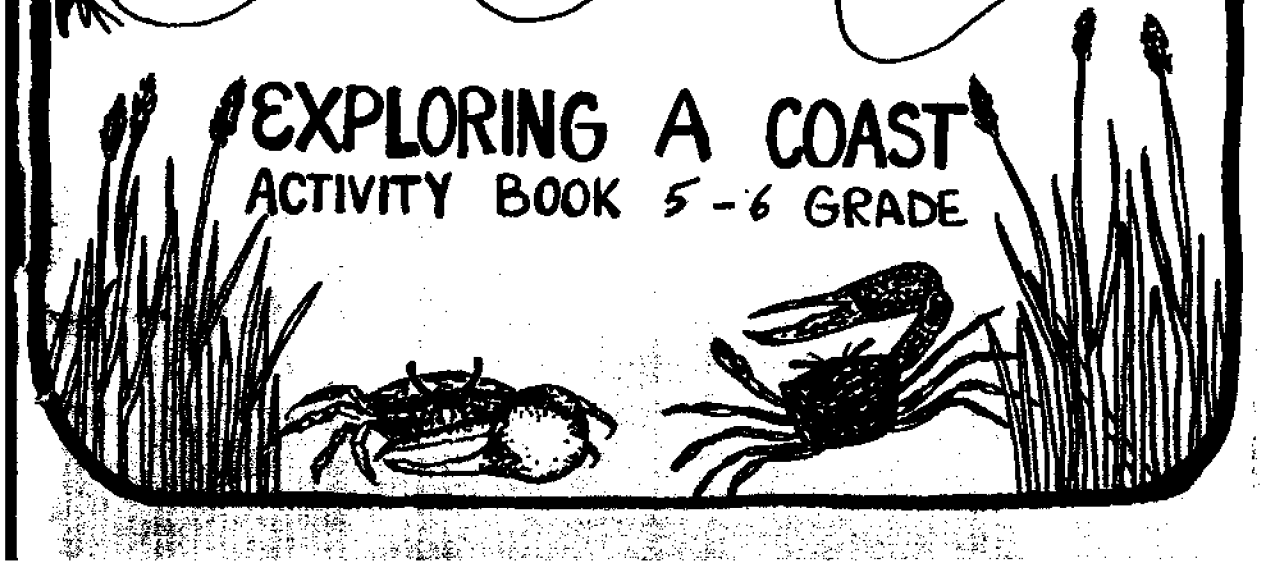
WHERE LAND MEETS THE SEA

EXPLORING A COAST
ACTIVITY BOOK 5-6 GRADE



HAVE YOU EVER BEEN TO THE SEASHORE? PERHAPS YOU HAVE BEEN ONE OF THE MILLIONS OF TOURISTS WHO EACH YEAR VACATION AT THE NEW JERSEY SHORE.

PERHAPS YOU ARE A RESIDENT OF ONE OF NEW JERSEY'S SEASHORE COUNTIES? EACH YEAR MORE AND MORE PEOPLE DECIDE TO LIVE YEAR ROUND AT THE SHORE.

THE SEASHORE IS PART OF A LARGE AREA CALLED THE COAST. THE COAST IS WHERE THE LAND MEETS THE SEA. THE COAST IS VALUABLE BECAUSE IT PROVIDES MANY BENEFITS TO MAN SUCH AS FOOD, RECREATION AND BUSINESS OPPORTUNITIES. SOMETIMES THE ACTIVITIES OF MAN CONFLICT WITH THE WAY THE NATURAL ENVIRONMENT OF THE COAST WORKS. FOR EXAMPLE: DUMPING SEWAGE ON A SALT MARSH MAY GET RID OF THE WASTE BUT IT MAY ALSO POLLUTE THE WATER, MAKING IT UNSAFE FOR SWIMMING AND MAKING SHELLFISH UNSAFE TO EAT. WHEN THESE CONFLICTS HAPPEN MAN HAS TO DECIDE HOW TO SOLVE THEM.

LOOK AT THE MAP OF NEW JERSEY

A) NOTICE THE SHAPE OF THE COAST. USING THE SCALE, FIGURE OUT HOW MANY MILES OF COASTLINE ARE IN NEW JERSEY.

_____ *MILES OF COASTLINE*

THE COAST OR SHORELINE OF NEW JERSEY DOES NOT ALL LOOK ALIKE. THERE ARE MANY DIFFERENT PHYSICAL FEATURES SUCH AS MOUNTAINS, BLUFFS, SPITS, SANDY BEACHES, BAYS, BARRIER ISLANDS, AND EVEN A SECTION WHICH IS REALLY A RIVER BANK.

B) TRY TO LOCATE EACH OF THE SECTIONS LISTED BELOW ON THE MAP. USE OTHER MAPS OR PICTURES OF NEW JERSEY TO HELP YOU.

DIFFERENT PHYSICAL FEATURES OF THE NEW JERSEY COAST

1) *Delaware River*
2) *Delaware Bay*
3) *Northern barrier spit*
4) *Palisade mountains*
5) *Northern barrier islands*
6) *Raritan Bay*
7) *Southern barrier islands*
8) *Northern headlands/bluffs*

C) LABEL THE COASTAL COUNTIES. DO YOU LIVE IN ONE OF THESE COUNTIES? _____

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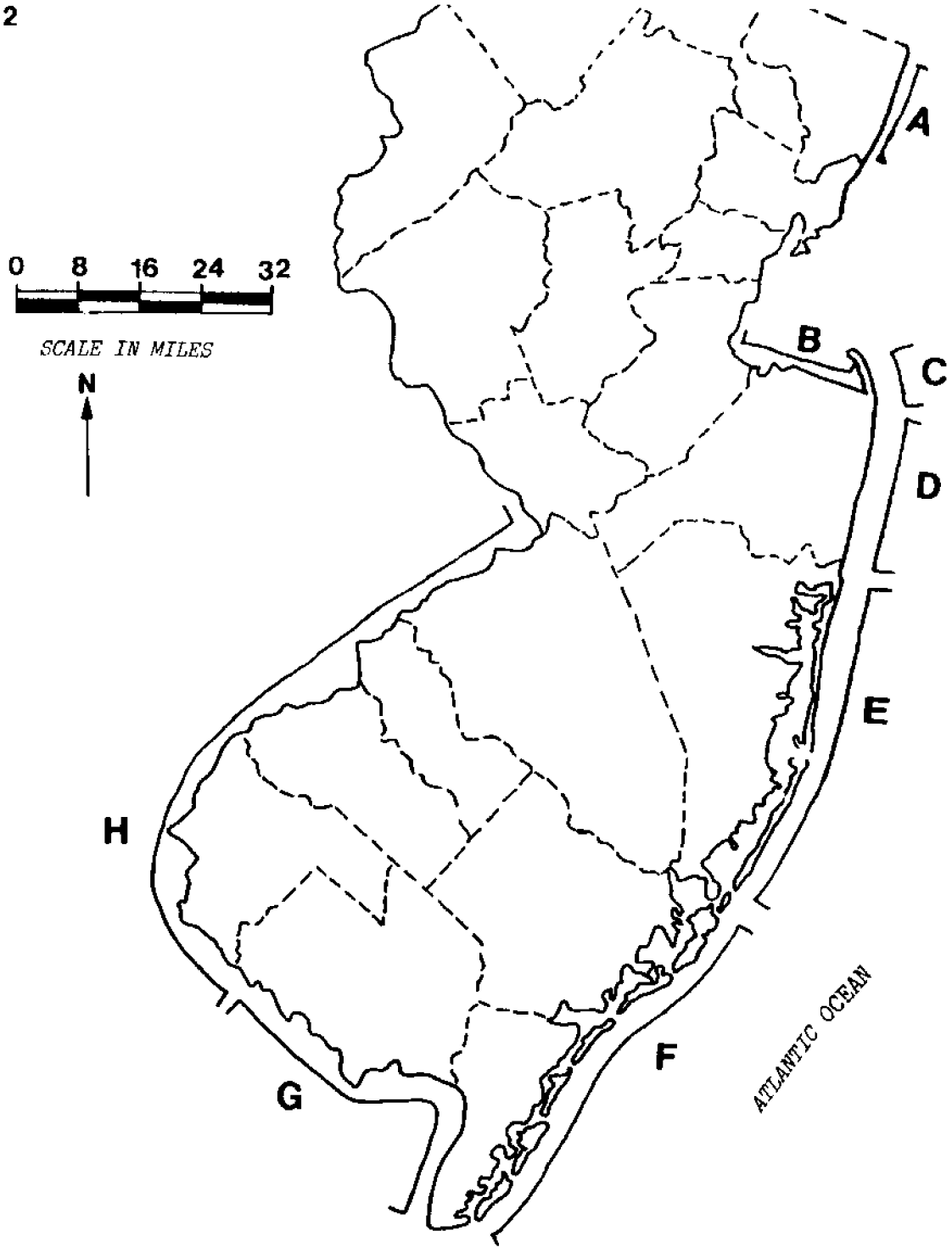
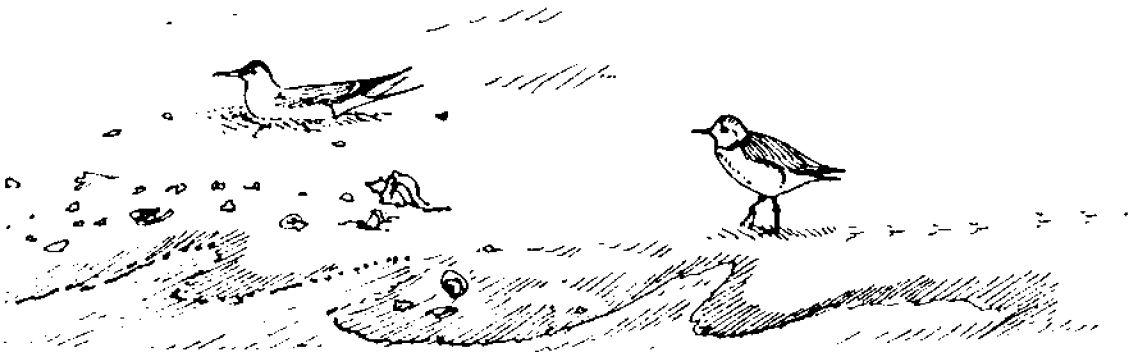


HAVE YOU EVER SEEN THE BEACH MOVE? IT DOES YOU KNOW—ALL THE TIME. SOMETIMES THE MOVEMENT IS SO SMALL YOU DON'T NOTICE IT. AT OTHER TIMES THE MOVEMENT IS SO GREAT THAT THE BEACH CHANGES SHAPE OR IS EVEN WASHED AWAY.

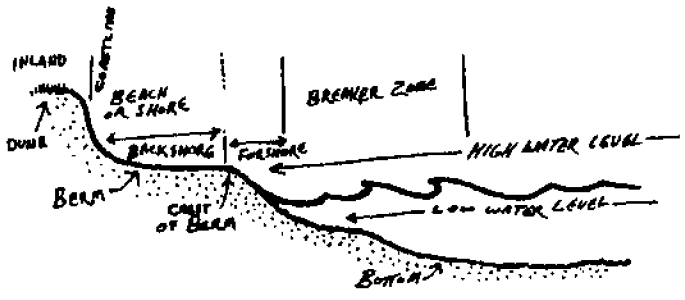
HOW AND WHY DOES THIS OCCUR?
WHAT DOES THIS MEAN TO THE PEOPLE WHO LIVE ALONG THE COAST?

LET'S FIND OUT!

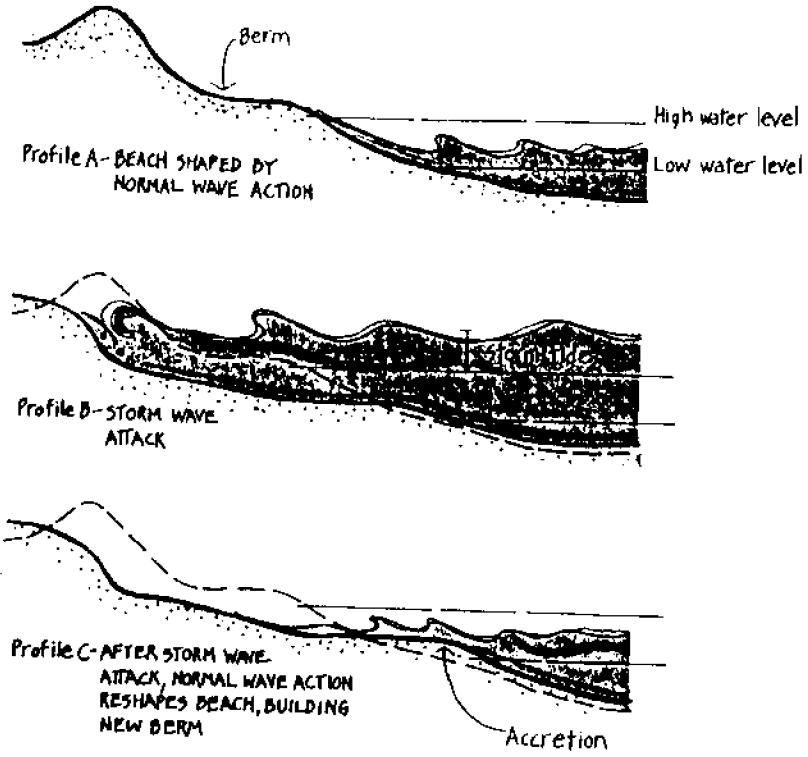


A *BEACH* IS A GENTLE SLOPE OF LAND COVERED WITH LOOSE SAND. THE ENERGY TO MOVE THE SAND COMES FROM WIND, WAVES AND TIDES. IN CALM WEATHER THE WAVES ARE LOW AND GENTLE. THEY RUN UP OVER THE *"FOREBEACH"* UNTIL THEY USE UP THEIR ENERGY. THEN THEY FALL BACK DOWN THE SLOPE.

THE INCOMING WAVES CARRY SAND AND DEPOSIT IT ON THE BEACH. AT THE HIGH TIDE LINE A LOW RIDGE OF SAND OR A *BERM* MAY BE FORMED.



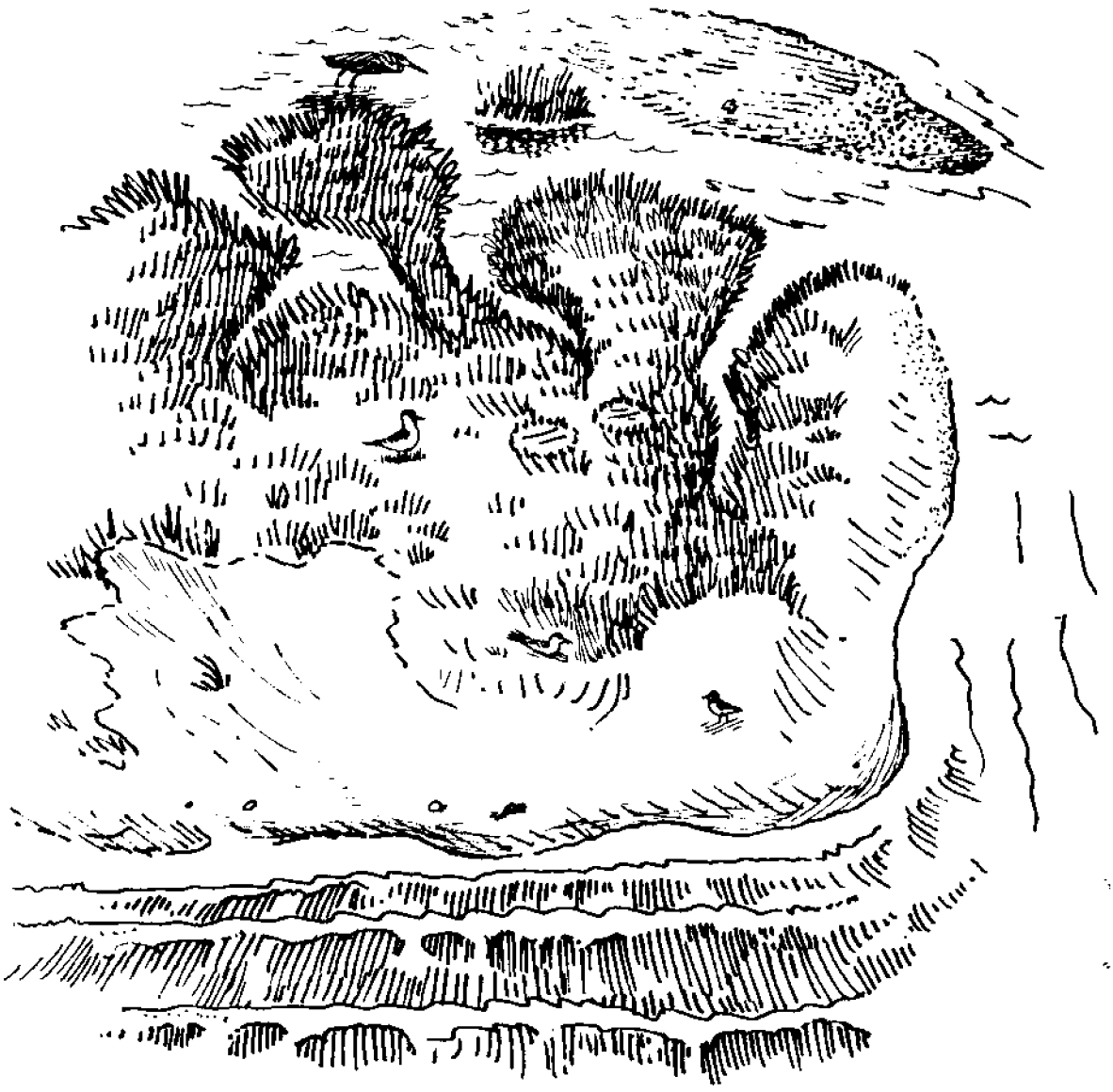
DURING STORMS THE HIGH TIDES BRING THE WAVES HIGHER UP THE BEACH. BECAUSE THE WAVES HAVE MORE ENERGY THEY *"WASH OVER"* THE BERM ONTO THE *BACKSHORE* AND INTO THE DUNES, CARRYING SAND WITH THEM. THEY ALSO CARRY SAND OFF THE BEACH INTO DEEPER WATER. THIS CHANGES THE SHAPE OF THE BEACH; WASHING OR *ERODING* THE SAND AWAY.



DUNES ARE FOUND ON THE INLAND SIDE OF THE BEACH. THEY ARE FORMED BY THE WIND BLOWING SAND FROM THE BEACH. WHEN THE WIND HITS A BLADE OF GRASS IT LOSES ENERGY AND DROPS THE SAND. THE SAND BUILDS UP INTO DUNES. WHEN THE HIGH TIDES AND WAVES OF STORMS WASH INTO THE DUNES THEY MOVE THE SAND EITHER BACK ONTO THE BEACH OR FURTHER INLAND, FORMING *OVERWASH AREAS*.

WHEN THE CALM WEATHER RETURNS THE NORMAL WAVE ACTION RESHAPES THE BEACH, BUILDING A NEW BERM. EVEN THOUGH A BERM IS BUILT, THE SHAPE OF THE BEACH IS NEVER EXACTLY THE SAME AS BEFORE THE STORM.

IN NEW JERSEY MOST BEACHES ARE NOT CONNECTED DIRECTLY TO THE UPLAND. THEY ARE FOUND ON ISLANDS CALLED *BARRIER ISLANDS.* THE FRONT OF THE ISLAND FACES THE OCEAN AND IS CONSTANTLY CHANGING SHAPE DUE TO WAVES AND WIND. THE BACK OF THE ISLAND IS SHELTERED FROM THE WAVES AND WIND.

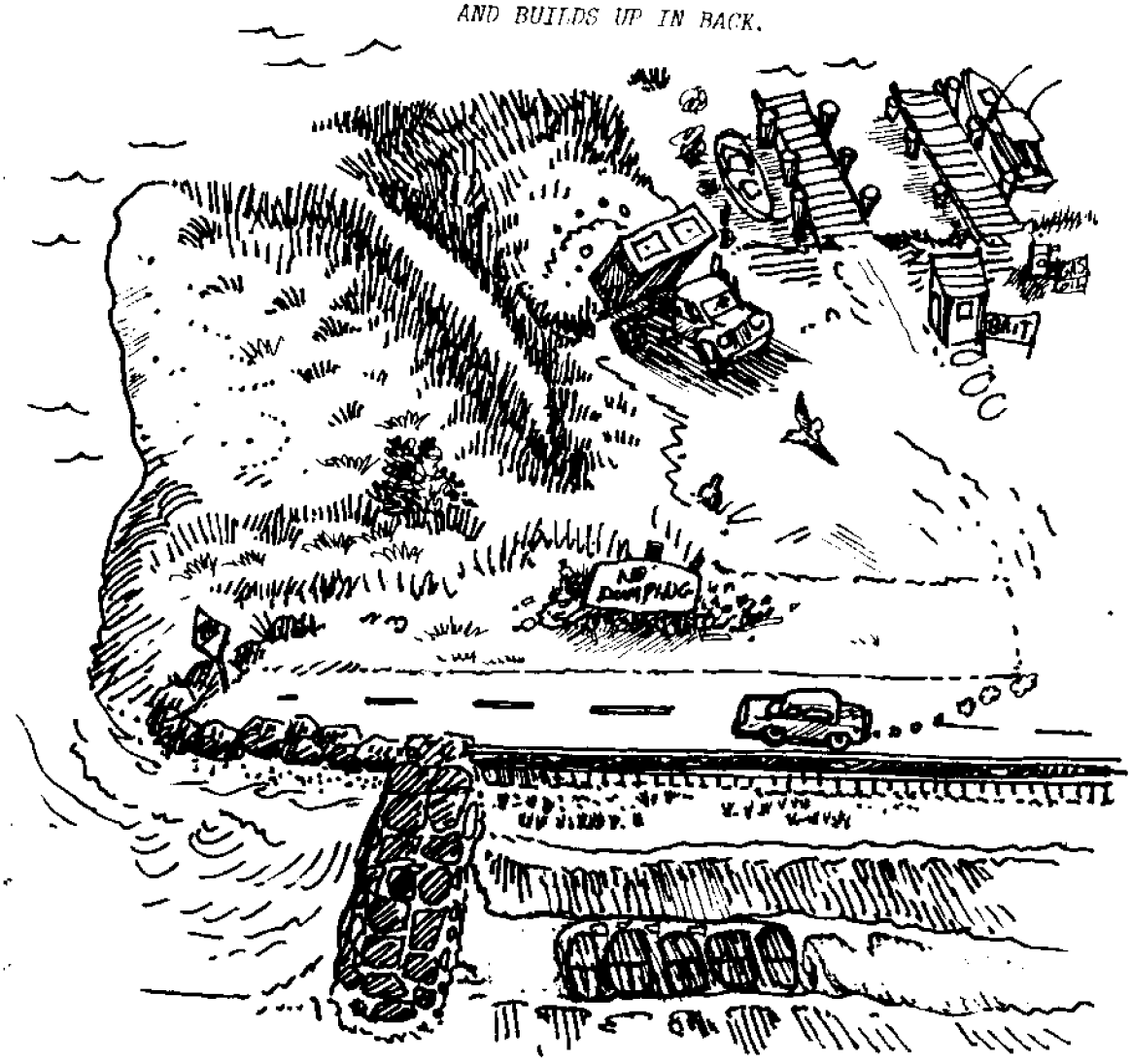


THE ERODING AWAY OF THE FRONT OF THE BARRIER ISLAND TOGETHER WITH THE BUILD UP OF SAND IN THE BACK DUNES AND OVERWASH AREAS MEANS THAT THE WHOLE BARRIER ISLAND IS MOVING CLOSER TO THE MAIN-LAND.

THAT'S RIGHT - THE WHOLE ISLAND MOVES - IT IS WASHED AWAY

IN FRONT

AND BUILDS UP IN BACK.



NOW YOU KNOW HOW AND WHY BEACHES CHANGE SHAPE.

HOW DOES THE MOVEMENT OF THE BEACH AFFECT THE PEOPLE WHO LIVE ALONG THE SHORE? _____

_____

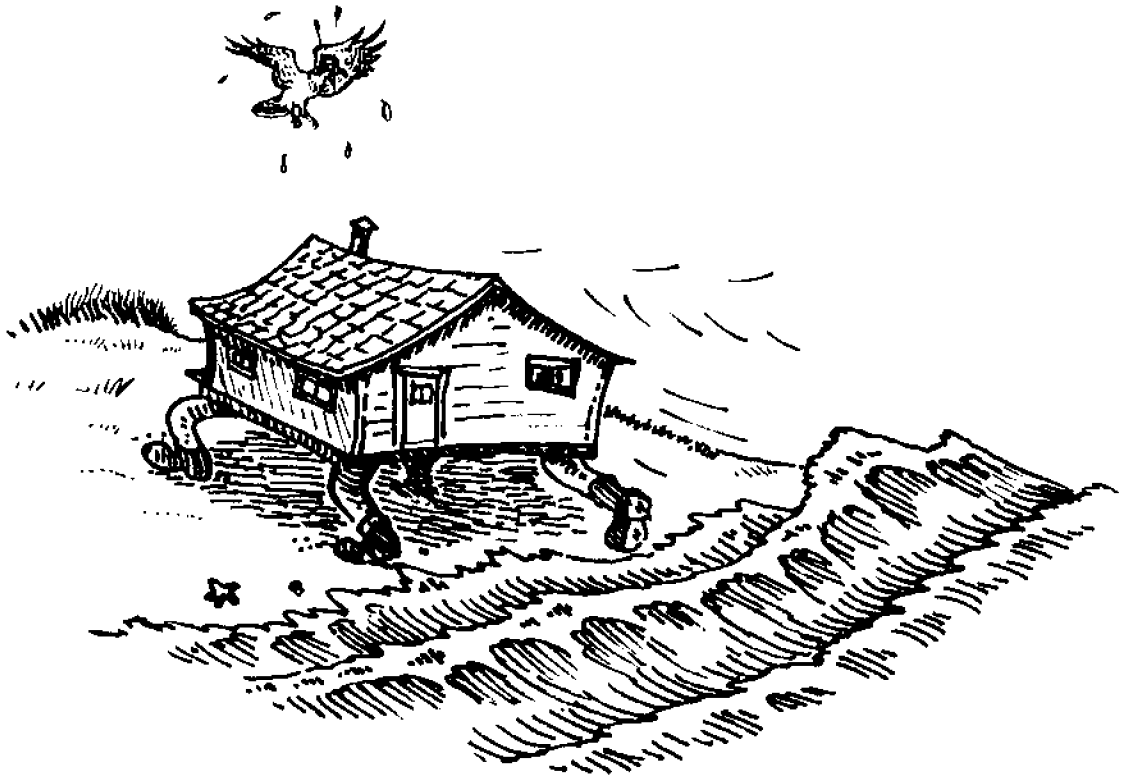
IF PEOPLE BUILD TOO NEAR THE BEACH OR IN THE DUNES THEIR HOMES CAN BE WASHED AWAY BY STORMS OR HURRICANES.

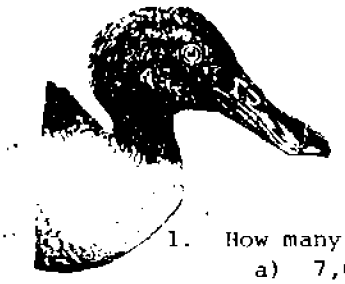
BECAUSE PEOPLE WANT TO PROTECT THEIR HOMES THEY TRY TO PREVENT EROSION. *WHAT WOULD YOU DO TO KEEP THE SAND FROM WASHING AWAY?*

_____

HOW WELL WILL YOUR METHOD WORK? HOW MUCH WILL IT COST?

YEARS AGO PEOPLE WHO BUILT NEAR THE BEACH WOULD BUY A LONG SKINNY PIECE OF LAND. IF THE BEACH IN FRONT OF THEIR HOUSE WASHED AWAY THEY WOULD JUST MOVE THE HOUSE BACK. *WOULD THIS BE POSSIBLE TODAY?* _____ *WHY OR WHY NOT?* _____.





Do YOU know?...

1. How many acres of salt marsh are there in New Jersey?
   a) 7,000 b) 245,000 c) 756,000 d) 96,000

2. In Spring and Fall, the Jersey salt marshes are important resting and feeding places for thousands of migratory....
   a) hawks b) geese c) monarch butterflies
   d) all of these

3. The dominant, most successful plants in the salty world of the wetlands are...
   a) cedar trees b) bayberry c) Spartinas or cord grasses d) seaweeds

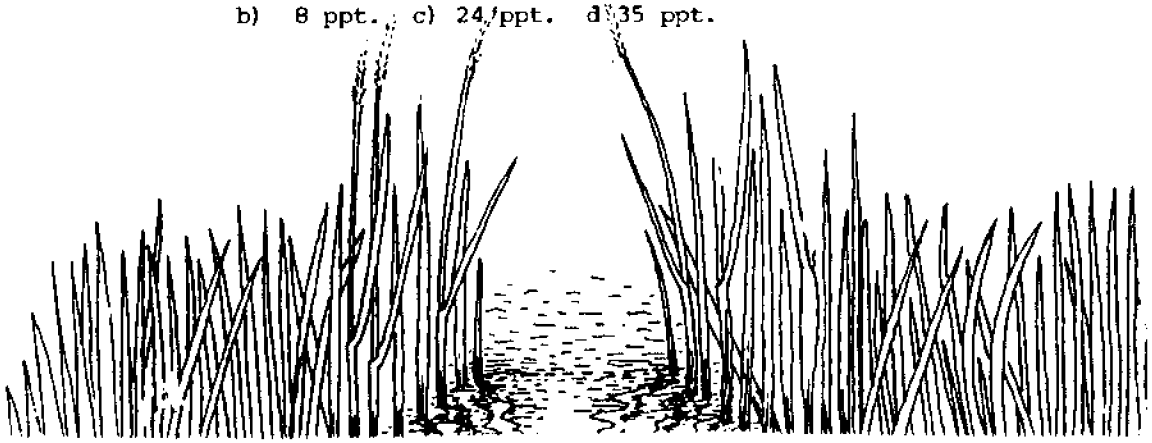
4. Acre for acre, which type of environment is most productive?
   a) wheatfield b) saltmarsh c) coral reef d) open ocean

5. Many shellfish that live in the bays concentrate disease-causing bacteria from pollution in their flesh. Which doesn't?
   a) blue mussel b) oyster c) blue crab d) quahog

6. The earliest people to take advantage of a summer at the Jersey shore were...
   a) English settlers b) Leni Lenapi c) Spanish explorers
   d) Colonial Philadelphians

7. When did the barrier islands, such as Cape May and Atlantic City first become popular as summer resorts?
   a) 1790-1810 b) 1750's c) 1890's d) 1920-1930

8. The salinity of seawater is generally about...
   a) 42 parts of salt per 1000 parts water (ppt.)
   b) 8 ppt. c) 24 ppt. d) 35 ppt.

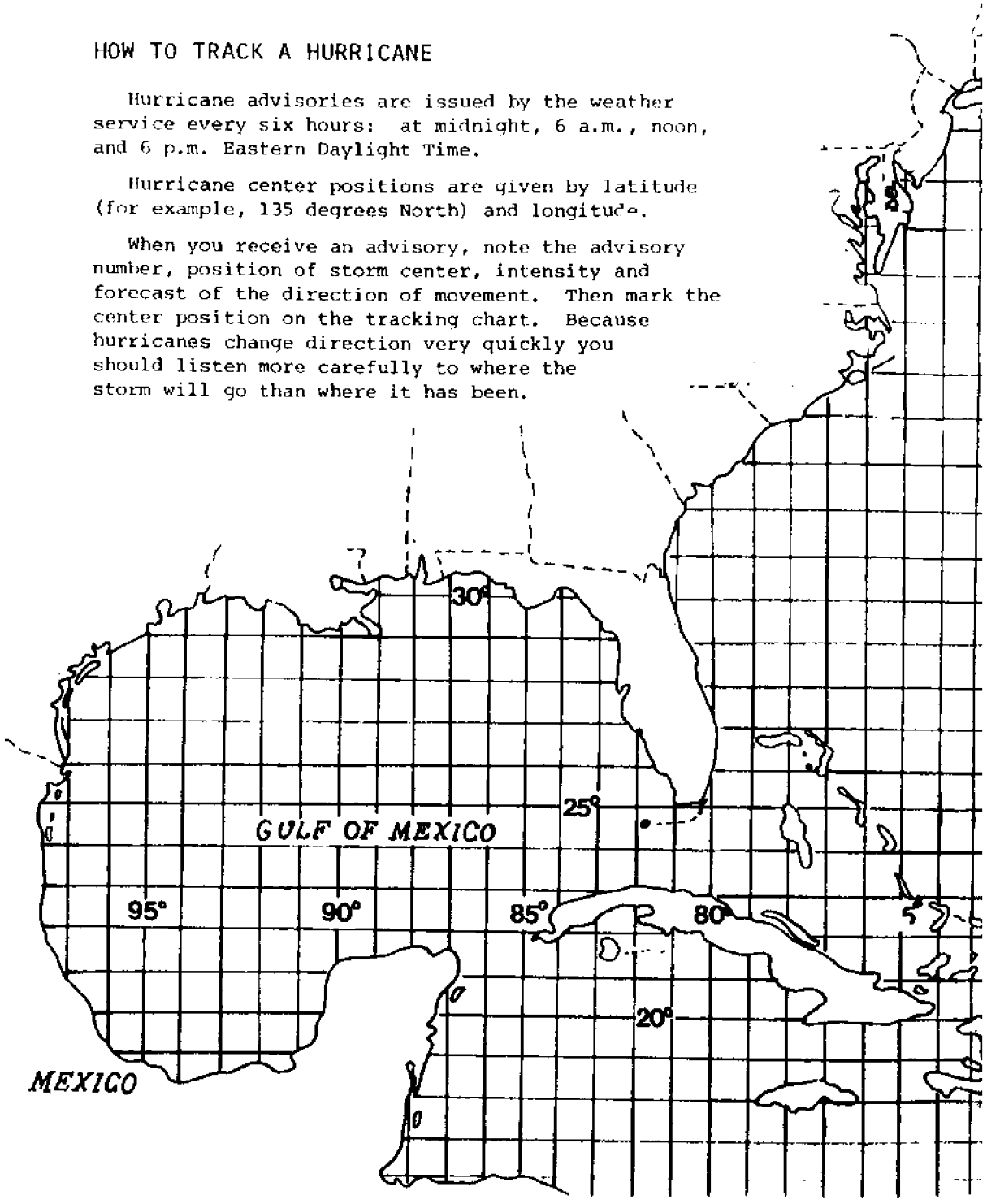


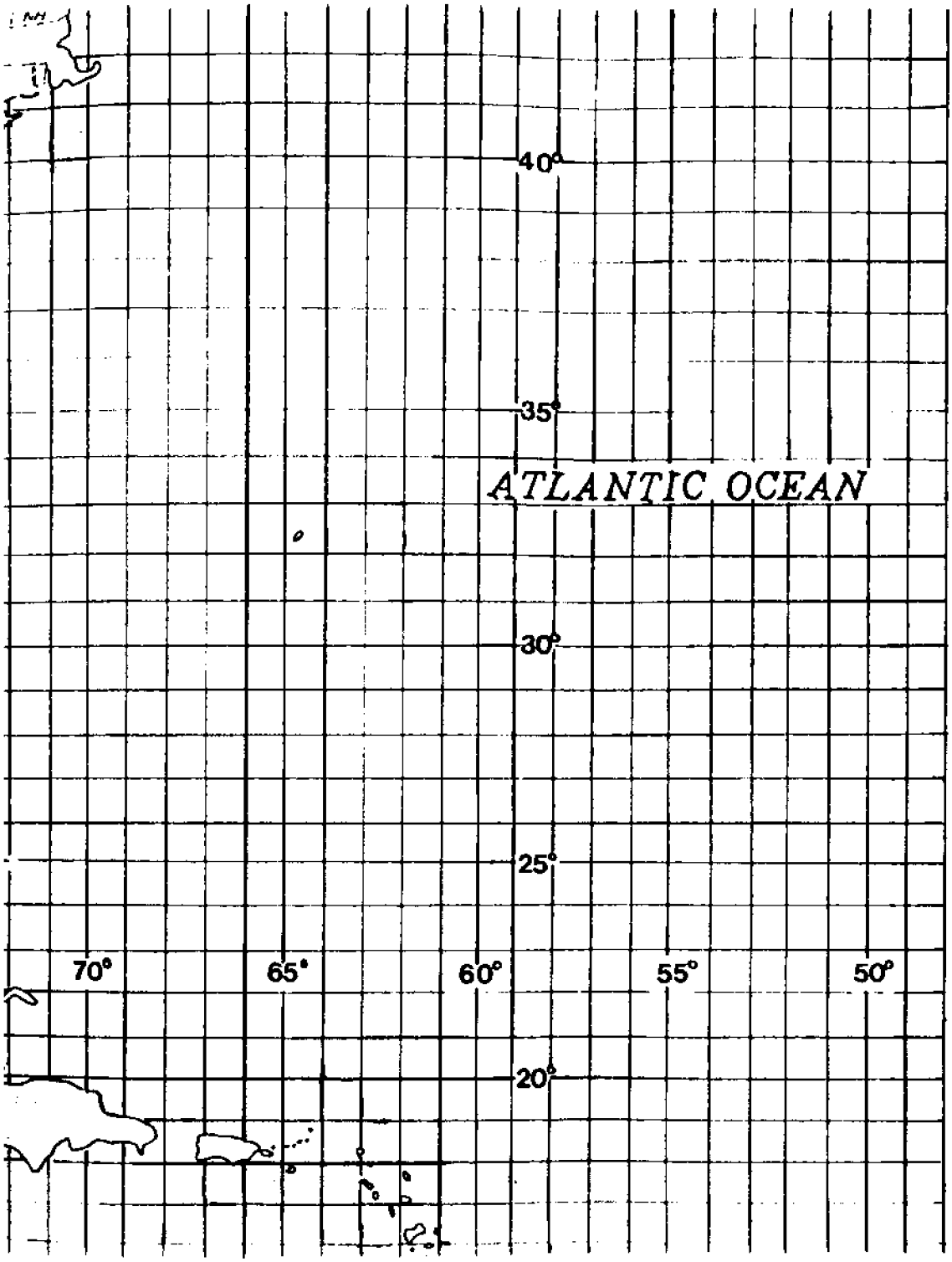
HOW TO TRACK A HURRICANE

Hurricane advisories are issued by the weather service every six hours: at midnight, 6 a.m., noon, and 6 p.m. Eastern Daylight Time.

Hurricane center positions are given by latitude (for example, 135 degrees North) and longitude.

When you receive an advisory, note the advisory number, position of storm center, intensity and forecast of the direction of movement. Then mark the center position on the tracking chart. Because hurricanes change direction very quickly you should listen more carefully to where the storm will go than where it has been.

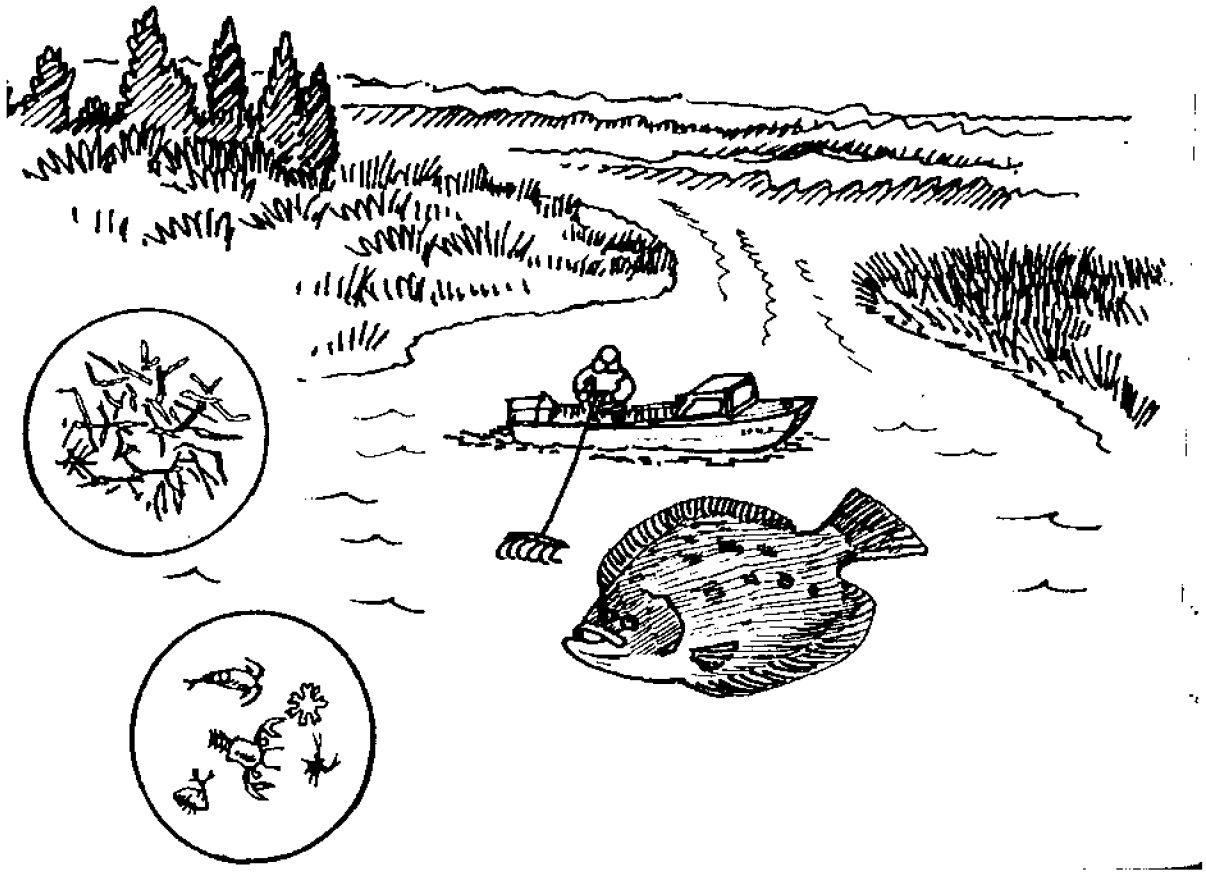



40°
35°
ATLANTIC OCEAN
30°
25°
70°
65°
60°
55°
50°
20°

BETWEEN THE BARRIER ISLAND WITH ITS BEACHES AND DUNES AND THE MAINLAND WITH ITS WOODS AND RIVERS EXISTS THE "IN BETWEEN" WORLD OF THE *SALT MARSH*. HERE IN QUIET BAYS AND ESTUARIES SALT WATER, FLOWING TWICE DAILY IN FROM THE SEA, MIXES WITH FRESH WATER FROM UPLAND STREAMS. SILT AND SAND CARRIED BY THE CURRENTS SETTLES OUT, FORMING MUDFLATS. A SPECIAL PLANT, CALLED *CORDGRASS*, GROWS IN THE SHALLOWS.

THE CORDGRASS CHANGES ENERGY FROM THE SUN INTO FOOD. A FEW ANIMALS EAT THE LIVE CORDGRASS. MORE ANIMALS EAT THE DEAD GRASS WHICH IS BROKEN INTO TINY PIECES CALLED *DETRITUS*. TIDES WASH DETRITUS OUT INTO THE OCEAN WHERE EVEN MORE ANIMALS CAN FEED ON IT. OTHER ANIMALS EAT THE DETRITUS EATERS, FORMING A *FOOD CHAIN*.

SALT MARSHES ARE A GOOD *NURSERY GROUND* FOR FISH AND SHELLFISH BECAUSE THERE IS A LOT OF FOOD AND THE WATER IS QUIET WITH MANY PLACES FOR YOUNG ANIMALS TO HIDE.



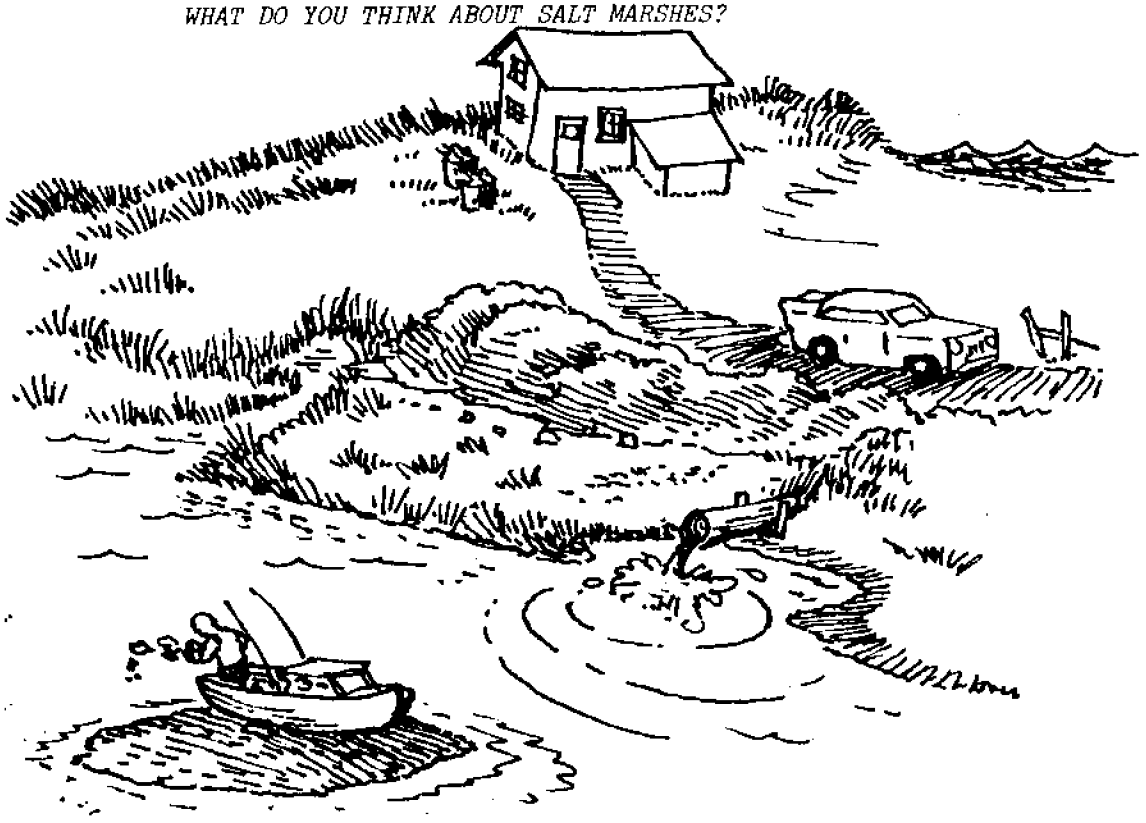
DURING STORMS THE MARSH ABSORBS WATER AND PREVENTS FLOODING. MARSHES CAN EVEN FILTER SOME POLLUTANTS OUT OF THE WATER.

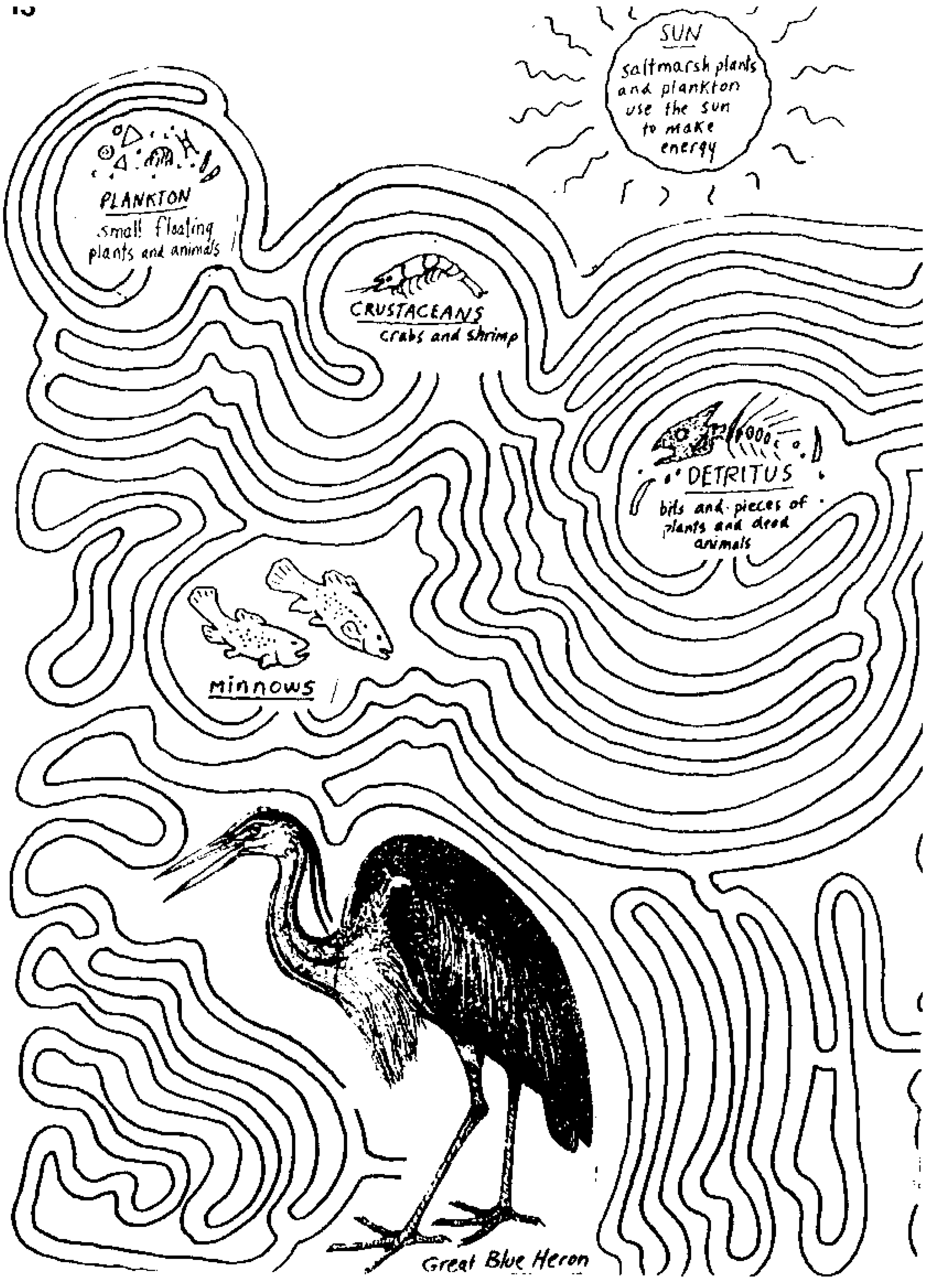
LIKE THE BEACH THE SALT MARSH IS ALWAYS CHANGING. UNLIKE THE BEACH THE CHANGE IS USUALLY SLOW. RATHER THAN WASHING AWAY, THE SAND BUILDS UP IN CREEKS, CHANNELS, BACK BAYS AND MARINAS. WHEN THE CREEKS AND CHANNELS BECOME TOO SHALLOW BOATS CAN NO LONGER USE THEM. WHEN THIS HAPPENS MAN *DREDGES* OR DIGS UP THE SAND. SOMETIMES THE SAND IS DUMPED ON THE MARSH, SOMETIMES IT IS PUMPED ONTO THE BEACH.

PEOPLE SEE SALT MARSHES DIFFERENTLY. TO SOME IT IS A SMELLY, MUDDY PLACE FILLED WITH BITING INSECTS AND BENEFITING MAN ONLY WHEN DRAINED, FILLED AND BUILT UPON OR USED AS A GARBAGE DUMP.

TO OTHERS THE SALT MARSH IS A QUIET, INTERESTING WORLD FILLED WITH LIFE WHICH BENEFITS MAN SUFFICIENTLY IN ITS NATURAL STATE.

WHAT DO YOU THINK ABOUT SALT MARSHES?

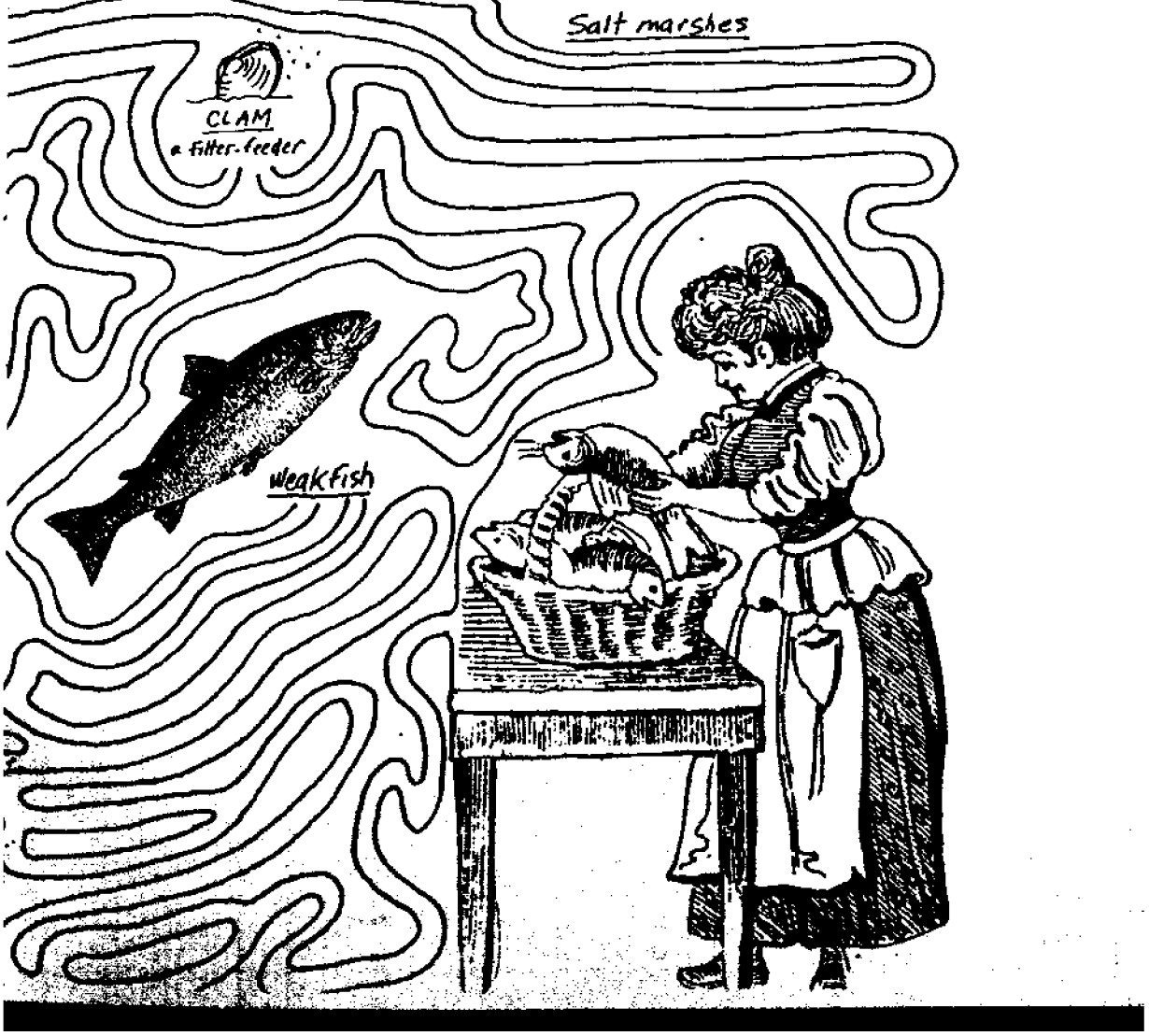



SUN
saltmarsh plants and plankton use the sun to make energy
PLANKTON
small floating plants and animals
CRUSTACEANS
crabs and shrimp
DETRITUS
bits and pieces of plants and dead animals
minnows
Great Blue Heron

THE A-MAZE-ING FOOD CHAIN

Follow these THREE food chains through the maze:

1. PLANKTON to CLAM to DINNER TABLE.
2. PLANKTON to MINNOWS to WEAKFISH to DINNER TABLE.
3. SALT MARSH to DETRITUS to CRUSTACEANS to MINNOWS to GREAT BLUE HERON.



SUGGESTED READING LIST FOR STUDENTS

HURRICANES:

Burnett, L. and H.S. Zim. Weather. Simon and Schuster, Inc., New York, 1957.

Bova, B. Man Changes the Weather. Addison-Wesley Publishing Co., 1973.

Jennings, G. The Killer Storms—Hurricanes, Typhoons, and Tornados. J.B.Lippencott Co., New York, 1970.

SHORELINE PROCESSES:

Roach, M. Dune Fox. Little Brown Co., Boston, 1977.

Manley, S. and R. Manley. Beaches: Their Lives, Legends and Lore. Clinton Publishing Company., Philadelphia, 1968.

SALT MARSHES:

Salber, L. Estuary: What a Crazy Place. National Wildlife Federation, Washington, D.C., 1972.

Snow, J. Secrets of a Salt Marsh. Guy Gannett Publishing Co., Portland, Maine, 1980.

Perkins, P. Marsh Marvels. The Wetlands Institute, Stone Harbor, New Jersey, 1981.

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Art Work: Tony Hillman, Sally Levine, Polly Perkins

WHERE LAND MEETS THE SEA

EXPLORING A COAST

TEACHERS GUIDE

5-6 GRADE

TEACHERS GUIDE

OVERVIEW

Some of the most critical problems facing shore communities today are:

1) The problems of erosion of the beach and subsequent loss of property and the expense involved in the construction of beach protection devices.

2) The dispute over whether or not dunes should remain intact or be used as valuable beach front real estate.

3) The growing potential, as the result of an ever increasing number of citizens living and visiting the coast, of catastrophic property damage and loss of life due to hurricanes and severe storms.

4) The conflict between the boating community, which requires passable waterways and inlets, and those who oppose, on economic and environmental grounds, dredging as a technique of maintaining these waterways.

While these problems are too complex for the average 5-6 grader to deal with they can nevertheless understand the basic, underlying geological, biological and social concepts. This activity booklet is designed to help students and teachers explore these concepts. The activities suggested can be easily integrated into existing curricula because they involve both humanities and science and relate to many children's summertime experiences at the shore.

Above all, children should be helped to realize that they are a part of the natural world, not apart from it.

HOW TO USE THIS PACKAGE

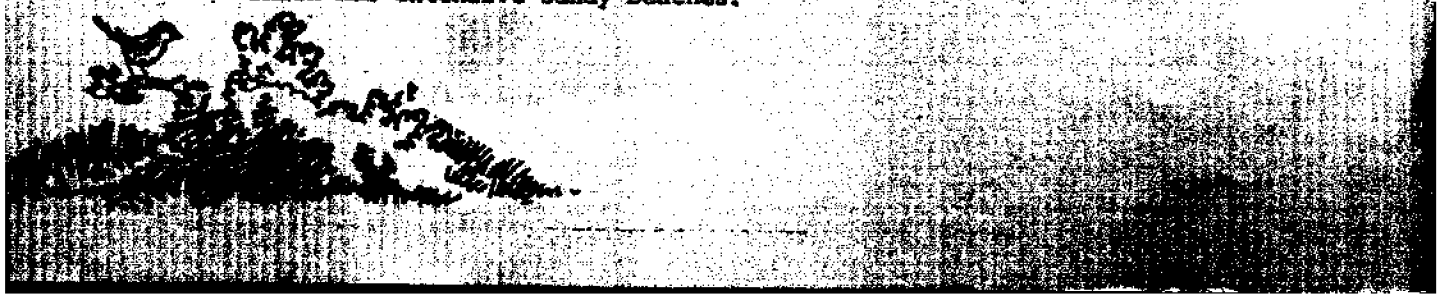
The first two pages of the student activity book are designed to focus on coastal geography and to increase map reading skills. The teacher's guide contains the answers to the questions, as well as background information for the teacher to use in explaining new terms.

Pages 3-7 and 11-12 contain an illustrated text which explains the natural functioning of beaches, barrier islands and salt marshes and how this affects man. New terms and important concepts are in *italic print.* The teacher's guide contains a glossary of terms and additional activities to supplement the narrative and enlarge upon the concepts. Throughout the student booklet are puzzles and games which reinforce certain concepts in the text. Answers to the puzzles are in the teacher's guide.

In addition the teacher's guide contains four fact sheets that provide background information on the four critical problems mentioned above. A list of additional readings completes the teacher's guide.

EXPLORING A COAST - page 1 & 2

Overview - The second most important industry in New Jersey is tourism. Each year millions of people visit the coast; primarily the Atlantic side, which has extensive sandy beaches.



ACTIVITY A Have the students determine how many miles of coast there are in New Jersey.

1) Using a piece of string trace the outline of the state from Bergen down to Cape May then around to Burlington County. Because the Delaware River is tidal as far north as Trenton, the lower western side of the state can be considered coast (where land meets sea).

2) Using a ruler measure the string and, based on the map's scale of miles, cumpute the number of miles.

ACTIVITY B 1) Instruct the students to study the map, noticing the differences in the shape of the various sections, A - H.

2) Focus their attention on the differences between sections. Use a road map, a topographic or 3-dimensional wall map as well as the map in the book.

Section C is a short, north pointing finger of land.

Section E is a long, narrow south pointing stretch of land with water on three sides.

Section F is a series of islands.

Sections A,B,D,G, and H are continuous unbroken stretches of shoreline not separated from the mainland.

3) Collect pictures of New Jersey. The Chamber of Commerce of each county is a good source of free information as they often have illustrated brochures. Use the pictures to help you understand the physical coastal features of each section on the map.

PHYSICAL FEATURES OF THE NEW JERSEY COAST - Definitions

1) Delaware Bay - A large area of open water with a wide, open inlet to the ocean and with a major river flowing directly into its upper portion. The southern shore of the Bay is characterized by low bluffs fronted by a narrow strip of eroding coarse sandy beach. The northern section is an irregular low, eroding salt marsh coast with isolated small beaches backed by low dunes and firm ground.

2) Delaware River - Forms the southwestern boundary of New Jersey. Tidally influenced to Trenton; important commercial shipping lane to Philadelphia. The main stem of the river begins at Hancock, New York, about 197 miles north of Trenton. From Trenton south, the river has been improved under Federal navigation projects. The river shore from Salem River to Trenton is highly developed and industrialized, with port commerce at Camden, Gloucester, and Paulsboro.

3) Hackensack Meadowlands - In northeastern New Jersey; containing thousands of acres of uplands and phragmites marsh. The Hackensack River drains this area. Once considered desolate wasteland with extensive garbage dumps, it is now valuable industrial real estate. The Meadowlands Sports Complex and 2 major highways are found here. Development is regulated by the Hackensack Meadowlands Development Commission.

4) Northern Barrier Islands - Consists of two long barrier elements: 1) south reaching Barnegat Barrier, which extends 21 miles from Bay Head to Barnegat Inlet and 2) Long Beach Island, extending 20 miles south. The tidal lagoons or back bays behind are quite wide, ranging from 3 to 4 miles in most places.

5) Northern Barrier Spit - Area referred to as Sandy Hook; extending 10 miles. A spit is a narrow strip of sand extending into bays or lagoons. Spits are connected to the coastline or to an island, and are formed by waves and currents piling up sand and sediment.

6) Northern Headlands/Bluffs - Bluffs are steep shoreforms composed of softer erodible material such as clay, sand, or soft rock. Bluffs may be unstable because of the physical characteristics of the bluff material, seepage of groundwater in the bluff, and erosion of wave action at the base. The Northern Headlands area covering most of Monmouth County is characterized by narrow beaches at the base of subdued bluffs. This area extends from Monmouth Beach on the north through Long Branch, Asbury Park and Point Pleasant to Bay Head on the south.

7) Palisade Mountains/Cliffs - Northern most section of the New Jersey coast. Composed of steep rock formations that erode very slowly if at all.

8) Raritan Bay - The terrain along the shore between Perth Amboy and the Shrewsbury River ranges from high bluffs in the west and east to low marshlands. Beaches are low and narrow, and a number of tidal creeks intersect the shoreline. Much of the shoreline has been stabilized by structures such as bulkheads, groins and revetments. Some beaches are artificially filled.

9) Southern Barrier Islands - A chain of smaller islands separated by seven inlets. The beaches are characterized by fine sand and have a flatter slope than northern beaches.

Activity A Have students collect pictures of coastlines from books or magazines. Compare physical features. Locate the places where the pictures were taken on a map of the world or the U.S.A.

Activity B Have the students locate and name the seven inlets of the southern barrier islands complex. Locate their favorite shore town on the map.

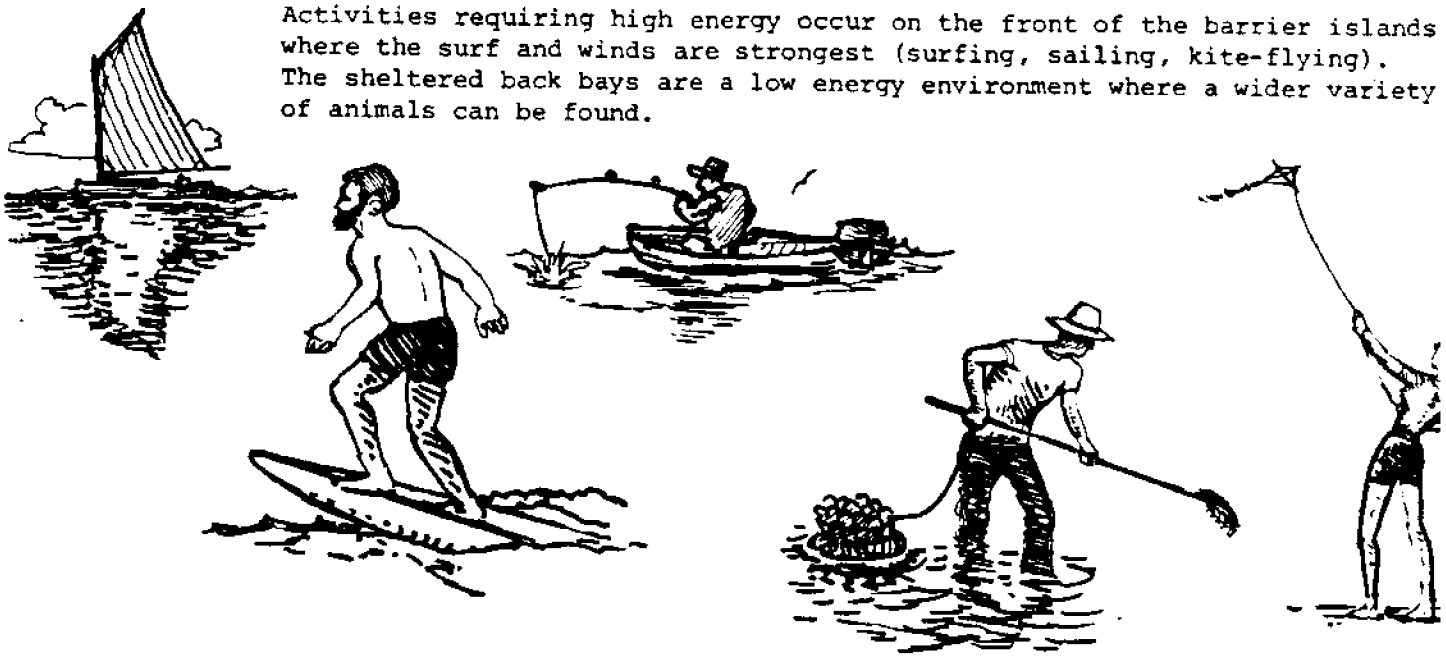
THE BEACH ON THE MOVE - page 3-4

Overview - The physical and geological factors which control the shoreline include the action of wind, waves and tides. It is important for students to understand that the coast is a dynamic system which is constantly changing. Pages 3-6 explain, on a very elementary level, how this system functions. Please refer to the fact sheet on Shorefront Protection for further information.

A concept which may be difficult for students to understand is that "energy" is needed to move the sand and cause the changes in shoreline shape. It may be easier for the student to comprehend that there is energy or "power" in wind and waves and that the beach is a high energy system and the bay and salt marsh a low energy system by relating this to their own experiences and recreational activities.

Activity - 1) Duplicate the figures below.
2) Instruct the students to cut out the figures and place them in the appropriate places on the diagram on pages 5 and 6. Ask the students to explain their choices.

Activities requiring high energy occur on the front of the barrier islands where the surf and winds are strongest (surfing, sailing, kite-flying). The sheltered back bays are a low energy environment where a wider variety of animals can be found.



Activity - 1) Label the features of a barrier island-salt marsh system - page 5. Include: beach, washover area, dunes, salt marsh, inlet, mud flat, berm, foreshore, backshore.

THE COAST AND MAN - page 7

Overview - At present a nationwide debate is taking place concerning the coast. On one side are those who believe that it is unwise economically, environmentally and socially to continue to develop barrier islands. On the other side are those who feel that the technology exists to protect shorefront development from erosion and storms and that to develop the coast is economically, environmentally and socially practicable cost effective and in accord with the demands of a public more and more inclined to locate along the coast.

Activity - The questions on page 7 are designed to encourage students to think about the problem of erosion. Use the questions to guide a class discussion. Refer to the fact sheet on Shorefront Protection for further information.

Additional questions you may wish to ask are:

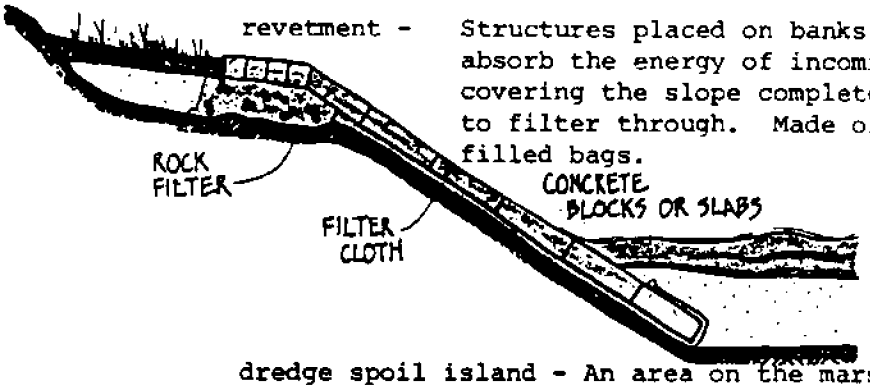
a) Have the students ever climbed on a jetty? What is a jetty made of? (Jetties and groins are fingerlike structures of rock which extend perpendicular from the shore. Jetties are usually at the ends of barrier islands on either side of an inlet; their main purpose os to prevent sand from entering the inley. Groins are usually constructed in groups called groin fields; their purpose is to trap and retain moving sand, nourishing the beach between them.)

b) Have the students ever seen a sign asking them to stay off the dunes? Why are they asked to do this? (The vegetation which grows or is planted on the dunes is an effective way to stabilize the sand. Roots and stems tend to trap fine sand and soil particles, forming an erosion-resistent layer once the plants are established. Because the plants are sensitive to human disturbance they should be protected from pedestrians and vehicles.)

c) Why are many houses along the shore built on pilings? (To protect them from storm tides and flooding.)

Activity - 2) Label the man-made features of a barrier island—salt marsh system on page 6. Include the following:
jetties, groins and grass planting fields - see above
breakwaters - structures placed offshore to dissipate the energy of incoming waves. May be fixed or floating; allows for drift material to accumulate behind the breakwater. Made of stone.

revetment - Structures placed on banks or bluffs in such a way as to absorb the energy of incoming waves. May be watertight, covering the slope completely, or porous to allow water to filter through. Made of rock, concrete slabs, cement-filled bags.



dredge spoil island - An area on the marsh which has been diked and filled with material dredged from the bottom of creeks and channels

* *LOW COST SHORE PROTECTION* - An excellent, well illustrated, non-technical book which describes a variety of shore protection techniques is available FREE from: Commander, U.S.Army Corps of Engineers, ATTN: DAEN-CWP-F, Washington, D.C.

DO YOU KNOW - page 8

Overview - Students take a short quiz about the New Jersey coast. The quiz is designed to encourage students to think about the coast; it is not intended to be graded as a test. Each question focuses on an important concept or fact. Questions 1 - 5 relate to coastal salt marshes; questions 6 - 8 to barrier islands.

Answers - 1) Although there are only 245,000 acres of salt marsh in New Jersey, less than 5 % of the total land area, it is one of our most valuable natural ecosystems. In 1972 the state passed the Wetlands Act protecting salt marshes from unwise alteration or distruction.

2) The salt marsh is a year-round cafeteria for a diverse group of organisms. Particularly noticeable are the large concentrations of migrating geese and shorebirds. Herons, egrets, gulls and terns nest and feed on the marsh. Hawks migrate along the coast, resting and feeding on both the barrier islands and the marsh. In fall the southbound migration of the Monarch butterfly can be seen along the salt marsh border where they feed on seaside goldenrod.

3) Cordgrass is a plant well adapted to survive in the salty, twice-daily flooded world of the salt marsh. Special glands on its leaves give off excess salts from the plant and hollow tubes in the stems and leaves bring oxygen to the roots which are growing in the waterlogged mud of the marsh.

4) Because of the formation of detritus (finely divided, partially decayed plant material) salt marshes produce more usable material for the food chain than any other environment.

5) The blue crab does not feed by filtering food from the water. It does not concentrate disease-causing bacteria in its flesh. Filter-feeding mussels, oysters and clams can cleanse their flesh if moved to clean water.

6) The Leni-Lenapi Indians came to the shore each summer to harvest food from the salt marshes and ocean.

7) Cape May and Atlantic City were fashionable resorts as early as the late 1700's and early 1800's. People came to the shore to escape the southern heat.

8) Salinity is a measure of salt content. Ocean water has a salinity of 35 parts per thousand (35 °/₀₀) which means that each 1,000 grams of sea-water contains 35 grams of dissolved salts. Sodium, chloride and sulphate together make up more than 93% of sea salt. Another 6% is magnesium, calcium, potassium. Sixty-six different elements make up less than 1%.

TRACKING A HURRICANE - pages 9 - 10

Overview - Please refer to Hurricane Fact Sheet for more information.

Major hurricanes are relatively rare. However the potential for damage to life and property continues to grow as more and more people live along the coast.

The hurricanes that strike the eastern United States originate in the tropical and sub-tropical North Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico. The Atlantic hurricane season extends from June 1 to November 30, although most hurricanes occur in August, September and October. On the average, six Atlantic hurricanes occur each year.

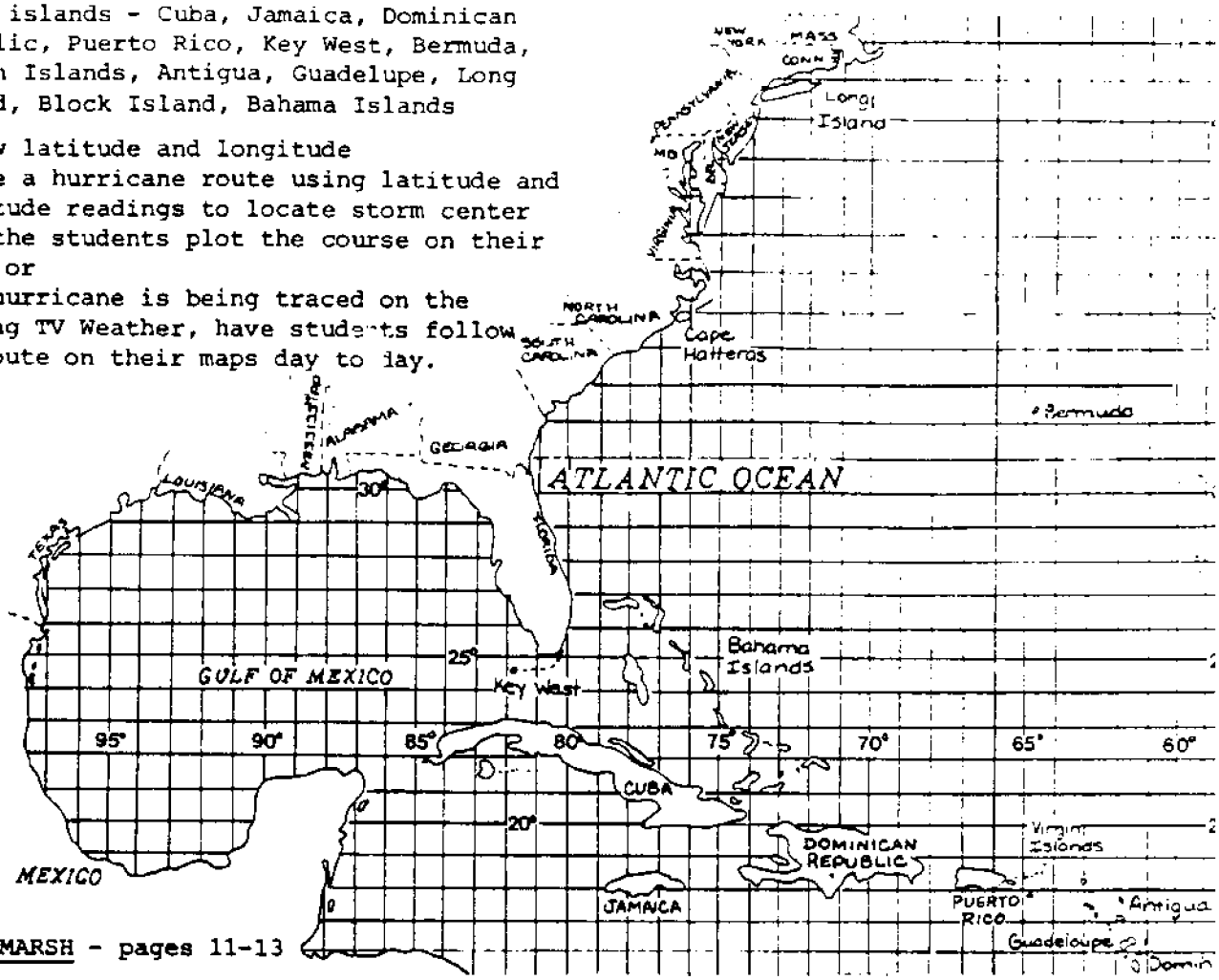
Hurricanes begin as relatively small tropical cyclones which drift gradually to the west-north-west in the Northern Hemisphere, influenced by tropical tradewinds. If conditions are right these cyclones will increase in size, speed and intensity until they become hurricanes.

The forward movement of storms in the tropics is relatively slow. They may even stall for short periods of time. Initial forward speed is usually 15 mph or less. As the hurricane moves away from the equator, its speed increases. At middle altitude it may, in extreme cases, reach a forward speed of 50 mph. The path is often erratic with quick changes of direction.

Activity - 1) Have the students locate on the map on pages 9-10 the following:
   a) East and Gulf coast states from Texas to New Hampshire
   b) Gulf of Mexico, Caribbean Sea, Atlantic Ocean

c) Major islands - Cuba, Jamaica, Dominican Republic, Puerto Rico, Key West, Bermuda, Virgin Islands, Antigua, Guadelupe, Long Island, Block Island, Bahama Islands

2) Review latitude and longitude
3) Devise a hurricane route using latitude and longitude readings to locate storm center
4) Have the students plot the course on their maps, or
5) If a hurricane is being traced on the evening TV Weather, have students follow its route on their maps day to day.



THE SALT MARSH - pages 11-13

Overview - See fact sheet on Salt Marshes and Dredging for further information. Salt marshes are important because they provide many benefits to man.

Activity - Have each student prepare a brief report on a plant or animal of the salt marsh. They may wish to create their own food chain as many more animals live in the salt marsh including: muskrat, black duck, laughing gull, mosquito, greenhead fly, fiddler crab, blue crab, otter, osprey, geese, grasshoppers, weakfish, raccoon, starfish, seahorse, snails, herons, eels, grass shrimp, meadow vole and others.

SUGGESTED READING LIST 5-6 GRADE

Students - See back of activity book

Teachers - SHORELINE: 1) Hiekoff, J. Politics of Shore Erosion: Westhampton Beach. Ann Arbor Science Publisher Inc., Michigan, 1976. 2) Kaufman, W and O. Pilkey. The Beaches are Moving. Doubleday Press, New York, 1979. 3) Shepard, F and H.R.Warless. Our Changing Coastlines. McGraw-Hill, New York, 1971.
HURRICANES: 1) Battan, L. Weather. Prentice-Hall, Inc. N.J., 1974. 2) Laun C. The Natural History Guide. Alsace Books. Alton, Ill., 1970.
SALT MARSHES: 1) Ursin, M. Life In and Around the Salt Marsh. Crowell Publishing Co., New York, 1972. 2) Teal, J. Life and Death of the Salt Marsh. Little, Brown Co., Boston, 1969. 3) Beard, W. Salt Marsh Through the Seasons. The Wetlands Institute, Stone Harbor, NJ 4) Carlson, C. and J. Fowler. The Salt Marsh of Southern New Jersey. Stockton College, Pomona, NJ 5) Snow, J. Secrets of a Salt Marsh. Guy Gannett Publishing Co., Portland ME, 1980.

WETLANDS A National Resource

We often see or hear the word "wetlands" but many of us have little idea of what it means. The definition used by the federal government describes wetlands as "areas that are inundated or saturated by surface or ground waters at a frequency or duration sufficient to support—and under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions". A somewhat broader definition describes a wetland as "a land where water is the dominant factor determining the nature of soil development and the types of animal and plant communities living in the soil and on its surface". The commonly used categories of coastal and inland wetlands include salt marshes, swamps, wet meadows, bogs, fens and potholes.

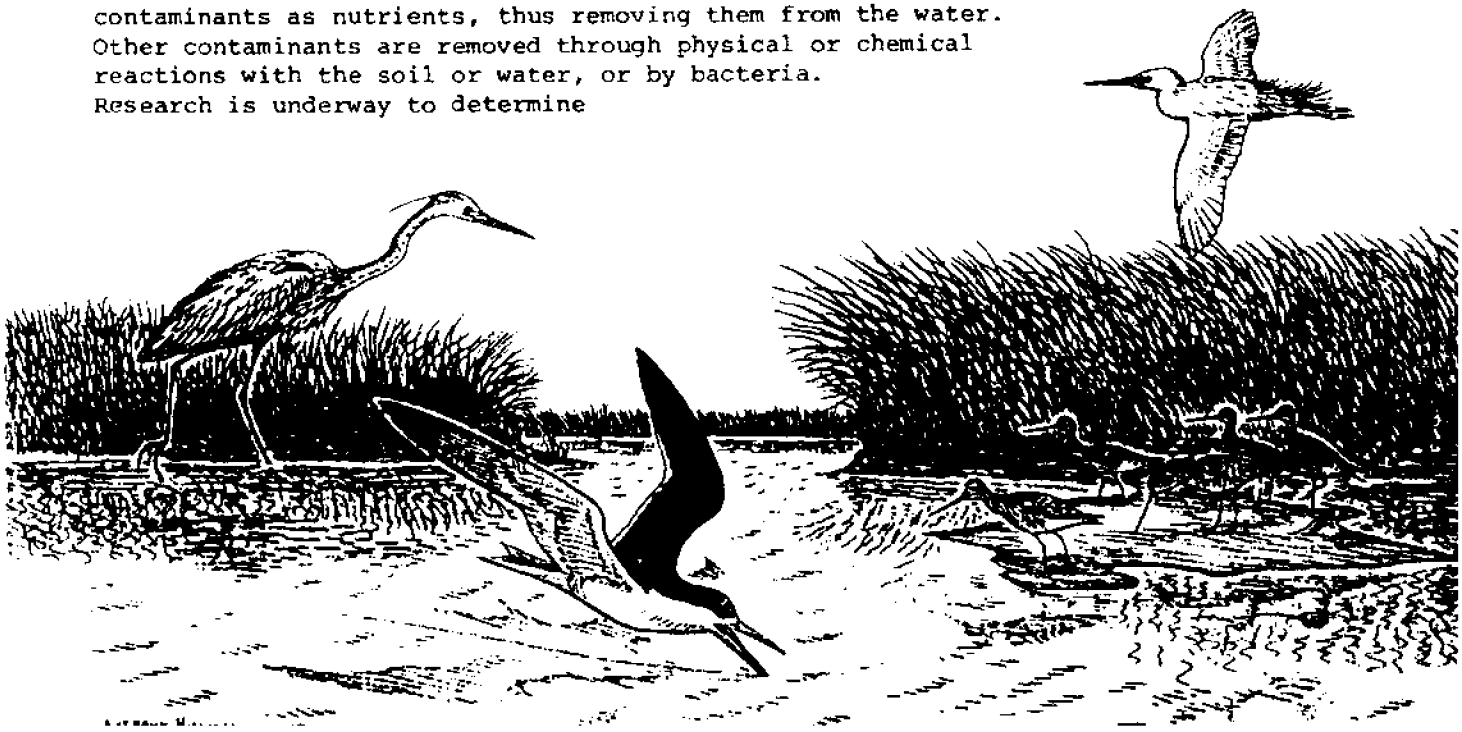
Defining the boundaries of wetlands is a difficult task since the transition from wet to dry is a gradual one. The dividing line moves to and fro depending upon the eye and the motives of the beholder. Salt marshes account for only about 10% of the wetlands of the United States, but along the Atlantic and Alaskan coasts they predominate. New Jersey contains 245,000 acres or 583 sqaure miles of salt marsh; this is 5% of the land area of the state.

To many people a salt marsh is a place where their offspring get muddy, the source of a faint odor of rotten egges when conditions are right, or a row of ramshackle docks along a marsh creek. What good is a salt marsh? Why should we conserve them?

DESTRUCTION OF A SALT MARSH WOULD REDUCE THE CATCH OF SPORT AND COMMERCIAL FISH ALONG THE COAST BY THREE QUARTERS. Approximately 75% of all fish caught off the east coast spend some part of their life cycle in the salt marsh. For some it is their birthplace; for others a nursery where they can mature safe from ocean predators.

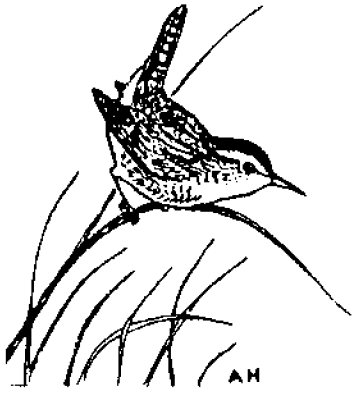
SALT MARSHES PROTECT MILLIONS OF DOLLARS WORTH OF RESIDENTIAL AND COMMERCIAL PROPERTY FROM THE BATTERING EFFECT OF STORM WAVES. Salt marshes can store hundreds of thousands of gallons of water for a short time, lessening the threat of flooding in low areas.

THE THIRD MAJOR ECONOMIC USE OF ALL TYPES OF WETLANDS IS POLLUTION CONTROL. Wetlands absorb vast quantities of pollutants that would otherwise contaminate potable water supplies and swimming and boating areas. Growing plants in wetlands can utilize some contaminants as nutrients, thus removing them from the water. Other contaminants are removed through physical or chemical reactions with the soil or water, or by bacteria. Research is underway to determine



such things as the use of wetlands to remove nutrients from the effluent water of sewage treatment plants. There is however a limit to the amount of polluted water a marsh can handle; therefore, the use of wetlands for wastewater treatment must be carefully controlled.

For those who are fond of the outdoors, the value of wetlands surpasses any economic estimate. Wetlands are home to hosts of plants, birds, crustacea, insects and other animals. Nothing is more beautiful to the marsh lover than the ever-changing colors of waves of grasses as they undulate in the breezes.



For those who look only at the bottom line, unaltered wetlands probably provide, for all functions that can be quantified, some $100,000 worth of benefits to man per acre.

The hand of man has had an increasingly heavy impact on wetlands over the centuries. Lenni-Lenape Indians came during summer to sample the gourmet treats that had only to be caught to be enjoyed. Early colonists used the marsh for grazing lands, a practice that continued until the barrier islands began to be summer resorts. Ditching to lessen the mosquito population began about the turn of the century and became more prevalent as the resorts grew. The Civilian Conservation Corps (CCC) ditched many marshes during the depression in the 30's and by 1938 about 90% of marshes from Maine to Virginia had been ditched, substantially changing their capacity to function naturally. Much of the damage is irreversible.

During the 50's and 60's the public became more aware and concerned about the depletion of our natural resources. Reflecting this concern, New Jersey legislators passed the Wetlands Act in 1970. The Act required the Department of Environmental Protection to set regulations controlling dredging, filling, polluting, or otherwise altering the natural features of wetlands. An inventory of all tidal wetlands was to be made and permits were required to alter wetlands in any way. Two years later the federal government passed the Coastal Zone Management Act of 1972. Its intent was to provide the states with funds to develop comprehensive programs to protect and manage their coastal areas. Concurrently, the Clean Water Act mandated not only protection of the waters of the United States but also included protection of all adjacent wetlands.

The Coastal Area Facility Review Act (CAFRA), passed by the state in 1973, made it necessary to plan and regulate coastal development projects so that the best balance of interests is maintained. Permits are required to alter the salt marsh in any way; requests for such alterations must be fully documented and must be in the public interest. Although conservation groups and governmental agencies have acquired vast tracts of wetlands for conservation and wildlife refuge purposes, important issues remain. By what means can wetlands best be acquired so that no penalty or burden is placed on individuals woho have owned those lands prior to the implementation of the laws strictly regulating wetlands use? By what manner can the local tax burden resulting from restricting wetlands use be spread among all people who benefit from their preservation?

A Presidential Order and statement issued in 1977 concisely summarizes the importance of wetlands: "The Nation's coastal and inland wetlands are vital natural resources of critical importance to the people of this country. Wetlands are areas of great natural productivity, hydrological utility and environmental diversity, providing natural flood control, improved water quality, recharge of aquifers, flow stabilization of streams and rivers and habitat for fish and wildlife resources. Wetlands contribute to the production of agricultural products and timber, and provide recreational, scientific and aesthetic resources of national interest".

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Funding provided by the Sea Grant program of the N.J. Marine Sciences Consortium

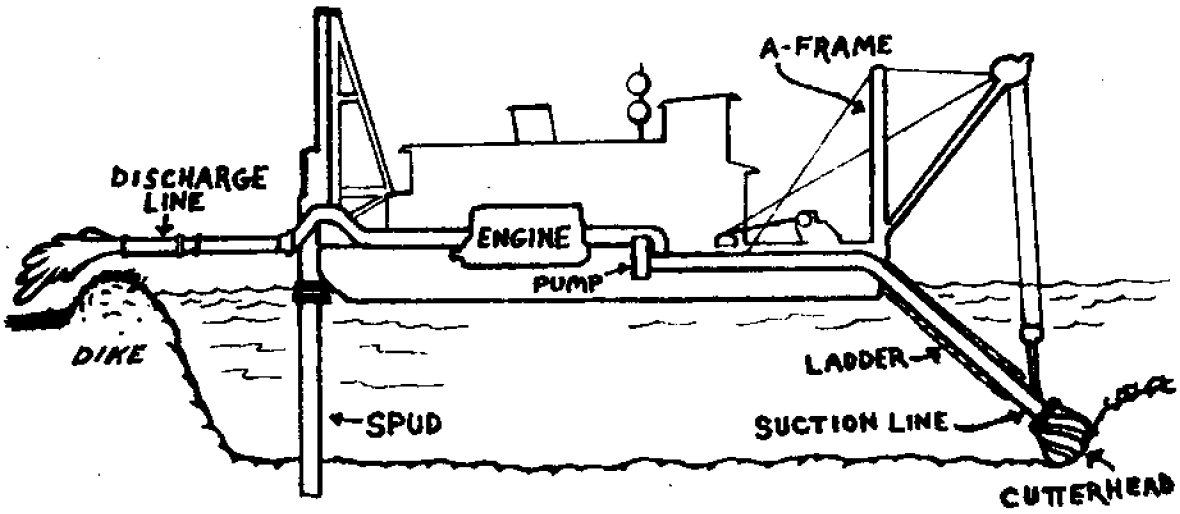
DREDGING

A CRITICAL COASTAL ISSUE

The major industry of coastal New Jersey is tourism. An important aspect of this industry is recreational boating. In addition boating for commerce and fishing are vital activities. There are an estimated 110,000 registered recreational boats in New Jersey. Annually the average boater puts about $3,000 into the economy of the state. This 500 million dollar industry demands safe, navigable channels and inlets; hence the need for maintenance dredging, an activity subject to much debate. Central issues include funding, definition and management of environmental impact and the problem of dredge material disposal.

Maintenance of navigable waterways is shared by federal and state governments and private concerns. The U.S. Army Corps of Engineers is responsible for 167 miles of waterways including the Intracoastal Waterway, various inlets and creeks. The federal government also annually funds 9 million dollars worth of maintenance dredging in the Delaware River and Bay. The State of New Jersey is responsible for 500 miles of channels, 5 lakes and 3 inlets. Private dredging is performed for residential, commercial and industrial activities under state and federal permits.

State funding for maintenance dredging is provided by annual budget appropriations and has been a critical issue since 1970. Prior to 1970 this figure averaged $500,000 annually. From 1970 to 1976 appropriations decreased or were non-existent. In 1977 the Beaches and Harbors Bond Issue was passed, providing 20 million dollars of state aid for shore protection projects, including some dredging, on a 50/50 state-local government cost sharing basis. During the fiscal year 1980, maintenance dredging expenditures were slightly over $1 million. In 1981 funding included a $600,000 direct appropriation and an additional $500,000 in state aid requiring 50/50 matching local share. In November, 1981



HYDRAULIC DREDGE

the legislature, after much controversy , amended the cost-sharing formula, increasing the state's share to 75 % because resort communities contended that they could no longer afford the old formula.

The environmental impact of maintenance dredging is an issue of concern to many. The severity of the impact on the ecosystem depends on the type of dredge used and the nature of the material being removed. On site effects tend to be short term and occur during the actual dredging operation. They include: destruction of bottom dwelling organisms, increased water turbidity, possible disruption of fish migration and resuspension of pollutants in such locations as New York Harbor and localized chemical outfalls on the Delaware River. Long term effects involve primarily the problems associated with the disposal of dredged material. Two types of disposal methods are used. Overboard disposal in the water results, over a period of time, in island formation. Impacts at the disposal site can include changes in bottom elevations and water flow patterns plus effects similar to those already mentioned as occuring during the actual dredging operation. On the beneficial side, dredge material islands can provide habitat for nesting birds.

The second type of disposal is on wetlands, a practice common prior to the awareness of the importance of wetlands in the 1960's. When dredge material is disposed of on wetlands the vegetation is destroyed and the marsh loses its ability to produce organic matter and support fish and shellfish resources. The marsh's ability to store flood water and to improve water quality is also damaged. Diking an area to contain the spoil helps to extend the life of the site and reduces but does not eliminate impacts. Hence, the number of environmentally acceptable wetlands disposal sites has decreased since 1970 from 126 to 35 while the need to dispose of dredge material has remained. Use of dredge material for beach nourishment and wetlands accretion are two alternatives to filling marshlands but these practices are not environmentally and economically practicable in all situations.

Recognizing that there is a need to maintain navigable inlets and that there are serious problems associated with traditional dredging and disposal methods, Lehigh University began in 1977 to study an alternative to dredging called fluidization. This process involves burying a perforated pipe lengthwise through an inlet and pumping water through the pipe. Water coming through the holes fluidizes or stirs the sand above the pipe, allowing the ebb tide or the gentle slope of the bottom to carry the sand out to sea. Scale model field tests conducted in a corner of Corson's Inlet in June, 1980 proved succesful. The long term operation and stability of a "full scale" system for the entire inlet now need to be tested. Initial capital costs for a test of this type are estimated to be several hundred thousand dollars for an inlet such as Hereford, Townsend's or Corson's. The cost to dredge Hereford Inlet by traditional means is approximately $500,000 per dredging. Although the initial cost of a perfected fluidization system may be greater than a single dredging, the expected life should be 15 to 20 years, thus providing a long term saving. In addition, the fluidization system would keep the channel at a navigable depth at all times and may produce less environmental impact than traditional methods. Further research awaits funding sponsorship.

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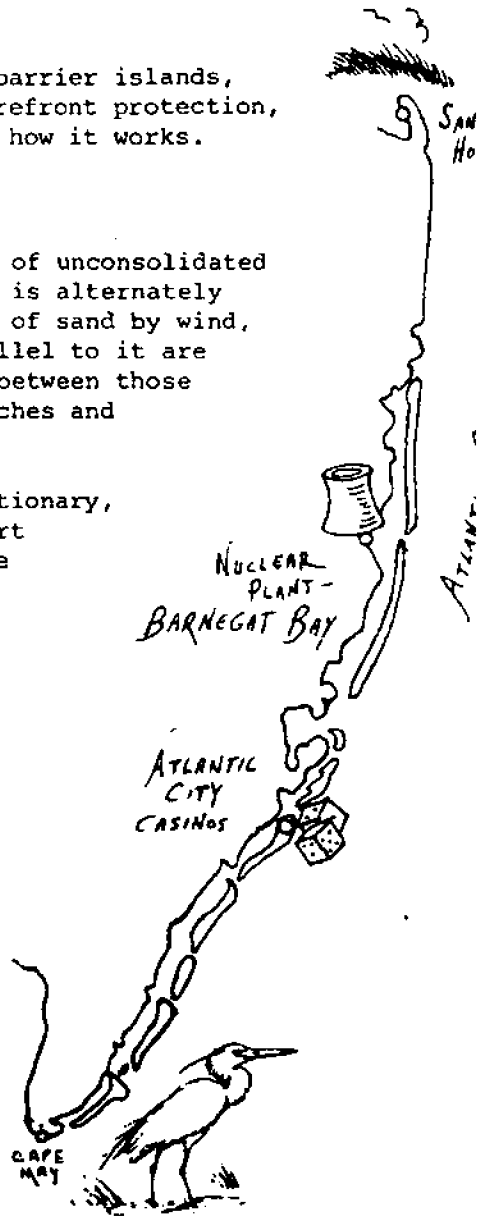
SHOREFRONT PROTECTION

A Critical Coastal Issue

New Jersey: A famous shore resort and a state which contains examples of how to and how not to develop the Coast. The Coast supports the state's second largest industry——tourism. The Coast is a resource of critical concern to many people.

The New Jersey shorefront extends for 127 miles from Sandy Hook to Cape May. A major portion of this shoreline is composed of barrier islands. During the past seve decades extensive development has taken place along the coast in response to people's desire to live and play near the ocean. As the result of natural processes, the shor line is constantly changing. There often arises a need to protect development from these changes. How to best protect the shorefront from erosion is a controversial state and nationwide issue.

In order to understand the relationship between barrier islands, coastal development and the controversy regarding shorefront protection, we must first understand what a barrier island is and how it works.



BARRIER ISLAND PROCESSES

A barrier island is an elongated, narrow landform of unconsolidated sand and gravel. Along the ocean side, the beach zone is alternately expanding and contracting as a result of the transport of sand by wind, waves, currents and storms. Behind the beach and parallel to it are the dunes; ridges of sand. A delicate balance exists between those forces that maintain or destroy the barrier island beaches and dunes.

The barrier islands would remain more or less stationary, if the sand supplied from the ocean by onshore transport and longshore drift, or from the upland sand dunes were sufficient; and the energy from wave action and storm surge were low.

In reality, however, various sections of New Jersey's barrier islands (beaches) are eroding or retreating inland as a result of a sediment deficit. The erosional process is particularly observable and dramatic during periods of storm when sand is transported either offshore or over and through dunes forming washover areas. On the seaward side of the barrier island, the washover process results in a loss of sand to the beach while at the same time allowing the build up of sand on the back side of the island. With time, the whole barrier island system migrates landward and upward, "rolling over on itself". This process of change allows for the continued existence of the land form.

In addition to functioning as a sand reservoir, dunes help to protect against

storm surge by absorbing wave energy, and they buffer inland properties from onshore wind.

Shorefront development has attempted to restrain the natural process of continual migration of barrier islands. This has resulted in the narrowing of the beach and dune system and the consequent loss of their recreational and protective value. Steady beach erosion has necessitated the construction of structures such as seawalls, jetties and groins in an effort to protect life and property.

In spite of engineering efforts, some beaches are still eroding. The question of how best to manage and protect this vital coastal resource is one of critical concern in New Jersey.

THE LEGISLATIVE EFFORT

Two different management strategies have emerged from the debate over the State's effort to legislate dune and shorefront protection. Both strategies acknowledge the need to encourage and protect natural dune systems. One strategy is based on non-interference with the natural functioning of barrier island processes. The other relies on man's technology to provide the overall solution to the conflict between the natural barrier island processes and the development of the barrier island for residential and recreational purposes.

The initial State legislative effort was based on a policy of encouraging the natural functioning of the dune system, including overwash. This was to be accomplished through a regulatory program administered by the Department of Environmental Protection and enforced by the municipalities. Only those limited land uses which were compatible with the dynamics of the natural system were to be allowed. To achieve this objective, several provisions were promulgated including:

* definition of a dune and shorefront area to include, in part, those lands..."lying between the ocean waters and the first paved road, tips of islands and spits, existing and future barrier islands, beaches and dunes..."

* allowance for the Commissioner of DEP to modify the landward definition of the above area based on scientific study

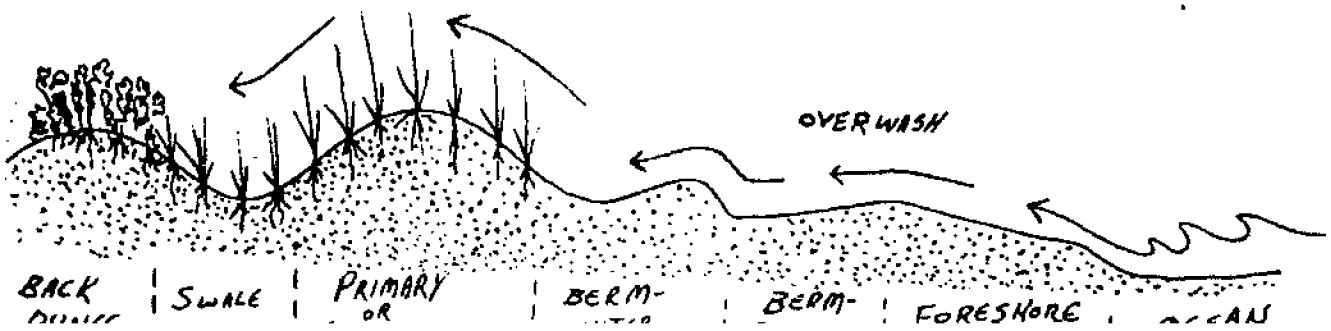
* a list of regulated activities including the prohibition of:

  "the reconstruction of any structure if fair market value of the structure is reduced by more than 50% as the result of coastal storm related damage"

  "removal of any soil or sand"

* need to adopt structural standards to insure the integrity of structures from storms

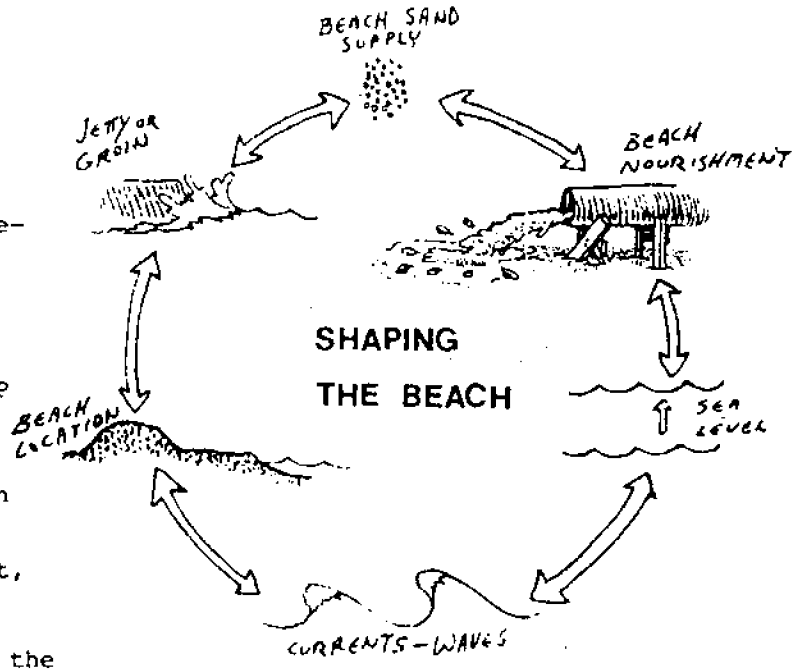
* development of a single coastal building permit process



The underlying management philosophy was that a natural dune system provides the most dependable and least expensive protection for life and property. Objections to this version of the bill were raised by many shore residents and officials. Criticism focused on:

* the definition of dune and shorefront area as arbitrary and unscientifically established
* discretionary permit, interpretive and enforcement powers given to the Commissioner of DEP were too broad and lacked legislative review provisions
* impact of the 50% reconstruction clause because it:

  would discourage investment, shrink tax base, shift tax burden to other property owners, force "retreat" of the barrier islands



In the fall of 1980, revised legislation was proposed which eliminated the controversial 50% reconstruction provisions, redefined the shorefront zone to extend 200 feet from the dune line and introduced the concept of the right of first refusal mandating that the owner of a beachfront property intending to sell first allow the State 60 days to consider purchase. The revised version also proved unsatisfactory to many citizens who objected to:

* the right of first refusal as financially unfeasible
* the strategy of returning the shorefront to a natural condition rather than using beach nourishment and engineered structures to protect the shore
* the need for State laws where existing local dune protection ordinances occur
* State control of local zoning
* the impact on the right of private ownership of oceanfront property

Dissatisfaction with state legislation prompted a coalition of shorefront Mayors to draft their own bill. They felt that the importance of the coastal tourist industry warrants massive, immediate and long range financial aid and technology to solve the problems. Their proposed bill, the New Jersey Shorefront Protection Act of 1981, was introduced into the Assembly (A-2262) and Senate (S-1936) in December, 1980.

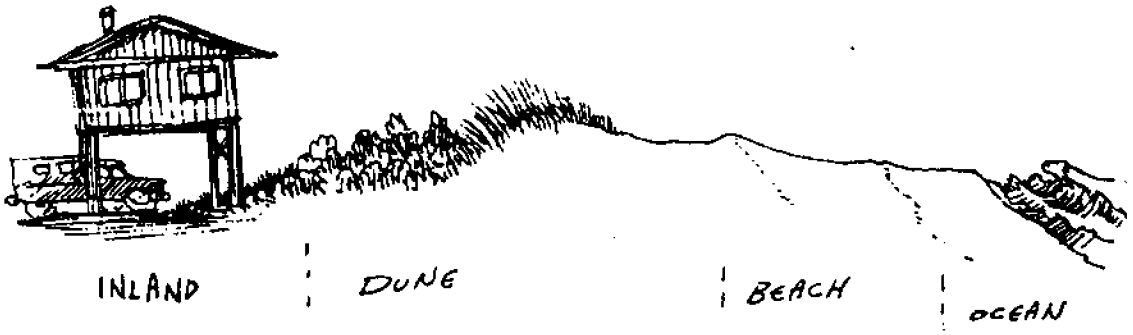
Concurrently, A-1825 was revised a third time. Now known as the Beach and Dune Protection Act (A-2228), it has been referred to the Assembly Energy and Natural Resources Committee along with A-2262 for consideration in early 1981.

The two bills are significantly different. A-2228 continues to emphasize the natural functioning of the dune system as a major protective technique for shorefront areas. The legislation would protect the beach and dune through a land use regulatory program enforced by municipalities and monitored by the Department of Environmental Protection. The bill mandates that every municipality adopt beach and dune protection ordinances based on a model developed by the DEP. The department retains the right to certify all municipal ordinances and impose ordinances if the municipality fails to do so.

The "Mayor's Bill" (A-2262) proposes to regulate construction, protection and restoration through locally imposed ordinances in beach, dune and shorefront areas deliniated and updated by shorefront municipalities themselves. The Act places greater emphasis on the importance of coastal engineering projects; such as beach nourishment, dredging, and construction of jetties, groins and seawalls in critical areas to protect beach, dunes and shorefront. Responsibility for enforcement of the Act would rest with the municipalities. Information dissemination, scientific inquiry and technical assistance would be provided by the Department of Environmental Protection.

Both bills currently await legislative debate and resolution of the issues.

The debate on how best to manage the coastal resources of New Jersey extends beyond State boundaries to questions of national importance. Who should pay the cost of shorefront protection? Should programs which encourage, insure or subsidize barrier island development and rebuilding be continued? Should tax dollars to State and Federal governments generated from resort economies be reinvested in protection, nourishment and upgrading of this unique and valuable resource? The options are many and the decisions made will certainly affect the management and use of this important natural resource for ourselves and future generations.



Produced by the Wetlands Institute

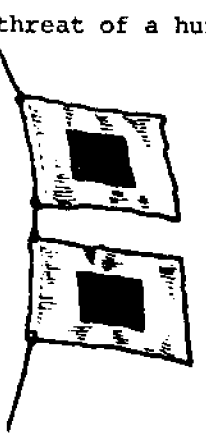
Funding provided by the Sea Grant Program of the New Jersey Marine Sciences Consortium

CAPE MAY COUNTY HURRICANE PREPAREDNESS PLAN

Because of its low-lying peninsular geography, southernmost location, population increase during the hurricane season and limited exit routes, Cape May County has devised one of the most comprehensive hurricane evacuation plans in the country. With the aid of National Weather Service updates and a computer that gives decision time for evacuation, the county could be emptied in 27 to 30 hours.

The underlying philosophy of the plan is to provide sufficient time following an evacuation alert to allow all residents to exit the county before the onset of gale force winds. Contingencies have been devised to provide transportation for car-less summer renters, assistance to the homebound, alternative vertical evacuation sites, coordination of routes with neighboring Cumberland County, and removal of stalled vehicles which might block exit routes. All activities would be coordinated by radio through the Office of Emergency Preparedness located in the County Library building.

In the event of a hurricane watch with the possible threat of a hurricane within 24 hours you should do the following:



* Listen to radio or television announcements
* Get gas for your car
* Obtain a few days supply of special medicines
* Stock up on canned goods
* Check flashlight and radio batteries
* Bring in outdoor furniture and equipment
* Secure boat
* Board and tape up windows

Following a hurricane warning with a hurricane expected within 24 hours an evacuation may be ordered. If so, leave. To prepare, you should do the following:

* Shut off all utilities
* Take small valuables and important papers with you
* Bring along needed medicines
* Leave in the daylight

A SAFE STORM, ONE WITH NO INJURIES OR LOSS OF LIFE, REQUIRES, ABOVE ALL, FULL PUBLIC COOPERATION.

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Funding provided by the Sea Grant program of the N.J. Marine Sciences Consortium

HURRICANES —— HOW REAL IS THE THREAT ?

A CRITICAL COASTAL ISSUE

* The statistical probability of a hurricane hitting New Jersey's coastline in any one year is about one per cent.
* The last time the eye of a hurricane made landfall in New Jersey was in 1821.

While some may find these facts reassuring, others view the threat of hurricanes and coastal storms with their potential for untold disaster as very real. Consider these facts:

Between 1960 and 1971 the population of the United States grew 12 per cent; the number of people living along the coast soared more than 40 per cent.

Almost 80 per cent of people now living in hurricane threatened areas have never experienced a major hurricane. This lack of experience could result in their not heeding warnings or instructions.

Along the New Jersey coast 100,000 or more weekenders jam each of the coastal islands during the height of the hurricane season.

Hurricanes pick up speed as they move north.

In Cape May County:

A 100-year storm with tides 10 feet above mean low water would flood all but three roads.

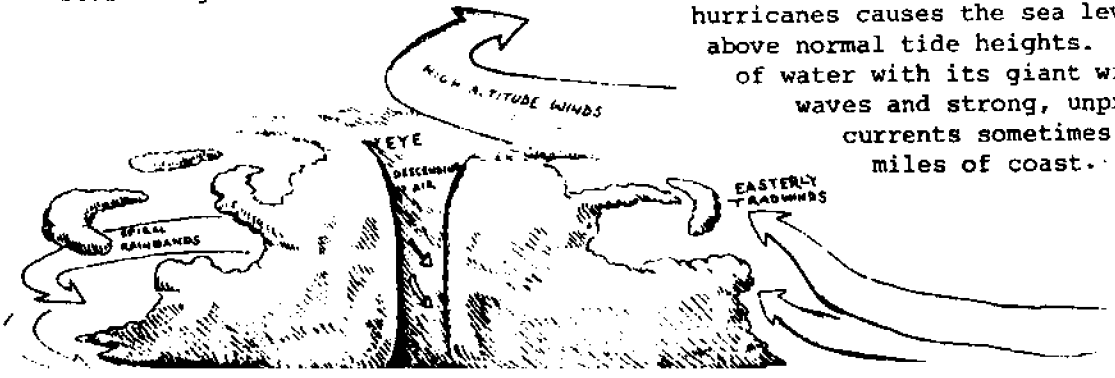
At any one time during hurricane season there are between 300 and 400 thousand people on the barrier islands, plus 50 to 60 thousand people in campgrounds. The total county population is over one million.

Planning estimates indicate that about 4,000 people per traffic lane could be evacuated per hour, thereby requiring 27 to 30 hours for evacuation.

A hurricane is a tropical rainstorm with sustained winds of 74 or more miles an hour. The tropical storm starts when heat energy from the sun is collected in the ocean. As the water evaporates it is carried by rising air and forms thunderclouds. Unlike a typical summer thunderstorm, however, there is a drop in atmospheric pressure which results in a cyclonic, counter-clockwise spiral of heated air and evaporating water. Scientists are not sure exactly what causes a tropical storm to turn into a hurricane.

At the center of the hurricane is the "eye" where the winds are low. The diameter of the eye varies from 10 to 30 miles, depending on the strength of the hurricane. The most powerful winds are at the edge of the eye, an area called the eyewall. Beyond the eyewall are rainstorms and powerful winds.

One of the major destructive agents of a hurricane is a wall of water called a storm surge which moves ahead of the hurricane. The strong winds associated with hurricanes causes the sea level to rise above normal tide heights. This dome of water with its giant wind-driven waves and strong, unpredictible currents sometimes covers many miles of coast.



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