

Marine and Aquatic Field Trip Guide to New York State



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edited by
Robert Jaeger

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MARINE AND AQUATIC FIELD TRIP GUIDE
TO NEW YORK STATE

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CONTRIBUTING AUTHORS, BY SITE LOCATIONS

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Orient State Park
Mount Sinai Harbor
Nissequogue River
Sunken Meadow
Sunken Forest
Captree State Park
Cold Spring Harbor Whaling Museum

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Jones Beach State Park
Loop Bridge
Garvies Point
Oceanside Nature Study Area
Long Beach
Manhasset Bay Marshlands
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INTRODUCTION

The Marine and Aquatic Field Trip Guide to New York State incorporates marine and aquatic education into existing elementary, intermediate, and secondary curricula. In its simplest form, it is a guide written by educators throughout the state who have found a particular field site suitable to their needs. With each trip the author-educator attempts to extend the classroom, to broaden the scope and impact of the lesson, and to develop an awareness of the environment that only 'being there' can establish.

The guide is more than a mere listing of good places to visit. It was written by teachers for teachers, using a format that concisely tells the educator where to go, whom to contact, cost of the trip, how best to use the area, and some suggested activities for the field site. The guide does not purport to include all possible field sites in New York State, nor does the guide pretend to present the only way to study or use a particular field site. However, by including all types of aquatic environments, it can be a model for any teacher interested in taking a similar trip.

Teachers using the guide are encouraged to visit the site before taking their students there. Taking advantage of the uniqueness of the area, specific activities can be planned to suit the particular needs of the teacher and student. Take care in collecting specimens (if permitted) to ensure that the site is not disrupted. Take only what is needed for the lesson.

The sites are listed by county, starting from Montauk Pt. and moving upstate. Individual field trip guides were written by educators familiar with the sites. A list of the author-educators is on page v. Reference materials were compiled from the recommendations of the field-site authors. The appendices supplement the information presented throughout the guide.

Questions and suggestions are welcome, and should be directed to Robert Jaeger, Mineola Public Schools, 200 Emory Road, Mineola, NY 11501.

NOTES ON TAKING A FIELD TRIP

A field trip is an educational experience and not a day off from school. The first job of a teacher is to convey this fact to his students. Students should also realize that the field trip will be both fun and an unique opportunity for hands-on learning. These goals can be accomplished through simple preparation and common sense. Granted, there can be many aggravating problems that accompany a field trip, but most of these problems can be solved before they occur.

Some suggestions for making this trip an exciting and rewarding experience both for you and your students are:

Prior to trip:

1. Always visit a field site prior to taking your class there. This will enable you to realize how best the field site can be adapted to your curriculum, what you can expect the students to accomplish, and any expenses which might be incurred.
2. Plan trips to a field site during an appropriate season.
3. Contact the transportation office of your school or call your local bus company to find out costs (if any) of the bus, tolls, etc.
4. Submit to your supervisor the appropriate field trip forms.
5. Distribute and collect permission slips from students. Encourage parents, fellow teachers, and administrators to accompany your class - a well run field trip does more for you and your program than any classroom visit.
6. Prepare a set of 2 attendance lists - one for you, one for another supervising adult that will be accompanying you.
7. Be sure to know the best route for the bus to take from school to the field site.
8. Materials generally needed by the teacher:

first-aid kit	plastic garbage bags
whistle	pocket knife
sun glasses	hand lens
clip board, paper, & pencil	nets, buckets, etc. where appropriate
reference materials	
9. Discuss with the students the appropriate conduct for the trip; materials needed (clothing, cameras, jars, notebook, etc.); avoidance of hazards, lunch time, etc.
10. All students must wear sneakers or shoes at all times (even in water).
11. Prepare students for trip by discussing the problems to be investigated at the field site, and by actively getting them involved in the preparation. For example, the obtaining of simple materials, construction of home made sampling equipment, researching the physical characteristics of the area, its history, names of organisms found at the site, etc.

12. If your trip is to a field site and not an institution, limit the number of students, when possible, to 1 bus load.

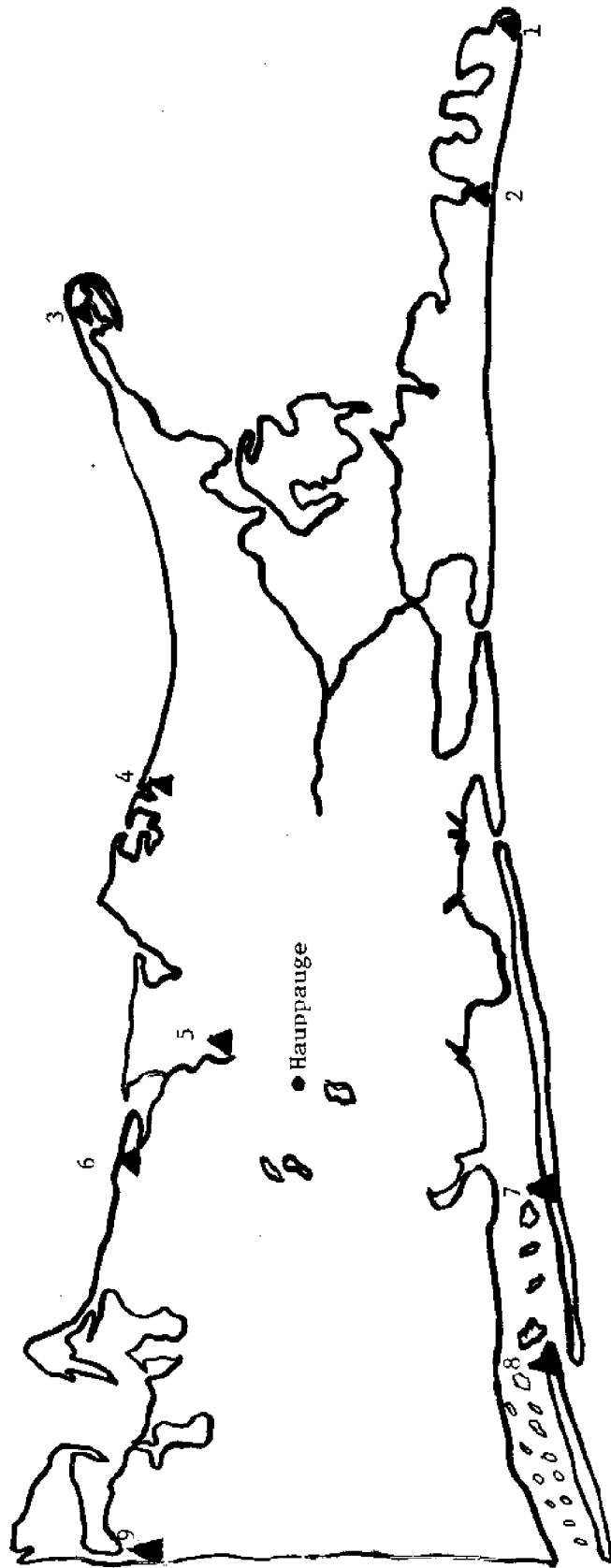
On the trip:

1. Remind students on the bus of the purpose of the trip, the appropriate conduct, and distribute worksheets.
2. Warn students of any possible hazards at the site.
3. Allow students to work at their own speed. Listen, observe, and ask pertinent questions and this will ensure adequate progress.
4. Institute changes in the assigned procedures as these are deemed necessary.
5. Suggest, when appropriate, additional projects for investigation for students who demonstrate high interest and ability levels.
6. Remove living flora and fauna from the beach only if permission has been obtained and if a suitable environment for them can be provided in the classroom.
7. Leave the area in a better state than you found it, if feasible.
8. Appoint one student in each group to check on the equipment to assure its safe arrival and return to the class.

Remember: There is a fine line between constructive permissiveness and chaos. Allow students a degree of freedom while pursuing YOUR prescribed course of 'discovery learning'.

After the trip:

1. Have the students discuss their investigations and prepare a written/oral report.
2. Permit the class to analyze and question the data collected by the students.
3. Collate information gained on the trip and relate it to generalizations or concepts in the area of study. This will result in an ongoing process which will continue throughout the term.
4. Share your experiences and enthusiasm with other classes in the school in order to stimulate interest among other teachers and students.



Suffolk County

types of pollution of bay and coastal areas and possible causes and solutions. Discuss the extent of farming in eastern Long Island and the crops raised. Review the decline of farming in recent years due to labor costs, taxes etc.

At the site: Visitations: Montauk Point Lighthouse, Montauk Ocean Science Lab., Lobster houses on Gossman's Dock, Deep Hollow Ranch. Children may photograph, pencil and charcoal sketch and write descriptive writings.

Field work: Oyster Pond - seining, plankton sampling, testing waters (pH, salinity, temperature, dissolved oxygen), core sampling or sampling of benthic life, collecting of live specimens for tank, collecting of rocks and other shore debris for later use in beach crafts. Collect, float and mount algae. Detailed comparison of environmental factors in the three types of marine environment (fresh, brackish and salt) with the types of marine organisms found in each. Record types of algae, fish and benthic life. Note types of substrate in each area. Shagwong Point on the Northeast side of Montauk facing Block Island Sound is a good place for the study of geology. Eroded cliffs expose the layering of the land formation.

Upon return: Set up a salt water aquarium. Make a large map of Long Island showing the route and the highlights of the trip. Start a bulletin board of newspaper articles pertaining to aspects of Long Island discussed or visited. Map out the territories occupied on the island by the various Indian tribes. Have poetry readings of Walt Whitman. Frame and display charcoal and pencil drawings. Blow up particularly interesting photos for display. Write up visitations and observations. Listen to and discuss the tapes. Make a display of the rocks collected and label.



Montauk Point Lighthouse

Research the life of an American lobster. Research the oyster industry and the clamming industry. Research the historical importance of the whaling industry on Long Island.

Compile data and make charts on the marine environments worked at. Define the limits of physical tolerances for each of the types of animals.

Discuss how the environs of these marine animals might be changed by man's activities. Discuss also how nature might change the environment.

Preparation: Educational: Awareness question sheet for trip out to Montauk and another for Montauk Point itself (i.e., note the decrease in population as we go eastward and what factors might influence this).

Seine net, plastic gallon containers for water and specimens, plankton nets, microscopes and slides, water testing equipment, shallow pans and cardboard for floating and mounting algae, collection bags for beach debris and rocks, identification books, charcoal, pencils, drawing pads, notebooks.

Physical: Boots, change of clothing, bathing suits, towel, etc.

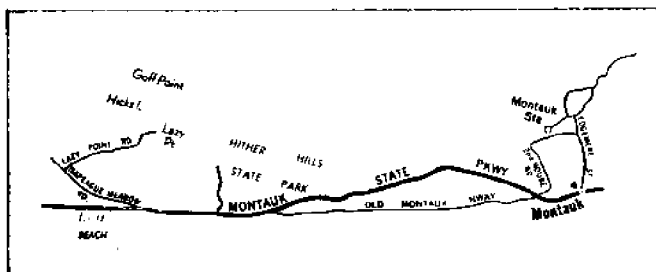
General Comments: There must be a minimum of thirty children on this trip. Cost of train will depend on where on the Island the children board. (Cost from Penn. Station and Brooklyn is \$2.50 per student. The bus for the tour is \$60.00.) The time element must be taken into consideration in planning. It is doubtful that both a tour visitation and a working field trip could be included in one outing, but that is left to the discretion of the leader.

Author - Educator: Ann T. Kempner, Saw Mill Road School, North Bellmore, N.Y.

Home address: 1449 Sycamore Ave., North Merrick, N.Y. 11566

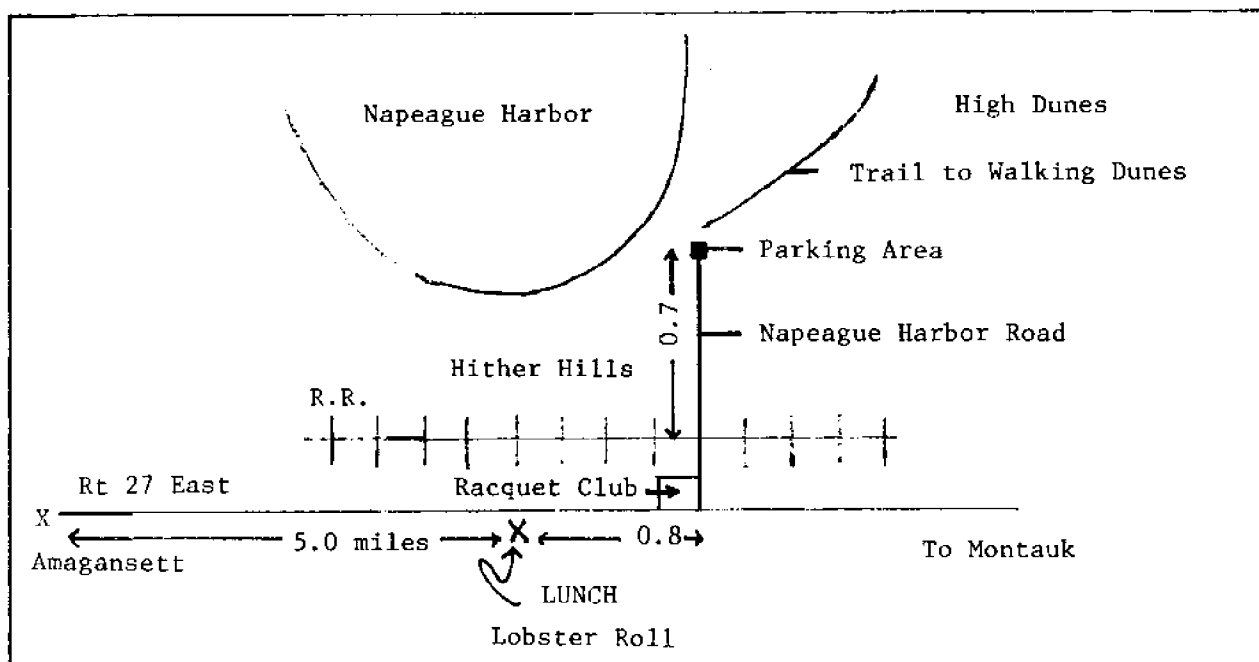
Suggested References: (GE) 13, 16, 20, 22, 32; (B) 38; (I) 45; (M) 52; (PL) 68.

LEVEL: Secondary, but activities can be modified for elementary, intermediate, or college study



Arrangements: Since the area is a State Park, no special arrangements have to be made prior to the field trip.

Facilities: It would be advisable for the field trip group to meet at the Lobster Roll, a roadside restaurant, approximately five miles east of Amagansett where food, parking, restrooms, and shelter from foul weather can be found. At the Lobster Roll one can purchase an excellent and reasonable lunch. There are outside benches and tables which can serve as an outside meeting place for those involved with the field trip. However, the Lobster Roll is only open from Memorial Day to Labor Day!!



Water Facilities: A beach is located at the end of Napeague Harbor Road. The Bay is only 150 feet from the road. The Bay is shallow enough for seining and swimming if these activities are part of the planned field trip.

Beach Environment: The area provides the following for investigation:

1. Massive sand dunes that are the highest active dunes on Long Island
2. Salt water marsh
3. Freshwater marsh and bog
4. An extinct pitch pine-black oak forest
5. An extant pitch pine-black oak forest
6. A shallow estuary

Materials and Equipment: The following items (depending upon the habitats studied) should be brought along:

1. Small pocket handbook
2. Bathing suit
3. Sneakers
4. Long-sleeved shirt
5. Suntan lotion
6. Bug spray
7. Clothing suitable for habitat to be studied
8. Towels
9. Plankton nets
10. Seines
11. Water test kits
12. Camera
13. First-aid kit
14. Soil sieves and shovels
15. Dissecting microscope and petri dishes
16. Collecting bottles
17. Soil cups
18. Plastic garbage bags for plant specimens
19. Buckets for shells
20. Clam rake or spade

Caution:

1. Pre-plan to sample salt marsh vegetation and/or shellfish populations at low tide.
2. Stay on natural paths because poison ivy is abundant.
3. Check clothing and bodies for ticks before leaving and again when arriving home. Ticks can cause ROCKY MOUNTAIN SPOTTED FEVER.
4. Apply bug spray and wear long clothing if mosquitoes are a problem.

Suggested Activities:

Pre-field trip:

1. Describe how sand dunes are formed.
2. Show pictures of insectivorous plants and explain how insectivorous plants trap insects.
3. Make sure all students understand the delicate nature of the area and also that they know how to recognize poison ivy.
4. Demonstrate shells of common shellfish; clams, oysters, and scallops. Discuss their life cycle and habitat preference.

5. Show slides of plants in various habitats so that students can identify these plants in the field.
6. Introduce the topic of primary succession.

At the Site:

A. Walking dunes

1. Identify beach grass and other species present.
2. Examine the extinct forest of black oak and pitch pine.
3. Note direction in which dunes are moving.
4. Collect and identify vegetation.

B. Salt marsh

1. Walk area and identify vegetation in the salt marsh.
2. Sample sand and mud at or below low tide level for marine invertebrates.
3. Make plankton tows at different depths.
4. Seining and listing of marine organisms.
5. Test water samples with portable test kits.
6. Collect soil samples in different vegetation zones of the salt marsh--note vegetation associated with each.
Soil sample and collect vegetation samples.

C. Freshwater marsh and bog

1. Note the insectivorous sundew, orchids, cranberry, club moss, and other species that are indicative of freshwater marshes and/or bogs.
2. Take pictures of each species.

D. Black oak-pitch pine forest

1. Identify the dominant trees and shrubs of the forest.
2. Sample trees and shrubs by use of the Quadrat Method.
3. Collect vegetation samples in the forest.

Post-field trip:

1. Identify marine organisms and/or local flora.
2. Preserve animal specimens.
3. Mount plant specimens.
4. Discuss the ecology of each habitat visited.
5. Discuss the ecology of each organism identified.
6. Discuss preservation of rare and endangered species.
7. Extract chloride from soil samples in salt marshes and convert to salinity.
8. Relate species tolerance to salinity in accordance with tidal flooding.
9. Dissect clams and shellfish.
10. Observe phytoplankton in guts of shellfish.
11. Discuss how vegetation stabilized dune.
12. Discuss food chains in an estuarine ecosystem.

General Comments: The walking dunes are the highest sand dunes on Long Island. Moving from three to five feet per year in a southerly and easterly direction, the dunes have buried a forest of pitch pine and black oak.

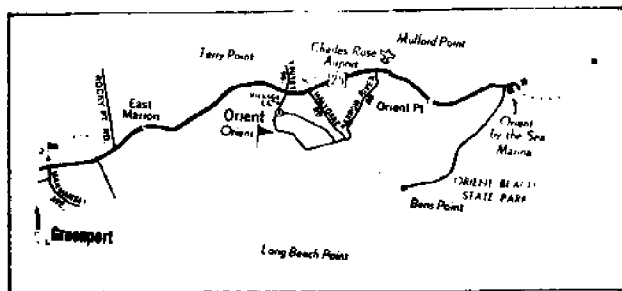
The walking dunes provide the students with four distinct habitats within one-half mile of each other. An instructor could concentrate on one or several of these unique habitats: sand dune community, salt marsh community, freshwater marsh-bog community and pitch pine-black oak community.

I recommend visiting this site during late spring, summer, or early fall. Field trip leaders desiring more information, including species lists or special activities, should contact the author-educator.

Author-Educator: Dr. Richard Stalter, Director of the Environmental Studies Program, St. John's University, Jamaica, New York 11439

Suggested References: (GE) 9, 10, 13, 18, 33; (B) 36; (f) 39; (I) 46, 51; (P) 59, 60; (PL) 63, 67, 72.

NAME: Studies of the North Fork
TYPE: Field work and visitations
LEVEL: Secondary
AREA: North Fork of Long Island



Arrangements:

1. For Orient State Park - at least two weeks ahead
Phone: 516/SU 5 - 1600
Write for Permit - Long Island State Park &
Recreation Commission
Jones Beach State Park
P.O. Box 1000
Wantagh, L.I., N.Y. 11793
2. Isle-End Snack Bar at Orient Point Ferry Landing
(Food only, no restrooms, very small) Call ahead
if you wish to have food ready for a group.
Pete 516/423-2560

Directions: Long Island Expressway all the way to the last exit
for Orient. On to Route 25 which will go East all the
way to Orient.
A bypass route at Mattituck is located just north of
the main street of town. The route is called North
Road. It joins Route 25 at the Greenport light.
See Map.

Facilities:

At Orient Park - picnic tables, benches, restrooms (open from spring
thaw to first frost in late November), barbecues, a small weather
overhang near the restrooms, plenty of parking.
At Greenport - town parking behind Main Street stores.
At Oyster Farms plant - parking in front on dead end road.
At East Marion stop - parking is available at watersedge on the right
side of the road at the east end of town. Opposite Dam Pond and facing
Orient Harbor.
There is a KOA Kampgrounds if an overnight is planned. Hot showers,
tent sites and water and electric hookups available. (516-477-0022)

Water Facilities:

At Orient; seining beach and salt marsh, swimming at park beach,
inflatables could be used.
At East Marion site; seining near sea wall, excellent tidal flow anytime
for a plankton haul at the bridge, tidal flats.

Best Usage:

At Orient Park - water chemistry beach and marsh
- geology - beach of stone - typical North Shore
- collecting biological specimens
- plant studies - beach plants
- ecosystems - beach, marsh
- maritime history

At East Marion site - tidal flats ecosystem
 - tidal movements
 - salt water marshes ecosystem
 - collection of specimens

At Greenport - economic interrelationships - the fishing fleet and the oyster farms plant
 - historic relationships - the buildings are some of the oldest on Long Island, telling the history of the old fishing village.

Type of Environment:

At Orient State Park - both north and south faces of the beach are typical rocky beach environments with five zones:
 surf-intertidal-upper beach-dune (depleted) - maritime forest

FAUNA*

Snails - Littorina (periwinkle)
 Scallops - Pecten
 Razor Clam - Ensis
 Boat Snail - Crepidula
 Fish-Killifish - Fundulus
 (many others in season)
 Osprey nests on poles

SEAWEED

Codium - green
Chondrus - red
Cladophora - green
Ulva - green
Fucus - brown
Laminaria - brown

FLORA*

Cactus - Opuntia
 Pine - (Black) - Pinus (2 needles)
 Poison Ivy - Rhus
 Sea Beach Goldenrod - Solidago
 Beach Pea - Lathyrus
 Sea-Rocket - Cakile
 Scrub Oak - Quercus
 Salt-Spray Rose - Rosa rugosa
 Sea Rose - Rosa virginiana
 Dusty Miller - Artemisia
 Dune grass - Ammophila
 Eel Grass - Zostera

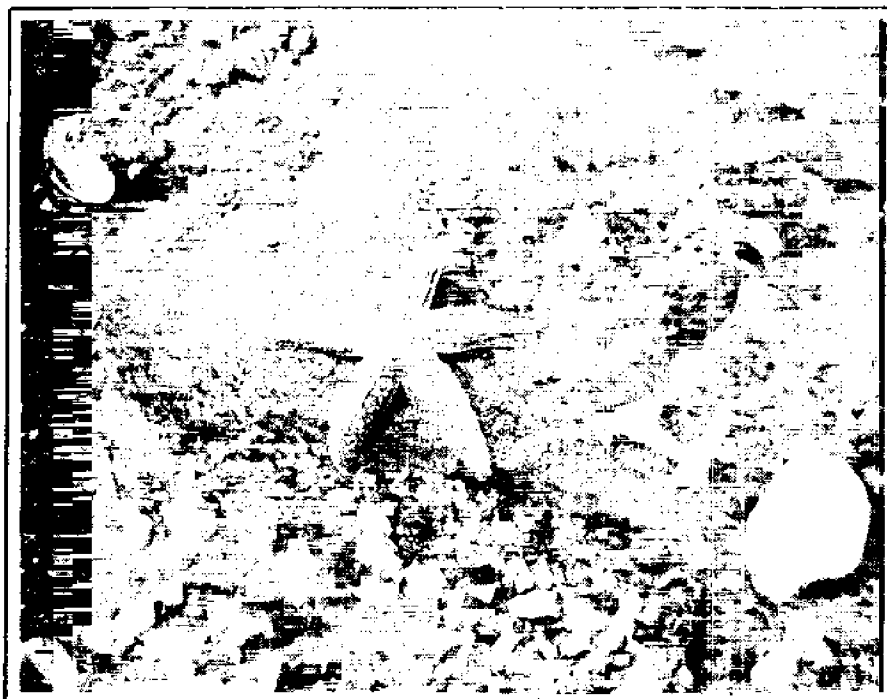
*This is a partial listing.
 There is a bird sanctuary also.

This area is ideal as a model for a beach environment to maritime forest in this climate and coastal form.

At East Marion - on Route 25, east end of town, the road is bordered by a sea wall on the right and a salt marsh (Dam Pond) on the left. On the south side, facing the harbor, is a tidal flat exposed at low tide. The place is extremely good for the inspection of scallops. They are like a carpet in this area. The fauna is similar to the list above for Orient with the addition of these species:

Clam - Mya, Mercenaria
 Worms - several species

Several of the seaweeds mentioned above are also found in abundance. On the north side of the road is a large salt water pond and marsh. Typical marsh plants are here. There is a small bridge between the two areas. This is an excellent place for the collection of plankton by net. The area drops away



quickly to about eight feet in the middle of the bridge. The current is always moving. It would be excellent to arrive at either high or low tide early in the day and then return later to see the water moving in the opposite direction. This spot is the farthest point for the tide to reach as it influences Gardiners Bay, the Orient Harbor section. Seining can be very productive.

Suggested Activities on all three levels:

Prior to trip:

Lessons including these topics:

- salt marshes - formation, vegetation, value
- beaches - formation, types, zones, flora and fauna found on the beach
- geology - last glacier up to the present for Long Island
- plant succession in this area and climate
- history of the East end North Fork Area
- care and preservation of live specimens: prep aquaria.

At site:

Water chemistry - test each site for dissolved oxygen and the salinity using a portable kit, commercial or homemade.

Seining - fish should be put in a tub with a battery operated aerator; some should be immediately identified; some preserved in jars for further study and dissection; the rest should be returned to the water as soon as possible.

Collection of seaweeds - identify each; put some in an open pail for further study in the classroom; preserve some by floating in a shallow pan of water, placing a stiff blotter or white board under the specimen - raise the paper slowly out of the water, taking care to center the seaweed on the paper. Let water drain off, then place between corrugated paper, tie tightly and allow to set overnight. You will have a set of plants for the class to study.

Collection of animals - take only what can be used to learn about the species, whether for a class dissection or individual research project. Either aerate or place in a wide-mouthed container for air supply; also preserve some for study.

Microscopic Examination - bring some stereoscopes with mirrors, a few watch glasses or culture dishes, even half of a petri dish will do to hold the smaller specimens for viewing.

Collection of Water - using five-gallon plastic gas-can-type jugs that have never had anything but water in them, fill and cap for use in the classroom tanks. You can put your specimens in water of the same temperature from which they came.

Plankton Collection - use glass jars with wide mouths to put the hauls into. Using small dropper and a petri glass dish, have the students observe and identify some critters; the stereos are used for this work. Put several hauls in a larger jar for use in the tanks when you arrive back at school.

Upon return:

Each seaweed can be tested by chromatography. The page-dried specimens can serve as posters for identification. The plankton can continue to be studied. A millipore filter can be used to get a good concentration which can then be looked at by several students. Another idea would be to inoculate a small tank or a graduated cylinder with a concentrated sample. Place this in direct sunlight. Each day note the turbidity of the sample. Keep making a microscopic examination daily to determine the surviving plant and animals. A regular compound microscope and glass slide preparation will reveal the algae present. Use of a spectrophotometer can give a very good graph for study.

Each animal collected should be identified by using a key; the dichotomous type is best. Then, if you have brought back enough, an investigation of the internal anatomy would enable all to learn some of the characteristics of the various phyla. Another alternative would be to divide the class into groups responsible for different specimens. Each will prepare an oral report on the organisms studied and also will be responsible for leading the overall class in a dissection of the specimens. One stencil may be given to each group for the written lab instructions they have planned.

Maintenance in tanks can be another ongoing project assigned to members of the group.

Preparation:

The following are suggestions for good order and coverage:

1. Tides - find a date to suit your time of arrival at East Marion site (tidal flats). To compute this, using the free high tide tables available at your local bait and tackle shop, use the Sandy Hook listing, add one hour and you have the high tide time at Greenport and East Marion. About three and one half hours later the tide should be out enough to expose the flats for study.
2. Arrange transportation, two or three weeks prior to departure.
3. Write or phone for permit - the listing is included above.
4. Teach lessons needed as background.
5. Make ready all classroom facilities for the work ahead.
6. Give each student a list of things to bring (baggies, knife, etc). Include a map of the area, times of visitations and a

special worksheet to be handed in after the trip. This last item should include questions about what is found, where and why?

7. Pack tubs, microscopes, glassware, nets, buckets, etc. and assign students to be responsible for these items during the entire expedition. If a fish fry is planned, the students should also be put in charge of the planning and cooking needs.

Warnings:

At the East Marion site - do not wade into the water just under the bridge for its depth suddenly drops off. Also, there are signs that only residents of Southold township may take scallops in numbers without a permit. So if you are planning for a meal, a permit from the township is necessary. The Dam Pond area is a delicate one - care should be taken not to enter in too far from the road.

At Orient State Park, observe the park signs; students should not bother the birds nesting in the sanctuary, especially the osprey nests. There is a short hike along the one road in the park in order to reach the marshes. It has some curves; watch for oncoming cars.

At the Oyster Farms on Shipyard Lane which is 1.3 miles east of the blinker light on Route 25 at Greenport, there is actually not much to see in the plant, but just getting a verbal permission to walk over and observe the tremendous pile of shells is enough to make a short stop worthwhile. In the pile are many other sea creatures that came up with the oysters when dredged. You may even get to see the oyster boat at dockside with all equipment aboard. Be sure to stop at the office and ask.

General Comments:

Orient Park comes just before the Plum Island Headquarters on the mainland. This is a restricted area, but one can see the special boats used to transport personnel to the Animal Disease Laboratory. Just beyond this facility is the end of Route 25 and the ferry landing. The Plum Gut Light can be seen, and the original lighthouse on Plum Island can be seen if you bring binoculars. The Gut is known for its very strong tidal currents. Standing waves can be seen. The snack bar mentioned before is here. No restrooms, just a few tables. Parking is available next to the snack bar.

The ride could take two hours from around mid-Nassau County. It may alleviate the long travel if you plan a lecture on Long Island geology and as you pass the moraine and pine areas, an ongoing lecture and question period could be accomplished. Refrigerate plankton to save.

Author-Educator:

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Seaford, N.Y. 11783

Suggested References:

(GE) 3, 13, 32; (F) 39; (I) 46, (P) 60; (PL) 70.

NAME: Mt. Sinai Harbor

TYPE: General Field Work

LEVEL: All levels

AREA: North Shore, Eastern Suffolk, LI Sound

Arrangements: NONE

Directions: Long Island Expressway to Nichols Rd. (exit 62). North on Nichols Rd. to Nesconset Highway (347), 7 mi. East (right) on Nesconset Highway to Crystal Brook Hollow Rd. in Port Jefferson Station, 5 mi. North (left) on Crystal Brook Hollow Rd. to Brook Hollow Rd, 2 mi. Right on Brook Hollow Rd. to end, 1 mi.

Facilities: NONE (no restrooms). There are plans to construct some basic facilities, but to date they have not been started. Limited parking.

Boating Facilities: NONE. There is a town launching ramp, must have permit from Town of Brookhaven.

Type of Environment:

- 1) Long Island Sound with beach
- 2) Mt. Sinai Harbor with beach
- 3) Salt Marsh with estuary

Best Usage: Any type of near shore field work, beach botany, terrestrial salt marsh, poor city planning, beach erosion, coastal geology, birding.

Suggested Activities: Observation of local flora, some limited animals, comparative observation of several habitats, geology of beaches (area has high sand cliffs along the sound and very gentle beach in harbor, large spit develops at yacht club), ground water seeps, salinity, phosphate, nitrate tests on water.

Flora and Fauna

1) Salt Marsh Area

Ruppia maritima, ditch grass

Ammophila breviligulata, dune grass

Distichlis spicata, salt grass

Panicum virgatum, panic grass

Spartina alterniflora, salt cordgrass

Spartina patens, salt hay

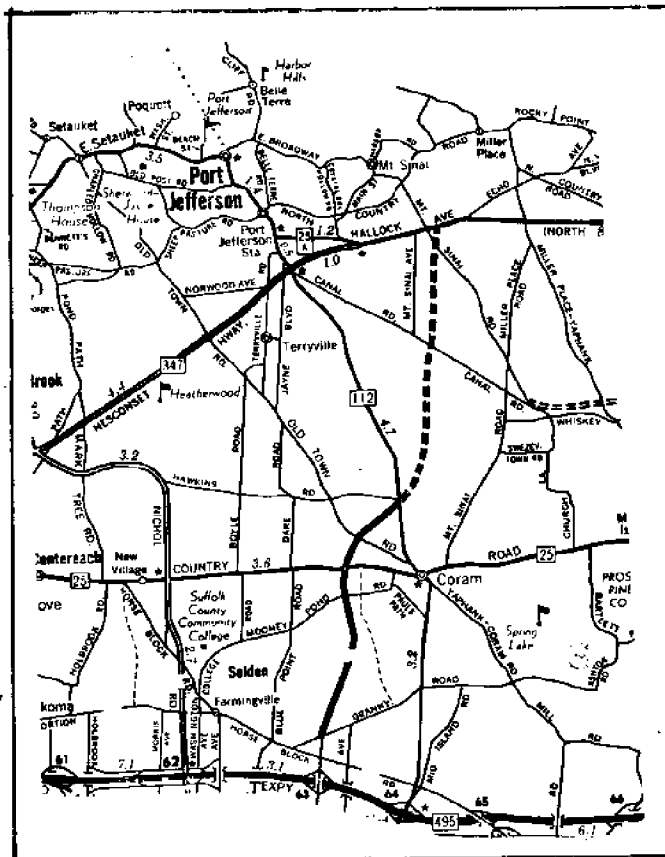
Juncus gerardi, black grass

Chenopodium album, Lamb's quarters

Rhus radicans, poison ivy

Iva frutescens, marsh elder

See publications below for more complete listing of plants.



fiddler crabs

many birds, egrets, heron, plover, sandpiper, sanderling,
gull yellowlegs, kingfisher (see publications for more
complete listing of birds)

- 2) Harbor, wooded area
black, red and chestnut oaks
beech
maple
flowering dogwood
sassafras
more complete listing in publications

mud snails
periwinkles
hermit crabs in tidal creeks
razor clams on intertidal islands
goosefish
moon snails and starfish on jetty
lobster
offshore in harbor -- chitins and sea urchins

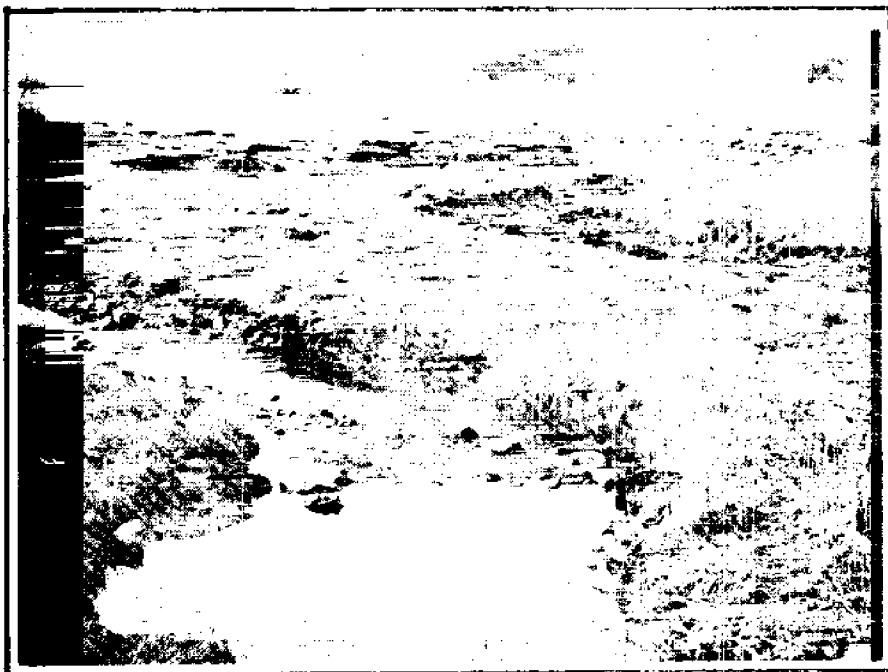
- 3) Long Island Sound
all types of seaweeds
mussels
clam worms
barnacles

Preparation:

Only organization of equipment

Warnings:

Watch tides, beach features best to observe at low tide
avoid sensitive area of heath peninsula
may get stuck in the mud
patens marsh not as sensitive as alternaflora.



A typical tidal creek

General Comments: Particularly good to see varied habitats within a small area. Construction of the last few years has greatly damaged part of the area and is good to show poor planning. Major drawback is the lack of facilities, but if the Marine Sanctuary is developed somewhat this drawback should be eliminated.

Author-Educator: John Black
Suffolk County Community College, Selden, New York

Suggested References: (GE) 11, 17, 26; (F) 42; (I) 46, 51; (PL) 64, 65, 70.

NAME: Studying an estuary, the Nissequogue River

TYPE: Field work

LEVEL: Secondary

AREA: Smithtown, N.Y. - North Shore, L.I.

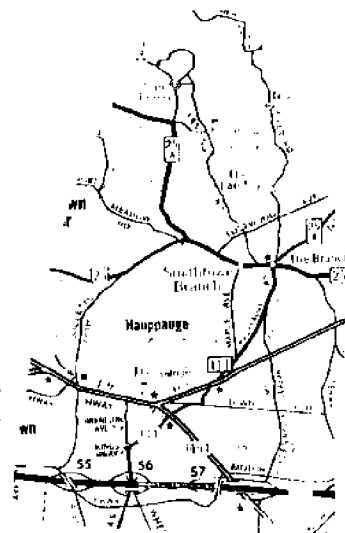
Arrangements:

Contact: 1. Suffolk County Dept. of Parks - specific - Blydenburg Park, Smithtown (Request form by phone and mail)

2. Smithtown Dept. of Parks - specific - parking at: The Landing Rd. Park and Short Beach Park on River Rd. (Request must be made in person, phone first.)

Directions:

1. Blydenburg Park - Take Veterans Highway, Hauppauge east-turn North on Brookside Rd. (2nd light east of the County Bldg.) Proceed to intersection of Brookside Rd. and Mill Dam Road, turn left at the light. The park is at the end of Mill Dam Road.
2. The Landing Road Park - return to Brookside Rd. and turn left or North at the light. Cross Rt. 25A, at the light, on to Edgewood Road. Turn left off Edgewood Road, at the light on to Landing Rd. The park is on the right hand side after the first bend in the road.
3. Short Beach Park - Return to Edgewood Road, turning left at the light. Proceed North. Turn left at a light on to River Rd. This is a narrow winding road which borders the river and ends at the beach.



Facilities:

Parking and rest rooms, except the Landing - no rest rooms.

Water Facilities:

Blydenburg - no in-water activity. Seining possible at the other stations.

Suggested Activities:

1. To observe the transition of a fresh water stream and its neighboring hardwood banks to become a predominantly salt water environment.
2. To investigate the changes in the physio-chemical properties of the estuary from its origin to its termination.
3. To observe changes in plankton obtained from each of the three stations using the microscope.

Blydenburg Park - The headwaters of the Nissequogue River are the spring-fed waters of Mill Dam Lake. Students can gather leaf samples of each of the hardwood trees. These leaves will be pressed, mounted and labeled in the classroom. A plankton sample is taken. Physio-chemical tests will be made of the following: Temp - Air and water; density; salinity - titration; Dissolved oxygen - D.O.; Carbon dioxide- CO_2 ; pH-water and bank soil. Fresh water plants and algae can be obtained. The many wild fowl present on the lake can be surveyed.

Landing Road Park - Here the students can graphically observe the dynamic change in the environment. A fresh water stream with its hardwood banks has now interacted with the Sound's tidal saltwater. To the south, the river has meandered and its valley widened. A fresh water marsh borders the river between the hardwood boundary. To the north, the marsh transcends into a brackish (salt-fresh) water marsh.

The students can walk into both marshes and survey the flora. With the aid of the teacher, floral zonation mapping can be done. Student teams can obtain one sample of each flora. The tidal height can be measured and its time recorded. Physio-chemical tests can be taken. Utilizing a seine net, those animals present in the river can be caught and identified. Sifting the bottom will isolate worms and eels.

Short Beach Park - The marsh, adjacent to the parking lot, is an excellent place to look for fiddler crabs, mud snails, hermit crabs and worms. Along the shore of the river, beach flora can be identified. Beach plums are abundant through the early Fall months. At the mouth, physio-chemical data is taken. Seining, behind the protected spit in the river, is excellent. The swail zone is evident along the shoreline.

Landing Road Park

Return to the Park. Measure the height of the water and record the time. Take physio-chemical tests.

Post-trip Activities:

1. Student teams will mount and identify all flora. These mounts can be displayed illustrating vertical zonation.
2. Observe the plankton samples diagram, identify and compare the three different stations.
3. Graph the physio-chemical data as a function of distance (Head waters; Landing; Mouth)
4. Individually complete a field report which consists of questions related to the activities.

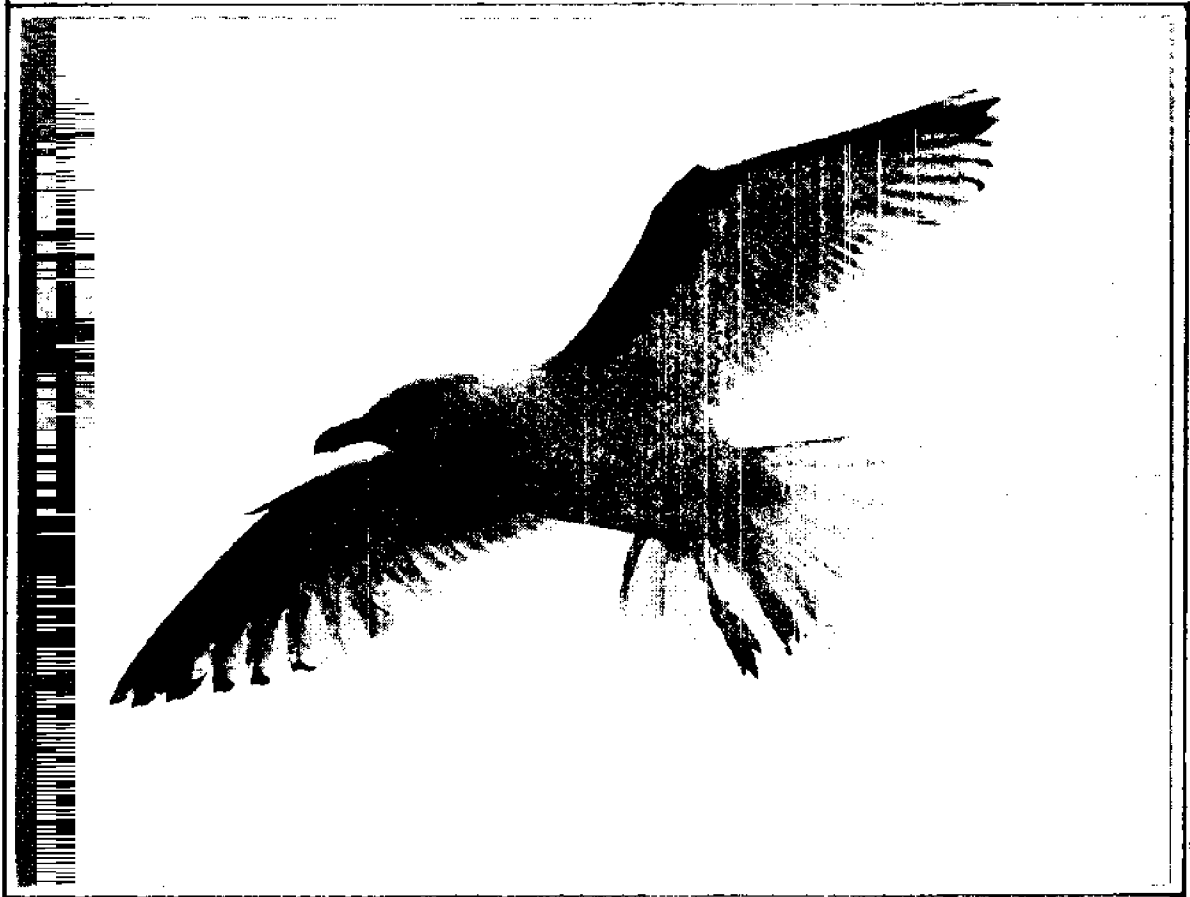
Preparation:

1. Student equipment: boots; baggies; lunch.
2. Use of physio-chemical test kits.
3. Familiarization of the area.
4. Class equipment; buckets; ice packs; nets; plankton tow; shovels; sifters; physio-chemical kits; meter stick.
5. Recommend taking slides and movies; and field glasses.

Warnings: The water is very swift at the mouth and in-water activity is not recommended. Poison ivy is present in the beach flora.

Author - Educator: Don Annino
West Islip High School, Higbie Lane, West Islip, New York.

Suggested References: (GE) 16, 26; (P) 59, 60; (PL) 63, 64, 71, 72.



On a not so-distant shore

NAME: Sunken Meadow State Park

TYPE: Marine Field Study - Beach and Salt Marsh Areas

LEVEL: Elementary, Intermediate or Secondary

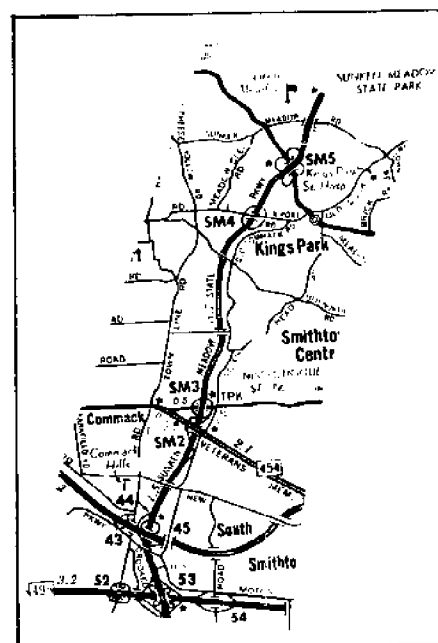
AREA: Suffolk County - North Shore of Long Island

Arrangements: Obtain permit from the Long Island Parks and Recreation Commission if the group exceeds 50 persons (telephone 516/MO9-1000). There is a charge of \$6/bus.

Facilities: There are parking accommodations, restrooms, shelter and picnic tables.

Water Facilities: Swimming and seining are possible.

Best Usage: Excellent specimens from beach and salt marsh environments may be found and zonation observed.



Type of Environment: Marine fauna are plentiful and diverse. They include the shells of clams, oysters, mussels, "moon" and jingles. Barnacles, drills, whelks, periwinkles and "slipper limpets" are abundant. Tubes of "trumpet worms" and "ribbon worms" are easily found. A search in the salt marsh may produce whelk casings, mud snails and amphipods. The flora includes green and brown algae and sometimes red algae when washed up from storms. This salt marsh displays the beautiful zonation typical of salt marsh vegetation.

Suggested Activities: A study of the flora and fauna expected to be found should be made prior to the trip and the zone where each item will most likely be found should be explained. For younger children, a list of plants and animals can be drawn up and points given for each item according to probability of finding it. Upon return from the trip, a thorough examination, under the microscope (if necessary) and a comparison of similar plants and animals should be made. Appropriate animals can be cleaned and displayed. Plants can be dried and processed.

Preparation: Appropriate clothes such as shorts and sweaters or jackets (it is colder at the beach) should be worn. Sneakers are a must! Pails, jars, plastic bags, tags and pencils (not pens) should be brought for collecting. Shovels and seine nets are also necessary.

Warnings: Again sneakers should be worn to protect the feet. Small children must not be allowed to wander alone on the beach. Care should be taken in the salt marsh. Small children should not be allowed here.

Author-Educator: Marjorie von Stade, C.W. Post College, Marine Science Department

Suggested References: (GE) 3, 11, 17, 26, 32; (I) 45; (PL) 68.

NAME: Sunken Forest, Fire Island

TYPE: Visitation, field work
(by ferry only)

AREA: Fire Island, Suffolk County

Arrangements: Contact the National Seashore Ferry at 516/589-1884 or at 10 Browns River Rd., Bayport, NY 11705 for schedule, group rates, and parking fees.

Directions: Long Island Expressway to exit 59 South. Continue South onto Lakeland Ave. and proceed across Main St. to dead end. Turn left and continue to end. Turn right onto Foster Ave. Turn left onto Terry St. (watch for Sunken Forest Sign) to River Rd. Immediately on left after turn look for sign next to gate to fenced-in parking area. Ferry ride to Sunken Forest approximately 30 minutes long.

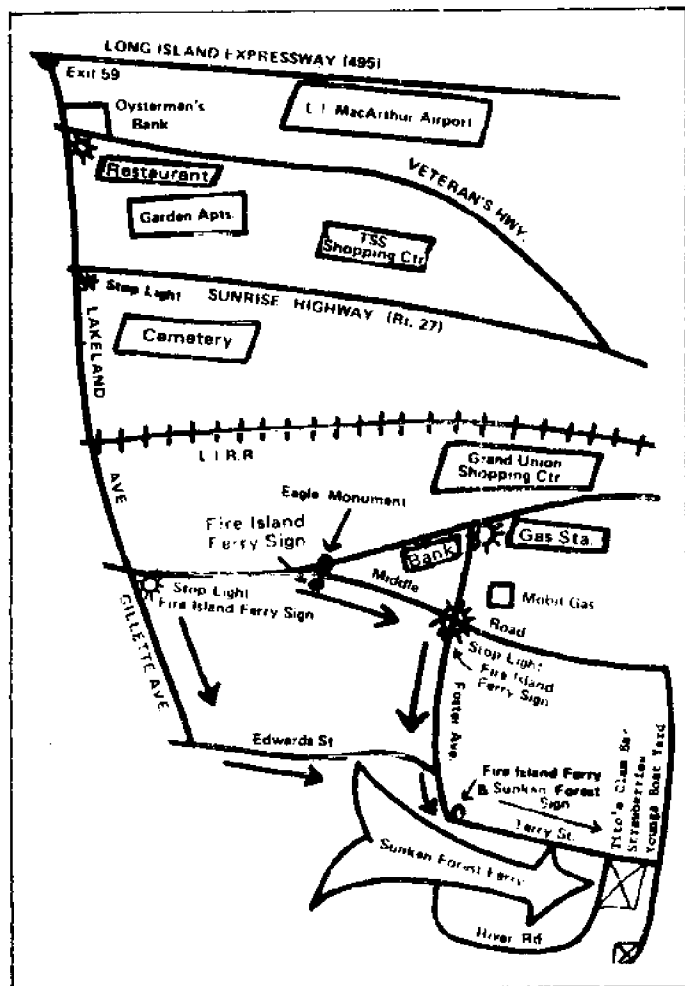
Facilities: The Park Rangers offer an interesting variety of programs at the open amphitheater during the evening hours and meet each ferry to give you a brief talk on what to see during your visit.

Brochures and booklets are available pertaining to the Sunken Forest and Fire Island 516/289-4810. During the summer months you may swim in the ocean and bay. Lifeguards are on duty during the summer only. There are also showers, clean bathroom facilities, a small museum and a concession stand for light lunches. The boardwalk starts at the Marina and winds through the cool forest sunken below the line of wind and salt spray from the Atlantic Ocean. Only one hundred steps away are the Atlantic Ocean and the Great South Bay.

Water Facilities: The bay environment offers a protected area where students can easily seine and observe the characteristics of organisms living on a sand flat. The ocean environment contrasts the gentle bay with its rough surf and erosive winds and currents. Students should venture into the ocean only under strict supervision.

Best Usage: The Sunken Forest is a prime example of succession from a salt marsh through a primeval forest into a dune protected ocean beach. This underdeveloped portion of Fire Island will give everyone the opportunity to see a remnant of the seashore that our forefathers saw.

Type of Environment: The Sunken Forest is a living wonder of nature, a primeval woodland region with centuries old trees, tangled vines, wild marsh, small ponds, and bay areas. The forest consists of wind-twisted pines, holly trees reaching thirty-five feet high, groves of oak, tupelo, sassafras, thickets, vines and berry bushes. The forest is sunken below



the line of wind and salt spray from the Atlantic Ocean. The fall foliage, migratory birds and monarch butterflies (flying by the thousands along the top of the sand dunes) are a wonder to see. The sand dunes protect the forest and the living creatures that inhabit it. This area of Fire Island contains a water table of fresh water held by the peat bog, which provides the forest and its animals with fresh water. The bay waterfront has grassy wetlands and salt marsh where waterfowl abound. The flights of duck and many other water fowl darken the skies with their forms in the fall and spring migration. The area provides the following habitats for investigation:

1. A well-developed holly (*Ilex opaca*) forest
2. Sand dunes with associated vegetation
3. Salt water marsh
4. Estuary (Great South Bay)

Suggested Activities: The following are a few of the questions that can be used prior, during, and after a trip to Sunken Forest:

Pre-field trip:

1. Prepare a vegetation (and) topographical map of the area.
2. Introduce students to phytoplankton and its importance in food chains.
3. Describe how sand dunes are formed and the importance of vegetation in stabilizing dunes.
4. Introduce students to concepts of primary succession.
5. Give students a brief lecture on the ecology of dominant vegetation at the Sunken Forest: slides, pictures, herbarium specimens could be used to acquaint the students with: holly, black cherry, shad bush, sassafras, black gum, red maple, and various oaks, the most common trees and suffrutescent species.
6. Approximately how old is Fire Island? How was it originally formed?
7. What is the name of the body of water which separates Fire Island from Sayville? From Greenland?
8. What are the general dimensions of Fire Island? Are they changing?

At Site:

9. Tour the Sunken Forest. Point out different kinds of vegetation in different areas and relate the presence of this vegetation to its relative tolerance of salt spray, and primary succession.
10. The effects of salt spray. Show how the woody and shrubby vegetation has been sculptured by salt spray.
11. Use plotless methods such as the point centered quarter method or random pairs method to sample woody vegetation in the Sunken Forest. This can be done from the wooden walk. Students should estimate trunk diameter of tree species so they will not have an excuse to run wild in the forest.
12. Coastal bird identification.
13. Soil sieves to determine dominant particle size of sand along the various points of the Sunken Forest. (Secure park ranger's permission before attempting this task.)

At Site:

14. Chemical tests of bay waters using water test kit.
15. Plankton tows at different depths from the dock in the bay.
16. Optional: Ranger's lecture on the geology, flora, and climate of Fire Island.
17. Optional: Special films of coastal life can be observed at the museum.
18. Brief examination of salt marshes on walk.
19. Name five functions of the Park Ranger on Fire Island.

Post-field trip:

20. List vegetation in each area of Fire Island beginning at the first line of dunes where dune grass dominates proceeding through the second dune system that shelters the Sunken Forest with damp depressions in the forest dominated by black gum and red maple to the sheltered salt marshes of the bay.
21. Primary succession. How long might it take a forest like this to develop? Specific studies of holly, dune grass, and/or other species in the area.
22. The importance of salt marshes in the estuarine environment.
23. Overhead projector to magnify plankton samples in the classroom (place concentrated plankton samples in petri dishes which when placed on the overhead projector will magnify the specimen from 10 to 30 times).
24. Discuss the importance of water salinity and nutrients in maintaining shellfish populations in the Great South Bay.
25. What does the term 'introduced species' mean? Give an example of one found on Fire Island, and why this particular organism is used.
26. List three causes of erosion which affect Fire Island.
27. Why are sand dunes never the same year after year? Why are the stones and shells on the ocean side so smooth?
28. What can be told from a cut-out, layered section of a sand dune?
29. Name three differences in water between the Ocean side and the Bay side of Sunken Forest.
30. Why is Fire Island growing westward? northward?

Preparation: Warm clothes, a big lunch, clipboard, plastic collecting bag, and a change of clothes (only if students are going in the water) are all that is necessary. Appropriate equipment for your individual class activities. This might include:

1. A small 3" x 5" notebook.
2. Appropriate clothing (sneakers, long-sleeved shirt, suntan lotion, bug spray, comfortable walking or hiking shoes.)
3. Small pails and bottles for samples.
4. Plankton nets.
5. Water test kits.
6. Collecting cups for soil.

Warnings: Sneakers should be worn at all times, both on land and in the water. Fire Island has an abundance of Poison Ivy. Also watch for splinters on the boardwalks.

General Comments: The Sunken Forest of the Fire Island National Seashore supports a unique ecosystem, an evergreen maritime forest dominated by holly Ilex opaca. The dominance of holly, importance of salt spray and the area's relative isolation make this a most unique site for a field trip. This site should be visited during the summer, late spring, or early fall. Dr. Stalter will be pleased to provide any interested individual with much more detailed information about the ecology, geology, floristics (including plant lists), plant communities, and more detailed information about special activities.

Author-Educators: Linda Jaeger, St. Clare's School, Rosedale, N.Y.

Dr. Richard Stalter, Director of the Environmental Studies Program, St. John's University, Jamaica, New York 11439.

Suggested References: (GE) 8, 9, 10, 13, 26, 28, 33; (B) 35, 36; (F) 39; (I) 45, 46; (P) 60; (PL) 62, 64, 68, 70, 71.

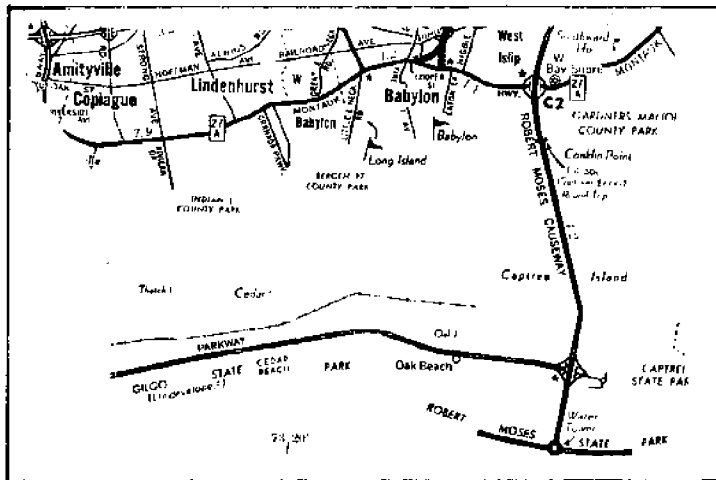
NAME: Ecology of a Barrier Beach

TYPE: Field Work

LEVEL: Elementary - Secondary

AREA: Fire Island Inlet -
Captree State Park

Arrangements: Contact Jones Beach
Parkway Authority, Permit
Division, Wantagh, NY, at
least three weeks in ad-
vance to obtain bus permit.
No parking fee for educa-
tional groups.



Directions: Wantagh Parkway to Captree State Parkway (about 20 miles). Bear left around water tower at Jones Beach and continue on Captree Parkway, past Robert Moses Bridge to Fire Island. About 1/4 mile past bridge, make right turn into parking lot (picnicking). Park bus at far end of field. Walk down towards beach and continue about 1/4 mile along beach to site under bridge. (See map)

Facilities: There are facilities for food, rest rooms and shelter at the Captree Boat Basin. In order to use these facilities, students would have to walk or the class could be transported by bus. There are no facilities at the working site.

Water Facilities: Since Fire Island Inlet has direct access to ocean, there are many good areas for seining at low tide. Particularly good areas are the bridge pilings and mud flats in the surrounding areas.

Best Usage: Particularly good seining area for various types of fish and arthropods. Because of direct access to ocean, many varieties of seaweeds may be found.

Many organisms attached to pier pilings and cement bridge pilings (sponges, fan worms).

Also, further up the beach is an interesting hard-packed sand flat containing many forms of Annelids and Echinoderms.

Suggested Activities On All Three Levels:

a. Prior to trip

The preparation for this trip could be in many areas. The following is a list of some preparations which I undertake.

1. Classification of seaweeds
2. How to mount seaweeds, introduction to chromatography
3. Class discussion on plankton
4. Ecological relationships of a barrier beach environment
5. Fish population census

b. At the site

1. Collection of seaweeds and plankton
2. Seining for fish
3. Digging for various annelids on sand flats
4. Use of secchi disc and forele scale
5. Observation and study of the herring gull colony (Larus argentatus)

c. Upon return

1. Students examine plankton samples and identify organisms
2. Mount seaweeds, chromatographic analysis of seaweed pigments
3. Fish population analysis
4. Follow-up discussion of ecological relationships

Preparation:

Maps of area

List of organisms which may be found in area

Things to bring on trip - boots, collecting buckets, snorkels, masks, shovels, nets, etc.

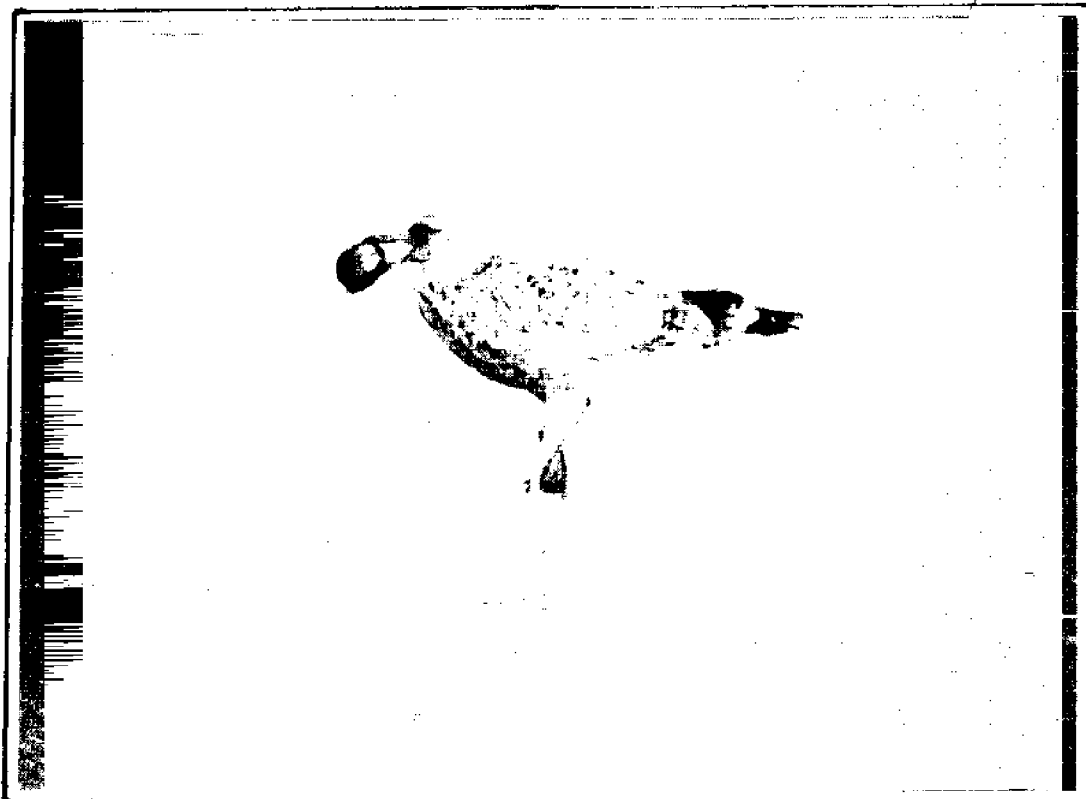
Warnings:

Do not walk out too far.

Possibility of swift current beyond first bridge piling.

Author - Educator: Burton Goldfeld, Marine Science Instructor, Valley Stream North High School, 750 Herman Ave., Franklin Square, New York, 11010

Suggested References: (GE) 8, 13, 26, 32, 33; (B) 35, 36, 37; (I) 45, 46.



A moon snail lunch

NAME: EARLY INDUSTRY ON LONG ISLAND
"Whaling"

TYPE: Visitation

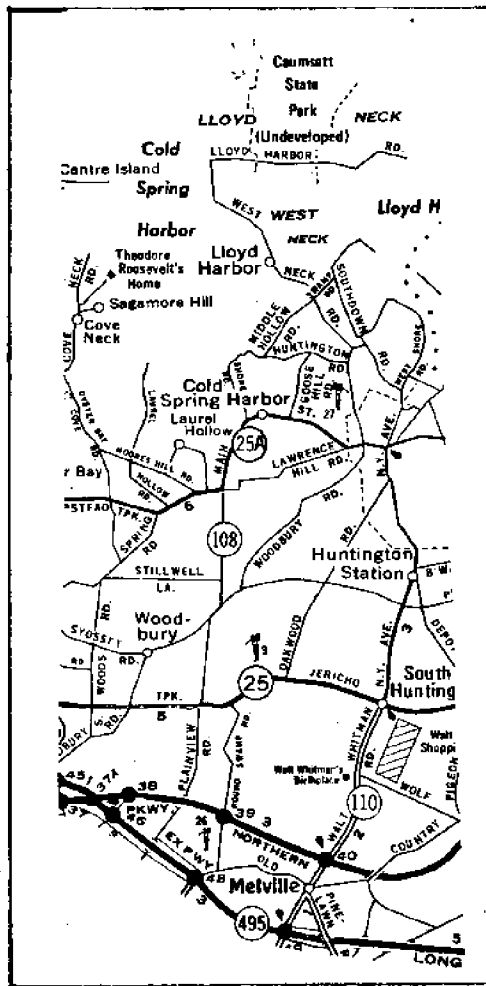
LEVEL: Secondary, Jr. High

AREA: Long Island

ARRANGEMENT: Contact Cold Spring Harbor Whaling Museum. 516/367-3418, Ms. Caroline Warner. Arrangements made for as convenient a time as possible, but on a first-come first-serve basis.

DIRECTIONS: Long Island to exit 49 north (Route 110). Follow Route 110 through Huntington and follow signs to Cold Spring Harbor. Museum is on east side of town.

BEST USAGE: This trip can be an inter-disciplinary trip because it can be used for Social Studies, Science, and English. It is suitable for Social Studies curriculum seventh grade New York State and eighth grade "Industrial Revolution." Science curriculum for whale anatomy and physiology. English classes can read the novel "Moby Dick" and use the trip to supplement and enrich.



SUGGESTED
ACTIVITIES:

Prior: To prepare the students for the trip they should have a background in the physiology of whales, whaling as an industry and history of Long Island.

On Site: Activities at the museum can be concerned with the physiology of the whale and an inspection of tools used in whaling such as a whale boat, harpoons, etc.

Upon

Return: Follow-up activities on such topics as man's effect on his environment, endangered species, and conservation. The following questions can be used upon return from the Whaling Museum.

1. When was the town of Cold Spring Harbor a whaling town?
Describe the whaling fleet that was based at Cold Spring Harbor.
2. What physical aspects of Cold Spring Harbor made it difficult for the whaling fleet to operate?

DIRECTIONS: While viewing the film "Down to the Sea in Ships" answer the questions below:

- A. Describe the life in a whaling town.
- B. Describe life on a whaling vessel.
- C. Describe the actual whale hunt.
- D. What are the dangers of a whale hunt?
- E. What parts of the whale are useful to the whaling industry?

SCRIMSHAW EXHIBIT

- 3. What is meant by scrimshaw?
- 4. What useful purpose did the making of scrimshaw collections serve while on a whaling voyage?

WHALE BOAT EXHIBIT

- 5. Describe the equipment on a whale boat.
- 6. How many men made up a whale-boat crew?
What were the different jobs they had?
- 7. What was the purpose of harpooning?
- 8. What is the purpose of the axe in the bow of the boat?
- 9. What were some of the early mechanical means of killing whales?

EXHIBIT OF TOOLS

- 10. List the various tools and other implements used in processing the whale.
- 11. Name some other tools that are necessary for a ship to have before leaving on a whaling voyage.

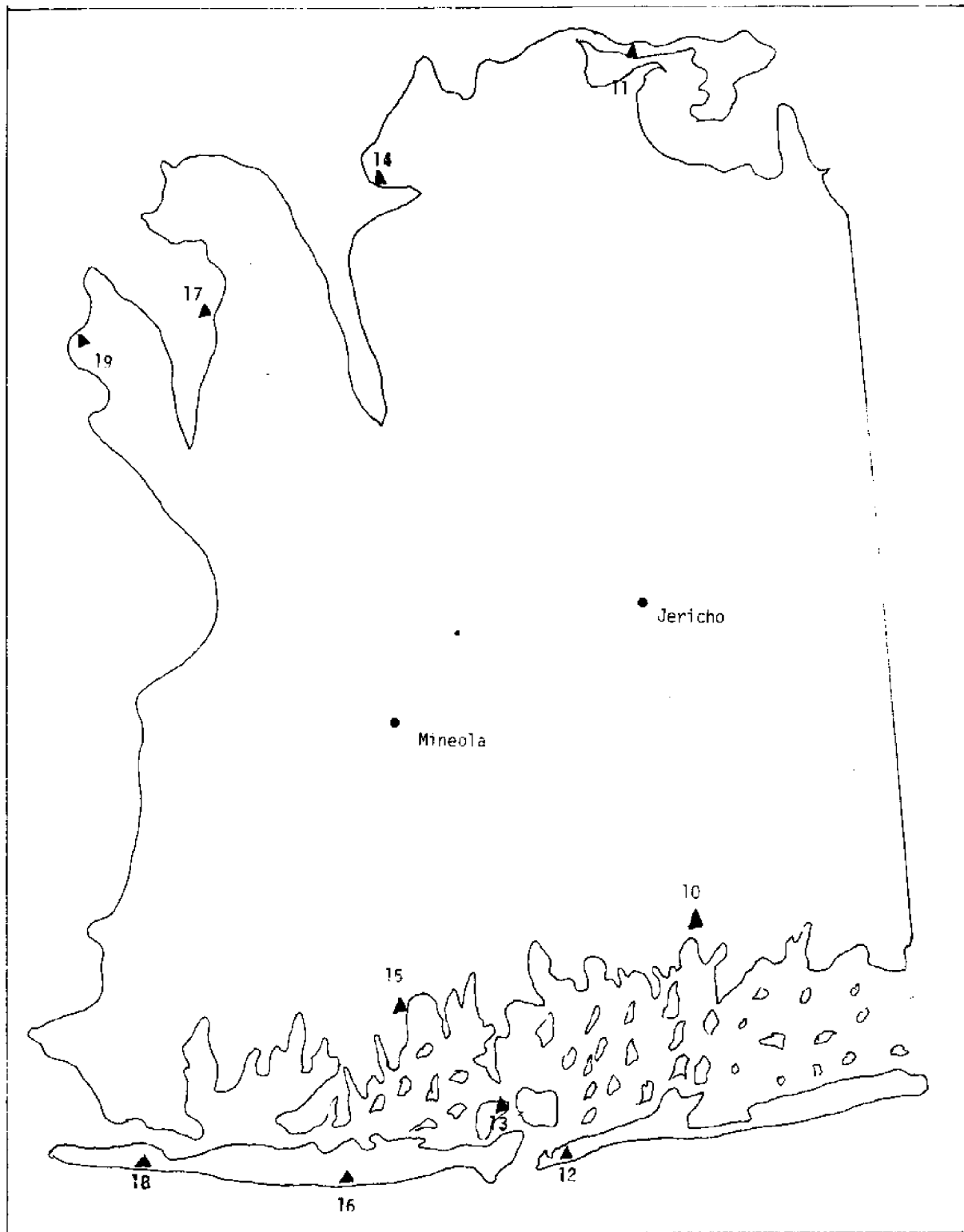
PREPARATION: I would strongly suggest that the students have a knowledge of the whaling industry on Long Island and why it became extinct. Also it would be a good idea for them to read "Moby Dick".

GENERAL

COMMENTS: The fee for the tour is \$10 per group and due to availability of space, groups are limited to 30. There is a movie, "Down to the Sea in Ships", that you can arrange to view while you are at the museum. In addition, you can arrange for museum personnel to visit your classroom for a \$15 fee, and present a slide show and a movie entitled "California Gray Whale".

Author Educator: Roy Shepherd
Mineola JHS, 200 Emory Rd., Mineola, N.Y. 11501

Suggested References: (GE) 20, 22, 31; (M) 53



Nassau County

NAME: Cedar Creek Water Pollution Control Plant

TYPE: Visitation

LEVEL: 5th through college

AREA: Wantagh, New York

Arrangements: Contact Mr. David Flaumenbaum at 516/781-4439
Monday - Friday 8AM - 4PM. Arrange tours at least
two weeks in advance.

Directions: Seaford-Oyster Bay Expressway (Rt. 135) south
to Merrick Rd. West on Merrick Rd. Approximately
3/4 mile to Cedar Creek Park. Left into Park.
Proceed through the park to the Plant.

Facilities: Parking and restrooms available. Visitation
takes about 1 1/2 hours, including 45 minutes in
classroom setting (capacity 35) with large, multi-
functional diagrammatic light-board showing the
plant, its functions, and treatment process, and
45-minute walk-thru tour, giving students a look
into the continuous process of sewage treatment.

Best Usage: The material presented includes the function of this plant as a
positive impact on our environment, and the actual operation of the various
treatment processes.

Suggested Activities:

Prior to trip:

- a) vocabulary review (dependent on level)
- b) discussion of the need for a treatment plant versus cesspools
and septic tanks
- c) review of the general treatment process

Upon return:

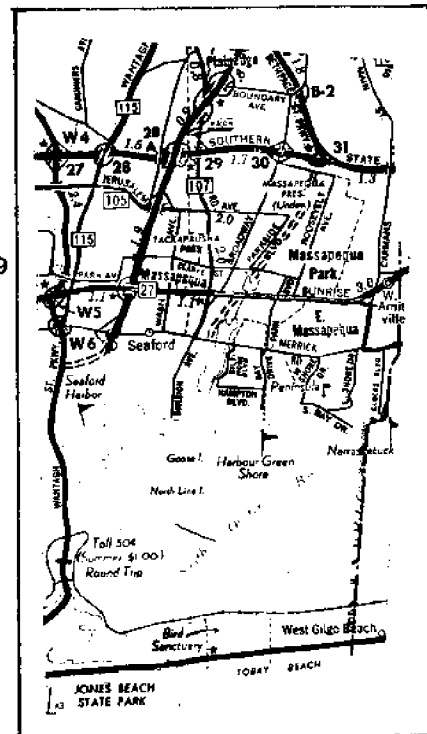
- a) review and define all vocabulary
- b) discussion of the general way a treatment plant is conceived,
funded, built, and operated
- c) review treatment process at Cedar Creek versus the process of
older plants versus cesspools
- d) discussion of the effect of the laws prohibiting ocean
dumping of sludge in the 1980s
- e) discussion of the practical uses of sludge
- f) discussion of the need for tertiary treatment on Long Island

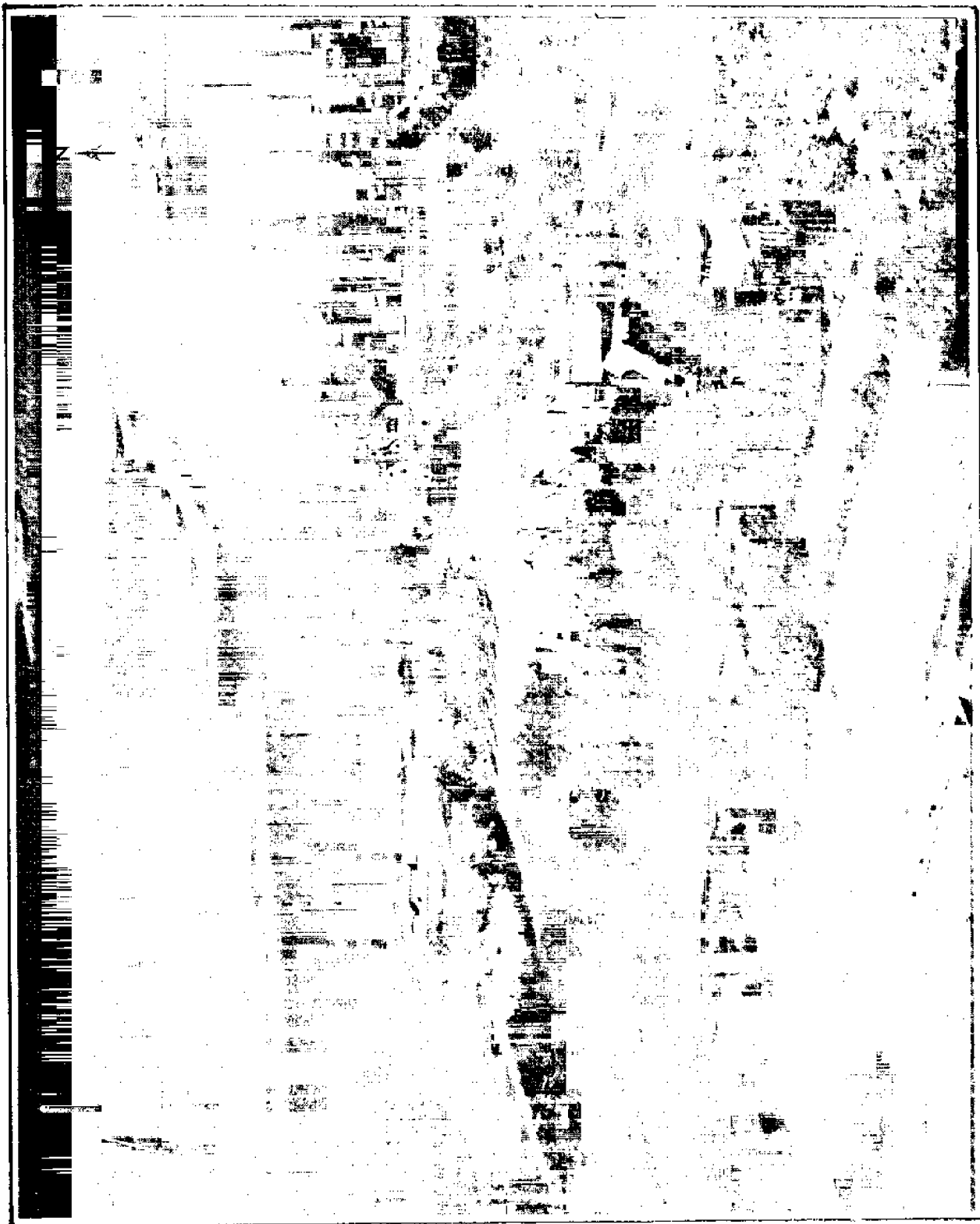
General Comments: Cedar Creek is one of the most modern treatment plants in the
country, and it is well adapted to perform the functions of an educational
institution.

Warnings: Please advise students to stay within their groups and not to go near
the edge of the treatment tanks.

Author-Educator: Mr. Dave Flaumenbaum, Cedar Creek Water Pollution Control Plant,
Wantagh, New York 11793.

Suggested References: (GE) 17, 18.





Aerial photo of Huntington Harbor

NAME: Rocky Coast Field Trip

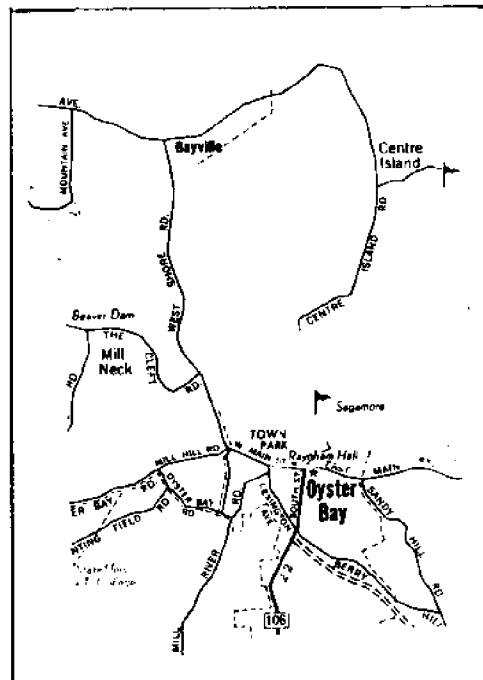
TYPE: Field Work

LEVEL: Secondary; however, the activities can be modified to interest intermediate and elementary students.

AREA: The North Shore of Long Island; Town of Bayville, Nassau County.

Arrangements: During school year, no arrangements are required. Park buses and cars along the road or in Town of Oyster Bay Parking Fields without permits.

Directions: Long Island Expressway to Exit 41N. Route 106 to Berry Hill Rd. Left on Lexington Ave. to Shore Rd. Follow Shore Rd. (turn left). Shore Rd. winds around Oyster Bay and over the Bayville Bridge. At traffic light in Bayville turn right and follow Bayville Ave. to entrance into village of Centre Island. On left are hundreds of glacial erratics partially exposed in Long Island Sound.



Facilities: During the school year, this site offers no provisions for food, shelter or restrooms. Parking facilities were indicated under arrangements.

Water Facilities: There is no suitable site to launch a boat; however, inflatable rafts are possible. Swimming, seining, snorkeling and collecting are permitted.

Best Usage: The intertidal rocks that comprise the Centre Island Reef are just about the closest a Long Islander can come to studying the ecological interactions of a Rocky Coast Community. At low tide, students can walk out several hundred yards into Long Island Sound without getting their chests wet.

Type of Environment: An intertidal area in Long Island Sound that has many large glacial erratics. At high tide these rocks are completely submerged; however, at low tide they are exposed and accessible for student study. A modified type of zonation is in evidence on these rocks. It is an excellent study in flora and fauna adaptations. Also in evidence are many examples of symbiosis.

Suggested Activities: The number and variety of activities possible in this area make it applicable to all grade levels. Listed below are some that can be used:

- (1) The area can be used to discuss glaciation and its role in the formation of Long Island.
- (2) The teacher and his students can wade out to an erratic sand-rock bar, and engage in a show-and-tell type activity.
- (3) Students can divide the rocks into distinct zones, collect specimens from each zone and relate the distribution of an organism with his adaptive structures.

- (4) Using snorkeling devices, students can collect specimens from the sub-tidal portions of the rock as well as from the bottom adjacent to the rock.
- (5) Using simple quadrats, barnacle and blue mussel densities can be determined. Students will see the inter and intra-species competition that results from limited substrate.
- (6) Upon returning to class, students can key out their specimens and place them into trophic levels. Trophic levels can be matched with approximate population densities to demonstrate the "pyramid of numbers" concept in ecology.
- (7) A typical follow-up lab report might include the answers to the following questions:
 - (a) Identify all the plants and animals you found on the intertidal rock. For each species you identify, indicate (1) whether it was a primary consumer, producer, secondary consumer, scavenger or decomposer; (2) its location on the rock and (3) what it feeds upon.
 - (b) Draw a sketch of the rock and show the location of the different plants and animals with respect to the low tide line.
 - (c) Which plants seem to be dominant? Indicate their density in some suitable unit.
 - (d) Which animals are most numerous? Indicate their density as above.
 - (e) Rank your animal species in an order showing decreasing abundance on the rock. Does your ranking data conform with the concept of "pyramid of numbers" in Ecology?
 - (f) Which plants and animals seem best able to withstand the extremes of temperature, salinity, dessication and wave action? Do these organisms have the least or greatest tidal range?
 - (g) For each of the following physical problems, select 2 species and describe the structural adaptations they possess that enable them to overcome the following hazards (1) maintaining one's position in the surf and current and (2) avoiding drying out and oxygen deprivation.
 - (h) Which species seem to have the least tidal range? Explain.
 - (i) Was there any evidence of interspecific competition or intra-specific competition on the rock. Explain.
 - (j) Where are the favorable spots on the rock. What makes them favorable?
 - (k) Did you find any evidence of structural or behavioral camouflage in this study?
 - (l) Describe the physical makeup of the bottom next to the rock. How did the plants and animals on the bottom compare with those attached to the rock?
 - (m) After examining shells and seaweeds, did you find any epiphytes epizooites?
 - (n) Did you find any examples of symbiosis (mutualism, commensalism or parasitism)?
- (8) Concepts can be tested with traditional exams or with a "practical" using the specimens collected.

Preparation: The following items should be brought by the students or teacher: clipboard, paper, pencil, bathing suit, (worn) towel, old sneakers, warm clothing (for when you come out of the water), face mask, snorkel, swim fins (optional), pocket knives, tweezers, quadrats, jars or plastic bags, styrofoam basket.

Warnings: Do not attempt this trip at mid or high tide. Students should wear protective coverings on their feet and hands in order to avoid barnacle cuts. Be alert for jellyfish as Cyanea has been seen on several occasions in this area. Look out for rocks coated with enteromorpha as they can be very slippery.

General Comments: This is a highly motivational trip.

Author-Educator: Robert A. Bosco,
c/o Deer Park High School, 30 Rockaway Ave., Deer Park, N.Y. 11729,
516- 242-6548.

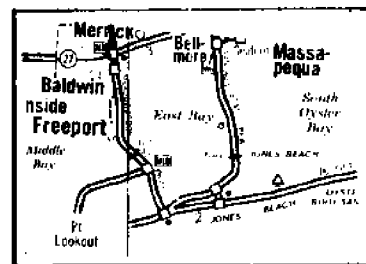
Suggested Publications and References: (GE) 1, 6, 7, 10, 13, 23.

NAME: Ecology of a Salt Marsh

TYPE: Field Work

LEVEL: Elementary - Secondary

AREA: Long Island - Jones Beach - State Channel



Arrangements: Contact Jones Beach State Parkway Authority, Wantagh, N.Y. for permit to enter tollgate. Do not pay parking lot fee since this is an educational trip. Call for permit at least three weeks in advance.

Directions: Wantagh State Parkway toward fishing piers at Jones Beach (bear right approximately $\frac{1}{2}$ mile past the tollgate). Sign will indicate fishing piers. Take road toward Coast Guard Station and turn right at sign for fishing piers. Enter parking lot and make right turn and proceed to the end of the parking lot.

Water Facilities: Mud-flats - excellent for seining -- flounder, pipefish, killies, occasional tropicals
Sandy beach - swimming, snorkeling
Piers - attached organisms - sponges, sea anemones, sea urchins

Best Usage: This strip could best be used for collecting organisms.
a. Seining - population studies
b. Plankton work
c. Net can be tossed from piers
d. Snorkeling
e. Pollution tests
f. Attached to piers and docks are large numbers of anemones, sponges, sea squirts.

Type of Environment: Estuary - salt marsh particularly good site for collections of salt marsh types.

Preparation: Educational - Lessons on salt marsh and estuarine ecology, cycles, bird life
Physical - How to use equipment - nets, etc.

Suggested Activities On All Three Levels: Prior to trip: plankton lesson, how to use nets. Since great numbers of anemones (Metridium) may be collected, it is advisable to study the anatomy beforehand. Same with sea squirts - especially heartbeat and circulation; At the Site: Collections - students may study zonation of organisms on pier post piling. Plankton collections from piers, surface, depth. Fish sampling and anemone and Sea Squirts collection.

At the end of the trip: Many follow-up lessons can be undertaken:

- a. Analyze specimens collected in zonation study. Why were certain organisms collected at different levels?
- b. Microscopic examination of plankton from surface and greater depth.
- c. Stomach analysis of fish.
- d. Use anemones to study stinging cells, digestion.
- e. Circulation may be studied in sea squirts.

Warnings: Barnacle-covered rocks, debris along bottom.

Author - Educator: Burton Goldfeld, Marine Science Instructor, Valley Stream North High School, 750 Herman Ave., Franklin Square, New York, 11010

Suggested Publications: (GE) 8, 13, 26, 32, 33; (B) 35; (I) 45, 46.

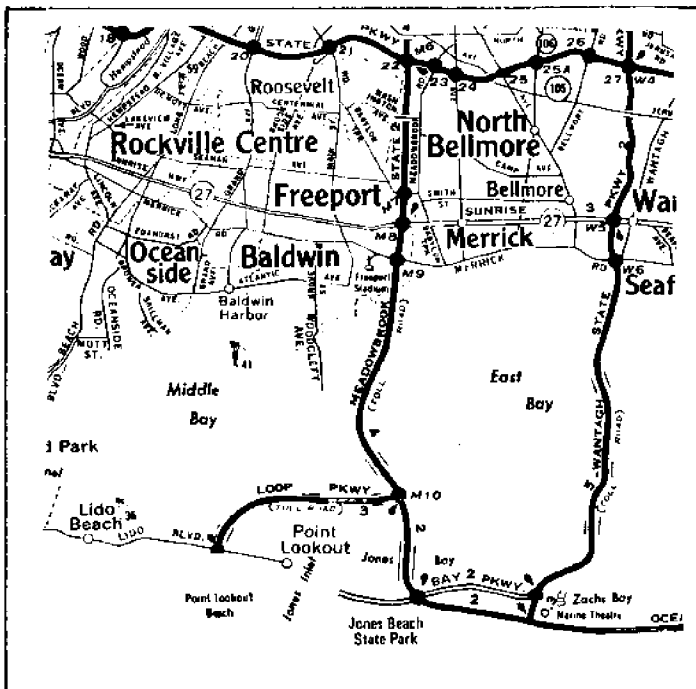
NAME: Loop Bridge Field Trip

TYPE: Field Work Including Testing,
Collecting and Hiking

LEVEL: Secondary but Activities can be
modified for Intermediate or
College Study

AREA: A Marsh Island in Great South
Bay

Arrangements: Since no parking facilities are available, only the discharge of students and materials is permitted. Several days previously, notify Nassau County Police Dept. of arrival and departure times (Traffic Safety 516/535-4126 and the Marine Bureau 516/593-7132.



Directions: Take Merrick Road (Route 27A) to Meadowbrook Parkway southbound. Pass through the toll booths on the right side and pass on to the Loop Parkway extension in the direction of Point Lookout and Long Beach. Continue just 100 feet beyond the second bridge and stop on the right shoulder. Immediately unload materials and students for no parking is allowed. Walk down (do not cross over the parkway) to the beach, under the bridge to the beach on the other side of the parkway. Bus and automobile parking is available about one-half mile from the site at the parkway's end. Bear to the right and park in the lot provided for in the public marina.

Facilities: There are no services available and as there are no phones, previous arrangements must be made for pick up. Vehicles upon their return can now stop on the opposite side of the parkway as before and students need only carry their materials up to the roadway.

Beach Environment: The area provides the following for investigation:

1. Narrow sandy beaches that lend themselves to docking small boats or rafts
2. A swift current in the boat channel during mid tides
3. Sand dunes with associated vegetation
4. Salt water marsh
5. Bridge pilings and supportive rock structures with distinct zonation

Materials and Equipment: The following items should be brought along:

1. Clipboard or small pocket notebook
2. Bathing suit to be worn and warm clothes for after-water work
3. Towels
4. Skin diving gear - mask, snorkel, fins
5. Plastic pails and jars with screw lids

6. Seine nets
7. Plankton nets
8. Portable aerators
9. Chemical test kits
10. Liquid refreshments
11. Camera
12. First aid kit
13. Comfortable walking-hiking shoes
14. Pocket and salt water diving knife
15. Sieve boxes with shovels

Caution: 1. Sample collecting from the bridge pilings is easy and highly recommended. The first set of pilings are at the waters' edge and go to a depth of about 3 feet. The second set of pilings are about 15 feet from the shore and are in about 6 feet of water. Do not go beyond these for you will then be in a boat channel.

2. Pre-planning, to be in the water collecting at slack low tide, is most important. The shallow water diving and lack of tidal currents provide a more accurate situation for viewing and sampling.

3. Caution when walking underneath the bridge is recommended because there is a great deal of algal growth on the rocks making them slippery when wet.

4. When walking through the dunes stay on the natural paths because some poison ivy is present.

Suggested Activities:

Pre-trip activities:

1. Map study - road, topographic, navigational charts.
2. Marine life study - organisms are attached and in area of rapid tidal currents.
3. Marine aquariums must already be in operation if sampling is to be done.
4. A great deal of marine algae will be exposed at low tide with zonation among the brown and green algae most prominent.

At site:

5. Assign groups of students to sample specific depths along the bridge piles - barnacles, mussels, sea anemone, sponge, hydroids, snails.
6. Plankton tows at different depths.
7. Seining.
8. Sand sampling - quartz, magnetite, garnet.
9. Clamming on the beach on the other side of the bridge.
10. Water transport measurements with incoming tidal currents.
11. Chemical tests and physical measurements.
12. Coastal bird identification.
13. Sieve boxes for sediment study and small-organism study.
14. Hike through dunes and identification of associated vegetation.

Post-trip activities:

15. Key out marine organisms and local flora.
16. Herbarium mounting.
17. Specific ecologic studies - sponges, crabs, clams, fish.
18. Chromatography and pigmentation studies.

General Comments: The general location of this area in the bay near Jones Inlet and ocean beaches is most attractive and full of diversified life. I recommend visiting this site in very early fall, summer or very late spring.

Author-Educator: Ronald S. Carol, Baldwin High School, High School Drive, Baldwin, New York 11510 (516) BA-3-8100.

Suggested References: (GE) 11, 12, 17, 26, 29, 32; (I) 46; (PL) 68, 70.

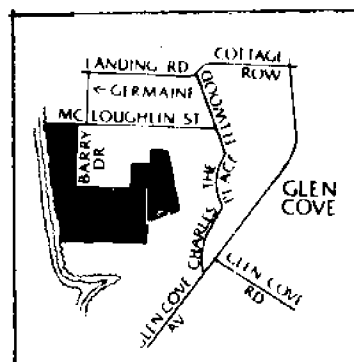
NAME: Garvies Point

TYPE: Field Work and Observation

LEVEL: Elementary, Intermediate, Secondary

AREA: North Shore of Long Island

Arrangements: Approximately two months notification that you will be there with your classes is all that is necessary. Check with the tide table and confirm with Garvies Point when the lowest tides are in order to reveal more of the beach area. Contact the museum at 516 671-0300.



Directions: Long Island Expressway or Northern Blvd. to Glen Cove Rd., follow north to Glen Cove. Once in Glen Cove follow signs to Garvies Point.

Facilities: Picnic tables available (suggest students bring lunch), parking available and free for both autos and busses; adequate restrooms indoor and outdoor; no boating; shelter from foul weather provided for those groups taking a planned program supplied by the Museum at the point.

Water Facilities: Not for boating, seining possible. Investigation and exploration recommended best at low tide.

Best Usage: All facets of biology and botany. Ecology and the study of ecosystems; the interrelationships between organisms; and geology.

Type of Environment: A harbor of the Long Island Sound noted especially for its formation due to past glacial action. Garvies Point has the distinction of having a cliff the facade of which exposes layers of rock strata formed in the cretaceous period. Results of wave and tide action are also observable.

Suggested Activities: (see accompanying papers)

Preparation: Outdoor clothing (boots, etc.), writing utensils, clipboard, etc.; field guide books, collecting bottles, magnifying glasses, camera, nets.

Warnings: Cliffs are very steep; there are steps, but caution must be used. Rocks and boulders on shore are slippery. There is also much clay on the shore which should not be stepped in. Students can become lost in the woods, and thus must stay in the group.

General Comments: Cost varies with the price of the bus rented from the school. It usually averages about \$1 per student. There is no fee to enter the preserve. However, if you wish to tour the museum, a fee of \$5.00 per class of 30 is required. Checks are made payable to Treasurer of Nassau County.

Author-Educators: John Kaiser
Alva T. Stanforth Junior High School
700 Hempstead Turnpike
Elmont, New York 10003

Brother Alphonse Matuga
51 Clapham Ave.
Manhasset, N.Y. 11030

SUGGESTED ACTIVITIES:

1. Beach Area: Shore life differs on rocky and sandy beaches, and on exposed and protected ones. Each bit of beach shows how plants and animals live together in certain broad life zones or areas. First and highest is the dry beach or dune area. The uppermost beach is reached only by the highest tides, storm waves, and ocean spray. The upper beach gets wet by tides twice daily, but the plants and animals are more adapted to land and air than to water. In the middle beach, which is covered with water most of the time, plants and animals are normally less exposed to air and are more harmed by drying. The lower beach is almost always submerged or covered with water except during the very lowest tides.

Plant and animal life form characteristic communities within these broad zones. Each is adapted to a particular marine environment and its food supply.

1. You will each make a detailed study of a section of each area of the beach. Include:
 - a) The names of all the animals and plants you find (including dead animals or plants - make sure the specimen just didn't float into your area, rather than actually living there). This includes all shells of animals - identify the shell, and determine whether it or anything else would belong in this zone .
 - b) Study each animal (such as a snail, oyster, barnacle, and more) in detail such as: 1. how it moves 2. how protected 3. color 4. size 5. where found - in sand, on top sand, under rock, log, attached to rock, plant, to another animal, etc. From the way the animal is put together, give reasons for finding the animal where you did.
 - c) Were the animals found alone, or living very close with different animals or with its own kind. Describe how the animals were living together, why they were living together, and if one animal seemed to be more dominant than another. What was their means of protection as a group? Does one animal seem to be living off of another animal, or just plantlife? How does each animal feed? Does its feeding habits explain the reason for the area in which you found it?
 - d) Study each plant found in detail:
 1. Name the plant 2. Describe the plant in detail, such as color, size, shape, the way it feels, the way it is put together (its different parts, and the purpose of each part). Is it a floating or attached plant (careful - might be a dead floating)?
 4. Record exactly where you got the plant, and how it was growing.
 5. Was the plant by itself, or was it in a community with other plants or with the same type of plants?
 6. Were there any plants or animals attached to the plant you found? If so, explain what they were doing there!
 - e) What was the overall relationship between the plants and the animals found in your area (living together? animals feed on plants? more plants than animals? vice-versa?, etc.)
 - f) Do not forget to describe each area in detail, such as: sandy, many slimy rocks, or much soft clay, or moving water, or puddle in sand, under rocks, dry sand, cliff side, etc.
 - g) You will carry on the same detailed research (a - f) for each area or community (1 - 5).

2. You will then compare each community with every other community regarding
 - a) type of environment b) type of plant and animal life. Take plant and animal life from one environment and put them in the other environments (one area at a time,) and explain why that plant life and animal life was found where it was, and why it could or might not survive when put in each of the other environments or communities! Be sure to include in your explanation a) the biology of the plant and animal b) how it feeds c) the type food it needs d) the protection it needs e) how it moves f) its coloration g) its outer covering.
3. Look for and describe signs of pollution on the beach, in the beach area or visible from the beach (across the shore, factories in distance, etc.) Explain your solutions for the pollution signs that you see!
4. Look for and describe in detail signs of EROSION in the beach area, ESPECIALLY ON OR NEAR THE CLIFFS LEADING DOWN ONTO THE BEACH.
 - a) Find a very small stream (trickle) of water coming down from the top of the cliff and follow it as far down as it will go. This is just the way rivers erode or wash away the land.
 1. Describe the course of the stream or how the stream goes. (Does it travel straight down or crooked?) Explain why! Does the stream carry anything? What? Where do these things go? Are there different particle sizes carried in the stream, and do they go to different places? What does the area at the end of the stream look like and why? Where is the water coming from for the stream?
 2. Describe any other examples of erosion, such as chunks of the cliff sliding onto the beach.
 3. Describe your solutions to the erosional problems seen.
5. THE MEADOW: The meadow is a grassy, sun-filled open area, and is an example of another type of ecological community or environment.
 - a) Look for signs of life, such as tracks of animals, feathers, clumps of fur, animal droppings, etc. From these signs, describe the kind of life that lives in a meadow.
 - b) Find actual examples of living animals, insects, etc.
 - c) Explain how these animals are adapted for living in a meadow, and not in the beach area.
 - d) What type of plant life is in a meadow and how are these plants adapted for living in the meadow?
 - e) Describe any signs and solutions of pollution here!
6. THE WOODLANDS: Characterized mainly by the heavy growth of trees.
 - a) While walking along the path, look for signs of spring, animal life, plant life being attacked, fungus, and vines, and pollution.
 - b) Make a study of an area of the woodlands, looking under leaves and dead logs. Notice the type of plant life and if one type of plant is more dominant than another.
 - c) Compare the Woodland community with the Meadow community and Beach community. Explain why the types of plant and animal life are different for each environment.
7. FRESH WATER: The pond was developed to establish a new environment. Minnows eliminate mosquito larvae. Dragonflies skim the pond. The quiet visitor

may surprise ducks on the water and seasonal birds in the trees. The fresh water attracts raccoons, chipmunks, rabbits, turtles and frogs.

- a) Describe the Fresh Water community in detail, including the pond itself, and the surrounding area. Include all plant and animal life seen, signs of any animal life, and any specimens discovered in the pond water (most likely done when brought back to classroom, as will the specimens of salt water also).
- b) Compare the Fresh Water community with the Woodland, Meadow, and Beach communities. Explain why the types of plant and animal life are different for each environment.

Suggested References: (GE) 5, 7, 10, 13, 20; (B) 35; (I) 46; (PL) 68, 71.

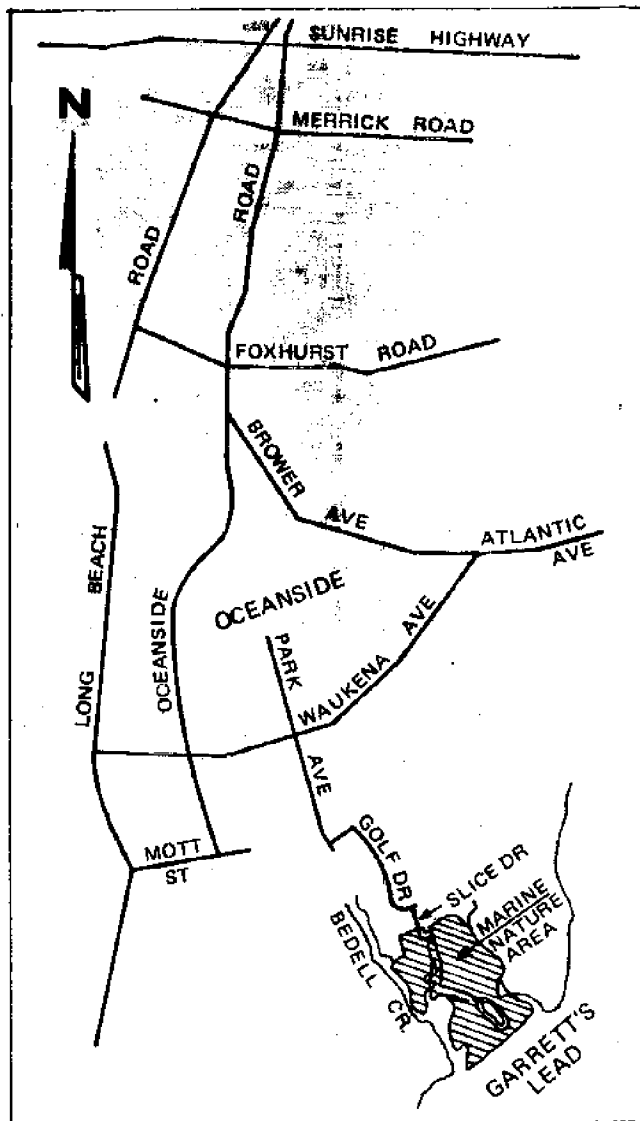
NAME: TOWN OF HEMPSTEAD MARINE NATURE
STUDY AREA
Foot of Slice Drive
Oceanside, NY

TYPE: Guided (or self-guided) tour of
salt marsh, bay and upland fringe
communities

LEVEL: Elementary (fifth and above),
Junior High School, High School
and College

AREA: South Shore of Nassau County,
Long Island, NY

Arrangements: Arrangements for guided
tours can be made by calling the
Marine Nature Study Area at
516/766-1580. Such arrangements
should be made at least two weeks
in advance, and special require-
ments or requests should be stated
at the time the reservation is
made. Request a Marine Nature
Study Area brochure from:
Department of Conservation &
Waterways
1 Parkside Drive
Point Lookout, NY 11569
516/GEL-9200
The brochure describes the area,
details the time when it is open
to the public, and describes the
best route to reach it.



Directions: Take any convenient route (e.g., Southern State Parkway, Merrick Road, Sunrise Highway) to Rockville Centre, N.Y. Proceed south on Oceanside Road in Rockville Centre and into Oceanside, N.Y. Turn left from Oceanside Road on to Waukena Avenue. Proceed east on Waukena Avenue to Park Avenue. Follow the green and white signs from the intersection of Park and Waukena to the Marine Nature Study Area.

Facilities: No food concession or picnic area on site.
Parking at the site is ample, but limited.
Restrooms at the site.
There is a small meeting room for a single class of 25-30 students or individuals.
There is a rain shelter located along the main trail to provide some relief from inclement weather.

Water Facilities: The Marine Nature Study Area is dominated by the bay, creeks, leads and drainages that surround it, but opportunities for water sport are not available; that is, there are no facilities for swimming or boating.

However, provisions are made for sampling and seining in the bay at the south end of the area, and nets, rakes and other collecting gear are

available upon request, but collecting of specimens is very limited and only under supervision.

Best Usage: The best use of the Marine Nature Study Area is as an outdoor classroom in which to become familiar with the salt-marsh ecosystem. A simulated barrier beach and the fringing upland afford a good opportunity to experience the interfaces of these systems with the marsh and bay.

The obvious surroundings of development (e.g., housing, landfill, park) illustrate man's impact on the estuarine environment.

Arrangements can be made for the limited collection of specimens (i.e., in small quantity and for a good purpose), and the area is an ideal place for nature photography (especially bird life).

Type of Environment: The Marine Nature Study area is a 52-acre salt marsh dominated by Spartina alterniflora. There are 5 Patens/Distichlis associations on a higher area of the marsh, and complex upland plant communities on the northern fringe. Many of the natural and introduced plants of the barrier beach are present.

The invertebrate population is numerous and quite varied (e.g., 28 species of mollusks), and the bird life is outstanding (area life list numbers more than 170 species). Muskrats are resident, as are diamond back terrapin, several of the mice and voles, raccoons and rabbits.

This is an outstanding example of Long Island salt marsh in the glacial outwash plain. It provides a unique opportunity to get close to the elements of the marsh and to enjoy a broad view of the entire estuarine ecosystem. It is also an excellent area to see and study the various types of shore birds and waders that visit and utilize the area both on a seasonal and year-round basis.

Suggested Activities:

Prior to trip (all three levels) - general reading concerning the salt marsh ecosystem. Read generally about ecological principles such as producers, consumers, and the salt water flora and fauna.

At the Site - 1. General guided or self-guided tours
2. Seining the fish populations
3. Also bird watching, photography, sketching, flora and fauna identification

Upon Return - Summation of the salt-marsh ecosystem. Discuss similarities between it and other ecosystems visited previously. Class could also establish and maintain salt-water aquaria. Plan follow-up visits to see how the salt-marsh ecosystem changes seasonally.

Post-tour projects should include discussion of the value of the marsh-estuary, man's impact upon it, the history of marsh destruction and protection, and research into recent legislation designed to preserve tidal wetlands and related ecosystems (i.e., recent public awareness of the changing nature of "progress").

Preparation: Physical - wear proper clothing according to season and day of visit. Bring binoculars and bird identification field guides. Bring containers, if collecting is to be done.

Warnings: Observe signs and general rules for visiting a wildlife sanctuary.

Comments: Staff at the site has a varied educational background and would be willing to set up any type of activity to accommodate any educational group that could find this area useful.

<u>Author-Educators:</u>	William Overton	Lawrence A. Kelly
	Conservation Biologist	Department of Conservation and
	Marine Nature Study Area	Waterways
	Foot of Slice Drive	1 Parkside Drive
	Oceanside, N.Y. 11572	Point Lookout, N. Y. 11569

Suggested References: (GE) 26, 27, 29; (B) 35; (F) 42; (I) 46; (PL) 68.

NAME: Long Beach

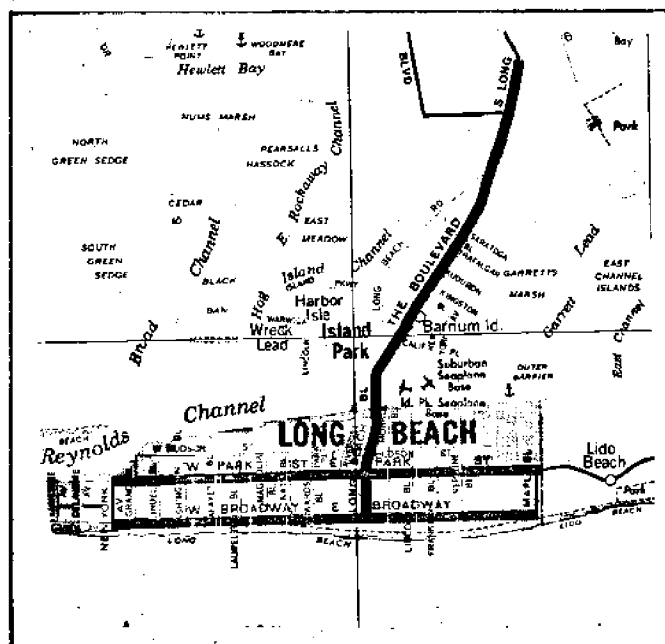
TYPE: Comparative - Sandy Shore vs.
Rocky Shore

LEVEL: All Levels

AREA: South Shore Long Island:
Ocean beach with well established
rock jetty

Arrangements: Commissioner of Parks and
Recreation of the City of Long Beach,
New York or for the area selected
(most all the beaches of Lido Beach,
Long Beach or Atlantic Beach are
useful for this field trip)

Directions: Southern State Parkway to
exit 19 (Penninsula Blvd.) South; to
Ocean Ave. Left on Ocean Ave. (across
Sunrise Highway) to Atlantic Ave.
Extension (East Rockaway); then left
to Lawson Blvd. to Daly Blvd.; then
left to Long Beach Rd.; then right
to Park Ave. in Long Beach; then
left on Park Ave. to Roosevelt Blvd.;
then right to Shore Rd.; then left to
beach at Pacific Blvd.



Facilities: None

Boating Facilities: None

Type of Environment: High energy sand beach (Quartz sand)
High energy rocky jetty
Tidal range of about 3 ft. with good zonation on rocks

Best Usage: Rocky shore zonation from splash zone to subtidal region. Some tide
pool but very small. Beach erosion and prevention. Life of the beach and
surf zone.

Suggested Activities: Substrate analysis vs. marine in fauna (in between sand grains).
Dominant plant and animals of rock substrate. Beach slope (good for seasonal
change also). Geology of Beach (Lamination). Comparison of sandy shore life
with rock shore life. Denude a section of rock and observe colonization and
succession (requires periodic returns to area). Microscopic blue - green
algae in splash zone on rocks. Water chemistry - DO, PQ, NO₃, salinity.

Sandy substrate - Emerita - mole crab

Other types of macro and micro crustacea

Polychaete worms

Flora and Fauna: Rocky substrate - Blue-green algae

Green algae - Enteromorpha, Cladophora

Brown algae - Cytosiphon, Fucus, Laminaria (some)

Zooplankton in tide pools and in water
Diatoms & other Phytoplankton in tide pools
Balanus Balanoides - rock barnacle
Mytilus edulis - Blue mussel
Asterias Forbesi - common sea star
Metridium - sea anemone
Various types of crabs (Blue, Green, Calico)

Advance Preparations: Equipment for carrying out the various tests and analyses.
Divide into two groups.

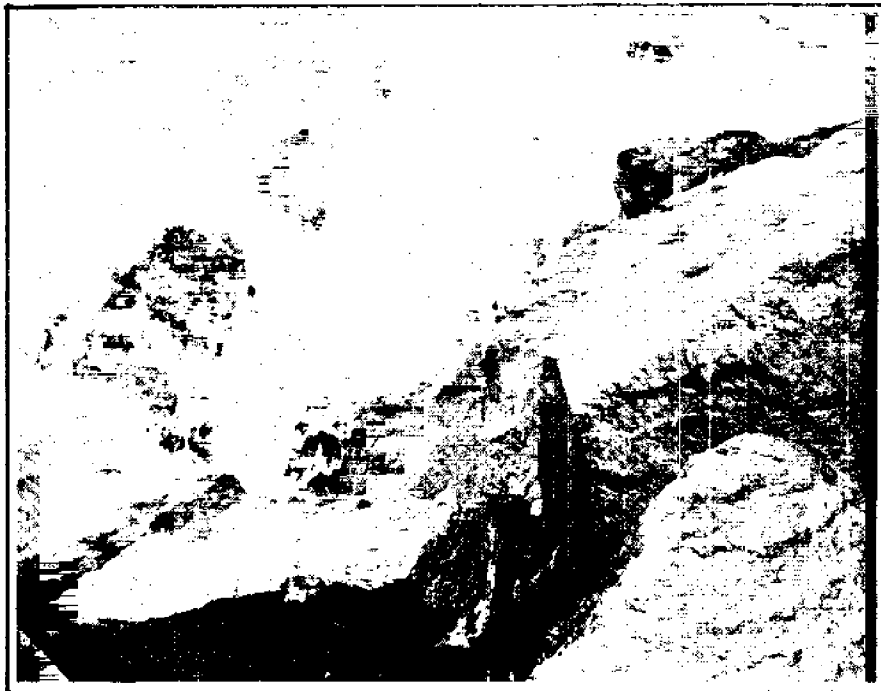
Warnings: Jetties can be very slippery and dangerous, especially at the breaking surf both on the jetty or in the water adjacent to the jetty.

Best to go at low tide - this will allow your group to get out to the subtidal area where there are anemones and some Laminaria.

General Comments: There are few places on Long Island where the rocky shore can be observed so well as these long-established rock jetties of the south shore. Also with the use of aerial photos this area makes a good study of beach erosion and its prevention especially if one can establish the history of the area from earlier aerial photos and maps and personal observations from some "old timers" in the area.

Author-Educator: Steven Lander, East Rockaway High School, Ocean Ave., East Rockaway New York.

Suggested References: (GE) 7, 32, 33; (B) 35; (F) 40; (PL) 62, 68.



On the rocks at Long Beach

NAME: Silver Point Beach and Jetty

TYPE: Field Work

LEVEL: Intermediate and Secondary

AREA: Long Island Beach South Shore

Arrangements: None - beach may be visited after Labor Day and before Memorial Day (off season).

Directions: Atlantic Beach Bridge - bear left towards Atlantic Beach several hundred yards on the right.

Facilities: Parking lot - no others

Water Facilities: Beach for seining and jetty for collecting

Best Usage: Collecting specimens, ecosystems, adaptations

Type of Environment:

Jetty: On Silver Point Beach - good spot for collecting sea urchins, starfish and observing rocky tidal zonation (at low tide), tide pool in rocks, variety of seaweed, barnacles, snails, etc.

Beach: Marine birds: gulls, sandpipers, beach wrack, and a variety of shells can be found.

Pilings: Barnacles, jellyfish, sandcrabs, amphipods and copepods.

Organisms which can be collected on the Jetty

Calothrix - blue green algae

Ulothrix flacca - filamentous green algae

Verrucaria - lichen (black tar-like patches)

Balanus glandula - acorn barnacle

Mytilus edulis - mussel

Enteromorpha - tubular green algae

Fucus vesiculosus - rock weed with air bladders

Fucus spiralis - rock weed without air bladders

Littorina littorea - periwinkle

Ulva - sea lettuce

Chondrus crispus - red algae

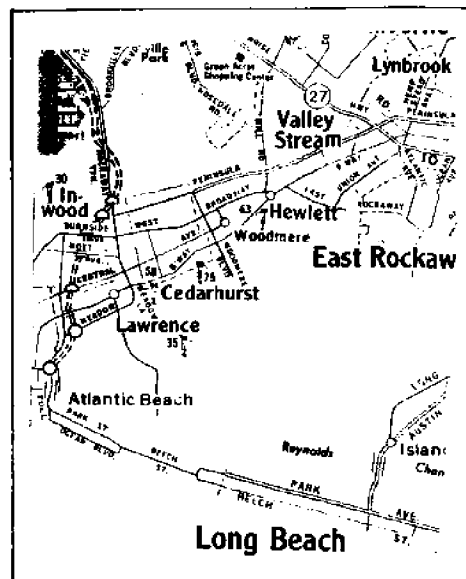
Asterias vulgaris - sea star

Strongylocentrotus - sea urchin

Suggested Activities: Prior to trip: discussion of beach, intertidal zone, marine birds, sea shells.

Post trip: lab work on organisms collected. For example:

Filter Feeding in Barnacles



Purpose -

To observe the filter feeding of barnacles and to observe the effects of a variety of changing parameters upon the feeding process.

Materials -

Binocular microscope or magnifying glass

Aerator

Culture dish

Barnacles

Seawater

Food - clam, brine shrimp, etc.

Lamp

Hot plate or bunsen burner

Procedure -

1. Remove a small rock, containing barnacles on its surface, from the rocky intertidal zone. Barnacles are difficult to remove from rocks without destroying the organism.
2. Place the barnacles in a culture dish filled with seawater.
3. Place the culture dish under the dissecting microscope.
4. Students should be able to observe the barnacle filter feeding. In barnacles the method by which they feed is filtering the water. The barnacle will open and extend its body and thoracic appendages which have bristle-like structures known as cirri.
5. Students should select several environmental parameters which can easily be altered and observe their effect on the organism.
6. Some of the parameters which might be altered include:
 - A. Changing the temperature of the water (higher and lower) and recording the number of movements of the cirri per unit of time.
 - B. Changing the amount of dissolved oxygen in the water (oxygen level in seawater can be decreased by boiling and increased by aeration). Caution - Cool the boiled seawater!
 - C. Changing the intensity of light (a high-intensity lamp may be used).
 - D. Feeding the organism different types of food (brine shrimp, minced clam, etc.).
7. Complete a parameter chart and draw conclusions from the data.
8. A diagram of a barnacle when it is closed and feeding should be drawn with the appropriate parts labeled.

Preparation:

Seine net, dip nets, boots, collecting buckets, field guides, binoculars, cameras, etc. Be sure to dress appropriately for the weather.

Warnings:

Jetty can be slippery. Sneakers should be worn at all times.

Suggested References and Publications:

(GE) 7, 32; (B) 35, 37, 38; (F) 42; (I) 45, 47, 48; (PL) 68.

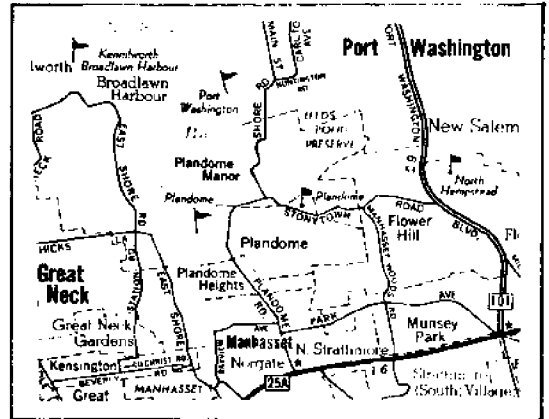
NAME: Manhasset Bay Marshlands

TYPE: Field Work and Visitation to Environmental Center

LEVEL: Elementary - Secondary

AREA: Long Island - Manhasset Bay - Plandome

Arrangements: Contact: Mrs. Fried - Administrative Assistant at 516/627-9400. Call at least one month in advance - no charge for bus parking.



The North Shore Science Activity and Environmental Center, staffed by volunteers and professional people, offers science programs for elementary and secondary school students. Located on a former estate, the center offers students and teachers choice woodlands, a marsh bordering Manhasset Bay, and opportunities to utilize the laboratories and other facilities.

Directions: Northern Blvd. to Plandome Road in Manhasset (it is the main road through the village of Manhasset). There is a large church on the corner. Travel approximately five miles to a stop sign. (Look for a sign pointing to North Shore Science-Museum Leeds Pond Preserve.) Make a left turn and travel around Leeds Pond. (Manhasset Bay is on your left.) Right turn at end of the pond toward the museum parking lot.

Facilities: There is ample parking. Restrooms are inside the environmental center. If permission is granted, laboratory and meeting facilities can be used.

Water Facilities: There is a saltmarsh, a small sandy beach, mud flats and a tidal marsh stream. Leeds Pond receives fresh water runoff and is constantly mixed with incoming salt water at high tide.

On the bay side, many small pools are left in the marsh, making it an ideal area for collections of fish and other invertebrates.

Best Usage:

- a. Salt Marsh Ecosystems
- b. Energy relationships in the salt marsh
- c. Bird Study - in the spring and fall months many migratory birds can be seen in this area
- d. Collection of Specimens
 1. Plankton study - there is a bridge overlooking the tidal stream. It is thus possible to suspend the nets in the current. Interesting plankton collections may be obtained.
 2. Large fiddler and marsh crab populations. An interesting distribution study could be made.
 3. Horseshoe crab studies
- e. Pollution studies
- f. Measurements in the tide pools

Type of Environment: Brackish pond - receiving fresh water runoff
Manhasset Bay - leads out to L.I. Sound; salt marsh and mud flats bordering Manhasset Bay

Suggested Activities on All three Levels:

A. Prior to Trip

1. Salt marsh ecology studies
2. How to use equipment
3. Plankton relationships
4. Pollution studies

Since this area is very close to New York City, it receives a great deal of out-flow from New York City waters. It would be interesting to monitor the waters for pH, coliforms, etc.

B. At the site

1. Transect study of the marsh
2. Population studies of fish, crabs
3. There are many annelid worms and clams. A detailed study of these organisms would be possible.
4. Pollution tests - O_2 , phosphate, nitrate
5. Salinity studies and oxygen levels in tidepools. Make a comparative study of tide pools.
6. Animal studies within the tide pools
7. Plankton collections

C. Upon return

1. Analyze and discuss organisms collected in transect study. Have students graph out transect, listing animals and plants.
2. Examine results of pollution tests, compare to other environments.
3. Laboratory studies of plankton

Warnings:

1. Be careful about mud flats - mud can be very deep. Difficult to pull someone out when caught.
2. Students must not walk barefoot - debris from L.I. Sound is everywhere.

Author - Educator: Burton Goldfeld
Biology - Marine Science Instructor
Valley Stream North High School
750 Herman Ave.
Franklin Square, New York 11010

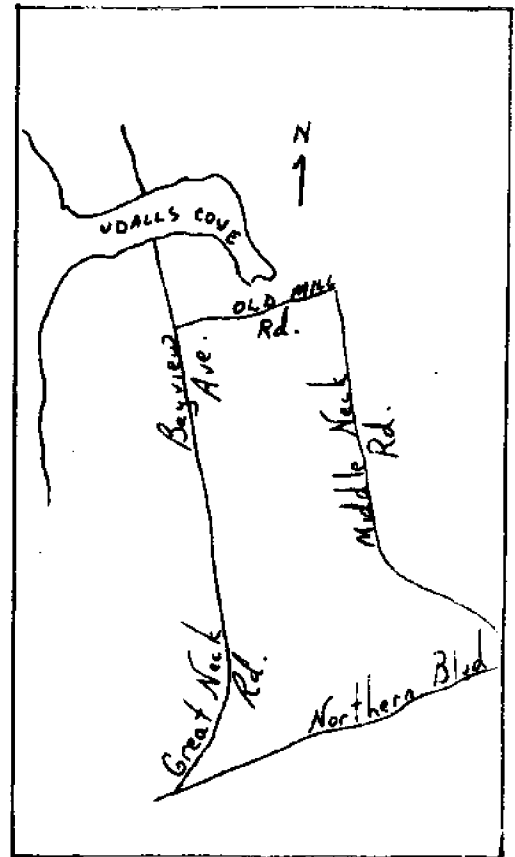
Suggested References: (GE) 8, 10, 11, 17, 26, 33; (I) 46.

NAME: Udalls Cove
TYPE: Salt Marsh, Estuary
LEVEL: Elementary, Secondary
AREA: Cove of Little Neck Bay,
Long Island Sound

Arrangements: Direct contact - letter of request one month in advance to the Board of Trustees, 4 Gateway Drive, Village of Great Neck Estates, New York, 11023 (516 - 482-8283) OR one week in advance by telephone to Robert D. Abrams, Coordinator of Environmental Education, Great Neck Public Schools, 516 - HU 2-8650.

Directions: Long Island Expressway, exit 33; North on Lakeville Road to Northern Blvd.; then left (west) to Great Neck Road; right (north) onto Great Neck Road which goes directly into Bayview Ave; left (west) onto Laurel Drive which deadends just past the junction with Juniper Drive. There is a small parking area at the entrance to the Park.

Facilities: None



Water Facilities: The park enters into a 58-acre salt marsh with a number of mosquito-drainage ditches containing freshwater run-off, a tidal marsh stream, sandy beach and mud flats.

Best Usage: The area illustrates the variations in flora and fauna between the following:
a) Saltmarsh; b) sandy beach and mud flats; c) meadowland; d) small forest area.

Type of Environment: A general tour of the area gives the student an overview of an environment that leads to and forms a saltwater estuary and marsh.

Following the circular park path in a counter-clockwise direction, your group will pass through a typical meadow with Giant Ragweed, Bindweed, Beach Wormwood, Queen Anne's Lace, Burdock, Curlydock, Butter and Eggs, Common Mullein, Peppergrass, Seaside Goldenrod, Asters, Plantains, Joe Pieweed and others.

Then the group enters a wooded area noting Staghorn Sumac, Ailanthus, Wild Cherry, Catalpa, Black Birch, Raspberry bushes, Pokeberry, Weeping Willow, Poplars, Honeysuckle and Fox Grape. A unique plant found here in abundance in the Spring is the Horsetail, Equisetum.

At the head of this small woodland, the group arrives at a bench and a view of the Cove and the Bay beyond. Going down a set of steps, the group passes through a stand of Japanese Knotwood with attached Deadly Nightshade and some Beach Rose (Rosa rugosa) to a small sandy beach. When seen at low tide, the sandy area is quickly displaced by mud flats. These flats contain many tidepools that are excellent for observing the local fauna.

Tidepools contain two types of snails, periwinkles (Littorina) and mud snails (Nassarius), ribbed mussels (Modiolus), rock barnacles (Balanus), an occasional hermit crab (Pagurus) or calico crab (Ovalipes).

The dominant algae of this shoreline includes Ulothrix, Enteromorpha, Ulva (sea lettuce) and Fucus (rockweed).

Walking along the sandy area fiddler crabs (Uca) are found and an occasional dead horseshoe crab (Limulus) is seen.

Digging on the edge of the mud flats you will be able to find clam worms (Nereis), soft shelled clams (Mya) and some small quahogs (Mercenaria).

Leaving the shore, the group walks along a "dike" through tall reeds (Phragmites). This is particularly intriguing for elementary youngsters. You will pass over a tidal stream where one can observe the oily surface and distinctive odors produced by blue-green algae (Cyanophytes). The stream is good for catching fish spawn and killies (Fundulus) with hand nets.

Arriving back at the fringe of the meadow, the group can observe the bulk of the salt marsh with its salt meadow grasses, Spartina alterniflora along the edges of the mosquito drainage streams and Spartina patens making up the greater mass of the area.

Usually unseen, the mud turtle (Kinosternon) and the terrapin (Malaclemys) are inhabitants here along with the muskrat (Ondatra). Large numbers of birds abound. Most common are the gulls (Larus) terns (Sterna) and Red-winged Blackbird. During the appropriate seasons, the American (Casmerodius) and snowy (Leucophoyx) egrets and Canada Goose (Branta canadensis) are found. During the migratory seasons, thousands of ducks (Anas) and brants (B. bernicla) use Udalls Cove as a stop-over on their fly-by.

Suggested Activities: A. Prior to trip: A review of the types of plants and animals that may be seen. A discussion of the vital interrelationships found in an estuarine salt-marsh ecosystem.

B. At the site: General population studies of the dominant forms. A transect of the marsh, sandy area and mud flat. Salinity measurements of tidal streams and pools. Oxygen levels in tidal pools.

C. Upon return: Identification and review of organisms seen. The impact of man and society on the marsh shoreline.

Preparation: a) Appropriate dress for time of year.

b) Equipment - small seine, dip nets, collecting buckets, hand nets, field identification guides, binoculars, poles and line, boots.

Warnings: This is a polluted area. Students should not taste anything or put hands to mouth. Sneakers must be worn. Do not enter water at high tide since the mud flats are full of "drop zones." At low tide mud flats can "hold" a person and removal may be difficult. Smoking or littering is not permitted.

General Comments: Since much debris is washed up in the Cove, it would be appreciated if the group brought plastic sacks with them to collect and remove some of society's artifact wastes.

High tide is roughly the same as the announced tide for Willets Point.

Author-Educator: Robert D. Abrams
Coordinator of Environmental Education
Great Neck Public Schools
345 Lakeville Road
Great Neck, NY 11020



New York City

NAME: Alley Pond Environmental Center (APEC)

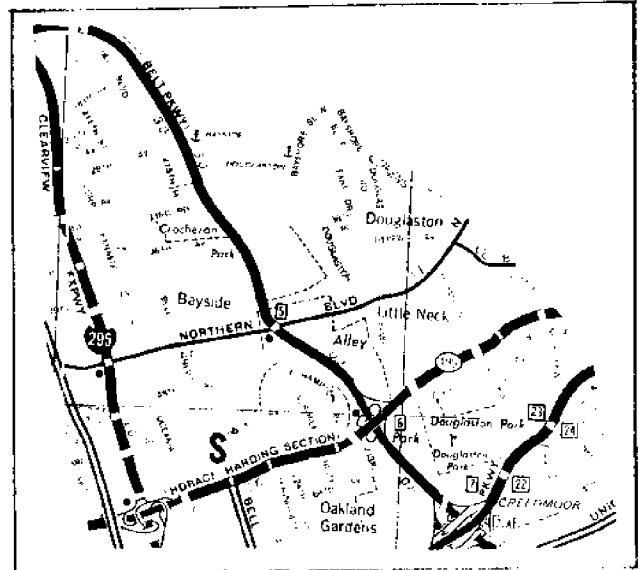
TYPE: Field Work, Visitation

LEVEL: Elementary through Secondary

AREA: Queens County, New York City

Arrangements: The Center is open Weekdays (except Wednesday) 1 - 4:30, Saturday 10 - 4:30, and Sunday 11 - 4:30. Contact the Center at (212) 229-5314 for information and reservations. The park area is open from daybreak to sunset.

Directions: The Center is located at 228-06 Northern Blvd. Take the Long Island Expressway to Cross Island Parkway, exiting east on Northern Blvd. The Center is about 300 yards east of the exit.



Facilities: The Center contains a natural science library, natural history and aquaria exhibits, and a meeting room with a capacity of 125 individuals. Outside is a recycling center which processes bottles, newsprint, motor oil, and metals. The Center is surrounded by several hundred acres of undeveloped New York City parkland.

Water Facilities: There are no facilities at the Center or elsewhere in the immediate neighborhood for swimming or public boat rentals. A public boat launching ramp is available as is marine fuel (at the Nichols Bayside Marina which is adjacent to the Cross Island Parkway). Fishing and seining are possible from the shoreline.

Best Usage: To show the succession of organisms from a bay-estuary environment to a tidal creek which leads into an upland meadow and pond area, and finally ending in a fringe forest.

Type of Environment: A tidal creek extends from Little Neck Bay for several hundred yards into an upland meadow that is bordered by a fringe of forest. *Spartina alterniflora* and *Spartina patens* are scattered along the creek. The meadows contain several ponds and springs.

A short walk across Northern Blvd. lies Little Neck Bay. The western edge is bordered by the Cross Island Parkway and a bicycle path which starts near APEC on Northern Blvd. and extends northward to Fort Totten. The entire west shore of the bay along the path is open to the public. This stretch of the bay presents a varied mixture of rocky areas, mud and sand banks, and patches of marsh. At low tide it is an excellent place for walks and collecting marine specimens. During winter and migration time, sea birds gather in large numbers in this area.

Suggested Activities: Activities are available for school groups K-12 on Tuesdays and Thursdays by appointment. However, the area can be used by individual teachers with their classes anytime. Some suggested activities are:

1. succession studies from bay to upland forest
2. digging in rocky, muddy, and sandy areas for various invertebrates and then comparing to see if there are any differences in the type, number of organisms present
3. seining for fish
4. tidal study
5. determination of the fresh water influx
6. pollution study vs. amount of boats present

Preparation: Have students make a map of the area, indicating the number of ponds, creeks, meadows and borderline forest. Things to bring on trip - boots, collecting buckets, shovels, sieve, nets, binoculars, etc.

Warnings: Do not walk out too far, especially in the mud flats. Be very careful when conducting the class on a walk near the Cross Island Parkway and Northern Blvd. since traffic is moving at a high rate of speed.

Author - Educator: Richard McDermott, John Adams High School
101-01 Rockaway Blvd.
Ozone Park, New York

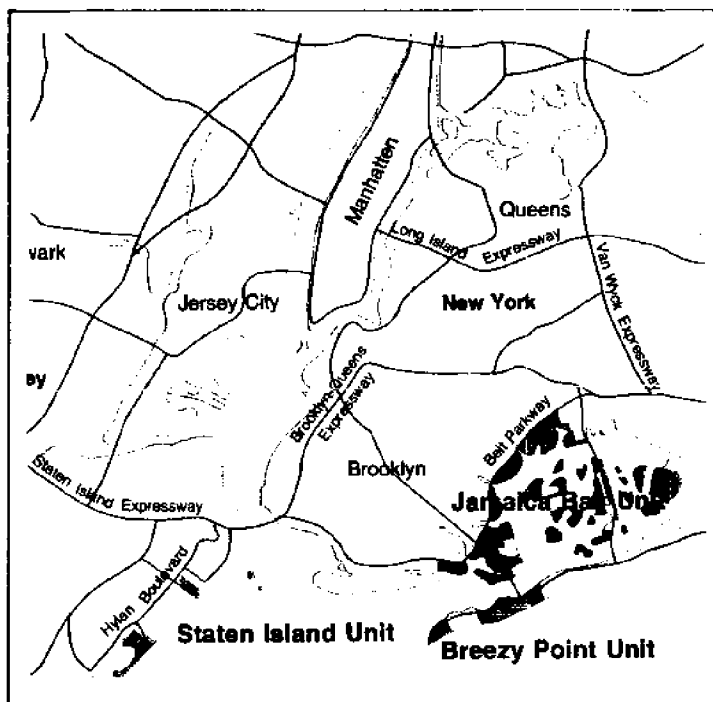
Suggested References: (GE) 10, 16, 22, 26; (B) 35; (I) 46; (PL) 68.

NAME: Gateway National Recreation Area

TYPE: Field (coastal) study activities- marine food chains

LEVEL: Elementary, intermediate, secondary, general public, college

Arrangements: Reservations for Ranger guided tours (minimum 10 people) must be made two weeks in advance through each Unit's Office:
Jamaica Bay Unit 212/630-0126
Jamaica Bay Wildlife Refuge 212/474-0613
Breezy Point Unit 212/474-4600
Staten Island Unit 212/351-8700



Directions: Breezy Point Unit:
Mass transit Subway: IRT 3 or 4 to Flatbush Avenue - Q35 bus to park; or IND A or E to Rockaway Park - Q22 bus to park. Bus: B6, B41, or B44 to Flatbush and Nostrand Avenues - Q35 bus to park; Q21 or Q53 to Beach 116th Street - Q22 bus to park. Auto: Belt Parkway to Exit 11-S, continue directly south across the Gil Hodges Bridge to Beach Channel Drive to park; or Woodhaven Boulevard to Cross Bay Boulevard, west on Beach Channel Drive to park.

Jamaica Bay Unit:

Jamaica Bay Wildlife Refuge Mass transit Subway: IRT 2 to New Lots Avenue - Q21A bus to refuge; or IND A or E to Broad Channel - walk to refuge.

Auto: Belt Parkway or Woodhaven Boulevard to Cross Bay Boulevard, south to refuge. Floyd Bennett Field Mass transit Subway: IRT 3 or 4 to Flatbush Avenue - Q35 bus to Field entrance. Auto: Flatbush Avenue to Floyd Bennett Field entrance.

Canarsie Pier Mass transit Subway: BMT LL to Rockaway Parkway-free transfer to B42 bus to entrance. Auto: Belt Parkway to Rockaway Parkway.

Plumb Beach Auto: Eastbound only on Belt Parkway to entrance between Knapp Street and Flatbush Avenue exits.

Staten Island Unit:

Mass Transit Rail: SIRT to R111 bus at Oakwood Heights Station. Bus: R103 or R111 to Great Kills; R7 to Sand Land and Hylan Boulevard and R103 to Great Kills; Domenico bus to Great Kills from Port Authority terminal; R117 to Miller Field. Auto: Verrazano-Narrows Bridge and I-278 to Hylan Boulevard to New Dorp Land for Miller Field; straight ahead on Hylan for Great Kills.

Facilities: There are few facilities for food, except at Riis Beach and Canarsie Pier. Restrooms are available at all locations as well as shelter from foul weather. Tours may be a distance from facilities, so that appropriate dress is required. Consult Park Ranger staff as necessary.

Water Facilities: Swimming activities are allowed at designated Beach areas. Fishing takes place on Cross Bay Boulevard bridge across Jamaica Bay and at Fort Tilden, Breezy Point.

Best Usage: Open year round, the Jamaica Bay Wildlife Refuge has provided a full-time or seasonal habitat for more than 300 species of birds, including horned owls in the winter, and egrets and glossy ibis in the warm weather months. The teeming marine life of the bay provides recreation for fishermen at the North Channel Bridge and Canarsie Pier.

The best usage of the area includes seining in the intertidal zone at Breezy Point and Jamaica Bay (Dead Horse Bay), bird nesting, along with behavior studies at the Wildlife Refuge, dune walks at Breezy Point (Fort Tilden), and a tour of a White Oak Swamp at the Staten Island Unit.

Type of Environments: Freshwater Ponds are located at the Jamaica Bay Wildlife Refuge; estuarine (marine) environments associated with Breezy Point, dune ecology and coastal wetland marshes are all easily accessible.

Preparation: Teachers are requested to attend a pre-trip workshop. Generally, the public should contact the Park Ranger at the site they wish to visit.

Author - Educator: John T. Tanacredi, Environmental Education Specialist, Gateway National Recreation Area - Headquarters, Floyd Bennett Field, Brooklyn, New York 11234. Office phone: (212) 630-0293(4)

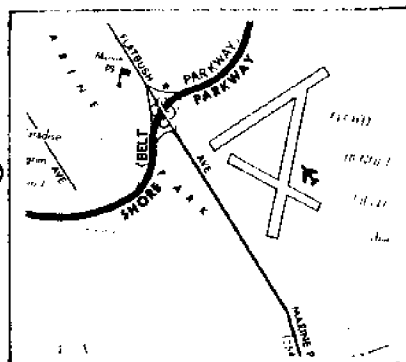
Suggested References: (GE) 4, 10, 16, 26.

Name: Dead Horse Bay Environmental Study Area

Type: Field Work, Collecting and Museum Visit (optional)

Level: All levels

Area: Brooklyn, New York



Arrangements:

Dead Horse Bay is part of the Jamaica Bay Unit of the Gateway National Recreation Area. The unit headquarters are located at Floyd Bennett Field, Building 272, in Brooklyn, 11234. Reservations can be made by contacting the Unit at 252-9286 or 252-9287. You can request a ranger-led tour with sufficient advance notice. A self-guided tour is also allowed, with reservations. An application for a collecting permit should be filed with the Unit Manager if materials are to be collected. A workshop is required for those teachers who have not participated in any previous workshops.

Directions:

Dead Horse Bay is located at the southern end of Flatbush Avenue, just before the Marine Parkway Bridge, opposite the entrance to Floyd Bennett Field. The trail system begins about 100 feet west of Flatbush Ave. at the traffic light.

Facilities:

Building 272 houses the Jamaica Bay Unit and a New York City Board of Education cooperative, the Gateway Environmental Studies Center. On the first floor there is a meeting room, restrooms, and a soda machine. In addition there is a small museum that students can visit. Limited parking is available at the guard station at the entrance to Floyd Bennett Field. Ample parking is available at Building 272, which is $\frac{1}{4}$ mile from the entrance. A trail system at Dead Horse Bay is composed of four looping trails, cut through the reed grasses. One of these trails is presently self-guided, and is marked by wooden posts.

Water Facilities:

A private marina is located at the northern end of Dead Horse Bay. At the present time there are no other launching facilities for boats in the area. Swimming is not permitted. A number of areas along the shore are excellent for seining collections.

Suggested Activities:

- historical significance of the docks, mills, landfill
- economic significance of the area
- seining for invertebrate and vertebrate forms
- beach succession
- beach erosion
- upland vegetation
- fouling (piling) community
- bird watching - including the nesting of terns and pheasant
- tidepool communities
- food-chain relationships
- micro-climatic studies of the beach versus the uplands
- beach zonation



Dense spartina found in a salt marsh

Type of Environment:

The environment includes an uplands, sand dunes, sandy beach, salt marsh, mud flat, rock jetty, piling community and an estuarine bay. There is a variety of natural successional environments as well as man-made or man-influenced environment.

Typical Flora:

Phragmites, cordgrass, dune grass, seaside goldenrod, broomsedge, salicornia, bayberry, sea blite, ailanthus, old field toadflax, soapwort, camphorweed, butter and eggs, pokeweed, virginia creeper, morning glory, Russian olive, wild rose, Northern cottonwood, rockweed, sea lettuce and other assorted algae.

Typical Fauna:

Rabbits, field mice, pheasant, sea gulls, terns, red-wing blackbirds, egrets, sandpipers, ducks, assorted shorebirds, insects, (assorted), killifish, spearing, flounder, blackfish, sea bass, eel, rock crabs, spider crabs, hermit crabs, mussels, soft shell clams, oyster drills, sand shrimp, glass shrimp, sandworms tube worms, mud snails, periwinkles.

Geological Studies:

Sand spit
Dune formation
Erosion of dunes and marsh areas

Succession on Landfill - differential decomposition of materials.

Preparation:

Boots or waders are advisable for work in the water
Nets
Buckets
Jars
Field Guides

Warnings:

Submerged rocks and pilings
Broken glass and cans
Insect repellent for summer use
Uneven terrain in uplands

Authors:

Alan Ascher
South Shore High School
6565 Flatlands Avenue
Brooklyn, New York 11236

Denise DiRienzo-Skalecky
Bishop Ford Central Catholic High School
500 19th Street
Brooklyn, New York 11212

Publications and References: (GE) 4, 8, 10, 16, 26; (B) 36; (F) 40; (I) 46, 51;
(PL) 64, 67, 70, 72.

4. The salt marsh environment provides an excellent setting for a discussion of the value of salt marshes, and coastal zone management in general.

5. For a geology or earth science class, the quick changing elevations of the sand dune areas provide an excellent area for practicing mapping, orienteering, and transect techniques.

6. Plumb Beach is an excellent site for viewing horseshoe crab mating during the spring.

Preparation: See information about mandatory teacher workshops above. There are many books and materials available for this type of environment. See references.

Warnings: Make sure that students are prepared to get wet, even if you do not plan to go in the water. Require that all students wear sneakers or some other shoe covering at all times, in or out of the water. The quality of the water varies greatly with the weather; avoid head or internal contact with the water. Always have students dress warmer than normal, due to the frequent cooling onshore wind pattern.

Author-Educator: Lou Siegel, John Dewey High School, 50 Avenue X, Brooklyn, N.Y.

Suggested References: (GE) 4, 8, 10, 14, 16, 26; (B) 36; (F) 40; (I) 46, 51; (PL) 64, 67, 70, 72.

NAME: N.Y. Aquarium
TYPE: Visitation
LEVEL: Elementary, Intermediate, Secondary
AREA: New York City

Reservations:

(212) 266-8540 - Must be made for a class trip or a program one month in advance of your visit. To reserve a date in the months of April, May or June a teacher must have attended an Aquarium Teacher's Workshop.

Directions:

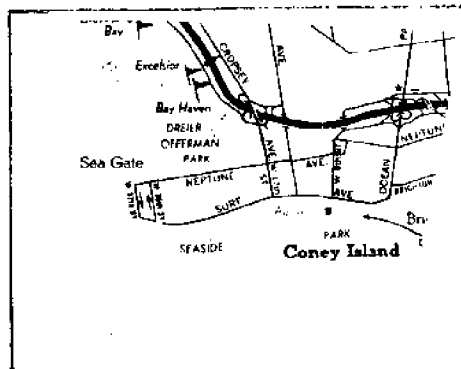
By car: The Aquarium is located at the intersection of West 8th Street and Surf Avenue in Brooklyn, N.Y.

By train: Take the IND "F" train or BMT "M" train to West 8th Street station.

By bus: (in Brooklyn)

B36 Nostrand Avenue - West 37th Street (East-West) to Surf Avenue and West 8th Street, Brooklyn.

B68 Prospect Park West - Sea Breeze Avenue (North-South) to Surf Avenue and West 5th Street, Brooklyn. Then walk three blocks west.



Facilities: The Aquarium has ample parking and restrooms. There is a cafeteria and snack bar and picnic tables are available outdoors in the summer months. Some Aquarium exhibits are unsheltered, outdoor exhibits.

Water Facilities: The Coney Island beach is located immediately adjacent to the Aquarium. Rocky jetties house an abundance of seashore life.

Best Usage: The Aquarium can provide a "living laboratory" where students can observe a variety of marine life, observe behaviors, methods of locomotion, reproduction, food-getting, and defense mechanisms. The beach provides an opportunity to study several natural habitats.

The Aquarium can be used to distinguish ecological zones such as marine life indigenous to intertidal, littoral, pelagic, rocky coast, marsh, tropical areas and indigenous species to the Northeast coast. They can teach the making of marine tools and artistic designs.

Type of Environment: The Aquarium is located on the Coney Island beach, a good example of a man-made, heavily impacted sandy shore. Man-made rocky jetties provide the opportunity to observe some of the characteristics of a rocky coast.

Suggested Activities on all three levels: There is a tremendous number of different activities that can be carried out at the Aquarium - most are of an observational nature. A teacher's approach will depend on the curriculum he or she is dealing with and the age and experience of the students.

Pre-trip:

It is recommended, whether or not you visit the Aquarium during the months when it is prescribed, that you attend a teacher's workshop. You will receive materials, suggestions and instructions for activities, and guided tours of the Aquarium and behind-the-scenes. Aquarium Education Kits can be purchased by mail from the Education Department. They contain information that you will find helpful in planning pre, on-site and post-trip activities; bibliographies, resources for information, and information and activities on various marine topics.

On-Site:

Do not fail to take advantage of the Coney Island beach for observation of seashore life, realia, and comparison with other less heavily utilized beaches.

Post-Trip:

Most discussions of observations made at the Aquarium should be delayed until you return to the classroom. The Aquarium's size and layout do not facilitate meaningful discussions on-site.

Preparation: Students should be focused before they arrive at the Aquarium. Knowing what to look for will enable them to get a lot more out of their visit.

General Comments: The Aquarium is open every day in the year from 10 to 5. Admission rates are \$2.00 for adults; 75¢ for children 2-12 years old. Special rates for groups.

The Aquarium offers programs on a variety of topics for a fee year-round. We offer an Aquarium camp experience and formal lecture programs, including pre- and post-trip materials and, in some cases, Aquarium tours or beach experiences. Contact the Aquarium Reservations Department (212) 266-8540 for free brochure.

An area is provided for feeling sea stars, shells, and other marine specimens in the aquarium and collecting on the nearby beach; viewing the electricity emitted from an electric eel; the feeding of whales, sharks, anemones, octopus, penguins, seals and others are available. Collages, bracelets, photographs, and seaweed prints can be designed from the above. The availability of this ideal location in the tri-state area between a multi-faceted, well staffed and equipped aquarium and juxtaposed beach front will be greatly appreciated and enjoyed by participating faculty, assisting parents and students.

Author-Educators: Karen Hensel
Curator of Education
N. Y. Aquarium

Mark Alan Goldberg
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Bronx, N. Y. 10473

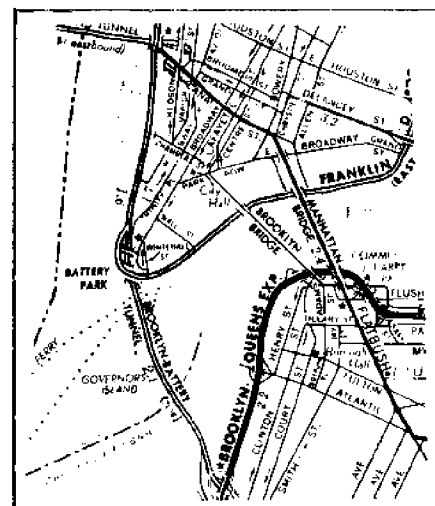
Suggested References: (F) 43.

NAME: BATTERY PARK AREA, LOWER MANHATTAN, NEW YORK CITY

TYPE: Historical, economic, and cultural walking tour, museum visit, and boat trips in an area which holds much of the immigration history of this nation and which is still one of the busiest ports of trade in the world.

LEVEL: Elementary through high school.

AREA: The Battery Park area is located on the west side of lower Manhattan, at the tip of the Island. The area includes Battery Park on which is located Castle Clinton, a fortress built to defend the harbor in the War of 1812. From the Battery ferries leave for Staten Island, the Statue of Liberty and the American Museum of Immigration and Ellis Island. The Seamen's Church Institute of New York is located across the street from Battery Park at 15 State Street and houses a museum and public cafeteria. Within walking distance are the U.S. Custom House, the site of the future Battery Park City, and the World Trade Center.



Arrangements: No arrangements are needed for Castle Clinton, but information may be obtained from the National Park Service; Heritage Trail Markers are located throughout Battery Park. No arrangements are needed for the Staten Island Ferry and the round-trip cost is 25 cents per person. Arrangements for the ferry boats to the Statue of Liberty and the American Museum of Immigration which is also located on Liberty Island may be made through:

The Circle Line - Statue of Liberty Ferry, Inc.
Battery Park, South Ferry
New York, New York 10004
(212) 269-5755

Ferries leave every hour on the hour from 9 a.m. through 4 p.m. Visitors should allow two and a half hours for the complete round trip. The round trip fare is \$1.50 for adults and \$.50 for children under 11 years. There is a group rate for adults in groups of 25 or more, and no reservations are necessary for the ferry.

Arrangements for ferry boats to Ellis Island may also be made through the above address. This ferry does not operate during the winter months and information should be obtained as to schedule from the above address. Ellis Island, the major port of immigration after the close of Castle Garden is open and is in the process of restoration.

A self-guided tour of the Seamen's Church Institute of New York is available on a walk-in basis, but pre-arrangements for large groups is recommended; a 15-minute film and 30-minute guided tour is also available on request. Arrangements should be made for groups of over 15 to:

The Communications Dept.
The Seamen's Church Institute of New York
15 State Street
New York, New York 10004
(212) 269-2710 ext. 206

The Institute requests that visitors be at least of intermediate school age.

Directions: It is suggested that public transportation be used to reach Battery Park since parking is limited during the week. Any of the following subways may be taken to Battery Park: IRT Broadway 7th Avenue Local to South Ferry; IRT Lexington Avenue Express to Bowling Green; BMT Local Subway to Whitehall Street. The Broadway Bus #M6 may be taken to the last stop which is South Ferry. Battery Park is located close to the Battery Tunnel and parking although difficult during the week may be available in nearby public and private lots for a fee. There is very limited on-street metered parking also.

Facilities: This trip is suggested for good weather, since much of it is outdoors. The ferries are enclosed, but might be uncomfortable in bad weather. Restrooms are available on the ferries and on Ellis Island as well as Liberty Island. The Seamen's Church Institute has the cleanest restrooms in the area. It is suggested that the restrooms in Battery Park not be used. Food and refreshments are available from a wide variety of sources in the area. Cafeterias are located on Liberty Island, in Battery Park (limited in size), and in the Seamen's Church Institute. Snack bars are located aboard all of the ferries and there are vendors in Battery Park. Picnicking may be done in Battery Park; it is not permitted on Liberty Island or Ellis Island and it is discouraged in the Seamen's Church Institute cafeteria.

Water Facilities: These are limited to boat trips, although there is a training program for sail-boating during the warmer months which is based close to the Circle Line's pier.

Best Usage: This area will give the student an opportunity to explore an environment that demonstrates the interrelationship between human activities and the marine environment. The teacher and class should select from the many possible activities the ones best suited to their needs; it would be impossible to do all of the things available on one trip. The early history of this nation could be studied using Castle Clinton as an example of the protection of a port and Manhattan Island. This fortress was built between 1807 and 1811 and was used to defend the harbor area. It was renamed Castle Garden in 1824 and used as a public theater until 1855 when it became the nation's principal immigration processing center to 1890, processing over seven million immigrants. Now it is operated by the National Park Service. Immigration history has no better representation than the Statue of Liberty and the American Museum of Immigration as well as Ellis Island. A trip to these places is a trip back into one's own roots for many of the students. The economic base for the City of New York is illustrated by this busy port. Containerized shipping operations can be seen in the harbor as well as a marine fire-fighting station near Battery Park. (Younger students might especially enjoy this). Battery Park City, which is in the process of being built on land fill in the Hudson, is an

example of the City's continued development as are the new World Trade Center buildings which dominate the lower Manhattan skyline. The Seamen's Church Institute illustrates the human side of the economics of shipping; it is a service institute for working merchant seamen of which 300,000 visit the ports of New York and New Jersey each year; most of these people are foreign and speak no English. The Institute contains a sizable collection of ship models, nautical artifacts, figureheads, stained glass windows, paintings, photographs of early New York, ships' bells, nautical knots, and macrame.

Type of Environment:

The Hudson River is an estuary that is rich in historical as well as commercial sites. Of note is the lower Manhattan skyline and the many interesting buildings both old and new. As noted earlier this experience should be for many students a trip into their own origins.

Suggested Activities:

The historical importance of the area should be stressed. A photographic essay could come out of the experience and even younger students should be encouraged to take cameras with them. The students should be encouraged to imagine what it would have been like to come into the port of New York from a foreign land at the height of immigration and land at Castle Garden or at Ellis Island. Many movies, such as "America, America", and many books such as World of Our Fathers tell this story and might be used.

Preparation:

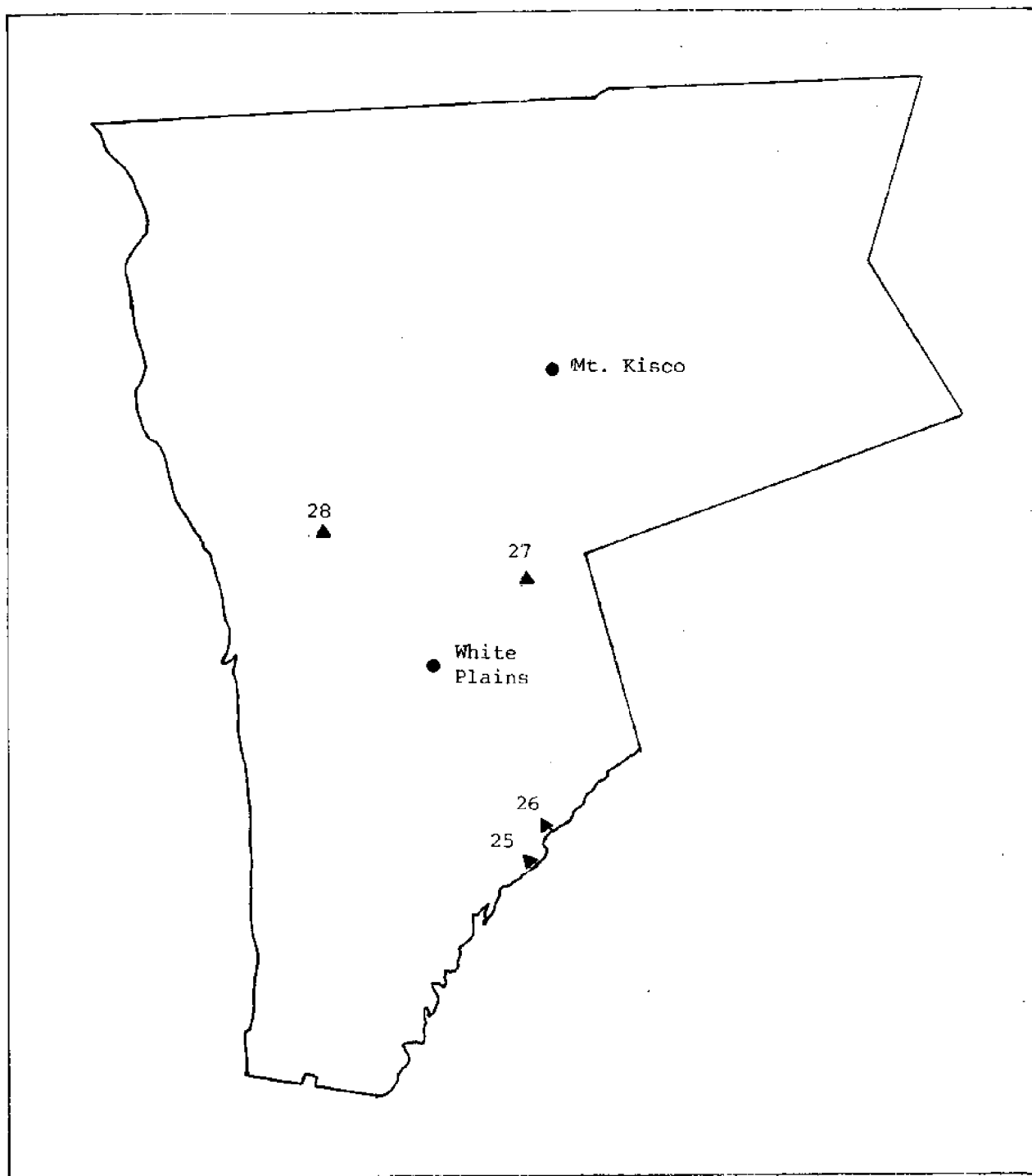
Advanced planning on the part of the teacher and students is necessary as the numbers of activities are great and the time is usually limited.

Warnings:

This area is very busy with people and traffic and it is suggested that students be chaperoned by one or more adults in addition to the teacher; this is especially true for younger students.

Author-Educator: Gary Schechter, J. F. Kennedy High School,
Kennedy Drive
Plainview, New York 11803

Suggested References: (GE) 20, 22, 26, 31.



Westchester County

NAME: Playland Beach, Rye, N.Y.

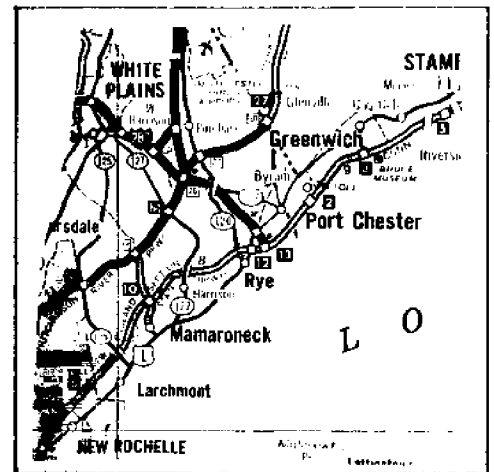
TYPE: Field Work and Collecting

LEVEL: All levels

AREA: Rye, N.Y. - Western Shore of Long Island Sound in Westchester County

Arrangements: None

Directions: Take New England Thruway to Exit 11 - Playland Parkway, Rye. Parkway leads into Playland. Go through the parking lot to the back of the property; park behind the fishing shack. Walk north along the beach, past the fence to the area adjacent to the ball fields and the bird sanctuary.



Facilities: Parking, emergency phone. No restrooms but the area is nearly deserted during all but the summer season. Spacious area for work. No shelter.

Water Facilities: Boats can be launched and landed at area. Seining and the use of plankton net by wading are possible. Swimming is possible but neither pleasant nor safe.

Best Usage: General field work requiring sandy beach and tide pools. Succession and zonation studies as well as collection of marine and intertidal specimens. Introduction to multi-use problems in county-owned areas.

Type of Environment: Large beach with rocky areas, grassy areas and sandy areas; beach slopes gently. Crabs and snails are especially abundant. Have seen a limited number of anemones, colonial sea squirts, bryozoans and starfish. Abundant seaside plants and algae can be found here.

Suggested Activities:

- A. Comparative studies of three types of beach areas can be done at any level.
- B. Collecting is possible here in the spring and fall; heavy usage during the summer tends to deplete the local flora and fauna. Small marine tanks can be set up in the classroom with a few specimens. Killifish caught here in the "stream" that connects the beach to a nearby brackish lake have proved to be remarkably hardy.
- C. The effects of storms on the biological and physical characteristics of the area can be investigated.
- D. Photographic studies are easily carried out.
- E. Large murals can be prepared after the field trip using the results of transect studies in the different areas. These can serve as a basis for discussions in other classes.

- F. Animal behavior studies of crabs, snails and other organisms in the intertidal zone can be studied. Longer range studies can be carried on during the off season. There may be some disturbance but we have done successful studies on home ranges over periods of several weeks.
- G. Follow-up studies with advanced classes on the multi-use concept for Long Island Sound and the Westchester County Park System have been successful.
- H. Preparation of a seafood meal, including some exotics such as seaweeds, can involve students and guests. Help from the Home Economics Department makes this easier and foreign dishes, such as those from Japan and the Mediterranean countries, make the feast more interesting.
WARNING! Most of the organisms collected in this area, especially in the non-swimming season, have been subject to extensive pollution. Buy the food; don't collect it.

Preparation: Students should be familiar with study methods; i.e. transects, plankton tows and sampling techniques. The use of a key should be reviewed if identification is to be tried. Photographs of the area can be used to help the students hypothesize about what they expect to find in their investigations. Materials for collecting should be prepared and assigned. Tanks for organisms must be prepared. Principles of conservation should be discussed so that the investigators create the minimum disturbance.

Warnings: Watch the tides when you plan a visit. A tide chart for the area is available at the Playland Fishing Pier. Visit should be made as the tide is going out and close to the time of low tide. Students must bring anything they will need, including lunches. Warn students about broken glass, etc. and insist that they wear sneakers or boots at all times.

General Comments: This area should be visited in the spring before May 15th, or in the fall, after October 1. The area belongs to Westchester County and is adjacent to a heavily used fishing pier and near a swimming beach. During the late spring and summer, the area is greatly disturbed. A brackish lake is across the road from the beach and is available for study. There is a bird sanctuary adjacent to the area that is open to the public. There is no charge for parking on weekdays in the off-season.

Author-Educator: Virginia A. Curry, Westlake High School, Thornwood, N.Y. 10594

Suggested References: (GE) 2, 19, 24, 26, 29; (I) 46, 49; (PL) 64, 66.

NAME: Marshlands Conservancy

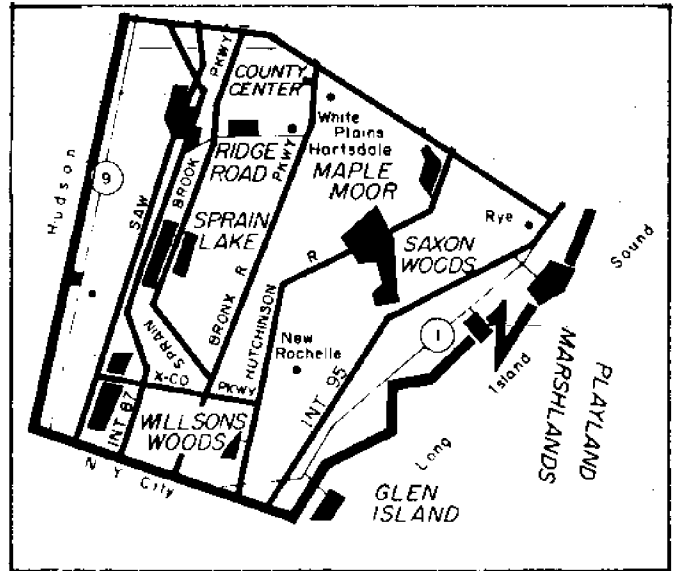
TYPE: Field Work or Visitation

LEVEL: All levels

AREA: Rye, NY - western shore of Long Island Sound in Westchester County

Arrangements: Contact Allison Beall, Marshlands Curator for conducted field trips and information at 914/835-4466. She is available Wednesday - Sunday. Groups may visit on their own.

Directions: Entrance is through a private road off Route #1 (Boston Post Rd.) in Rye, NY. Take the New England Thruway to Exit 11 - Playland Parkway, Rye. Use the first exit off Playland Parkway marked Rye, Harrison. Turn left and go one block. Turn onto Old Post Road (follow sign marked Mamaroneck). Continue until the road merges with Post Road (Route #1) at the light, then continue on Route #1 for .9 mile. Marshlands is on the left just south of the Rye Golf Club.



Facilities: Parking facilities, picnic area, restrooms and shelter are available. The shelter and a small museum are available if prior arrangements have been made with the curator.

Boating Facilities: None; boating is prohibited.

Type of Environment: This is a model salt water marshlands habitat with a fresh water estuary. The area also includes a small rocky shoreline, a very small sand area and fields and a small forest. Nearly every organism that can be expected in a salt marsh along the northeastern U.S. coast can be found here. A large number of birds are in residence and can be seen from a good vantage point.

Best Usage: This is an ideal place for ecological studies. A comparison of fresh water and marsh organisms can be done. Special programs have been developed for elementary school children; for secondary students and for adults. It is an excellent place to visit during the bird migration seasons.

Suggested Activities:

- A. Observation of ecological changes along the slope of the freshwater stream until it reaches the marsh, the spot where the tide enters the stream is easy to identify with "marker" organisms.
- B. A study of adaptations to the marsh habitat can be made as well as a comparison of marsh and beach adaptations by similar organisms, e.g. the blue mussel of the rocky shore and the ribbed mussel of the marsh.
- C. Observation of a wide variety of flora and fauna.
- D. Observation of succession in the field and forested areas.

Preparation: Preparatory reading and discussions of the physical and biological features of salt water marshes is helpful.

Warnings: Watch the tides; the marsh can only be seen properly at low tide. Binoculars and hand lenses will be useful. The area is a conservation area and should be protected. Collecting is prohibited.

General Comments: The curator is excellent; she is a knowledgeable young woman who is really liked by the students. Having Ms. Beall as a guide really adds to the trip.

Author-Educator: Virginia A. Curry - Westlake High School, Westlake Drive, Thornwood, N.Y. 10594

Suggested Publications and References: (GE) 2, 19, 26, 29; (I) 46, 49; (PL) 64, 66.



Marshland: the beginnings of the aquatic food chain

NAME: Kensico Reservoir

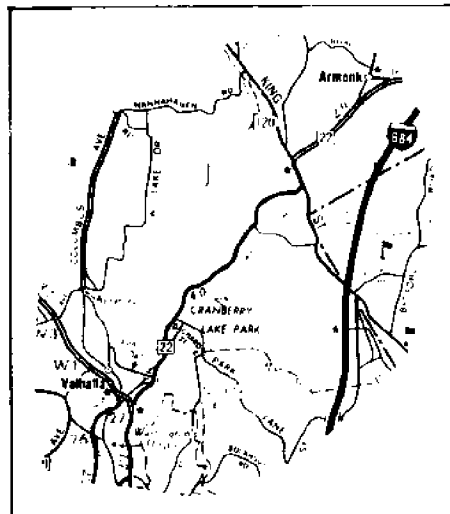
TYPE: Field Work

LEVEL: Intermediate and above

AREA: Westchester County

Arrangements: No arrangements are required for individuals or small groups except that students over 16 who plan to fish must have a license, available at the offices on Westlake Drive. Teachers planning a class trip to the area should file a request form on school stationery which includes the information on the sample form attached.

Directions: The reservoir can be reached from Route 22 in North White Plains or Westlake Drive in Valhalla. Good access sites, with parking, are marked on the map. There is also access from Route 22 where it is adjacent to the reservoir.



Facilities: No facilities, but portable boats can be launched from the sites marked.

Water Facilities: Boats are allowed on the reservoir as long as they do not have motors. Swimming is specifically forbidden as this reservoir is part of the New York City Water Supply system.

Best Usage: This reservoir forms a large lake and supports a substantial flora and fauna. It is stocked regularly with fish. It can be used for studies of fresh water bodies in biology or earth science. Its construction history, economic impact on the surrounding area from a tax point of view, and large dam are all subjects that can be studied.

Type of Environment: This is a large lake with islands. The depth varies considerably. The reservoir is stocked each year with fish of known numbers and types by the N. Y. State Dep't. of the Environment.

Suggested Activities:

- A. Field studies at the site can involve a chemical, biological and physical investigation of lake characteristics.
- B. Mini-ecosystems can be maintained in the school in one-gallon jars. These can be stocked with water, plants and animals brought from the reservoir.
- C. Microbiological analysis of the water can be made to determine the bacterial content of the water. The types of treatment given to reservoir water so that it will be safe for drinking can be studied. Miniature treatment tanks can be constructed to simulate and test these techniques.
- D. Analysis of turnover can be made in the spring and/or fall by advanced students.

SAMPLE REQUEST FORM - SHOULD BE SENT ON SCHOOL STATIONERY

Date

Hon. Francis X. McArdle
Commissioner, New York City Dep't. of Environmental Protection
Municipal Building
New York, N.Y. 10007

Dear Sir:

This is to request permission for a group of approximately _____
(describe size and nature of group) to visit Kensico Reservoir for the purpose
of _____.

I _____ am duly authorized to make the following statements in
connection with such a visit:

1. That the City of New York will not be held liable for any
accident or injury which may be incurred by the students
or employees while on Department property in conjunction
with this visit.
2. That the _____ (name of school district) will assume all
responsibility and save the City of New York harmless from
any and all damages resulting from this visit.

Signature and Title (responsible administrator)

HAVE NOTARIZED

Send copy to:

George Mekenian, P.E.
Deputy Chief Engineer (Watersheds)
P.O. Box 66
Valhalla, N.Y. 10595

- E. Since Kensico is listed as a high-risk dam because of its location, a study of dam construction and safety problems can be made by secondary students.
- F. Erosion factors and soil composition studies can be made at various sites around the reservoir. Trees have been planted in some areas to control erosion and some of these have been killed recently by a blight. A study of the effect on the soil and water of these plantings and the death of certain trees can be made.
- G. A comparison of the fishing potential between Kensico and the nearby Croton Reservoir is an interesting study. This should be made in conjunction with an analysis of as many factors as possible which might affect the fishing potential.

Preparation: Students should be familiar with testing kits, sampling techniques and safety precautions. Tanks or jars should be prepared to receive organisms if these are to be collected. Testing materials should be prepared.

Warning: Since this area is part of the N.Y. City Water Supply, students must be cautioned strongly about swimming. There are no bathroom facilities and it is important that they recognize the importance of not contaminating the water. The reservoir is surrounded by woods in many areas. This is not suitable for a full day trip. Fishing licenses should be obtained for anyone over sixteen who plans to fish.

Author-Educator: Virginia A. Curry, Westlake High School, Thornwood, N.Y. 10594

Suggested Publications and References: (GE) 2, 21, 30; (PL) 64, 69, 71, 73.

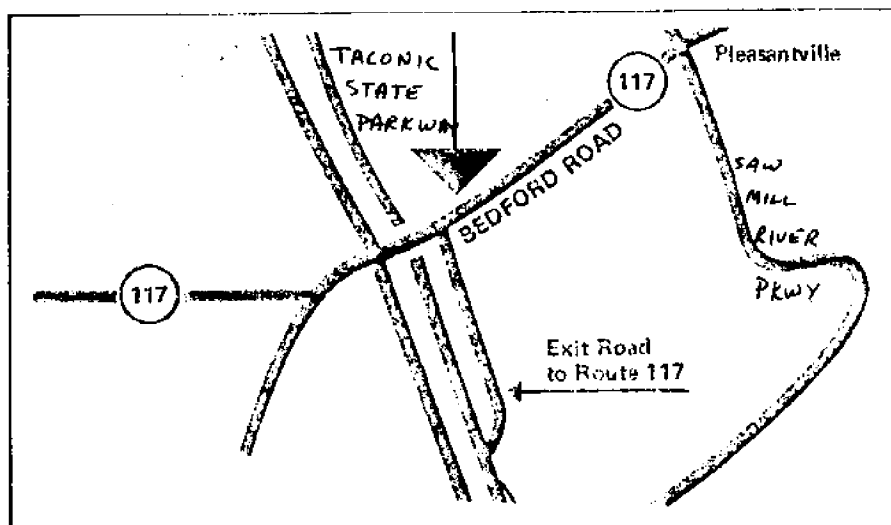
NAME: Freshwater Pond Environment

TYPE: Field Work & Visitation

LEVEL: All Types

AREA: Westchester County Pleasantville, NY

Arrangements: Pat Shea
Angelo Spillo
Frank Commisso
(Notify 2 weeks in advance)



Directions: Take 117 towards Pleasantville. Come in Entrance #3. The Environmental Center is about 1/4 mile down the road on the left. Parking area on right. Enter office located in brown farmhouse.

Facilities: Cafeteria in student center; ample parking nearby; restrooms in all buildings. No boating except as indicated. Classroom located on Farm grounds. Shelter can accommodate large numbers if Student Center is used.

Water Facilities: Row boat available for sampling. Can take no more than 3 adults at a time. No swimming. Equipment for plankton seining available.

Best Usage: Survey of plankton, nekton, benthos, and shore plant ecosystems available. Specimen collecting possible on a small scale.

Type of Environment: Farm pond with stream inlets; outlet to Saw Mill River. Associated with Environmental Center/Farm of Pace University in Pleasantville. Extensive variety of protozoans, aquatic invertebrates, insects, birds, fish, amphibians and reptiles. Excellent algal flora and grassland species. Island in center of pond used by water fowl for breeding. Area based on extensive tracts of Fordham gneiss. Woodland trails available. Scenic with examples of deciduous and coniferous woods, meadows, and ecotone areas. Excellent breeding areas for many small animals, perfect for illustrating animal habitats.

Suggested Activities: Lectures available on life cycles, types of environments, trail walks, collecting techniques, water and soil testings and habitat studies. Guides, maps and lecture notes available.

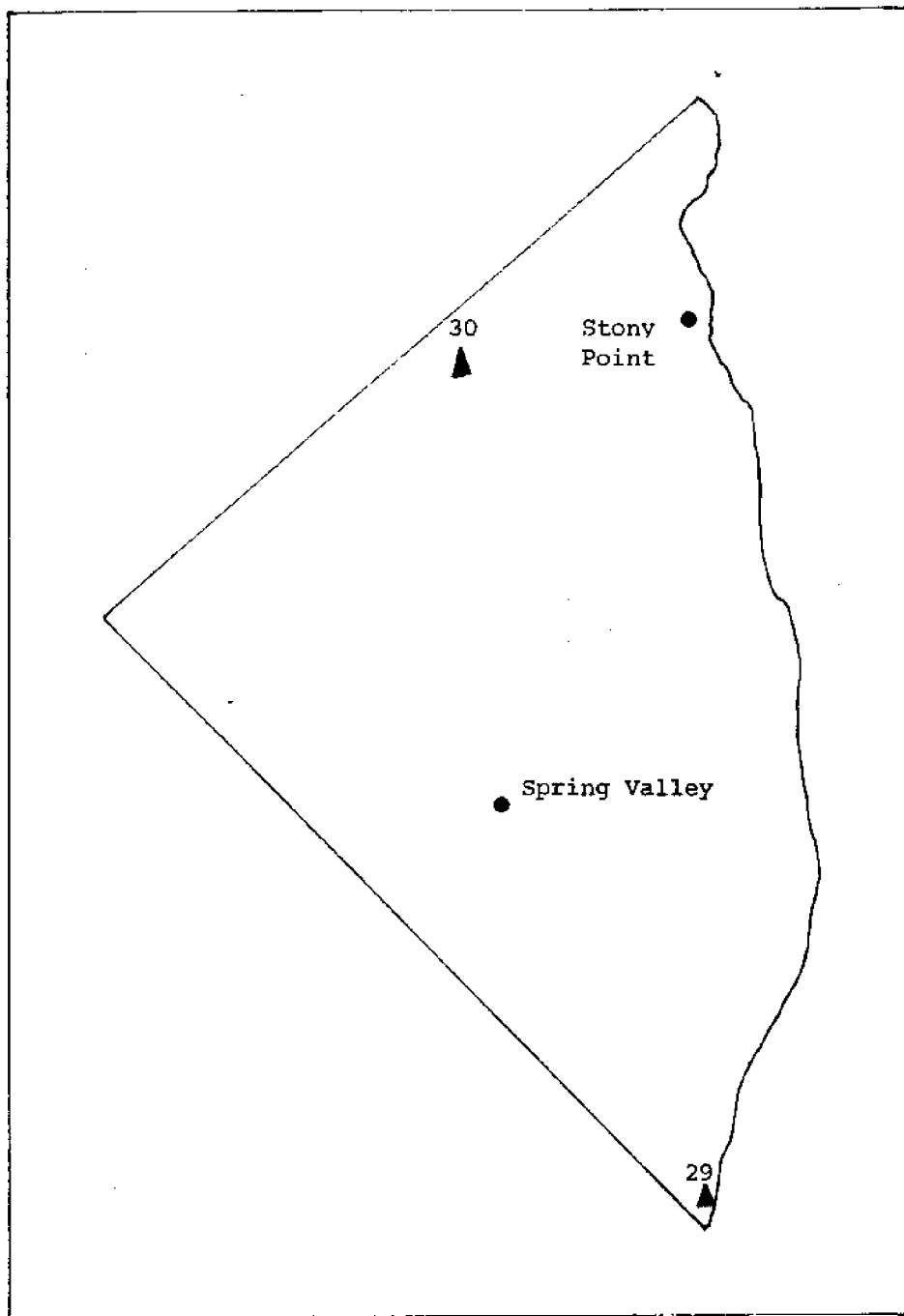
Preparation: Introductions to pond and woodland habitats. Bring boots, hand lens, nets, collecting bottles, tweezers, etc.

WARNINGS! VERY MUCKY BOTTOM TO POND - NO SWIMMING ALLOWED

Author-Educator: Angelo Spillo
Pace University Environmental Center
Bedford Road
Pleasantville, New York 10570

Prof. Frank Commisso
Pace University
Bedford Road
Pleasantville, New York 10570
(914) 769-3200 Ext. 230

Suggested Publications: (GE) 2, 21, 30; (P) 60; (PL) 72



Rockland/Orange County

NAME: Lamont-Doherty Geological Observatory

TYPE: Visitation

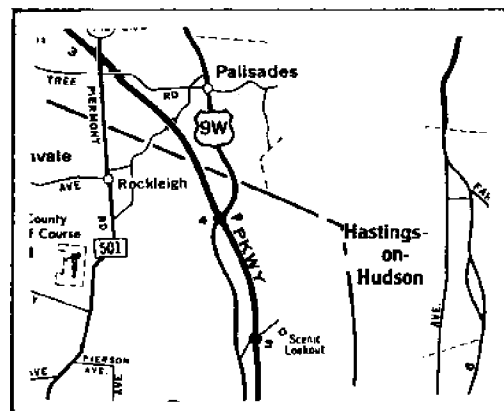
LEVEL: Intermediate and Secondary

AREA: New York Metropolitan Area

Arrangements: On or about April 1st of every year
a letter should be sent to:

Office of the Director
Lamont-Doherty Geological Observatory
Palisades, NY 10964
Telephone 914-359-2900

In the letter, request the date for their
OPEN HOUSE. This is generally the first
Saturday in May.
You will receive a return letter giving
the date of the OPEN HOUSE. Included will
be directions and the available facilities
to be viewed.



Directions: Cross George Washington Bridge and stay in right lane so as to
make right turn at west end of bridge onto PALISADES INTERSTATE PARKWAY
NORTH. Proceed north to Exit 4 (approximately 10 miles from toll booth).
Turn left (North) on Route 9W and proceed about 500 ft. to Observatory
road on right, and on to parking lot.

Facilities: There is ample parking for cars or buses in the upper parking lot.
Restrooms are available in most of the buildings. Many exhibits are indoors
thereby reducing the problems associated with foul weather.
Vendors are scattered about the facility; however a picnic lunch would be
best particularly if the weather is nice. There is plenty of lawn space as
well as refuse collectors.

Water Facilities: There is a wildlife sanctuary as well as a pond located on the
grounds. A trip to the base of the Palisades will bring you to the edge of
the Hudson River. If the Oceanographic Research vessel VEMA is in port at
the time you will be greatly rewarded as will your students.

Best Usage: These areas include deep-sea drilling, ocean-bottom topography,
plate tectonics, water sampling equipment, Long Island coastal formations,
underwater photography and a variety of other displays, especially those
oriented toward Earth Science.

Environment: Many exhibits both indoor and outdoor are available. There are areas
for collecting specimens as well as plenty of handouts from the different
specialists. This is truly a most enjoyable trip which students will never
forget.

Suggested Activities: Prior to the trip students are given a list of what they will be able to see. Each student then is asked to prepare a list of questions about one specific area of his/her choice. Make sure that some questions leading to career information are part of this list of questions. Students must then find the answers to these questions while visiting in the particular place of their choice. If the exhibit or lecture-demonstration does not answer these questions, then students must interview the person at the exhibit or demonstration. Part 2 of the preparation is a teacher-made "Bus Tape". Once the students have boarded the bus, play a tape cassette to the students. (My tape may be borrowed and copied; however, it would be better if each instructor made his/her own.) The tape should include an introduction as to what they are going to see. It also includes final instructions. After the tape has been played begin pointing out geological features. When you arrive at the site allow the students to move freely on their own. Establish a meeting time for lunch where experiences can be shared. After lunch students should move about freely again. You will find that most students will be unable to see everything. Any collecting or sampling that they do should be done as a group. On the return trip, make use of a "Bus Tape". This tape should be short and summarize some of the highlights of the trip. On return to class students will be asked to prepare both a written report and an oral report. These are presented to the class so that each area of demonstration is covered. The rest of the class is then allowed to either ask questions of the presenter or contribute to what has already been said. Again there is an emphasis on my part about the career aspect.

Warnings: Students should be aware of the Palisades. They should be instructed not to leave marked paths or trails. Insist that they travel in twos or threes. It generally ends up as fours and fives. There are people from the Observatory strategically placed through the entire grounds.

General Comments: I would suggest that any instructor planning to use this trip visit the site the first time on his/her own. Maybe bring 4 or 5 students in his/her own car. There is so much at this site that teachers would have to pick out those areas or topics that they wanted their students to see.

Author-Educator: Robert Fariel, Science Chairman
Stanforth Junior High School
700 Hempstead Turnpike
Elmont, N.Y. 11003
tel: 516 328-4839

Suggested Publications and References: (GE) 18, 25.

NAME: Lake Welsh

TYPE: Field Work

LEVEL: Secondary and Above

AREA: Rockland/Orange County

Arrangements: None.
No motorized vessels
allowed on the lake.

Directions: Take Palisades Parkway to
Lake Welsh exit. Park at the
designated parking spaces.

Facilities: None in the fall and winter; bathrooms open in the spring.

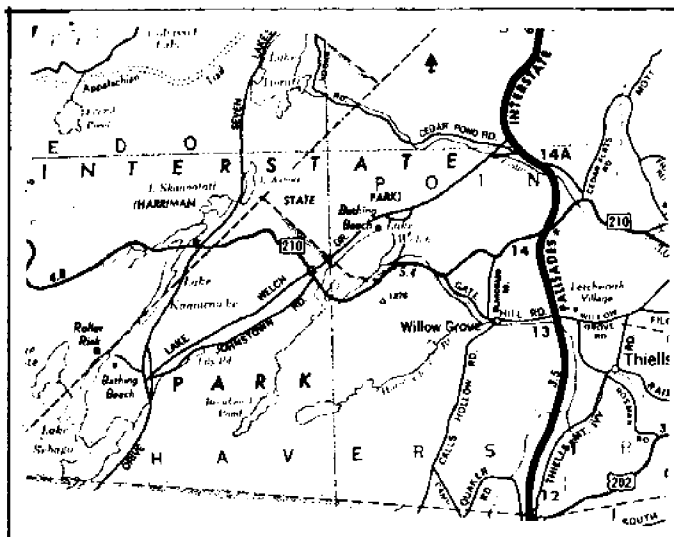
Water Facilities: Boats allowed on the lake; see arrangements. No swimming.

Best Usage: We have done earth science oriented field work on the lake. Measuring the size, determining a bottom profile, measuring for a thermocline. We have also collected flora and fauna specimens from near the lake and cataloged some of the specimens. This is a man-made body of water and recently has come under close scrutiny for fear that the dam holding back the lake may collapse.

Type of Environment: A large fresh water lake only 35 miles from New York City.

Suggested Activities:

1. Immediately at the lake we have students map the lake front, also indicating air speed and cloud cover and wind direction.
2. An evaporation apparatus is set up and total evaporation from this fresh water body is calculated.
3. Bottom and near-shore sediments are collected for future class work.
4. Different sampling zones are determined and specimens are sought. Surface and deepwater samples are taken for microscopic examination.
5. Water samples are collected for chemical analysis in the field and at the school. Compare results from field analysis and class laboratory analysis. Do the results fall within acceptable values of each other? If not what could have caused the difference?
6. Determine chlorinity and salinity.
7. Test for pH at shore and lake locations.
8. We have found it very useful to graph as much of our results as possible.



9. Photograph as much of the activity as possible and also as much of the Lake as possible. Compare results from earlier visits. Are there any immediate visual differences? Explain.

Preparation: Use of field test kits and small boat handling should be described beforehand. Sampling jars should be prepared before leaving the classroom. We have our students collect and bring to class a wide assortment of jars which are then labeled with their names.

Possible Cautions: Do not have your students wander too far in search of specimens. This is a wooded area and walkers have been known to fall and hurt themselves. This is also unsuitable for an all-day field trip. We have found that half days are fine.

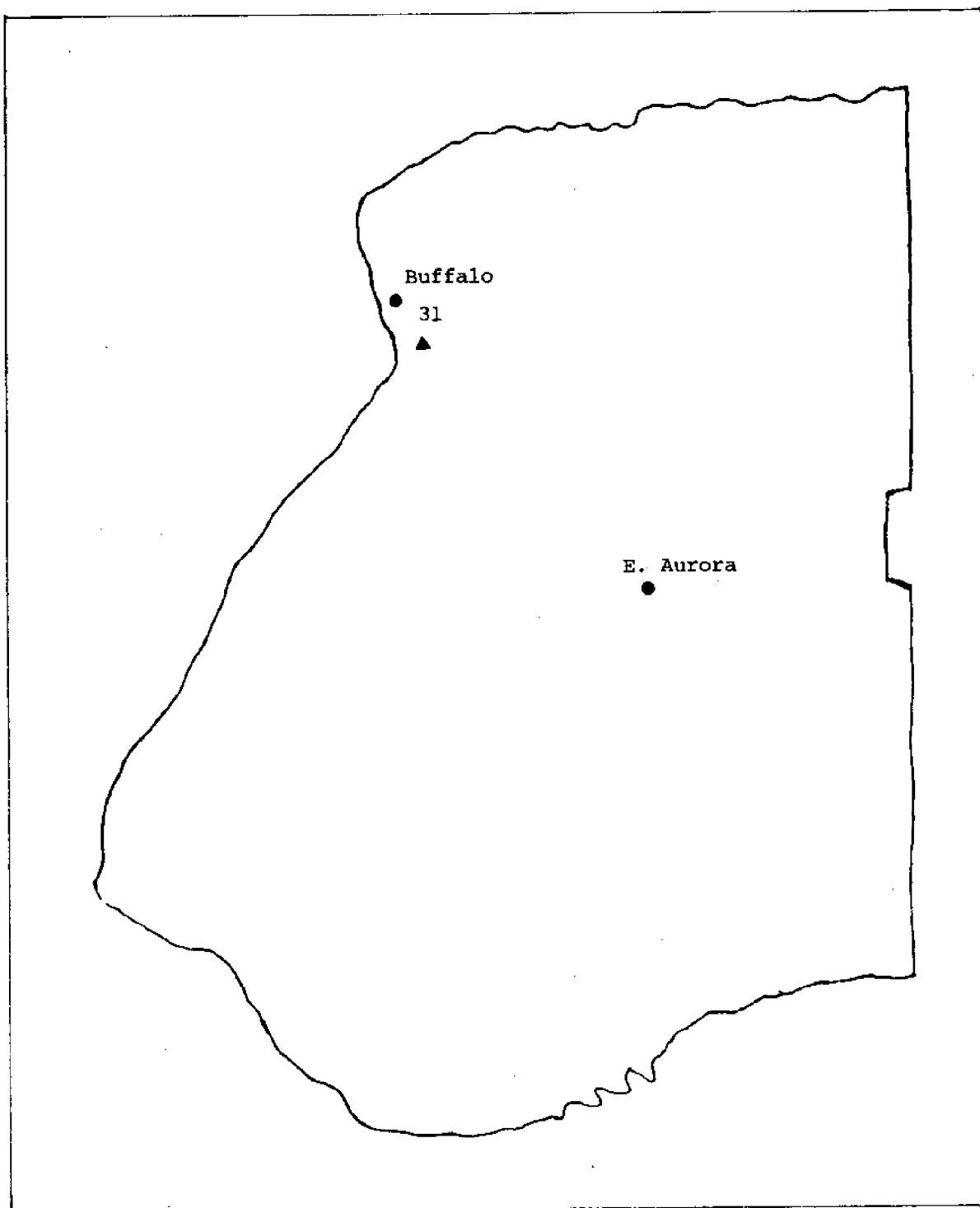
Post-Trip Questions:

1. Was there regularity in your temperature, salinity, chlorinity, and pH readings, also density? Can you explain these regularities or the lack of same?
2. Make a list of the aquatic flora and fauna found.
3. Did the density increase, decrease or remain the same? Any reason for this?
4. Make a diagram of the temperature, salinity and pH of the lakefront.
5. What is the water source for Lake Welch?
6. How would temperature, pH, and salinity affect aquatic life in this lake?
7. How can man control excessive evaporation from small bodies of water?
8. How can evaporation of water from small bodies of water affect aquatic populations?
9. Have you noticed any patterns in sediment samples?
10. Did water temperature measurably change? Explain your answer.
11. Name some of the pigments you may find in aquatic waters.
12. Why is there a measurable change in light penetration?

Contact person: Superintendent of Parks, Harriman Park Bear Mt., New York

Author-Educator: Roger Rodriguez
North Rockland High School
Theills, New York 10984

Suggested References: (GE) 2, 21, 30; (PL) 64, 69, 71, 73.

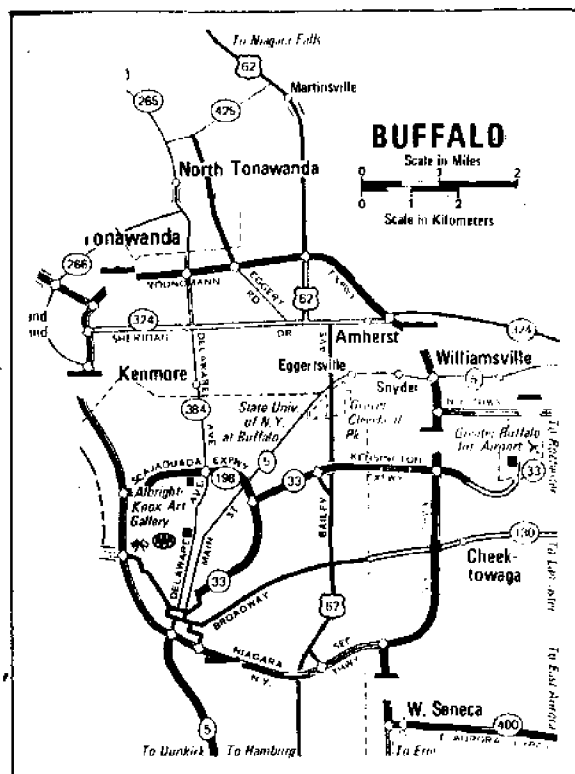


Erie County

NAME: Tifft Farm Nature Preserve
TYPE: Fieldwork and/or visitation
LEVEL: All
AREA: Buffalo, New York

Arrangements: Make reservations at least three weeks in advance. Teachers asked to attend an orientation meeting at Tifft Farm two weeks prior to the student field trip. Call Tifft Farm (716) 847-1323.
Mailing address: Tifft Farm, Inc.
1133 Ranch Building
Buffalo, NY 14203
Fee: for pre-planned programs -
50¢ per student

Directions: From East or North of Buffalo -
Take easiest route to Niagara Extension of NYS thruway (Rt. 190), to Rt. 5 (west), exit Fuhrmann Blvd. (south), at 1st light - turn left under bridge to Tifft Farm. From South of Buffalo -
Take easiest route to Rt. 5 (north), exit Fuhrmann Blvd. (north) near Tifft Street, continue straight to Tifft Farm.



Facilities: Parking area, picnic area, out-houses, tents in case of rain, log cabin meeting house under construction.

Water Facilities: Close proximity to the Buffalo small-boat harbor on Lake Erie. The boating at Tifft Farm is not presently in operation. No swimming allowed. In winter - ice skating.

Best Usage: Excellent for studying and developing concepts of ecosystems, interrelationships, food webs, population studies, ecology, collecting specimens, and utilizing measuring techniques.

Type of Environment:

Over 270 acres of preserve near the shore of Lake Erie which is surrounded by Buffalo's steel plants and other heavy industrial facilities.

The preserve includes 40 acres of rolling hills built on top of the city's collected refuse.

The largest fresh water marsh in Erie County.

Several fresh water ponds and streams developed from abandoned canal systems.

Many animals have naturally come to inhabit the preserve, especially many water fowl in the fresh water marsh.

Suggested Activities:

UNLIMITED

Tifft Farms welcomes and encourages individual ideas in using the area - anything to create a meaningful and relevant experience to each class.

Some programs are specially prepared by the staff at Tifft Farm and seem to work well. Some of these pertaining to marine studies would include:

Habitat Analysis - Marsh, Pond, Stream, Lake

including collecting and identifying various living things

A contest among groups - find the most kinds of animals

A scavenger hunt for marine animals and plants

Basic Survey Skills -

Map studies, Plane Table, Contour Maps, Topographic Maps

Introduction to the Compass

Census Techniques - (plant and animal) cover maps, grid method

Motivate Creative Expression -

This includes creative writing, poetry, essays, short stories, sketching skills, Nature's symphony-musical creativity, photography.

Preparation: The teacher and a representative from the preserve plan the class visit prior to the actual field trip. Groups of any number can be accommodated. Small groups (25 or less) are preferred. Larger groups will be broken down into smaller groups and the teacher will be expected to take an active part in the program. Prior classroom preparation depends on what is to be done at the preserve. All equipment and even some pre-trip classroom ideas are provided by Tifft Farm.

Warnings: The usual safety precautions for an out-of-door field trip.

General Comments: Visits can last anywhere from 2 hrs. to all day. Teachers are expected to take an active part in all programs, even programs prepared by Tifft Farms.

Tifft Farms is a privately funded - non profit organization.

Many public programs are also planned and it is open to the general public at no entrance fee.

Author-Educator:

Lori Bauers

15 Olcott Pl.

Cheektowaga, N.Y. 14225

Suggested References: (GE) 2, 21, 30; (PL) 72.



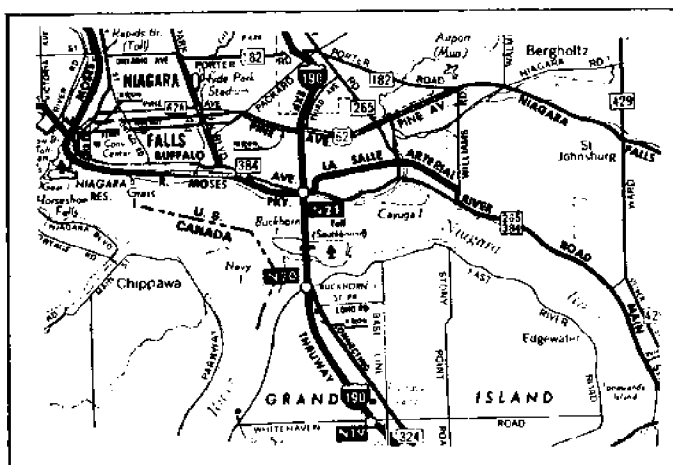
Niagara County

NAME: Aquarium of Niagara Falls, USA

LEVEL: Elementary through secondary

AREA: Buffalo and Niagara Falls

Arrangements: Contact the Aquarium of Niagara Falls, USA, 701 Whirlpool Street, Niagara Falls, NY 14301 716/285-3575 (in Niagara Falls) or 692-2665 (in Buffalo). Rates include students (preschool through college, 10 or more in a group) \$.65, adult supervisors free (one for every ten students), adults \$1.75. Bagged lunches not permitted in the Aquarium building but groups may eat lunch on grounds, weather permitting. Snack Shop open every day. Make reservations about one week prior to visit.



Directions: From Buffalo, take exit N21, the Robert Moses Parkway, as you get off the north Grand Island Bridge. Follow the leaping blue dolphin signs off the parkway exit downtown.

Facilities: The Aquarium has ample parking and restrooms. A ramp and elevator are available for handicapped groups.

Best Usage: The education staff of the Aquarium will help you teach the many phases of aquatic life. There is an open marine tank in the Aquarium classroom which houses seastars, horseshoe crabs, and a variety of other invertebrates from the sea. Groups of 20 or fewer children may handle the animals after a short orientation lesson. The sessions can be repeated to accommodate larger groups.

A number of in-school programs are offered by the education staff of the aquarium: a fishy story, fins and flippers, and marine mammal training. The grade level is generally elementary, although programs can be adapted to meet the needs of secondary students.

Preparation: The film strip, 'Explore Our Ocean', is sent to elementary classes before they visit the Aquarium. It describes how the animals are cared for, who works in the Aquarium, and what the children can expect to see.

A guide book describing the animals in the exhibits is available to teachers. It has suggestions for things to do before and after your class visits the Aquarium.

General Comments: A quarterly newsletter is sent during the year to all schools making reservations to visit the Aquarium. 'Schooling' investigates a different subject each issue and offers suggestions for classroom activities.

There is a dolphin and sea lion performance every hour beginning at 10 AM. A demonstration of the electric eel's shocking ability is given hourly beginning at 10:45 AM. Instruct your students not to drop anything into any of the tanks, since a fish or other organism can die as a result of swallowing foreign objects. Also, please instruct small children not to scream or tap on aquarium glass tanks.

Author-Educator: Bob Moore, Education Co-Ordinator, Aquarium of Niagara Falls, U.S.A.,
701 Whirlpool Street, Niagara Falls, New York 14301 (716)285-3575 or
692-2665.

Suggested References: (F) 43.

NAME: Schoellkopf Geological Museum

LEVEL: Elementary through Secondary

AREA: Niagara Falls

Arrangements: Tours are usually 2-3 hours long. Interpretive tours of the following state park areas are offered to school classes and interested groups:

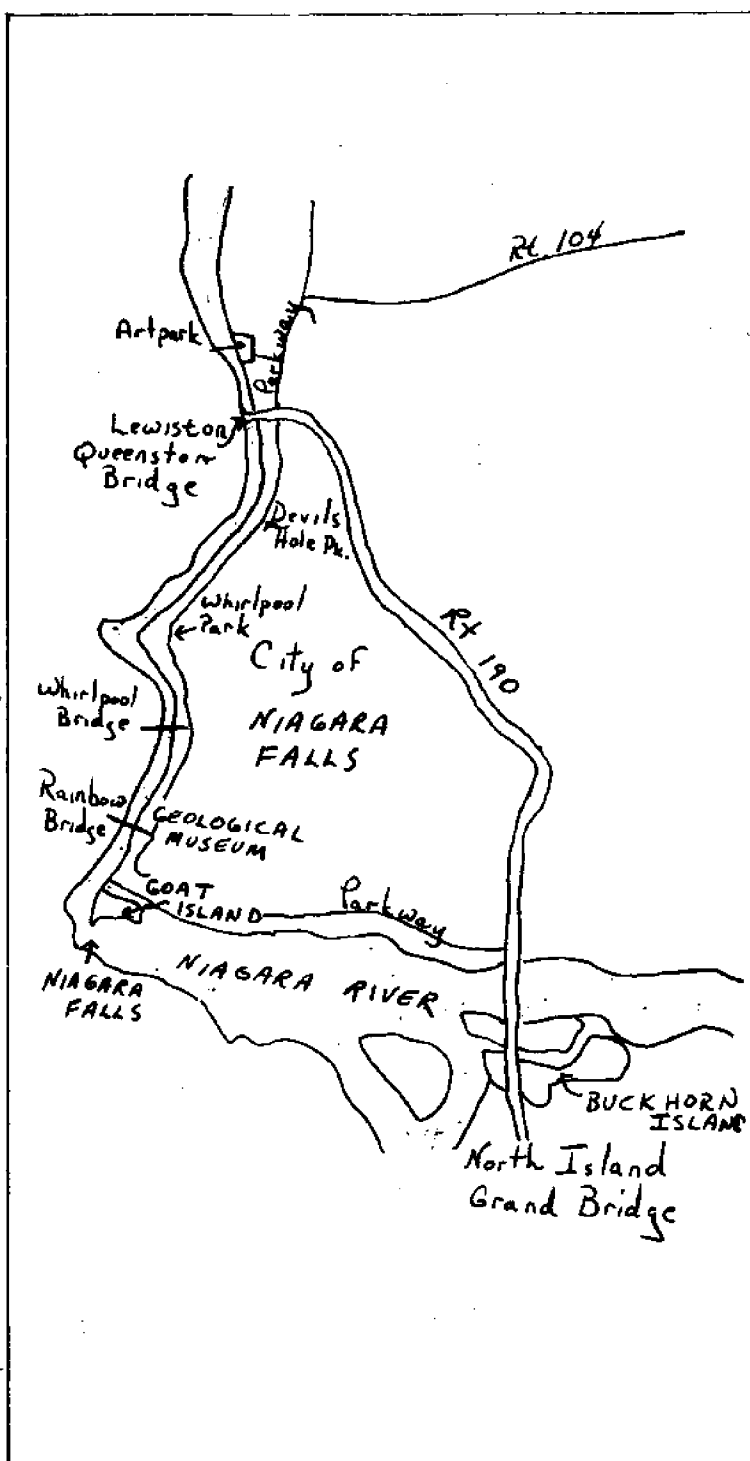
- . Niagara Reservation (Prospect Point and Goat Island)
- . Schoellkopf Museum
- . Whirlpool and Devil's Hole parks (Gorge and rim routes)
- . Earl W. Brydges Artpark (into Gorge)

For tour information and reservations contact: The Schoellkopf Geological Museum, Niagara Reservation, Niagara Falls, New York 14303.
Phone: 716/278-1780.

Directions: Park sites rim the city of Niagara Falls, running along the Niagara River. Follow map.

Facilities and Best Usage: Topics at park site are designed especially for the site. The Museum would be happy to accommodate individual teachers or special interest groups with modifications of the tours below, or with other programs designed for your needs.

1. **Niagara Reservation:** Start at Schoellkopf Museum and proceed to Prospect Point, Goat Island. The tour may include Luna Island, Terrapin Point, and Three Sisters areas. Facilities are available at Three Sisters area for picnicking after tour. It is a one-way walk with free parking at each end for busses and cars. The topics include: geologic history of the area, recession of Niagara and formation of the gorge, early industrial development power diversions, Schoellkopf Power Station collapse, and natural history and human history of this unique area.



2. Upper Great Gorge: Start at Schoellkopf Museum and proceed north along the abandoned gorge railway grade to the bottom of the gorge at the Whirlpool Rapids Bridges. Retrace path upon return. The topics discussed include: Lockport formation and fossil algal reefs, geologic time, gorge formation and reasons for differences between Whirlpool Rapids and Upper Great Gorge, the rail line, attitudes to environment and changing use patterns, flora and fauna of the area.

3. Devil's Hole and Whirlpool: Start at Devil's Hole, down stairs into gorge; proceed upstream to Ongiara stairway, climb stairs to rim, and return to Devil's Hole (or end at Whirlpool Park). Please note that this is a moderately strenuous, uneven trail, with access from stairways. The topics discussed include rock strata and geologic time, recession of falls, formation of Devil's Hole and Niagara Glen, and soil formation.

4. Earl W. Brydges Artpark: Start at lower parking lot, proceed into gorge and return. The use of spur paths varies with desired subject emphasis. The topics discussed include pre- and post-glacial drainage, Niagara at Lewiston, Lake Iroquois, local history and prehistory, Indian mound, geologic history, sedimentary environments, paleontology, and escarpment formation.

5. Buckhorn Island: There are no facilities on site; arrangements can be made at Beaver Island State Park, 5 miles south. The topics discussed include wetland and woodland life, plant succession from marsh to climax forest, migration, hibernation, and a wide variety of vegetation and fresh water studies are available.

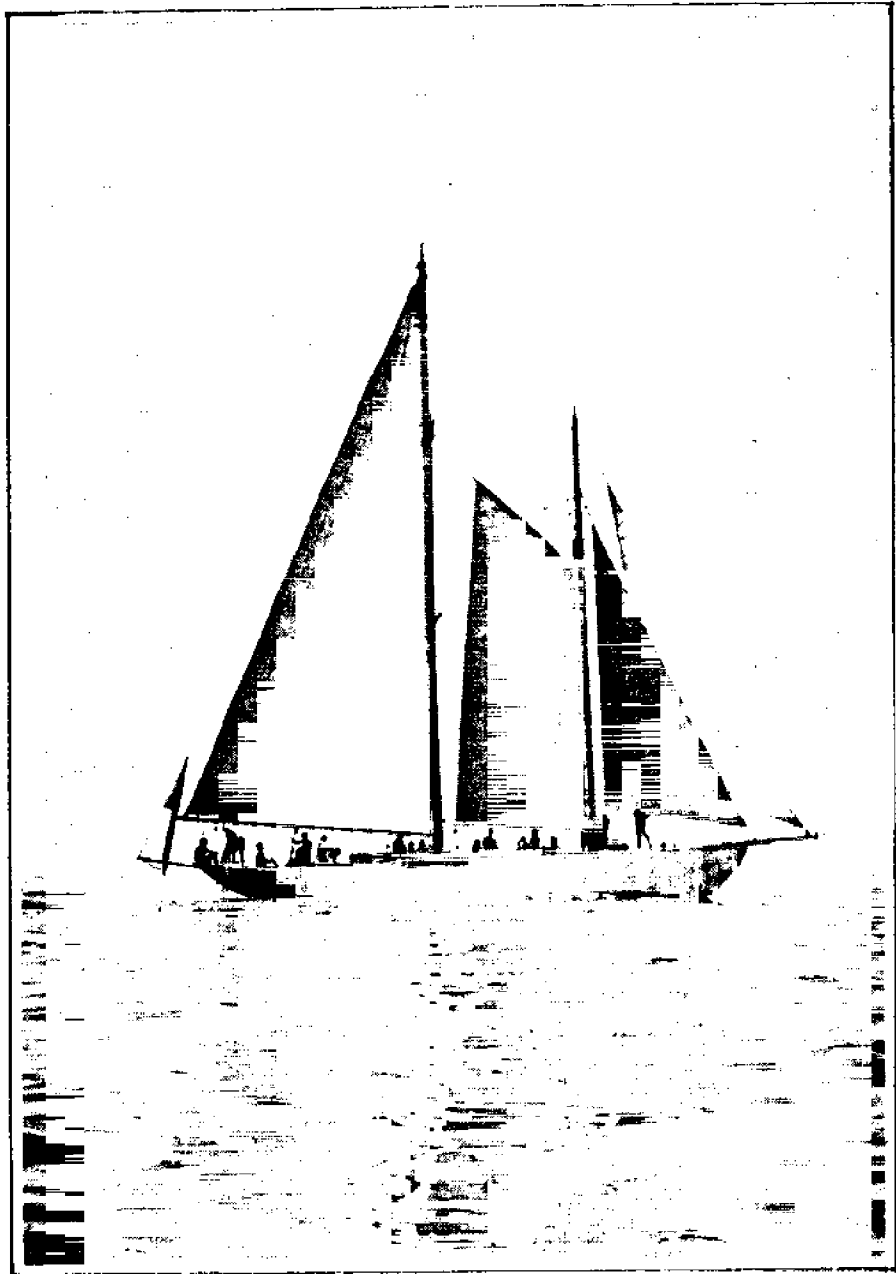
Warnings: Tours may become strenuous. Sneakers and/or appropriate footwear should be worn at all times. Classes should be instructed to stay together at all times.

General Comments: The tours are sponsored by the Niagara Frontier State Park and Recreation Commission. They emphasize a wholistic approach to man and his environment, and pose questions of resource use and management within the park. The field experience blends knowledge of the sciences into an ecological understanding of what is seen. Natural processes, such as the formation of Niagara Falls, the gorge, and rock layers are interwoven with the history and development of the area, so that the tour can meet the specific needs of your curriculum and age level.

Author-Educator: Mario J. Pirastru, Regional Administrator, Niagara Frontier State Park and Recreation Commission, Prospect Park-Niagara Reservation, Niagara Falls, New York 14303. (716) 278-1780
Jack Krajewski, Senior Scientist, Schoellkopf Geological Museum, Niagara Reservation, Niagara Falls, New York 14303 (716) 278-1780

Suggested References: (GE) 2, 18.

Boats and Research Vessels



NAME: PISCES - OCEANOGRAPHIC RESEARCH
VESSEL HUDSON RIVER, LOWER
MANHATTAN, NEW YORK CITY

TYPE: Field work aboard research vessel
Piscès includes basic water sampling
techniques and tests as well as
plankton tows and bottom dredging.
Programs tailored to suit the needs
of the visiting group.

LEVEL: Intermediate, high school, and
college

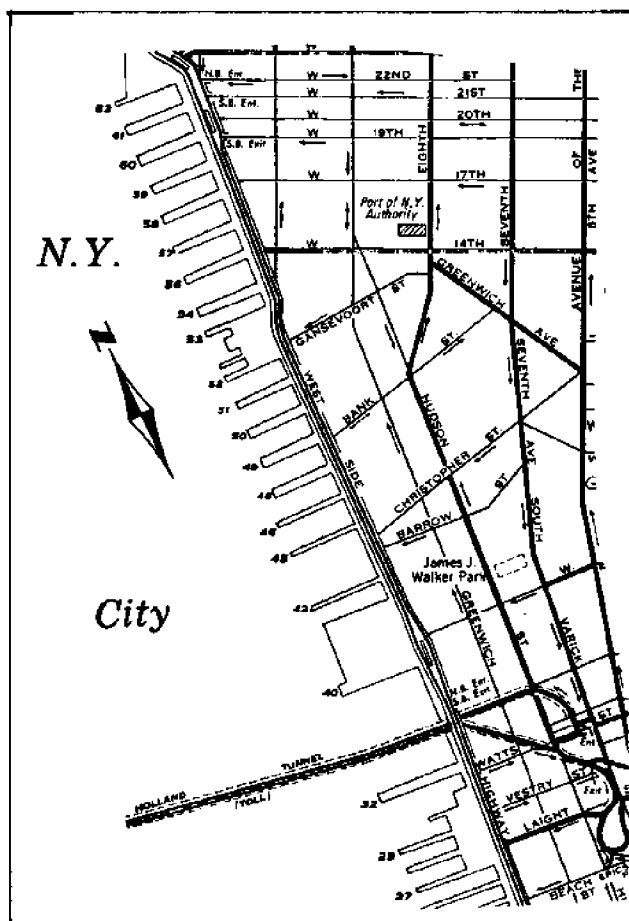
AREA: The R/V Piscès is docked at pier 42
N. River (foot of Morton St.) on the
Hudson River in Lower Manhattan,
next to Schoolships John W. Brown and
John W. Brown II. Most field work
done in Upper Bay off Governor's
Island within sight of Statue of
Liberty and Battery Park; trips can
also be arranged to Bay Ridge Flats
to south or to George Washington
Bridge to north.

Arrangements: Make reservations two to three
weeks in advance. The Piscès will
operate as long as weather permits.
Group limited to 28. Trips generally two to four hours between 10 A.M.
and 2 P.M. A donation to cover the cost of operations is suggested.
Reserve through:
Mr. William Van Loo, Assistant Principal
Schoolship John W. Brown
Pier 42 N. River
New York, New York 10014 tel: 212/255-6925

Directions: Pier 42 is located on the Hudson River at the foot of Morton
Street. It can be reached on the Westside Highway; it is one block
south of Christopher Street and three blocks north of Houston Street.

Facilities: Food: students should bring lunch and drinks with them.
Parking: Bus and car parking is available near or on the pier.
Restrooms: There are restrooms aboard the Schoolship John W.
Brown and the Piscès is equipped with a marine toilet.
Shelter from foul weather: Students should be prepared for rain
or shine and heat or cold. Mornings can be cold and windy
whereas afternoons may be rather warm. Sneakers should be worn,
and sunglasses as well as suntan lotion would be a good idea.

Water Facilities: A variety of equipment is available on board to carry out
various marine investigations and the captain will explain and help
the students operate the apparatus. Such items as a salinometer, secchi
disc, plankton tow, and bottom sampler may be used. A laboratory with
microscopes and reference books is located below deck and may be used.



Best Usage: The opportunity to use oceanographic research equipment on the Hudson River is one which makes a marine curriculum come alive with meaning for the student. The vessel will be operating in one of the busiest ports in the world; this provides a hands-on experience in a human-influenced marine environment. Undoubtedly this would be a highlight in a marine science or oceanography program.

Type of Environment: Very busy river estuary; this area is rich in historical as well as commercial sites. A containerized shipping operation is close to the area and many containerized ships can be seen coming into and leaving port. The Statue of Liberty and Ellis Island with their meaning for immigrants and their descendants are passed. An excellent view of the lower Manhattan skyline is available as is the site of Battery Park City to be built on fill.

Suggested Activities: A discussion of estuaries and their influence on human activities would be appropriate before the trip; a set of slides by students could illustrate the influence which humans have on the estuary itself. A pre-trip demonstration of instruments to be used on the vessel would enrich the experience although this is not necessary. Samples of fauna and flora may be taken for future identification. A profile of physical and biological parameters may be made from data gathered on the vessel and analyzed in the classroom.

Preparation: General discussions about behavior on a boat such as safety are suggested. Preparation and pre-labeling of sampling bottles is recommended and each student or group might be assigned observation tasks at stations before the trip.

Warnings: It should be noted that Federal laws apply to vessels on the Hudson River which are more severe than New York State laws concerning drugs.

General Comments: A side trip is available to the Schoolship John W. Brown which is a 440-foot cargo and dependent vessel which has seen action in World War II. It is now used as a training school and is an annex of Park West High School. The trip can be made on the same day as the Pisces trip and takes approximately one hour.

Author-Educator: Gary Schechter, Kennedy High School, Kennedy Drive, Plainview, New York 11803. 516 938-5400.

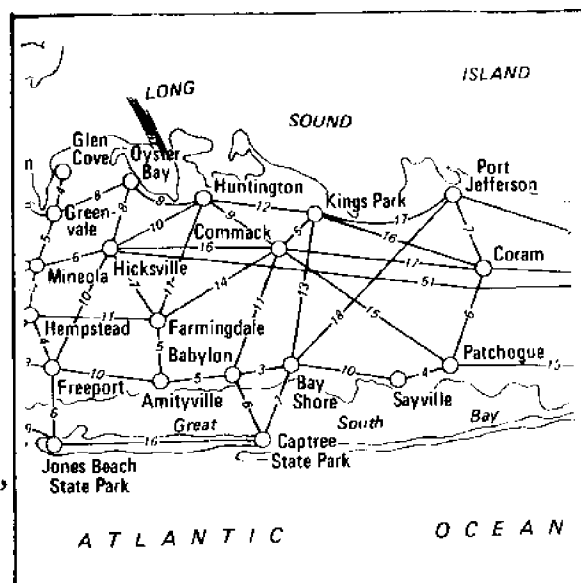
Suggested References: (GE) 18, 25; (B) 37; (F) 39, 40, 44; (I) 46, 51; (P) 56, 60, 61; (PL) 66, 70, 72.

NAME: Marine Ecology of Long Island Sound

TYPE: Open water field work aboard a 57' schooner including water sampling and testing, sediment sampling and collection of marine animals and plants by otter trawl and plankton tows. Subject matter can be varied to suit the needs of a specific class.

LEVEL: Facility is used by groups from 7th grade through college biology classes and teacher workshops.

AREA: Schooner, Inc. is based in New Haven, CT, but the research vessel sails from several Connecticut and Long Island ports. To serve N.Y. groups, departures could be from Stamford, CT., Cold Spring Harbor and Port Jefferson on Long Island or possibly City Island, N.Y.



WORK AREA: Western Long Island Sound

Arrangements: Reservations must be made in advance. The operating season runs from April through November. Early scheduling is strongly recommended. The capacity of the schooner is 18 people. The fee is \$225 per day, which includes use of the ship and equipment, ship's crew and Schooner's teaching staff. For groups leaving from ports other than New Haven, there may also be docking and launch fees. Field trip hours are from 9 a.m. to 3 p.m.

For Reservations, contact Jean-ellen McSharry or Jane Griffith at 203/865- 1737.

Directions: Because departure points vary, maps or directions to the location are provided when reservations are confirmed.

Facilities: Food- Students provide their own lunch and beverage
Parking- There is generally ample parking near the pier the boat uses.
Restrooms- TRADE WIND is equipped with a head.
Shelter from foul weather- The vessel sails rain or shine, though in extreme weather a trip may be cancelled at the discretion of the licensed Captain. Students should wear rubber-soled, flat shoes (warm boots in late fall and early spring) and bring warm clothing and a rain jacket even on fair days.

Water Facilities: The entire field experience takes place on board the research vessel in the inland waters of Long Island Sound.

Best Usage: A trip is best used to expand on and demonstrate concepts and principles learned in the classroom as part of a science or environmental studies program. Students are involved in using scientific equipment to collect biological, water and sediment samples and observe and measure physical and chemical factors in the marine environment. The setting of the boat also provides an interesting perspective on the shoreline which can be used as a starting point for discussion of land use and coastal management topics.

Type of Environment: Inland waters--special features vary with the study areas.

Suggested Activities: A handbook is available describing curricula and recommended and required preparation. Groups at any level may specify the particulars they would like to accomplish, e.g., collecting specimens for a salt water aquarium in the classroom.

Preparation: Handbook will provide guidelines.

Warnings: There are no particular dangers, but it should be emphasized that students' behavior be appropriately disciplined and that clothing recommendations and ship's rules be followed.

General Comments: Free teacher workshops and orientations will be offered during the operating season to familiarize teachers with the boat and its potential and to assist them in pre-trip planning.

Author-Educator: Staff, Schooner, Inc., 60 South Water St., New Haven, CT 06519
phone: 203 865-1737. Office hours: 9-5, Monday-Friday, year-round.

Suggested References: (GE) 18, 25; (B) 37; (F) 39, 40, 44; (I) 46, 51; (P) 56, 60, 61;
(PL) 66, 70, 72.

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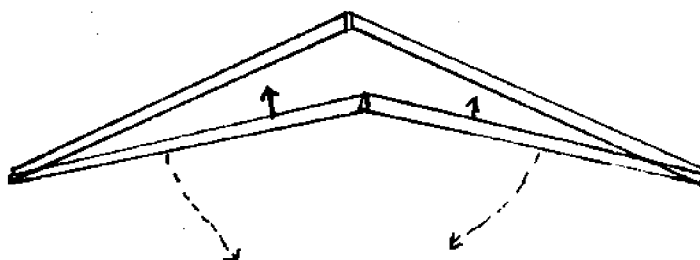
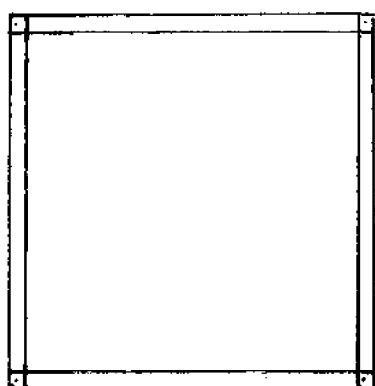
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APPENDIX 1: DETERMINING POPULATION

Two methods of taking a population census and determining population density:

I. Meter Square Plot Method:

1. Prior to the field trip prepare several meter square plot markers. This can be done by fastening 4 sticks, each about 1.04 cm, with a single nail or nut and bolt near the ends. This should form a square one meter on a side measured on the inside. These can be folded or even dismantled for easy transportation.



2. Upon arrival at the salt marsh a test site can be selected. The teacher may wish to select a site in one zone or over several zones. Students can now drop their meter square plot markers in the selected site.
3. Students should try to count all the plants within the marker area. This will be impossible to do in the *Spartina* grass area due to the large number of plants. In this situation, students should be instructed to mark off several sections 10 cm square (100 sq. cm.) within the meter square area. Each meter square marker can be marked off at 10 cm. intervals and string used to subdivide into the smaller plots. This is a miniature quadrat method.
4. Students can now determine the number of plants of each species counted per square meter by selecting five - 100 square cm plots and averaging the number of plants/ 100 square cm. Multiply this number by 100 (the number of plots in one square meter) to find the number of plants/ square meter. Comparisons can be made to other plots in different areas or averaged with other plots in the same area.
5. The same method - direct counting - can be used to determine the population density of small slow moving animals. One such animal is the small pulmonate (air breather) snail *Melampus melampus* (edentatus). Although they are capable of moving, they are extremely slow and can be on the surface of the marsh or in the base stalks of the *Spartina alterniflora*. They feed on mud algae and algae growing on the *Spartina* stalks.

II. Lincoln Index Method

1. Select an area in the *Spartina alterniflora* zone of the salt marsh. Set out stakes to encompass an area of 200 meters square (about 10 m x 20 m).
2. This is a workable plot for a group of 8 to 10 students. One or two students will set up a marking station. This can simply be an overturned bucket. Red nail polish serves as a very good marking agent.
3. The remainder of the group will search for the small snails *Melampus melampus* (edentatus). These will be found in and around the bases of the *Spartina* grass.
4. The captured snails should all be marked and the number marked recorded, and then set out into the study plot. Replace snails gently so as not to bias your results by giving the marked snails a disadvantage. Be careful to distribute the marked snails uniformly throughout the study plot.
5. Leave the plot marker stakes and return to the site in two or three days. Recapture about 200 snails and record the number of marked and unmarked snails.

- a) The total population of snails can be estimated by the formula:

$$\text{TOTAL POPULATION} = \frac{\text{marked snails} \times \text{unmarked snails (recaptured)}}{\text{marked snails (recaptured)}}$$

- b) Although these snails are mobile, they generally do not migrate out of the study area. However, to check this, have students search the adjacent area for marked snails.

APPENDIX 2: A TRIP TO A BARRIER BEACH

A field trip to a barrier beach is a lesson in ocean dynamics. Because of waves, tides, currents, the beach never appears exactly the same on any two visits. It changes with the seasons, with the winds, with the storms, and with just the passage of time. Students who go to the beach in the summer just to swim may never see these changes, but by calling their attention to the existence of clues to change, a teacher may set up a long-term process of observation that can greatly enrich a young person's understanding of his own environment.

PURPOSE: To observe the nature of a barrier beach, in order to understand how it came about, how it is changing and what will be its eventual fate.

OBJECTIVES: When you have completed this field trip, you should be able to:

1. Define a barrier beach and discuss its evolution,
2. Explain the nature and origin of the sand,
3. Identify the various sections of the beach and draw a profile of the beach, including the area immediately offshore,
4. Describe the effects of tides, longshore currents & breakers on the beach.

PREPARATION: About a week before the trip, distribute copies of the ESCP booklet, Field Guide to Beaches by John H. Hoyt, Houghton Mifflin Company, Boston, 1971, and assign reading of the whole booklet, 39 short pages with meaningful diagrams. Use this as a basis for discussion in class of the parts of a beach, beach formations, action of waves, tides, long-shore currents, rip currents, formation of dunes and barrier islands, types and sources of sand. Use filmstrips, filmloops, slides and/or overhead transparencies to illustrate beach formation, barrier islands, spits, hooks, mid-bay bars, tombolos. On a map of Long Island, show where all of these exist. Look for locations along the south fork where bars have sealed off whole bays, allowing them to become brackish or fresh (Mecox Bay, Agawam Lake, Hook Pond). Explain that Shinnecock Bay had experienced the same fate until it was deliberately opened up through the Shinnecock Canal, and then accidentally opened up to the ocean through Shinnecock Inlet, created by the hurricane of 1938. This discussion will prepare students for the fact that the beach is constantly changing. If possible, show the film, "Beach, A River of Sand".

Consult tide tables and pick a convenient day when the tide on the ocean side will have peaked about two to three hours before you get there. Thus, the tide will be dropping fast when you arrive. If you cannot work this out, it is better to have the tide on the low side than the high side.

Prepare a list of items for each student to bring, preferably in a waterproof totebag.

- An extra pair of shoes, socks, and a towel; extra layers of clothing
- Brownbag lunch and something to drink
- 3 small plastic containers with tight lids (such as cottage cheese containers)
- Half-gallon plastic milk bottle with top, well washed, for water sample
- Notebook, clipboard, graph paper, ruler, protractor, pencil, hand lens, camera
- A garden trowel or child's shovel and pail.

With help of students, teacher should assemble the following additional materials to be taken on board the bus:

- One large styrofoam cooler for keeping soft drinks cold, if it is warm
- A seine net, a long-handled shovel, a compass, six meter sticks, a large ball of twine, a dozen corks painted bright orange or yellow, thermometers
- A stop watch or watch with second hand

A coffee can with holes punched in bottom and a long string tied through holes
Copies of Golden Nature Guides: Seashores and Fishes, or similar guides
Topographic Map
A cardboard mailing tube 2 ft. or longer, attached at right angles to the
top of a six ft. pole (for sighting and profiling)
Instruction sheets for students to be distributed on the bus

ACTIVITIES: With notebooks fastened to clipboards, record some immediate observations:

1. Direction of the wind, use the compass. Is it blowing onshore or off? Why?
2. State of the tide, put a marker in the sand where the highest wave left its mark a few hours earlier and another marker where the highest waves are now. If there has been a storm, look for evidence of even higher tides and waves.
3. Angle at which the waves are striking the beach. Line up your protractor parallel to the line of the beach and estimate how many degrees off the perpendicular the waves are coming in. Determine the direction with the compass.
4. Study the waves. Eyeball them and estimate the height of the open waves. In groups of two one counting waves, one timing with watch--determine how many waves break in a minute, divide that number into 60 and record the period of the breakers in seconds.
5. Take a good look at a handful of dry sand. See if you can identify quartz, feldspar, white mica, black mica, garnet and magnetite. Look at them with a hand lens. Notice locations where the dark-red garnets seem to be concentrated. Fill plastic containers with sand samples from different locations for sieving.
6. Take an overview of the whole beach area: note how straight the actual shoreline is, but look for crescent-shaped indentations called cusps. Observe the profile of the beach from the waterline back to the first line of dunes. Compare these features with the diagram in the Field Guide to Beaches booklet. Note where the berm is; this is the break that separates the foreshore or beach face from the back shore. In the spring the berm will be a sudden break as a result of the winter storms; in the fall after a reasonably quiet summer, the berm should be much less pronounced. Take pictures of the berm so that they can be compared with previous trips and succeeding trips.
7. Down near the waterline, dig a deep hole in the beach. Look for evidence of cross-bedding on the sides. Dig down till the hole is filled with water. Plunge one of the thermometers deep into the water, hold it there for a minute, then without withdrawing the bulb, read and record the temperature.
8. Let the water in the hole settle for a few minutes, then take a water sample. If you have a water analysis kit, determine the pH, the salinity, the dissolved oxygen, and the suspended particulate matter. Record all results.
9. Measure the depth of the water level in the hole below the sand surface. This is the water table. Dig two successive holes at ten foot intervals up the beach, and see how far below the surface the water table is at those places. Record the depth and the distance from the shoreline of each hole.

10. Measure the beach for a profile as described in the Beaches booklet. Turn the sighting tube toward the horizon to get it perfectly level, then sight up the beach to a given point and measure the distance to that point. By simple triangulation, determine the slope of each section. Make a sketch of the profile and put your figures on the sketch. Later translate this to graph paper and make a more exact profile. Later, draw a dashed line below the profile representing the water table as you found it below the surface.
11. Down near the water's edge, observe the swash-backwash pattern. Look for delta-shaped marks on the sand after the water retreats. Look for ripple marks; these have all been found hardened in sandstone. Pack the corks into the coffee can, weigh them down with wet sand and throw the can as far out as possible. The sand will wash through and the corks will float out. Pull the can in and follow the corks down the shore as they are carried by the long-shore current. Collect them as they are washed in. This will give you a reading on how fast the long-shore current is carrying the sand along the beach. Look for evidence of rip currents.
12. Make a list in your notebook of all living organisms or evidence of organisms found on the beach, including bird tracks or feathers, shells; dig holes in the sand and look for burrowing animals. Look them up in the guide books.
13. Before leaving the ocean side, note whether the wind has shifted and how the tide has dropped while you were working. Place another stick at the new water line. As you walk back to the parking lot and on to the bay beach, observe the dunes carefully. Count the rows; each row represents another period in the life history of the barrier island--one set migrates inland and another set forms. Notice their shapes and how they are carved by the wind.
14. Notice how different the bay beach looks, the color, the fineness of the silt, the flatness, the lack of breakers. Dig into the silt and note the color below. Wade out into the open water and take a temperature reading. Take a water sample and run analysis to be compared with the ocean water. Drag the seine net through the water and see what life forms you can find. This is the nursery area for many fish juveniles. Walk along the beach looking for other evidence of life. Jelly fish are sometimes stranded on the tidal flats. In the spring pairs of mating horseshoe crabs can be found here. Observe them carefully, but do not disturb them. Make sketches of some of the different plants observed in this area. Identify them in the Seashores guide.
15. Before leaving the parking field, go back and retrieve the sticks put down for tide markers. Note where the tide is at this last reading. Try to estimate the total vertical drop from your observation of the highest tide. Compare this with your observation of the drop of tide*as you ride back.
16. Back at school, observe some of your Bay water under the microscope. Observe sand grains under the stereoscope. Sieve different sand samples and graph the results. Determine the specific gravity of ocean water. Write a report.

Prepared by: Julia Sheldon
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APPENDIX 3: FIELD STUDY EDUCATION--EXPLANATION AND VALUE

Field Study Education is both a valid alternative and valuable supplement to more traditional educational approaches. A field study may be specific in content or multidisciplinary, but it always uses the uniqueness of the site as impetus to the expected educational goals. In a new environment, unaffected by the pressure and structure of the traditional classroom, there is a childlike sense of wonder on the part of students, a need to know, a spirit of inquiry, and a desire to explore both self and surrounding environment.

A field study is different than a field trip. A field study is a course in its own right rather than a supplement to an existing classroom course. At the very least, it is an extension of pre-training that may have been done in the classroom back home. By contrast, a field trip is usually a brief outing and serves merely as an adjunct to an existing course. A field study, on the other hand, is more rigorous, is long in duration (7-12 days) and may be credit oriented. Field studies are often done during regularly scheduled school time and may involve both pre and post course work.

CONSIDERATIONS IN SELECTING AN OUT OF STATE FIELD STUDY SITE

Although the whole world is open to you as a site for your field study, there are many practical considerations to keep in mind. It is a policy of Science Education Afield, for example, never to conduct a field study to a site not previously inspected by a member of its staff. However, if you have a site in mind, here are some important considerations.

COST

A rule of thumb is the greater the distance, the greater the cost. In light of the wide range of special fares now offered by airlines, it may be possible to roam farther than you think and still stay in budget. It is important to keep in mind that if you are interested in some remote area, private or small charter planes may be involved and this is often very expensive. In some remote areas it is often necessary to bring food, diving equipment, etc. since there are no facilities in the area and thereby can add substantially to the cost of the trip. Avoiding areas that are popular tourist sites and also avoiding peak vacation or in-season times will help to keep the cost down.

WEATHER

Many people are under the misconception that all Caribbean, Central and South American and Pacific countries have perfect weather year round. This is not so and thus the dates of the field studies should be coordinated with knowledge of the weather for that particular site. High winds, rainy season, currents, can all affect both top-side and underwater conditions and must be kept in mind when looking for a potential site.

SAFE LIVING AND DIVING CONDITIONS:

It is important to know before hand that the field study site has safe conditions for living and for underwater diving. Many beautiful Caribbean Islands do not have safe diving possibilities because of their volcanic formations. There is little shallow water and, thus, the depth is too great for scientific inquiry or for safe diving by the beginning divers.

MEDICAL FACILITIES:

It is important that the field study site be near appropriate medical facilities in the event of accidents. Teachers and staff should be certified in First Aid and emergency medical treatment procedures, and should not conduct a field study to a remote area where professional medical facilities are lacking.

HIGH AND LOW SEASON:

Since the Caribbean is a favorite area for field study programs, it is important to avoid the heavy tourist times both from the stand point of cost and from the stand point of having the student see the island in its most natural setting. Typically the high season is December first to April first and thus field studies are best conducted in the months of April through November.

DIVING FACILITIES:

Since most field studies use snorkeling or diving as a tool for scientific investigation, the site should have facilities for filling diving cylinders and must be able to provide diving boats, guides, etc.

SAFE ENVIRONMENT:

In addition to being sure that the diving conditions are applicable to the level of competency of the students, it is also important to know of other potential hazards before hand. The students should be informed of hazards from both marine and terrestrial flora and fauna and be taught to recognize and avoid these dangers. The political stability of a country is also an important consideration in assuring a safe environment.

LEAST INTERRUPTION OF SCHOOL YEAR:

A site should be selected for its ability to accommodate the field study group during the best time in the scholastic calender. Usually the months of October through the first two weeks of May are best for high school field studies.

SUITABLE ACCOMMODATION:

It is important that the accommodations be such as to comfortably separate male and female students. Each student should be housed in a comfortable situation and meal preparation, if done by the student, should take up as little time as possible so as not to interfere with the purpose of the field study. A centralized lodge for group feeding and lectures is usually important and the distance for carrying diving and scientific equipment from the living area to the activity area should be at a minimum. Appropriate trucks or busses to move groups of students are also an important consideration.

ORGANIZATION OF A FIELD STUDY

1. Select one or two teachers who are interested and enthusiastic about the field study program.
2. Determine the basic educational objectives of the field study. Start organizing the field study at least nine (9) months in advance.
3. Decide on the extent of pre and post instruction, and design a brief curriculum for the pre and post instructional aspects, if they are to take place, and for the actual field study itself.
4. Prepare a budget with all details filled out and a cost per student quote.
5. Submit the Field Study Manual, curriculum design and proposed budget to school officials.
6. Once the school officials give approval to conduct the field study, announce the program to the eligible students.
7. Set up a parent/student meeting which will present the field study site and answer questions about the actual field study. (An audio-visual program would be very useful.)
8. Set up the aquatic course for students and staff. (Should be done with guidance of a professional diving school.)
9. Have students fill out the field study applications and return them to school with a deposit.
10. Have the parent sign the Medical Consent and Release Form.
11. Students should submit proof of physical examination within three (3) months prior to the field study date.

SUGGESTED STUDENT EQUIPMENT LIST

The list of equipment that students should bring to the field study may differ from site to site, but in general the following list is typical for most field study programs. It is best that student equipment be packed in duffel bags as opposed to suit cases and a separate plastic or canvas bag to carry mask, fins, snorkel and other diving equipment is desirable.

PERSONAL NEEDS:

- Jeans and shorts
- T-shirt and/or short sleeve shirt
- Underwear
- 2 quick-drying bathing suits

Sweat shirt and/or sweater
Light weight water repellent jacket
Tennis shoes and Sandals
 (Shoes should have a tough sole for walking
 on coral and lava)
Personal toiletries
Insect repellent (Cutter's is best)
Sun Screen (Pre-sun is highly recommended)
Towels and wash cloths
Bedding (Either a sleeping bag or twin sheets
 and a light blanket)
Flash light with batteries
Pocketknife
Sun glasses
Note book and pen
Camera and film
Wallet with spending money in small denominations
Identification (Passport, original birth certificate
 or Voter Registration Card)

DIVING EQUIPMENT:

Each student must bring his diver certification card.
Mask, fins and Snorkel
Boots
Reef Gloves
If night diving is anticipated student must bring
an underwater light.

Other recommendations should be made as to personal items and diving equipment depending on the site of the field study.

STUDENT RULES AND REGULATIONS

A field study is an educational experience and not a vacation. Teachers have no desire to limit the educational benefit or enjoyment of the field study; however, student safety and comfort are major concerns. Therefore, students must agree to a few simple rules and regulations. Any violation of these rules could result in restricting your activities for the remainder of the field study. Serious violations could result in you being sent home and any additional expense incurred for this special transportation would become your or your parents' responsibility.

1. You agree to obey the laws of any state or country you are traveling or living in. You are also expected to tolerate local customs and be courteous to the people of the country you are visiting.
2. You agree to be courteous to all airline, customs, immigration, or security officials you encounter enroute. If you comply with their requests and questions the group will not be detained for any longer than necessary.
3. Joking about airline high-jacking or bombs is not considered funny by airline and security personnel and such behavior may seriously affect the group's travel schedule if you are to be detained. Therefore, you agree to refrain from such comments.
4. No illegal drugs may be in your possession nor may you purchase, or use, such drugs at the field site. Foreign laws are most severe with regard to illegal drugs and little can be done in your behalf by foreign officials.
5. The consumption of alcoholic beverages at the field site, enroute, is not permitted for participants of a high school group, regardless of age.
6. No weapons, explosives or fire works may be brought along on a field study, nor may they be purchased enroute or in the foreign country. Spear guns of any kind may not be brought to a field study.
7. The destruction of any living plant or animal is forbidden and is most likely illegal in the country selected for the field study.
8. Open fires will be restricted to fireplaces and/or fire rings, if they exist. Beach fires are not permitted.
9. Since you will be living closely with your fellow students it is important that you be courteous and tolerant at all times. Fights and gambling will not be tolerated and annoying fellow students will not be permitted.
10. A pre-established bed time will be announced for each field study group. Since getting proper rest is important to your safety and to the total enjoyment of the field study you will be expected to abide by the announced lights-out rule.
11. You agree to cooperate with members of your school faculty and people at the field site. You will be expected to complete chores assigned to you and to be on time for all scheduled activities and events.
12. Operation of motor boats or any motor vehicle is strictly prohibited.

13. Students may not leave the site of the field study without first telling the staff member where they are going and what time they expect to return. Students leaving the field study site should do so in pairs or groups.
14. Students not allowed to swim, snorkel or Scuba dive without the permission of the staff and without staff members present.
15. Students agree to abide by the diving safety rules set down by the dive master accompanying the field study. Students disobeying the dive master's rules and regulations will not be permitted to dive for the remainder of the field study.
16. All students must submit proof of a physical examination within three (3) months of the field study date.

TEACHER RESPONSIBILITIES

1. It is the responsibility of the teacher or teachers involved to complete, or have completed, all forms.
2. The teacher or teachers from the school district are responsible for all individuals or group violations of local state and federal laws during the field study.
3. The teacher or teachers agree to abide by all rules and regulations set forth by the field station or site used for the field study.
4. The safety of all personnel under the teachers' supervision will be their primary concern. The teacher will take all necessary precautions and considerations to insure the safety of all participants.
5. It will be the responsibility of the teacher to have the application and medical release form signed by all participants.
6. It is the teacher's responsibility to insure that the field study runs within budget and thus to obtain a sufficient number of students based on the quote initially submitted to the school district, otherwise the cost per student may have to be adjusted.
7. It is the responsibility of the teacher involved to inform the school district about all aspects of the field study.

8. The teacher agrees to be responsible for all equipment and to insure that the equipment is returned in an undamaged and clean condition.
9. The teacher or teachers involved agree to abide by the rules and regulations set down by the dive masters and/or professional diving consultants, if applicable.

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Within NYS 315/479-5544

Outside State 800/448-5521

**APPENDIX 4: Field Guide for Southeastern New England
Marine Environments**

Prepared by: Barbara S. Waters

Sponsored by:

**National Marine Education Association
Northeast Marine Education Council
Massachusetts Marine Educators
Cape Cod Sea Camps
Cooperative Extension Service
University of Massachusetts
United States Department of Agriculture
County Extension Services Cooperating**

Field Guide Sheet For Southeastern New England Marine Environments

The Sandy Shore and Dunes

Sponsored by:
National Marine Education Association
Northeast Marine Education Council
Massachusetts Marine Educators

Cooperating Extension Service,
University of Massachusetts,
Marine Laboratory at Woods Hole
County Extension Service & Cooperative

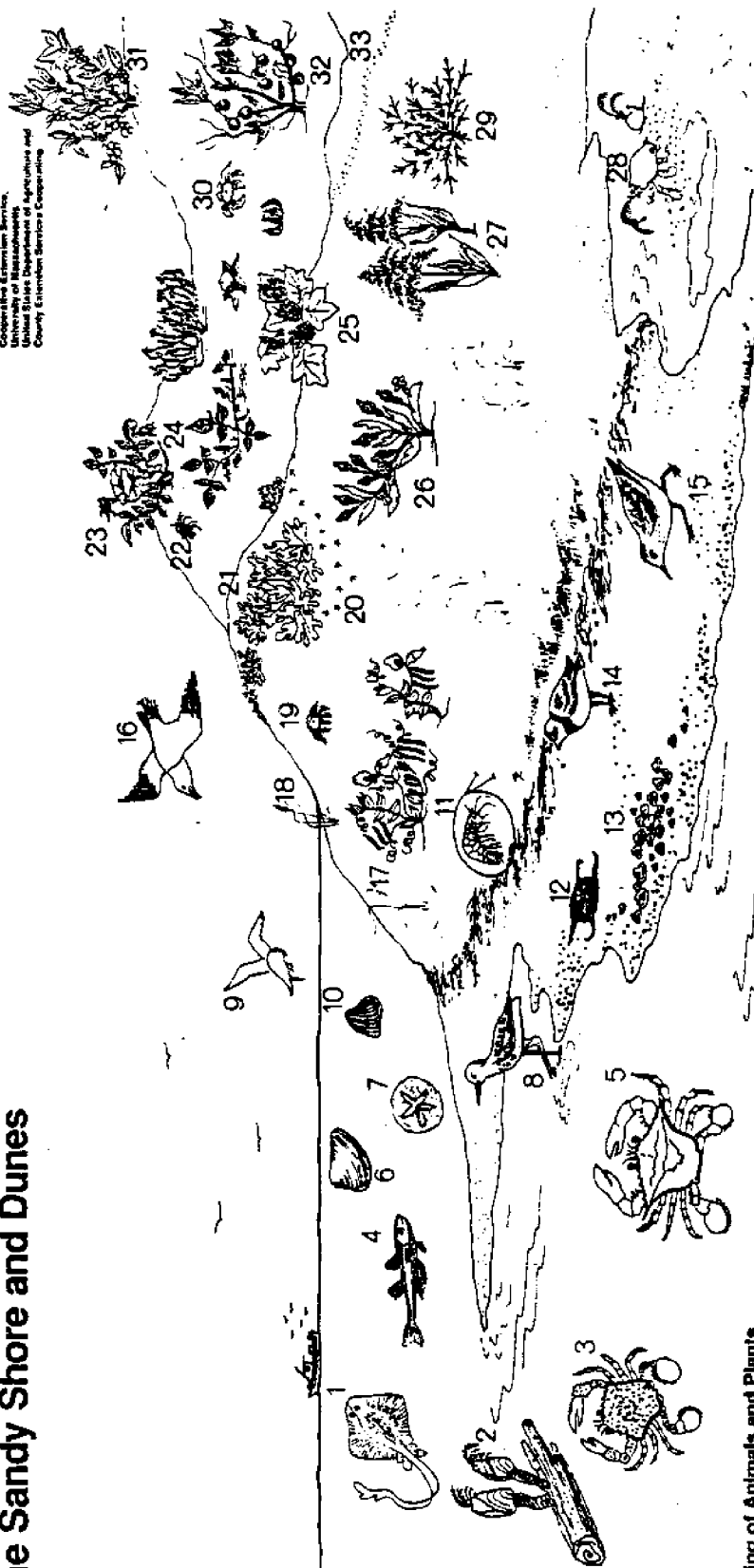


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Listing of Animals and Plants

n - northside
s - southside

1. Skate (*Raja*)
2. Gooseneck Barnacles (*Lepas*)s
3. Calico Crab (*Ovalipes*)
4. Silversides Minnow (*Menidia*)
5. Blue Crab (*Callinectes*)s
6. Surf Clam (*Spisula*)
7. Sanddollar (*Echinarachnus*)n
8. Greater Yellowlegs (*Totanus*)
9. Tern (*Sterna*)
10. Ark Shell (*Anadara*)s
11. Sandhopper (*Telorchestia*)
12. Skate Egg Case (*Raja*)
13. Gem Clams (*Gemma*)
14. Ring-neck Plover (*Charadrius*)
15. Sanderling (*Crocethia*)
16. Herring Gull (*Larus*)
17. Beach Pea (*Lathyrus*)
18. Beach Grass (*Ammophila*)
19. Dusky Miller (*Artemisia stelleriana*)
20. tracks of the Sanderling
21. Sea Rocket (*Cakile*)
22. Dune Wolf spider (*Lycosa*)
23. Salt-spray Rose (*Rosa*)
24. Poison Ivy (*Rhus*)
25. Beach Clover (*Xanthium*)
26. Tall Wormwood (*Artemisia caudata*)
27. Seaside Goldenrod (*Solidago*)
28. Mole Crab (*Emerita*)s
29. Beach Heath (*Hudsonia*)
30. Earth Star (*Geaster*)
31. Bayberry (*Myrica*)
32. Beach Plum (*Prunus*)
33. tracks of the White-footed Mouse (*Peromyscus*)

Description of the Sandy Shore and Dunes Environment

by Barbara S. Waters

A sandy beach at first glance may seem to be barren of animal life. The Herring Gulls stand quietly at the water's edge until someone walks nearby. Terns swoop back and forth and suddenly plunge down to catch a gleaming Silver-side Minnow. Sandpipers, large and small, run across the wet sand, stopping to probe with their long bills, always staying just ahead of the waves.

The remaining animals adapted to these open beach conditions are harder to find. Some are sand-colored, blending beautifully with their background; many dig into the sand; still others are so small that they can live in between sand grains. These animals and plants live in zones between the water's edge and the high dunes.

To find animal life in the intertidal zone (between low and high tide) requires careful observation. The elusive Mole Crab is an example of an animal difficult to find. Standing with bare feet where waves lap back and forth, you may feel the sand beneath your feet move. Look down and you will see a crowd of small, oval creatures which scurry down the slope of the beach with the receding water, and then disappear. Watch carefully to see the two feathery antennae waving above the sand. With a quick scoop of a strainer, you may catch the small Mole Crab with its shiny, smooth, gray-pink, body. It will try to snuggle into your hand (it is "digging"). Place the crab in a small dish and watch it dig backward into the sand. The Mole Crab catches plankton in its sieve-like antennae as the waves move back and forth.

Further up the beach, just above the high tide line look for pencil size, oval holes. Usually the holes are empty, but a careful search, several inches down, around them may turn up several sand-colored Sandhoppers (sometimes called beach fleas). They are from $\frac{1}{8}$ " to $1\frac{1}{4}$ " long. They might play possum or begin hopping into the air. Within a few minutes the Sandhopper will begin digging, head first, into the sand to escape heat and light. A careful inspection will show you that this creature is related to shrimp. It is a transitional animal, like the marsh snail and periwinkle, and spends all of its life in moisture, but out of the water. Lift up the damp seaweed and grass washed up on the beach to find Seaweed Hoppers, brown, shrimp-like animals and many assorted insects feeding on the decaying matter while staying cool and hidden.

Along the tideline many shells and other dried former seafare give you clues to animals and plants living in the sandy bottom, below the low tide line. Most of these animals are burrowers and keep from being carried away by waves and currents. You might find Sanddollars, Ark Shells, Surf Clams, Calico and Blue Crabs, Skate Egg Cases and the hundreds of Gem Clams which serve as food for shore birds. 98% of the empty crab shells are casts, not dead crabs. These can be detected as they are very light and have no offensive odor.

High above the tideline, in the dune area, live an amazing number of plants and animals, adapted to surviving what amounts to a desert environment. The sandy soil does not hold rainwater for long and the air is often full of salt spray, drawing out the fresh water already in plants. Adapting to this lack of water means finding ways to prevent water loss. Mice can conserve liquid by urinating only a few drops each day. Plants such as Sea Rocket and Sandwort have thick, waxy leaves, much like desert cacti. Fleishy leaves can store water. Dusty Miller has furry, leathery leaves; Beach Heath leaves are closely packed to its stem which prevents water loss; the Beach Plum has a long tap root (up to 30 feet) which descends into the water table; and the most important plant on the dunes, Beach Grass, has shallow roots that spread out over a great surface area. The leaf blade of the beach grass rolls shut in sunlight and opens flat during fog or rain. Plants adapted to living in dry conditions are called Xerophytes.

Another necessary adaptation which living things make is to the tremendous heat, which can reach 120°F (48°C). During the hot daylight hours many animals dig into the sand. If you do the same you can feel that it is many degrees cooler just under the surface. No animal can stay more than a few seconds on the hot sand. Leaves of many plants droop or curl which reduces evaporation. Sand dune insects, such as Robber Flies, Tiger Beetles and Wasps, have a dense "fur" covering their bodies which provides insulation by creating air spaces.

Because there is little natural cover for animals to hide from predators, color adaptation is necessary. Examples are the common large Dune Grasshopper and Wolf Spider. Both of these animals have dull gray speckled bodies,

hard to see against sand. The young Sandpeppers are pictures of protective coloration. When potential danger approaches they freeze in place and seem to vanish from sight.

The creator and guardian of our sandy beaches and dunes is the Beach Grass. This is a perennial, tough, native grass that can withstand some flooding, salt spray, drought, strong winds and building (accreting) sand. It is the first plant to be seen growing on a forming sand dune. Bits of broken rhizome from the beach grass root system will start growing with little moisture. This is why beach grass grows back so quickly after a storm has torn it to pieces or buried it completely. When a healthy stand of grass develops, the stems break the force of winds and blowing sand. Grains of sand come to rest at the base of the stem and a good stand of grass can accumulate up to four feet of sand in a year's time. This natural system is better than artificial methods for dune building and rebuilding. If you find an eroded bank with the root system of the grass exposed, you will see clearly that the clumps of grass are connected to each other by underground horizontal stems, the rhizomes. These horizontal rhizomes have enlargements from which grow tough wiry roots that spread out into the sand. As the grass is buried and grows up, decaying parts of the grass create humus so other beach plants can take hold and grow. You and others in your group can help dunes and beaches by not walking on the grass with shoes and by not sliding down or climbing up a dune face. Wherever beach grass is destroyed, the dune begins to disintegrate and blow away.

Field Guide Sheet For Southeastern New England Marine Environments Rocky and Man-Made Shores

Sponsored by
National Marine Education Association
Northeast Marine Laboratory, Coastal
Massachusetts Marine Fisheries
Cape Cod Sea Grant
Cooperative Extension Service,
University of Massachusetts
Marine Laboratory, Gloucester and
County Extension Service Cooperative

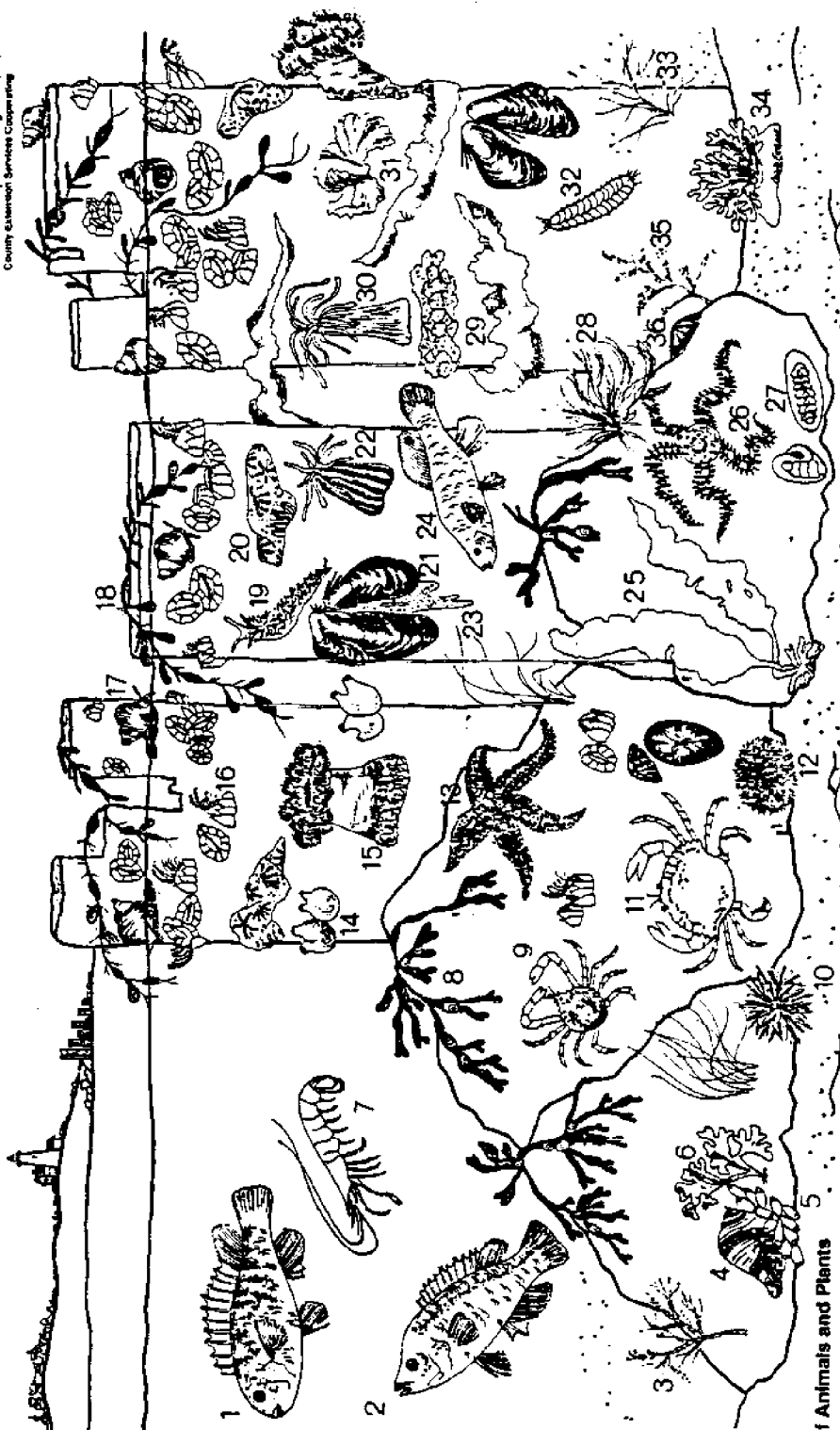


Illustration Copyright © 1978 Carole Eldridge

Listings of Animals and Plants

n - northside
s - southside

1. Tautog (Tautog)
2. Gunner (Gadus)
3. Pink Coral Seaweed (Corallina)
4. Atlantic Dogwinkle (Nucella)
5. egg capsules of the Dogwinkle
6. Irish Moss (Chondrus)
7. Glass Shrimp (Palaeomonetes)
8. Rock Weck (Fucus) with Coiled Worms (Spirorbis)
9. Spider or Decorator Crab (Libinia)
10. Purple Sea Urchin (Arbacia)
11. Rock Crab (Cancer)
12. Green Sea Urchin (Strongylocentrotus)
13. Eastern Starfish (Asterias)
14. Sea Squirts (Molgula)
15. Northern Sea Anemone (Metridium)
16. Barnacles (Balanus)
17. Periwinkle (Littorina)
18. Knotted Wrack (Ascophyllum)
19. Nudibranch (Coryphella)
20. Eyed Tunicate (Botryllus)
21. Blue Mussels (Mytilus)
22. Striped Sea Anemone (Haliplana) or Diadumene
23. Sea Lace (Membranipora)
24. Mummichog (Fundulus)
25. Brown Kelp (Laminaria)
26. Daisy Brittle-Star (Ophiopholis)
27. Chiton (Chaetopleura)
28. Red Seaweed (Polysiphonia)
29. Crumb of Bread Sponge (Halichondria)
30. White Sea Anemone (Sagartia)
31. Sea Lettuce (Ulva)
32. Scale Worm (Lepidonotus)
33. Pink-Hearted Hydroid (Tubularia)
34. Red Beard Sponge (Microciona)
35. Tufted Erect Bryozoan (Bugula)
36. Atlantic Plate Limpet (Acmaea)

Description of Rocky and Man-Made Shores by Barbara S. Waters

Rocky shore environments are found all along the Southeastern New England coast. They are made up of boulders and cobbles left by the glacial retreat, typically found on Cape Cod, or exposed bedrock and headlands seen in Brantrock, Mass., Newport, Rhode Island and parts of Connecticut. These shores are usually open to wave and current action, and organisms are subject to great physical stress. Each form of life must be able to withstand drying, rainwater, cold and buffeting by waves. Observe how each organism adapts in the ways it can hold onto and move over the steep rocks.

Look first at the total picture of a rocky shore, and soon a pattern emerges. At the high tide line, you see a thin dark line of blue-green seaweed (algae) living at the spray zone. Just below is a wider band of white made up of the Common Rock Barnacle. Put a face mask in the water and watch the forest of flicking barnacle feet waving back and forth from the tops of the tiny white cones.

Below the barnacle zone, the two rockweeds *Ascophyllum* and *Fucus* grow. *Ascophyllum* is green to yellow, long, ropey and branched with air bladders that float the seaweed closer to sunlight when the tide rises. *Fucus* is also branched, but flattened with a midrib and wings on either side. The tiny white spirals dotting the *Fucus* are calcareous cases of the Coiled Annelid Worm. Their delicately colored plumelike feeding tentacles extend out of the tubes in quiet water, and disappear instantly when disturbed.

Clustered between and under rockweeds are Blue Mussels of all sizes. The Blue Mussel has a modified foot that secretes strong threads used to fasten it to rocks and other mussels. In quiet tidepools or with a facemask you can see each mussel gaping slightly open, revealing a ruffled mantle. Crawling over everything are Periwinkles at upper tide levels and the Atlantic Dogwinkle at lower tide levels. The Periwinkle remains out of water for many hours between tides. They can shut the doorway (*operculum*) of the shell trapping a bit of sea water inside. Periwinkles feed on seaweeds. The Dogwinkle is slightly larger and multicolored ranging from white to orange, banded, to brown. They are active carnivores feeding on barnacles and young mussels by drilling a hole through the shells with a rasping tongue (*radula*). The 1/2 inch vase-shaped egg capsules of the Dogwinkle

are commonly found under clumps of rockweed in Spring and Early Summer.

Another snail, without a coil in its shell, is the Atlantic Plate Limpet or Chinaman's Hat. It is found firmly attached to rocks in the middle of the tidal zone. This snail can be pried off by gently inserting a knife under the edge of the shell and lifting slowly until it lets go its powerful foot. Pink tufts of the Coral Seaweed are common in this middle tidal zone here and there in rock crevices or on backs of large periwinkles. It looks like a pink coral, but is, in fact, a red alga with a hard calcium coating.

The lively amphipod *Gammarus*, flattened from side to side, is the first inhabitant of the tidepool in the spring. They are seen fastened together at this time, the larger female (up to 1" long) carrying a smaller male (1/2" long).

The tidal areas exposed at very low tides, during new and full moons, reveal an amazing diversity of life. Turn over rocks lying in shallow water, lift up rockweeds and feel in the dark and hidden crevices of rocks. Here multitudes of sealife wait for the tide to rise again, bringing in a new supply of food. The Eastern Starfish is always present. The Green Sea Urchin is common on the Northside of Cape Cod up to Maine, while the Purple Sea Urchin can be found on the Southside of Cape Cod down to the Mid-Atlantic Coast. Both urchins feed on seaweeds and dead sealife.

The Crumb-Of-Bread Sponge is found growing flat in open rocky areas at the base of rocks. It appears greenish to gray and is composed of many cone shaped mounds with openings at the top. The Red-Beard Sponge is bright red and grows flat in rough water, but will become fingerlike in quiet water.

Common Northern Sea Anemones are found in great numbers and in a variety of colors. Out of water they resemble brown slimy blobs but underwater and feeding, they extend tentacles which capture small prey. A relative of the sea anemones are the colonial hydroids. They look like many very small sea anemones living together on ends of branches. One colorful form is the Pink-Hearted Hydroid. The nudibranch *Coryphella* is found grazing on the hydroids. Nudibranchs are similar to the garden slug, a

snail without a shell.

Encrusting rocks and shells are lacy coverings. When viewed with a hand lens, you can see openings in geometric pattern. Each opening contains an animal form. These are bryozoan or "moss animal" colonies. Another form of bryozoan colony is the erect form most common being the Tufted Bryozoan. It would appear to be a seaweed, except it is pink to tan in color.

Manmade docks, seawalls, groins, and rip-rap, usually located in quieter bays and harbors, provide a convenient substrate for many sessile sealife to fasten. These animals feed by drawing in currents of water containing plankton and other bits of food. The outer platings of a dock, those exposed to direct sunlight, are often covered with brown and green seaweeds; the further in and darker (same rule applies to jeties) areas, have fewer plants and more animals take hold. The organisms found here are much the same as the more exposed rocky areas, with a greater number of the delicate colonial hydroids, tunicates and more erect forms of sponges.

A well-covered piling is thick with blue mussels, individual and colonial sponges, sea anemones, hydroids, barnacles, small shrimp and fish. The Sea Squirts, Sea Vases, and colonial urochordates such as the Sea Peach and the Eyed Tunicates are also very abundant. When tunicate animals begin life they are highly evolved tadpole-like forms with the beginning of a notochord. However, on becoming adults, they degenerate into the soft lumps you find attached to pilings. They are often vase-shaped with two siphons, one incurrent and one excurrent, to draw in food and expel wastes.

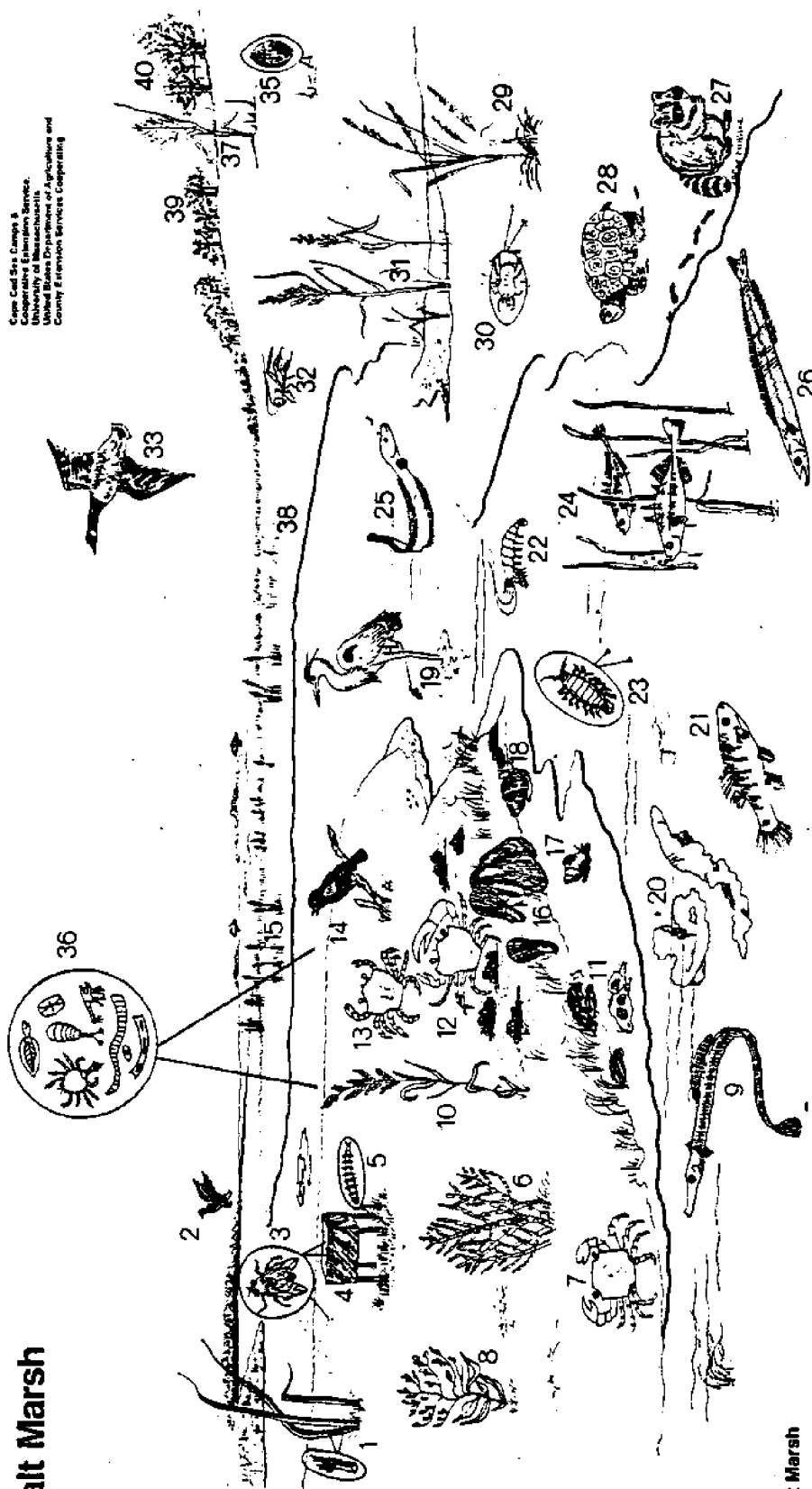
Close observation of a piling scraping provides many hours of fascinating study. Keep in refrigerator, or delicate forms will quickly deteriorate.

Field Guide Sheet For Southeastern New England Marine Environments

Salt Marsh

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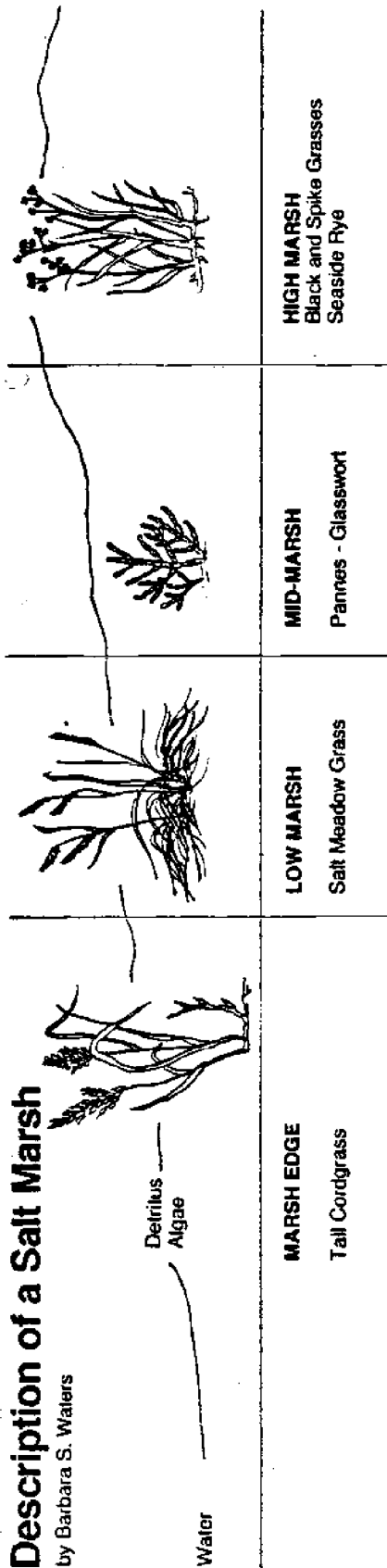


Salt Marsh

1. Marsh Bulrush (*Scirpus*)
2. Black Duck (*Nyroca*)
3. Greenhead Fly (*Tabanus*)
4. Boxes put out in marshes to trap Greenhead Flies
5. Larval form of the Greenhead
6. Glasswort (*Salicornia*)
7. Marsh Crab (*Sesarma*)
8. Sea Lavender (*Limnium*)
9. Pipe Fish (*Synbranchius*)
10. Spike Grass (*Distichlis*)
11. Rock Barnacles (*Balanus*)
12. Male Fiddler Crab (*Uca*)
13. Female Fiddler Crab (*Uca*)
14. Red Winged Black Bird (*Agelaius*)
15. Cat-tail (*Typha*)
16. Ribbed Mussels (*Modiolus*)
17. Marsh Periwinkle (*L. saxatilis*)
18. Mud Snail (*Nassarius*)
19. Great Blue Heron (*Florida*)
20. Sea Lettuce (*Ulva*)
21. Killifish (*Fundulus*)
22. Glass Shrimp (*Palaemonetes*)
23. Isopods (*Isoetea*)
24. Sticklebacks (*Gasterosteus*)
25. American Eel (*Anguilla*)
26. Sand Lance (*Ammodytes*)
27. Raccoon (*Procyon*)
28. Diamondback Terrapin (*Malaclemys*)
29. Salt Meadow Grass (*Spartina patens*)
30. Marsh Mite (order Acari)
31. Cordgrass (*Spartina alterniflora*)
32. Cricket (*Acheta/Gryllus*)
33. Canada Goose (*Branta*)
34. Panic Grass (*Panicum*)
35. Coffee Bean Snail (*Melampus*)
36. Assortment of plankton so plentiful and vital to the salt marsh ecosystems.
37. Cordgrass (*S. alterniflora*)
38. Salt Meadow Grass (*S. patens*)
39. Glasswort (*Salicornia*)
40. Black Grass or Rush (*Juncus*)

Description of a Salt Marsh

by Barbara S. Waters



Salt marshes border the salt water bays, and are flooded on high tide at some period during a twenty-four hour cycle. They are dominated by grasses of the genus *Spartina*. Cordgrass (*Spartina alterniflora*) is a sturdy grass, one of a group of salt-tolerant plants. It cannot survive underwater as eel grass, but it grows well with a salt-water bath twice each day. It sends out underground stems and new clumps of Cordgrass grow from these. The grass blades slow down the water movement so that the sediment in the water drops and the Cordgrass grows higher. Eventually it will form a peat bed many feet thick. Spike Grass, grows alongside Salt-Meadow Grass. It can be recognized by its shorter leaves. Black Grass takes its stand near the landward edges of the marsh. Where the marsh surface develops shallow depressions, known as pannes, water sometimes collects at the highest tides. In these pannes and along the salt-rimmed borders of the marsh the Glassworts grow beside the Sea Lavender. Colonial people and wild food lovers pick these slubby, fleshy Glassworts.

Looking out over a marsh for the first time you may not be able to tell each kind of grass from one another. Two clues to identification includes knowing where the grass is located in relation to amount of time it stays in the water and color. At the water's edge, the cordgrass forms a dark-green border, up to six feet tall in favorable conditions. The salt-meadow grass and nearby spike grass are one to two feet high and form a lighter green carpet. By late summer the salt-meadow grasses have bent at their bases to form flattened crowsnicks.

The black grass rims the landward side of the

marsh with red-brown patches. In bare patches and at the high dry edges, the short glasswort is easy to see. In fall it turns bright red, while the sea lavender is purple.

After this first survey, you are ready for a closer look between the grasses. Here the primitive algae grow, providing the basic nutrients for many animals. They grow in flat green mats or float up and down the creeks. Down between the grasses are dozens of the Coffee Bean Marsh Snail which feed on the algae mats and decaying vegetation. At high tide these snails climb to the top of the marsh grass out of reach of the water, and they move back down as the water recedes. It is a pulmonate snail and must breathe air (having lungs rather than gills). When up on the grass blades the Coffee Bean Snail is often eaten by birds. It is a squat, egg shaped snail, translucent brown and about 1/2" long.

Many holes the size of a fat finger puncture the marsh. Beside most of the holes are neat balls of sand and mud. These holes are dug by the Fiddler Crab. On a hot summer's day, the Fiddler Crabs scurry frantically when you approach trying to find their holes. At low tide, the crabs leave their holes by the hundreds to drink and feed at the water's edge. The name fiddle comes from the enlarged claw of the male crab, which it carries in front of its body like a musical instrument.

Near the water the marsh drops off to form an eroded peat bank providing homes for a number of burrowing clams and crabs. The box crab or Marsh Crab, makes a hole here about two inches in width with little piles of mud around the hole which leads to a network of tunnels that

can be traced to the water. This Marsh Crab is shaped like a box and it is bigger than the fiddler. When caught it will play possum, keeping the legs extended and rigid. When returned to the ground, it will suddenly come to life and dart away.

Every salt marsh has colonies of Ribbed Mussels which are often covered with Barnacles. These mussels are good to eat, if the marsh is clean.

The most unwelcome creature on the marsh, as far as man is concerned, is the Greenhead Fly. The female fly lays its eggs on grass stems in mid-summer. These females seek blood of warmblooded animals to develop their eggs. The eggs hatch into inch-long maggots, which winter in the mud at the base of the plants, feeding on insects, worms, snails and other greenhead larvae. Usually the following summer they emerge as the dreaded fly. They in turn provide a bumper meal in late July for the swallows, and many other birds as well.

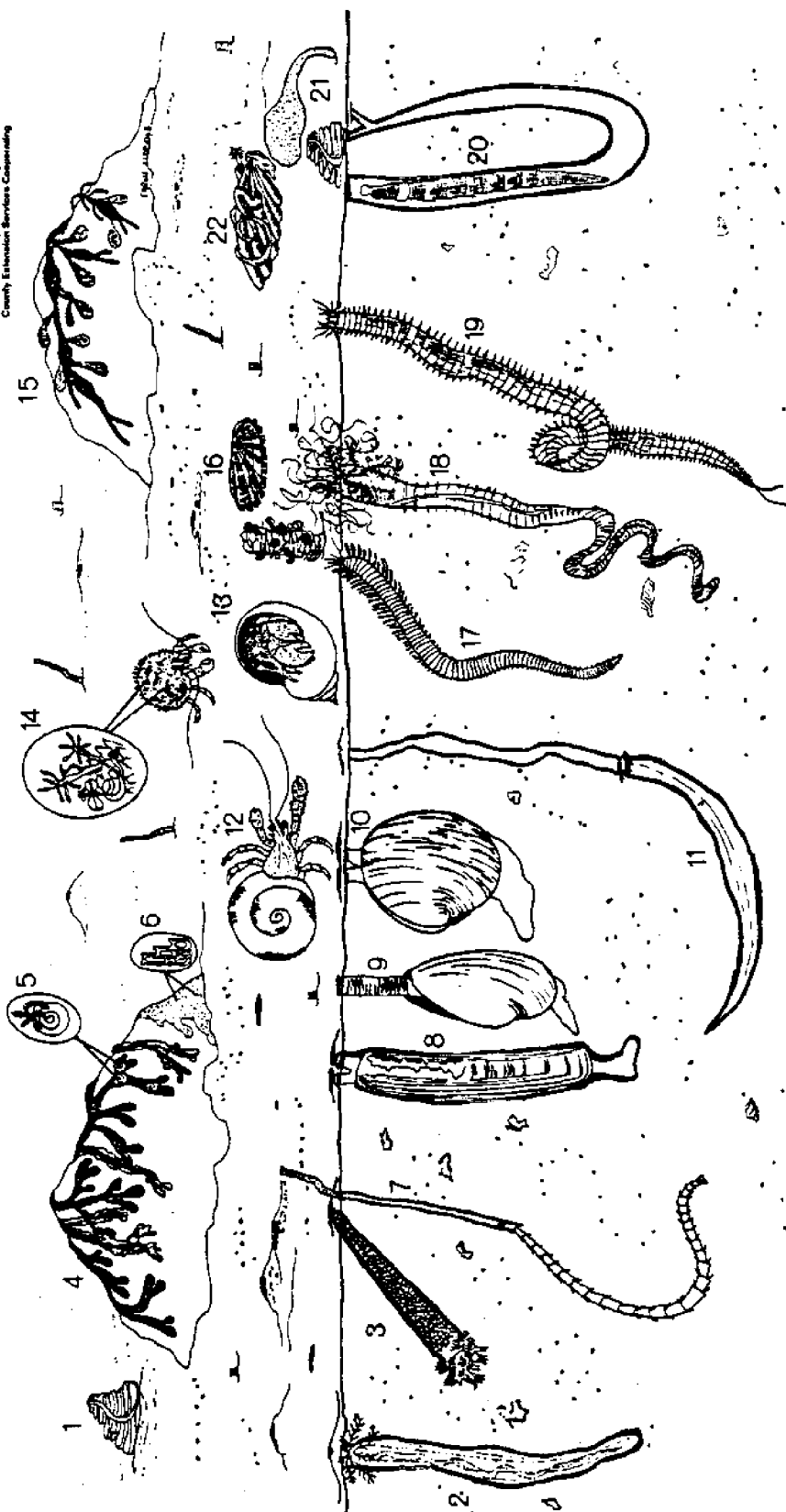
The green and blue boxes out on the marsh are our way to try to capture these pests before they bite. The female fly (only one who bites) is attracted to warm, dark places. Once in the box she cannot find her way out.

As many as sixty different kinds of fish have been found to live most of their lives in the marsh creeks. The young of many of our most popular fish begin their lives here such as flounder, mullet and menhaden. Larger fish such as striped bass, luna and swordfish feed in turn on these marsh raised fish.

Field Guide Sheet For Southeastern New England Marine Environments

Tidal Flats

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Tidal Flats

1. Castings from the Lug Worm (*Arenicola*)
2. Glass Sea Cucumber (*Leplosynapta*)
3. Ice Cream Cone Worm or Trumpet Worm (*Cisternides*)
4. Rockweed (*Fucus*)
5. Coiled Worm (*Spiroboris*)
6. Sea Lace (*Membranipora*)
7. Bamboo Worm (*Chymerella*)
8. Razor Clam (*Ensis*)
9. Soft-Shell Clam (*Mya*)
10. Quahog (*Mercenaria*)
11. Sipunculid Worm (*Goldingia*)
12. Long-Clawed Hermit Crab (*Pagurus longicarpus*)
13. Broad-Clawed Hermit Crab (*P. pollicaris*)
14. Snail (*Hydractinia*)
15. Knotted Wrack (*Ascophyllum*)
16. Awning Clam (*Solemya*)
17. Decorator Worm (*Diopatra*)
18. Ornate Worm (*Ampithrite*)
19. Clam Worm (*Nereis*)
20. Lug Worm (*Arenicola*)
21. Egg sac of the Lug Worm
22. Limy-tube Worm (*Hydroids*)

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Description of Tidal Flats

by Barbara S. Waters

Tidal flats, also called clam and worm flats, are found in quiet bays, in back of barrier beaches and in salt ponds. They also form a large part of the open shores from Barnstable to Provincetown on the northside of Cape Cod and are found extensively along the protected harbors of the southside of Cape Cod and Buzzards Bay. The protected area behind Duxbury Beach on the South Shore has well known, fertile tidal flats.

At low tide the sand and mud flats lie exposed to sun and weather. Many of the animals remain under the surface during low tide. To an experienced collector or marine biologist the mysterious markings in the sand are unmistakable labels of the sealife beneath.

Many of the holes are formed by worms of the Polychaete group. These are segmented worms which feed actively at high tide, sticking their heads out of the holes. The Ornate Worm has a head that is a mass of tentacles that resembles the ancient Greek Medusa with her hair of snakes. These tentacles grope for food in all directions and the bits of food are passed to the cavity (mouth) in the center.

Coils of sand and mud casings are created from the elimination of waste. A worm's gut constantly processes food sluff from the grains of sand and sediment which it sucks in. The indigestible sand grains pass out of the animal's anal opening to the surface forming the casings or mounds.

For this reason, it is common that many of the marine worms live in a verticle U-shaped position. The Lug Worm is an example of this with its head region coming to the surface to feed and the posterior a few inches away at the surface to release waste material. Worms living in tubes expel waste by a fining action of the worm's bristles (parapodia) in an upward motion. The Lug Worm has bright red bristles and there is a third opening for egg laying. In late Spring the large balloon-like clear jelly egg sacs, filled with thousands of tiny red-brown eggs, can be seen strewn over the surface of the flats.

The most abundant polychaete worm is the clam or Sand Worm, a favorite bait for many fishermen. It grows to a length of ten to sixteen inches. The males are a bluish green with red-orange side swimming paddles (parapodia). Females are more green. Both sexes have a shimmering iridescent dorsal side and are

graceful swimmers and active diggers. They can give a nasty, painful bite.

Great colonies of straw size sand grain chimneys are evidence of the Bamboo Worm. It looks like a bamboo stick when pulled from its sand tube. Its size is from three to five inches, and the color varies from brick red to grey.

If you see some shell and seaweed fragments waving in a shallow pool of water, it is the parchment tube of the Decorator Worm. These worms form their tubes by tossing bits of debris onto their bodies. The material sticks to a glue-like mucus secretion. Inside the tube, a few inches from the entrance, the worm sits out the low tide; the slightest vibration sends the worm retreating down the tube a foot or more.

The Trumpet or Ice Cream Cone Worm lives upside down in a symmetrical cone tube made from sand grains cemented in place with a fluid secretion. A black smudge on the sandy mud flat, about the size of a dime is the waste product of the worm. Without the cone, the worm looks fat and pudgy in shape, pink in color, two to four inches long, and on its head end it has a mustache of golden bristles (which blocks the end of its tube).

Tiny volcano shape mounds that dot the tidal flats are clues to homes of the Ornate Worm. The body color is red and the tentacles on the head are a flaming orange with red cini that act as gills.

Another common worm of the flats is the smooth, unsegmented Sipunculoid Worm which is brownish-white to tan. It leaves tiny holes, a little larger than a pinhead, on the sand surface and lives from eight to ten inches down. During high tide it sticks out its flower-like proboscis from the hole to feed. When first removed it falls limp, but within seconds becomes so rigid that it will remain straight as a stick when held in the middle of its body. When the worm is rigid and its skin is punctured, the hydrostatic pressure within forces out its blood and internal parts with great pressure. They do not bite.

Some areas of the tidal flat are packed with depressions the size of a five cent piece. It might seem that clams were here, but digging will bring up pieces of a white transparent wormlike animal. You will be more successful by scooping a few inches under the area and letting the sand

fall apart in your hands. You may have a Glass Sea Cucumber which looks like a worm. The glass cucumber is distinguished from a worm by the bushy tentacles at one end and the characteristic five rows of tube feet along the sides. The cucumber will stick to your hands with these tube feet.

The many shallow pools of water left on a tidal flat by retreating water, are good places to look for marine life. Fuzzy, pink shells move about, homes for the hermit crabs, both the Long-Clawed Hermit Crab and Broad-Clawed Hermit Crab. The shells once contained live snails. When taken over by the hermit crabs they often become covered with a reddish "fur," which is a colony of hydroid animals, commonly called Snail Fur. With a 10X hand lens you can see that this "fur" is a mat of single, flowerlike polyps.

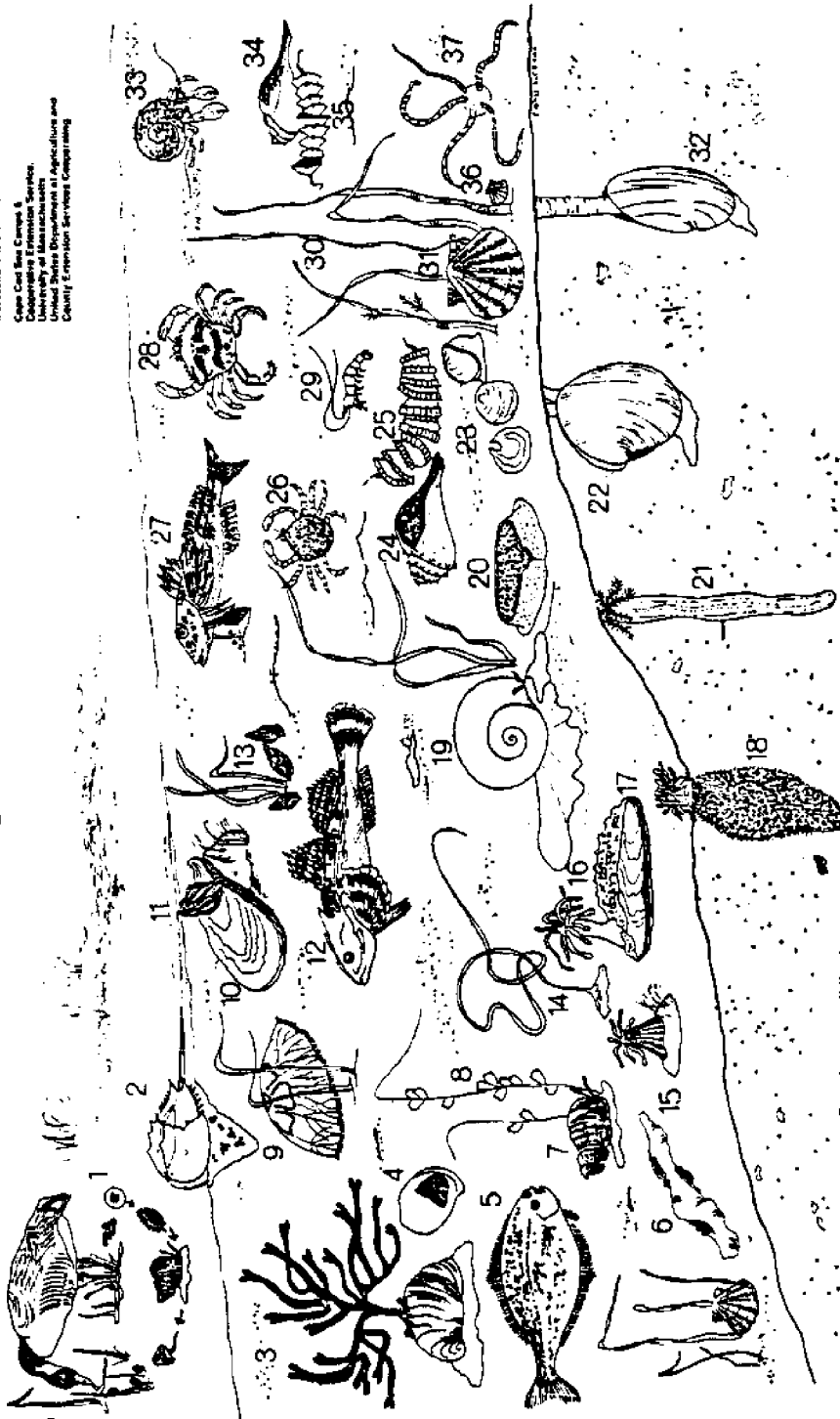
Many round holes, close together, about finger size in diameter and flush with the surface will squirt water when foot pressure is applied. These are formed by the Soft-Shell Clam. A larger, wedge-shaped hole with slight sloping sides is probably made by the Razor Clam, fastest digger of the tidal flats. A large meaty foot extended outward from the lower end of the Razor Clam is the efficient spade. The razor is shaped like its name, long and thin, six to eight inches and approximately one inch wide. The best meal to be had, when it can be caught.

Just below the surface of the sand or mud you may find a delicate and fragile, yellowish brown bivalve. It is covered with a brown epidermis which extends like an "awning" beyond the edge of the shell; thus the name Awning Clam. It sometimes swims about and is about one inch in length. This is the most primitive of the bivalves. The two lobes of the mantle are fused below with an opening for use as an imperfect siphon. The hinge is without teeth, and the foot is long and slender.

Large plants do not take hold on the flats because of the constant movement of sand and mud. Population density of life on flats is great. Measurements taken on intertidal flats at Barnstable Marsh indicate that the number of benthic animals range from 7,000 to 355,000 per square meter, with the Gem Clam and Soft-Shell Clam found in great numbers.

Field Guide Sheet For Southeastern New England Marine Environments

Salt Ponds



Salt Ponds

s - southside

1. Bather's Itch Life Cycle

A. Blood Liver Fluke (*Cercaria variegandis*) eggs released in droppings of infested shore bird;

B. - eggs hatch into microscopic ciliated forms

C. These forms are eaten by Mud Snails and here develop, grow, and are released as

D. Blood Liver Fluke larvae, which reenter a shore bird in the Spring through its thin skin.

If a human gets in the way, the larvae will borrow into our thick skin, die there and cause an itching infection which resembles poison ivy.

2. Horseshoe Crab (*Limulus*) laying eggs at the high tide line in May. Young hatch without tails.

3. Green Sponge Seaweed (*Codium*)

4. Boat or Slipper Shell (*Crepidula*)

5. Flounder (*Paralichthys*)

6. Sea Lettuce (*Ulva*)

7. Mud Snail (*Nassarius*)

8. egg capsule of the Mud Snail

9. Moon Jellyfish (*Aurelia*)

10. Eastern Oyster (*Crassostrea*)

11. Oyster Drill (*Urosalpinx*)

12. Sculpin (*Myoxocephalus*)

13. Dove Shells (*Anachis*)

14. Devils Bootlace (*Chorda*)

15. Striped Sea Anemone (*Haliplanolia*)

16. White Sea Anemone (*Sagartia*)

17. Sulphur Boring Sponges (*Cleona*)

18. Black Sea Cucumber (*Thyonopsis*)

19. Moon Snail (*Lunatia* or *Polinices*)

20. Sand Collar egg case of the Moon Snail

21. Glass Sea Cucumber (*Leptosynapta*)

22. Quahog (*Mercaenaria*)

23. Jingle Shell (*Anomia*)

24. Knobbed Whelk (*Busycon carica*)s

25. egg case of the Knobbed Whelk

26. Spider Crab (*Libinia*)

27. Sea Robin (*Phronotus*)

28. Green Crab (*Carcinus*)

29. Glass or Sand Shrimp (*Palaemonetes*)

30. Eel Grass (*Zostera*)

31. Bay Scallops (*Aequipecten*)

32. Soft-Shell Clam (*Mya*)

33. Hermit Crab (*Pagurus*)

34. Channelled Whelk (*Busycon canaliculatum*)s

35. egg cases of Channelled Whelk

36. many plants and animals attach to *Zostera* including young Baby Scallops, Coiled Worms, Dove Snails and seaweeds.

37. Green Bottle-Star (*Ophioderma*)

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Coastal Plain Community College
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Description of Salt Ponds

by Barbara S. Waters

Salt ponds are shallow, easily warmed, often muddy, tightly-enclosed bodies of water. They usually developed from kettle-hole ponds that have narrow openings to the sea, and are exposed to tidal exchanges. Good examples of salt ponds in Massachusetts are found on Nantucket, Martha's Vineyard, the South Shore of Cape Cod and along the shore of Buzzards Bay.

Salt marshes, tidal flats and eelgrass beds are typically found connected with salt ponds. The ponds are interdependent with these ecosystems, constantly exchanging food and minerals among eelgrass, saltmarsh, crustaceans, shellfish and worms found on tidal flats. Therefore many animals inhabiting the ponds are also found in related environments.

The eelgrass beds in salt ponds are vital to their production of sealife. The eelgrass is the only true plant with roots, stems and leaves which grows entirely underwater in marine environments.

If you use a facemask or glass bottom container just below the surface, sand flats which appear empty at low tide, are filled with life when covered with water. The water brings food to searching tentacles of many worms and the double lined siphons of the Soft-Shell Clam and Quahog. Crabs of all types scuttle about picking at bits of decaying materials. The Blue Mussels gape open, shrimp and fish swim back and forth. The active Bay Scallop, claps its two valves (shells) together and jets in a zig-zag course. It has rows of blue eyes rimming the edge of its mantle, with many small feelers waving in between which serve to strain plankton, its food.

Mud Snails move about leaving hundreds of tiny pathways across the flats. They are important scavengers which help keep the mud flats free of organic debris. However, when large wading birds are fed and encouraged to stay in salt ponds their feces encourages the Mud Snail population and increases chances of spreading Bather's Itch.

Wider paths in the muddy sand might be made by the Moon Snails. These fairly large, from one to three inch, snails have an enormous all enveloping foot used in eating clams and other Mollusks. It seems impossible that this foot could possibly fit back into the shell, but if picked up, it will withdraw completely into its shell, squeezing out a lot of water. The Moon Snail

makes an interesting sand collar egg case of sand grains cemented together, depositing eggs in between the grains. The typical collar, two to four inches in diameter, is found in late summer.

The Green Crab, Spider Crab and occasionally Blue Crab are found. The fierce looking Spider Crab is really harmless (note the tiny claws). It hides by decorating itself with bits of seaweed and sponge. Horseshoe Crabs, not true crabs but closely related to scorpions, are common in salt ponds. Empty horseshoe crab casts are common and have no odor. These are molted outer shells and if you examine the front of these casts, it is easy to see how the horseshoe emerges through the long slit between the upper and lower carapace in the front. True crabs molt their shells from the back.

During warm months, the Channeled Whelk emerges from the mud to search for food and to lay eggs. The large snail remains partially buried during low tide, and often feeds on quahogs or clams. It eats by boring a hole with the assistance of a chemical secretion which enables it to penetrate shells of bivalves. From six to eight inches in length, these are among the largest snails on the New England Coast. The Knobbed Whelk is closely related, and its shell is heavier and often larger. The interior is bright orange. The egg cases of both are much alike, similar to a leather string of round discs. Each disc is filled with tiny, perfectly shaped young whelks.

On small rocks look for the clinging Jingle Shell. The most frequently washed up part is the concave top shell. Few people realize that the Jingle Shell has two valves. The bottom valve takes the form of the object to which it is fastened; it is thin and has a hole through which it spins the threads which hold it fast.

The Common Boat Shell is a limpet type snail, with a deck. It lives in piles, one on top of the other. These limpets change sex as necessary when one member of the pile is displaced or a new member added. The yellow masses found in late May are eggs.

Shellfish good to eat, Quahogs, Soft-Shell Clams and Oysters are quite common. Salt ponds are good, protected areas to experiment with aquaculture techniques. However, the

Oyster Drill, a small whelk, preys on shellfish by rasping a hole in the valves much the same way the larger whelks do.

In quiet, muddy pools, just off the ponds, tiny black "bushes" emerge from the bottoms. Scoop under one carefully, and you may find a Black Sea Cucumber. It is made up of ten units of small branching tentacles. When irritated the sea cucumber will expel its respiratory tree and appear to be "turning itself inside out." Another echinoderm found in the shallow salt ponds and sometimes in rocky areas is the Green Brittle Star. It is called a serpent star because of the long slender arms radiating from a five-sided disc. The arms are flexible and snakelike, breaking off from the disc quite easily.

Many of the worms and other sealife described in the larger mud flats are found here. The small white and striped sea anemones are common on rocks and shells in any area where water is constantly moving, such as an inlet or outlet. The Red-Beard Sponge grows into fantastic fingerlike forms in quiet waters.

The Green Sponge Seaweed, an unwanted import from Japan, is causing problems in many shallow salt ponds. It grows unchecked (no natural predators) on shellfish; during storms the waves carry the seaweed to shore and attached shellfish along with it.

APPENDIX 5: GLOSSARY

In preparing the list, the following publications were used:

Adventures on the Beach
Board of Education of the
City of New York 1972

Dictionary of Biology
Edwin B. Steen
Barnes & Noble NY 1971

Adaptation: modification of an organism in structure or function in adjusting to a new environment.

Aerobic: pertaining to life in or conditions requiring free oxygen.

Alga: the simplest of all plants, having no roots, stems, leaves, or flowers. Larger marine forms are called seaweed.

Algin: a derivative of algae which is added to foods.

Amphipod: any of a number of elongate, shrimplike crustaceans, flattened from side to side. Ex.: sand-hoppers and beach fleas.

Amplitude: the distance between the lowest point in waves (trough) and the highest point (crest).

Anaerobic: capable of growing in the absence of molecular oxygen.

Annelids: a division of animals including earthworms, leeches and marine worms.

Antennae: the appendages of crustaceans and other organisms having a sensory function. They may be sensitive to chemical, light or tactile stimuli.

Appendage: a structure attached to a larger structure; a projection of the body or of an organ; a limb.

Barrier beach: a beach which is separated from the mainland by a lagoon or bay.

Bay: a relatively protected (sheltered) arm of the sea.

Beaufort Scale: a scale of wind velocities ranging from 0 (calm) to 12 (hurricane).

Benthos: the organisms living at the bottom of the sea or other body of water.

Bivalve: a pelecypod mollusk having two valves (shells). Ex. clam, oyster, scallop.

Bog: wet, spongy earth consisting principally of decayed vegetable matter.

Brackish: salty, with saline content less than that of sea water.

Breaker: crests of waves that plunge forward as waves enter the sloping beach area.

Bulkhead: a wall or embankment usually of wood or concrete, designed to prevent a land mass from slipping into the water.

Byssus threads: strong anchor-lines produced by mussels for attachment to rocks.

Calcareous: referring to the shell of an organism that is composed of calcium carbonate.

Carapace: the fused anterior head and thorax sections of some arthropod shells.

Carrageenin: a food additive which comes from a purple seaweed called carrageen or "Irish moss".

Chitin: a horny material comprising the exoskeleton or shell of crabs, shrimps, lobsters.

Chlorination: the addition of chlorine to water to kill pathogenic bacteria.

Chlorinity: a measure of the chloride content, by mass, or seawater.

Chromatography: a method of chemical analysis based on the selective absorption of components of a mixture in a column of absorbent (column chromatography) or on a strip of paper (paper chromatography).

Cirri: a slender filamentous structure, as the hairs on the antennae or legs of certain crustaceans.

Coastal Zone Management: the controlled use, planning, and management of the lands adjoining the marine and aquatic coastal zone.

Coliform bacteria: gram negative, non spore-forming rods, including *Escherichia coli* and *Salmonella typhi* (typhoid fever). Demonstration of their presence indicates human fecal contamination.

Colonial hydroid: a close association of many hydroids having numerous feeding polyps or hydranths.

Comb jelly (ctenophore): a group of jellyfish-like organisms which do not have sting cells (nematocysts) and move through the water by the action of eight rows of 'combs'.

Commensalism: two organisms existing together, one of which benefits from the relationship, and the other one is not affected.

Community: a loose association of organisms interdependent upon one another which survive under the same ecological parameters.

Competition: the simultaneous demand by different organisms for food, places for habitation, and other vital factors.

Copepods: a group of tiny crustaceans having rounded bodies and oar-like swimming appendages (in particular antennae). Great numbers are found in the plankton.

Crabs: any of a number of ten-legged crustaceans.

Crustacean: the group of arthropods which breathe by means of gills and have two pairs of antennae. These include the lobsters, crabs, daphnia, copepods and barnacles.

Decomposition: the converting of dead organic matter or excreta into simpler substances, as bacteria, yeasts, molds, and other fungi.

Density: is the mass of a substance per unit of volume, usually expressed as grams per cubic centimeter; the number of a particular type(s) of organism(s) found in a particular area.

Diatoms: microscopic plants having a siliceous shell. These are one-celled but they often form long chains.

D.O. (dissolved oxygen): the amount of oxygen which is found in a given volume of water (ml/L). This is dependent primarily on temperature, pressure, and salinity.

Dominant: an organism or group of organisms which, by their size and numbers or both, determine the character of a community.

Dune: a hill of sand which changes its location due to the action of the wind.

Ebb tide: an outgoing tide.

Ecological niche: a way of life of a particular organism.

Ecology: the study of the interrelationships of living things to one another and to their environment.

Ecosystem: an ecological system, a natural unit of living and nonliving components which interact to form a stable system in which cyclic interchange of materials takes place between living and nonliving units, as in a balanced aquarium.

Effluent: a substance that flows out of; outflow.

Epiphyte: a plant which grows upon another plant but is not parasitic upon it, securing its moisture through aerial roots.

Epizocite: an organism which lives on the surface of another animal. Ex. barnacle on whale.

Erosion: the wearing away and transporting of rock materials, by moving water, wind moving ice and gravity.

Estuary: a partially enclosed area of brackish sea water affected by both the tides and a fresh water source such as a river. The estuary is important as a breeding ground for many fish.

Evaporation: a change in state from a liquid to a gas.

Fauna: the animal life of a locality or region.

Flood tide: an incoming tide.

Flora: the plant life of a locality or region.

Food chain: a group of organisms involved in the transfer of energy from its primary source, plants, as algae-insects-small fish-larger fish-fish eating birds.

Food pyramid: the study of the movement of energy from one trophic level to the next within a food chain.

Food web: an energy pathway which describes where any organism fits into the complex interrelationships of living things; a complex pattern of several interlocking food chains in a complex community or between several communities.

Fossil: the remains of a prehistoric living thing, preserved either altered or unaltered through time.

Fond: the leaf-like part of a seaweed, a lichen or a fern.

Garnet: a mineral commonly found in igneous and metamorphic rocks. The color is usually dark red, brown, green or black with a glassy luster.

Gastropod: see univalve.

Gorge: a deep narrow valley, usually steep and rocky, having a stream or river at the bottom.

Groin: a type of sea wall projecting from the shore to prevent movement of sand by longshore currents. Erroneously called a jetty.

Habitat: the immediate surroundings or living place of an animal.

Herbarium: a collection of dried plants systematically arranged and labeled.

Herbivore: a plant-eating organism.

Holdfast: a section of an aquatic organism which holds it to its substrate.

Hydroid: the sessile or polyp form of anemones, corals and hydras. Anemones, corals, and hydras exist in this form throughout their lives while jellyfish may have a hydroid stage in their life cycles.

Hydrometer: a device used to measure the specific gravity of a liquid.

Incubate: to warm something at a particular temperature.

Indigenous: native; not imported or introduced; growing naturally in a country or locale.

Intertidal area: the area between the high and low tide lines which is alternately exposed and submerged by the tides.

Invertebrate: an organism without a backbone.

Isopod: any of a number of flattened crustaceans bearing several sets of similar legs.

Jetty: a structure extending into the ocean at river entrances or bay mouths to confine the flow of water to a narrow zone. If concentrated between a pair of jetties, the ebb and flow of tidal water keeps the sand in motion and prevents filling of the channel.

Larvae: the immature form of an organism which often does not resemble the adult.

Littoral: the region on or near the shore, especially living near the shore.

Longshore current: an ocean current that flows parallel to a coastline, caused by waves striking the shore at an angle.

Magnetite: a magnetic, black, iron oxide with a metallic luster. Magnetite is usually found in igneous rocks in the form of small crystals.

Mantle: a thin membranelike organ found among mollusks for the secretion of shell material.

Marina: a small boat basin.

Millipore filter: a plastic, semipermeable membrane of molecular dimension, used to filter bacteria from water.

Moraine: a mass of rocks and dirt deposited by a glacier.

Mollusk: a soft-bodied invertebrate such as a snail, clam, oyster, or squid.

Molting: the process of shedding a skin or shell. All arthropods must periodically shed their external shells as they grow. New shells replace the old and slowly harden.

Moraine: a mass of rocks and dirt deposited by a glacier.

Motile: capable of movement.

Mutualism: a form of symbiosis in which two organisms of different species live

together to the advantage of both.

Neap tide: a period of diminished tides accompanying a quarter-moon phase.

Nematocyst: the sting cells typically found in coelenterates (hydra, jellyfish, sea anemone, coral) which are used for capturing prey and for defense.

Orienteering: the ability of an organism to find its way back to its usual habitat after going to another point distant from it.

Outfall pipe: the sewage effluent pipe.

Parameter: a quantity whose varying amounts are related to known facts; abiotic or biotic factors which are likely to increase or decrease in size, number, amount, degree, etc.; variable.

Parasite: an organism that lives in or on another organism from which it derives its nourishment.

Pelagic: of or pertaining to the open sea.

Pelecypod: see bivalve.

Period (wave): the time necessary for a wave to travel one wavelength.

pH: the concentration of hydrogen ions or hydroxyl ions. A scale ranging from 0 to 14 which represents the acidity or alkalinity of a solution.

Phytoplankton: plant plankton.

Pigment: any coloring matter.

Piling: a wooden structure, usually a pole, driven into a submerged substratum.

Plankton: the minute animals and plants that swim or float near the surface of the water. The huge quantity found in sea water is an important food source for marine organisms.

Pollution: the addition of harmful or unnatural substances to the environment.

Polychaete: the class of Annelid worms that are found in the sea.

Population density: the concentration of a particular organism within a given community.

Prevailing wind: the predominant wind for a particular locality.

Primary treatment: the process of sewage treatment where the settleable solids are separated from the sewage water. This is accomplished when gravity is allowed to separate the solid and liquid sewage water.

Protozoa: the group of one-celled animals.

Quartz: the second most abundant mineral on the earth's crust. It is colorless or white and has a glassy luster. It exists as six-sided crystals and irregular grains of many sizes.

Reef: a ridge of rocks, coral, sand, or some artificial substance that is formed in shallow water.

Regeneration: the ability of certain organisms such as sea stars and crustaceans to grow back lost parts.

Reservoir: a place where water is collected and stored for use, especially an artificial basin created by the damming of a river or stream.

Salinity: the degree of saltiness of water.

Sand: small pieces of rock which have been broken up by the action of waves.

Sand spit: a small point of land formed from sand which projects into a body of water from the shore.

Schist: a metamorphic rock formed from shale, usually having flaky layers of other minerals.

Scrimshaw: the handicrafts practiced by sailors as a pastime during long whaling or other voyages. Ex. figures carved into whalebone.

Secchi disk: a black and white disk which is submerged into a body of water to determine the depth to which light will penetrate.

Secondary treatment: the process of sewage treatment where suspended solids are vigorously aerated and allowed to grow and feed. This results in the organism becoming heavy and sinking to the bottom of the tank. It is then processed in a similar way as primary treatment.

Sediment: particulate organic and inorganic matter which accumulates in a loose, unconsolidated form.

Segment: a distinct body section of an animal which is made up of several such parts.

Sessile: non-moving.

Sewage treatment: the process of removing the suspended and settleable solids from sewage water and treating both the solid material (sludge) and liquid effluent so that they can be disposed of safely into the marine environment.

Shrimp: a prawn; an elongate, segmented crustacean.

Silica: the basic component of sand; also called silicon dioxide (SiO_2).

Siphon: a tubelike organ possessed by mollusks through which they obtain and discharge water.

Slack tide or slack water: a period of very little tidal change occurring as the incoming tide changes to outgoing and vice versa.

Sludge: concentrated solid sewage

Spring tide: a period of especially high and low tides accompanying the new or full moon but having nothing to do with the season.

Substrate: the medium upon which an organism grows - rocks, seaweed, sand or even other animals.

Subtidal area: the area just below the low tide line which is constantly submerged.

Succession: the sequence of communities that replace one another in a given area.

Swell: a group of waves that have lost their original characteristics and move together as a unit, having a similar period and height.

Symbiosis: a mode of life in which two organisms of different species live in intimate association with each other.

Taxonomic key: the arrangement of animals and plants into groups based on their natural relationships which lead to the identification of an unknown organism.

Tertiary treatment: the process of sewage treatment where water from the secondary treatment process is cleaned and purified to make drinkable.

Thermal effluent: hot water discharge into a body of water, usually associated with electric power plants.

Thorax: in arthropods, the portion of the body between the head and the abdomen.

Tide pool: a basin formed by a depression in a rock, etc., which serves to catch water as the tide recedes. Usually contains an interesting array of life forms.

Tolerance: the degree of endurance; to bear, withstand or endure without injury.

Topographic map: a map or chart showing the surface features of an area.

Transect: to cut across; a line or belt used for study purposes.

Trough: the lowest point on a wave.

Turbidity: cloudiness of water.

Univalve: a gastropod mollusk having but one valve or shell. Examples: snail, periwinkle, whelk.

Variable: tending to deviate from type; subject to change.

Vertebrate: an animal with a backbone.

Wampum: pieces of the shells of quahogs (hard shell clams) which were used by Indians as we use money.

Wavelength: the distance from the crest of one wave to the crest of the next.

Weathering: the breaking up of rock materials by the action of the atmosphere and living organisms.

Whitecaps: winddriven tops of waves.

Windrows: ripples on the surface sand of a beach caused by the wind.

Zenith: the point of the sky directly above your head.

Zonation: the location and distribution of organisms in definite zones (delimited area or region).

Zooplankton: animal plankton.

