3 million at the dock — are caught in the lower bay.

The bay's finfishing industry ranks third in economic terms. (The majority of Rhode Island's commercial finfish catch comes from outside the bay, in Rhode Island Sound and the Atlantic Ocean.) Currently, about 30 small commercial trawlers fish in the bay, primarily for winter flounder, scup, squid, and butterfish. Between 10 and 30 million pounds of menhaden, most of it sold for use as lobster bait, are taken from the bay annually by purse seiners; and approximately 700 rod-and-reel fishermen are licensed to sell their catches commercially.

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.

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 of Rhode Island's economy. To accommodate the manufacturers, the shipping industry followed them up the bay to Providence and Fall River.

Today, the Rhode Island ports of Providence and Quonset Point/Davisville are major importers of petroleum products (fuel oil, gasoline, and kerosene) and automobiles. A 17-mile-long, 40-foot-deep dredged channel from the southeast side of Prudence Island up to Providence enables large ships to reach the port of Providence.

- The total cargo brought into Rhode Island ports exceeds 8 million tons annually.
- \$1 billion dollars worth of foreign automobiles, mainly Japanese and Scandinavian, have been brought into Rhode Island each year since 1985.

Recreation

Narragansett 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. Sailors can generally count on an afternoon sea breeze of 12 to 15 knots.

Recreational boating exceeds all other uses of the bay (swimming, commercial fishing and shellfishing, and shipping) in terms of number of people participating and economic impact. The biggest problem confronting the bay's sailors and motorboaters is the serious shortage of marina space.

- According to a recent survey, 32% of Rhode Island's population goes boating on Narragansett Bay one or more times per year.

Geological history of Narragansett Bay

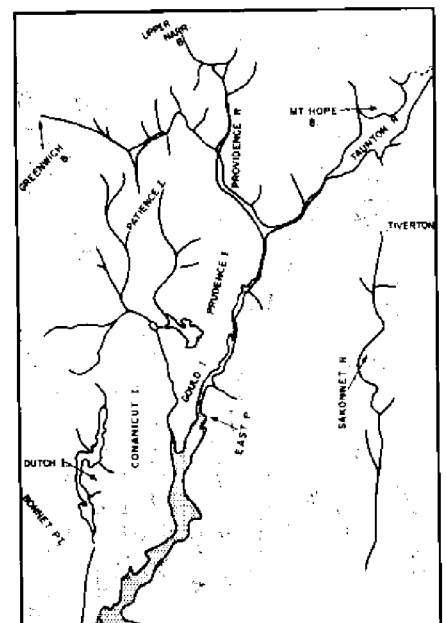
25,000 years ago: With the last Ice Age in full force, and sea level 300 feet lower than today, Rhode Island lay buried under a sheet of ice 400 feet thick. The glacier extended as far as Block Island. Southward from there, some 70 miles of frozen tundra led finally to the Atlantic coast.

10,000 years ago: Earth was warming up. 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 are today 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: The bay was filled to almost its present level.

Source: McMaster (1984)



Source: McMaster (1984)

Narragansett Bay 9,000 years ago

- There are an estimated 35,000 to 40,000 recreational boats in Rhode Island, with the majority using Narragansett Bay.

- Ninety-one percent of all boating facilities (marinas, boatyards, and yacht clubs) in Rhode Island are on the bay.

Recreational fishing on the bay — whether from a boat, a dock, a bridge, or the shore — is very popular. Bluefish and striped bass are especially prized as sport fish.

Near shore, the bay's water can reach a surface temperature of 74°F — ideal for swimmers at town and state beaches along the bay and island shores.

Pollution

In 1793, the opening of America's first water-powered textile mill on the Blackstone River in Rhode Island marked the beginning of the Industrial Revolution in the United States. This event also gave Narragansett Bay a head start over the nation's other estuaries in serving as a receptacle for industrial waste. By 1860, Rhode Island was the nation's most heavily industrialized state.

For over two centuries, a variety of pollutants from many sources have entered the bay. Toxic chemicals and metals arrive in industrial waste discharges from jewelry factories, chemical companies, and textile mills. Rainwater washes oil and gasoline from streets and parking lots, as well as fertilizers and pesticides from farms and gardens, into storm sewers. Antiquated "combined sewage" systems in Providence and other towns channel storm drain runoff into the same water treatment facilities as domestic sewage, overloading the treatment plants so that inadequately-treated sewage runs into the bay during heavy rainfalls.

- Twenty-nine municipal users and 145 industrial users discharge wastes into Narragansett Bay.

- About 7% of the bay's total fresh-water input consists of treated sewage, which flows in at the rate of 186 million gallons per day.

- Levels of copper and nickel in the Providence River periodically exceed EPA water quality standards.

Sewage contamination of Narragansett Bay hurts the shellfishing industry. Shellfishing is prohibited in the most polluted waters because clams taken from these waters can carry bacteria and viruses, including those that cause gastroenteritis and hepatitis. About one-fourth of the bay's total area — including the Providence River, all of Mount Hope Bay, and a number of small areas in the immediate vicinity of sewage treatment plants or marinas — is permanently closed to shellfishing, and an additional portion of the upper bay is closed after heavy rains.

Pollutants can also overfertilize the bay and cause eutrophication — a high nutrient/low oxygen condition that can kill seagrasses, fish, and shellfish. Inlets of the bay where oxygen circulation is poor are particularly at risk for eutrophication.

It is no wonder that, after serving for so many years as a disposal site, the upper portion of Narragansett Bay is polluted with bacteria and chemicals. But there may be grounds for cautious optimism. Rhode Island Sea Grant researchers have found that the level of dissolved oxygen in the Providence River is increasing due to improvements to water treatment plants. Also, metal inputs at the Fields Point wastewater treatment plant (the largest facility discharging into Narragansett Bay) have decreased substantially since 1980. The levels of cadmium, chromium, copper, mercury, nickel, silver, zinc, and lead coming into the plant have all decreased, because of waste pretreatment by industries, and, in the case of lead, the increasing use of unleaded gasoline.



RECEIVED
NATIONAL SEA GRANT DEPOSITORY

DATE JUN 16 1988

Sources

Chinman, Richard A. and Scott W. Nixon. 1985. *Depth-Area-Volume Relationships in Narragansett Bay*. Rhode Island Sea Grant, Narragansett, RI.

Hale, Stuart O. 1980. *Narragansett Bay: A Friend's Perspective*. Rhode Island Sea Grant, Narragansett, RI.

Jeffries, H. Perry and Mark Terceiro. Cycle of Changing Abundances in the Fishes of the Narragansett Bay Area. 1985. *Marine Ecology—Progress Series* 25:239-244.

McMaster, Robert L. 1984. Holocene Stratigraphy and Depositional History of the Narragansett Bay System. Rhode Island. *Sedimentology* 31:777-792.

Olsen, Stephen, Donald D. Robadue, Jr., and Virginia Lee. 1980. *An Interpretive Atlas of Narragansett Bay*. Rhode Island Sea Grant, Narragansett, RI.

Pilson, Michael E. Q. 1985. On the Residence Time of Water in Narragansett Bay. *Estuaries* 8: 2-14.

In addition, the following organizations kindly provided unpublished information: the Narragansett Bay Project; the Narragansett Bay Commission; Rhode Island Shellfishermen's Association; the National Marine Fisheries Service; Rhode Island Department of Environmental Management; the University of Rhode Island Graduate School of Oceanography; Rhode Island Sea Grant Marine Advisory Service; the International Marina Institute; and the Port of Providence.

Written by Eleanor Ely
Rhode Island Sea Grant
June 1988

P1065

Sea Grant is a national program dedicated to promoting the development and wise use of marine resources for the public benefit.

To obtain a free catalog listing other Rhode Island Sea Grant publications, call (401) 792-6800 or write to: Publications Office, Rhode Island Sea Grant, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197.