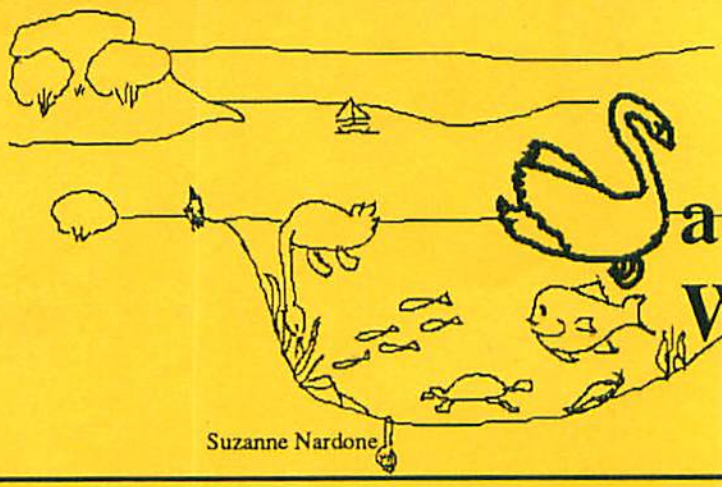

Salt Pond Watchers

Protocol Manual for Salt Pond Watchers

Coastal Resources Center
University of Rhode Island
Technical Report No. 12
May 1991

RHODE ISLAND SEA GRANT

SALT POND WATCHER'S MANUAL

Sampling Protocols

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ACKNOWLEDGMENTS

This manual is the result of years of testing sampling methods by Salt Pond Watchers, some of whom have volunteered their time to sample Rhode Island's salt ponds since 1979. Their careful work and dedication to improve the environmental quality of the salt ponds has provided an unprecedented data set on the salt ponds and valuable information for state and town decision makers. We found the Citizens Monitoring Manual developed by Kathy Ellett of the Alliance for the Chesapeake Bay to be very useful and have adopted their format and some of their text.

The Rhode Island Sea Grant College Program provided funding for this manual, and provided funding for the Salt Pond Watchers.

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May 1991

This publication is sponsored by and is the result of research sponsored by NOAA Office of Sea Grant, U.S. Department of Commerce under Grant NA89AA-D-SG-082. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear herein.

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INTRODUCTION

WHY MONITOR?

Monitoring can be defined as repetitive measurements or observations recorded over time for the purpose of determining a condition or change in conditions.

Citizens who undertake monitoring of a site along their local pond or river will become scientists carrying out an ecological study of that site. A number of scientific studies point to the necessity of doing long-term ecological monitoring before drawing conclusions as to cause and effect of observed changes, because:

1. Complex ecological systems require long-term observation and study for understanding;
2. a sequence of only 2 to 3 years of data can be very misleading about the direction environmental quality is taking;
3. environments have a "memory" or response time which varies greatly--it takes a certain amount of time to detect a change--perhaps a decade for lakes, a century for soil.

WHY MONITOR THE SALT PONDS?

Our ponds were formed after the last ice age. As the glaciers retreated, sand began to form, first in shoals, then eventually into barrier beaches. Gradually ponds and marshes evolved behind these barriers, with the rich plant and animal life that enabled them to become productive nursuries.

There is evidence that American Indians utilized the pond areas as sites for summer fishing camps, spradically from about 500 B.C., and probably continuously from about 1000 A.D. to the 1600s. With the arrival of European Colonists the areas near the ponds were divided into farms. Gradually, in the 1800s the areas became desirable for recreation, and resort communities began to grow.

After World War II, major changes occured around the ponds. Farm lands were sold to developers. Seasonal cabins gradually gave way to year round homes. Marinas, restaurants, and other businesses have grown to accommodate the increasing population.

Rhode Island's coastal salt ponds have several characteristics which make them prime candidates for ecological monitoring. These characteristics are related to their physical and biological properties as well as to the fact that they are an attractive location for coastal development.

The salt ponds are shallow lagoons along Rhode Island's ocean shore. They receive water from groundwater and overland runoff and from tidal flushing from Rhode Island Sound. Daily flushing only exchanges a small percentage (about 10%) of each ponds' volume. Nutrients draining from the surrounding watershed are the basis for the high productivity of the salt ponds.

The salt ponds are an attractive site for vacationers and local residents. People come to the ponds for fishing, quahogging, oystering, boating, swimming, bird watching and picnicking. Coastal development along the ponds has accelerated over the past several decades (Olsen and Lee, 1984) and all indications suggest that it will continue to do so. Increased development along the ponds means higher nutrient loadings in the ponds from leaky septic systems, runoff from stormwater drains, fertilizer runoff from lawns, and animal feces. Nuisance algae blooms, eelgrass wasting disease and other signs of eutrophication have been associated with high nutrient inflow into coastal waters and contamination of shellfish beds has been associated with high sewage levels. Monitoring bacteria and nutrients in the ponds give an indication of changes in water quality. Measuring other parameters such as chlorophyll and eelgrass wasting disease give evidence of how life in the ponds is reacting to changes in water quality. Evidence of serious eutrophication and bacterial contamination are signs that the type and magnitude of development around the ponds must be managed to keep the ponds healthy and safe for the activities for which they are so highly valued.

Each year about forty citizens donate their time to monitoring water quality in the salt ponds to assess whether conditions are getting better or worse. The information that is generated is used by state agencies for management decisions, by local municipalities for planning and zoning decisions and by researchers at URI and local high schools. This manual is intended to provide a clear picture of what we are monitoring and clear instructions as to how to take samples for a variety of water quality measurements.

WHY WE DO THESE TESTS

TEMPERATURE

Although temperature may be one of the easiest measurements to perform, it is probably one of the most important parameters to be considered. It dramatically affects the rates of chemical and biochemical reactions in the water. Many biological, physical, and chemical processes are temperature dependent. Among the most common of these are the solubility of compounds in sea water, cycles of reproduction and maturation and therefore distribution and abundance of organisms living in the ponds, and rates of chemical reactions.

Temperature is reported in degrees Celsius (centigrade). To convert Fahrenheit to Celsius: °F=1.8 °C+32 or conversely, °C=$\frac{°F-32}{1.8}$..

Typically, the temperature in the salt ponds ranges from near freezing in the winter (1°C) to 25°C or 77°F in summer.

WATER CLARITY

Water clarity in the ponds is affected by suspended particles in the water column. When there is a large amount of suspended material in the water, light penetration is reduced and it can be difficult to see the bottom.

Turbidity, or reduced water clarity, in the ponds is most likely caused by accumulations of plankton (single-celled algae and small animals) or of sediment in the water column. In the summer, warm temperatures, sunlight and nutrients promote the rapid growth of phytoplankton. Silt-laden runoff after a heavy rain, stirring up of the bottom by wind- or boat-generated waves, and shoreline erosion all contribute to turbidity by increasing the sediment load of the water.

Excessive turbidity can have a harmful effect on life in the ponds. Eelgrass and other aquatic plants depend on light reaching to the bottom for photosynthesis. Reduced light causes a "shading out" of these plants. In addition, large amounts of suspended matter can

clog the gills of fish and shellfish and can make it difficult for fish who prey visually to find and capture food.

Water clarity is measured by a Secchi disk. The depth to which light penetrates is measured by the depth at which the white portion of the Secchi disk disappears from view.

SALINITY

Salinity is a measure of total dissolved salts in a volume of water and is commonly expressed in parts per thousand (ppt) or number of grams salt dissolved in 1000 grams (roughly one liter) of sea water. Under natural conditions, salinity ranges from 0 ppt for freshwater to an average of 35 ppt in ocean water. The salt ponds exhibit all ranges of this spectrum. The upper reaches of Point Judith pond can be entirely fresh when large volumes of freshwater after a heavy rain are discharged into the pond from the Saugatucket River. The areas of the ponds near the breachways are usually very salty (30-34ppt) because of regular tidal exchange with Rhode Island Sound.

Salinity can be measured by several different analytical techniques. The international standard is based on electrical conductivity in a water sample and requires the use of a specially designed volt meter in the lab. Less precise, but often sufficient measurements can be obtained from meters that can be used in the field. Pond watcher samples are read in the lab by analyzing a few milliliters of the filtered nutrient sample with an optical refractometer in whch salinity is determined by the degree of light refraction through a water sample.

Levels of salinity in the ponds vary according to the time of year, and proximity to influxes of fresh or sea water. Stations near the breachways are naturally more saline than stations located near stream outflows. Salinity decreases in the spring when rainfall, groundwater, and melting snow cause increases in freshwater inflows. When freshwater inputs are reduced, salinity levels rise.

NUTRIENTS

Both nitrogen and phosphorus are necessary for the growth of plants, seaweeds, and microscopic phytoplankton. Together with light and temperature, available nutrients

control the productivity of ecosystems. Nitrogen and phosphorus are also present in sewage and so may be released in large volumes into coastal waters.

Productivity is important for fish, shellfish, and waterfowl. But if some productivity is good, is more better? Not necessarily. Too much growth of phytoplankton and algae can choke the system. Dying , decaying algae uses up oxygen that is needed by fish and benthic organisms. Turbidity caused by plankton in the water column diminishes light available to aquatic grasses which are an important food source and habitat for waterfowl and fishes.

Nutrients (nitrates and phosphates) flow into the ponds from the sea, from stream flow, from groundwater and stormwater runoff, and from rainfall. Nutrient concentrations in the ponds are generally low. It can be taken as a good sign that the ponds do not exhibit the high levels that are characteristic of extremely eutrophic systems. Even with low values there is a great deal of variability between stations and between samplings. For instance, nitrate ranged from 0.1 to 18 micromoles per liter in Winnapaug Pond, and from 0.1 to 15 micromoles per liter in Point Judith Pond, a 100-fold range.

CHLOROPHYLL

A host of single-celled algae inhabit the salt ponds. This rich source of phytoplankton is part of the reason that the salt ponds are such important nursery grounds for fishes, molluscs, and crustaceans. Phytoplankton respond to a number of environmental characteristics such as light, temperature, salinity, and nutrient loadings and can therefore serve as indicators of water conditions in the ponds. The relatively low rate of flushing in the salt ponds, their warmth in summer, and the influence of nutrients and freshwater from land enable the phytoplankton to grow more densely in the salt ponds than in the Sound.

The chlorophyll filtration test that the Pond Watchers perform provides an index to the amount (biomass) of phytoplankton that are present in a volume of water. Chlorophyll *a*, the chemical compound actually measured in the test, plays a crucial role in photosynthesis and is therefore present in some amount in all living phytoplankton. Chlorophyll *a* is measured by passing a known volume of water through a fine filter. The filter is wrapped in foil to protect it from light and frozen until it can be read. To be analyzed, each filter is placed in acetone to extract the chlorophyll, which is measured by using a fluorometer.

When chlorophyll is struck by a beam of ultraviolet light, it emits red light; the intensity varies with the chlorophyll concentration in the original water sample.

Phytoplankton occur in "patches" in the salt ponds. Abundance varies from station to station and from season to season. When two samples are taken only a meter apart, sometimes one may have twice as much phytoplankton as the other. The sources of this patchiness are not well understood; turbulence is known to be one factor, but patchiness is seen in calm water as well. Three replicate chlorophyll samples are collected from each station to reduce the influence of random variation due to patchiness.

Turbidity, salinity, and nutrients all contribute to phytoplankton distribution in the salt ponds. The highest abundance of phytoplankton tend to be in the upper (landward) reaches of the ponds and in poorly flushed coves. The concentration of phytoplankton tend to decrease as one approaches the breachways where water is exchanged more freely with the Sound.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is a measure of the amount of oxygen molecules dissolved in water. Oxygen in its dissolved form is required by fishes, shellfish, and all other living organisms to survive. Water near the surface is usually saturated with DO and contains plenty for animals to survive. Water at the bottom, where many animals live, for a variety of reasons, can fall below a level adequate for organismal respiration. Under low oxygen conditions animals will vacate for shallower or more oxygenated water or may be killed as would be the case for shellfish and other sessile benthic dwellers.

The ability of water to dissolve oxygen is dependent on temperature. Colder water can hold more oxygen. Consequently oxygen tends to be more limiting to organisms during the hot summer months. Vertical stratifications in the summer and inhibition of mixing of bottom water with oxygen--saturated surface waters also leads to lower oxygen in deeper water during the summer.

Biological activity affects the amount of oxygen dissolved in water. Plants and algae which photosynthesize give off oxygen and can supersaturate shallow water with DO. On the other hand, when plants die, oxygen is used up by bacteria as they breakdown the dead plant matter. Bacterial decay usually takes place at the bottom, and so large blooms of

algae in the spring and summer as typically occurs in the salt ponds, can also be responsible for consuming large amounts of oxygen from bottom waters at a time when vertical stratification can already be limiting replenishment of oxygen to the lower layers.

Because many areas of the salt ponds are very shallow, low dissolved oxygen is not a problem in these areas. DO is monitored at deeper stations on the ponds. A LaMotte kit is used to perform a variation of the standard Winkler titration analytical method which measures DO in parts per million (ppm) in terms of the amount of sodium thiosulfate reagent needed to neutralize a "fixed" water sample. Table 1 shows DO levels in ppm which you would expect in a sample at different temperatures under saturated conditions. In terms of marine life, levels of 5.0 ppm and above are believed to be protective of most organisms in Long Island Sound. Below this concentration the growth and survival of different organisms is affected to different degrees (Long Island Sound Study).

Solubility of Dissolved Oxygen in Water

Temperature Degrees C	Solubility Mg/L (ppm)	Temperature Degrees C	Solubility Mg/L (ppm)
0	14.6	16	10.0
1	14.2	17	9.8
2	13.8	18	9.6
3	13.5	19	9.4
4	13.1	20	9.2
5	12.8	21	9.0
6	12.5	22	8.9
7	12.2	23	8.7
8	11.9	24	8.6
9	11.6	25	8.4
10	11.3	26	8.2
11	11.1	27	8.1
12	10.9	28	7.9
13	10.6	29	7.8
14	10.4	30	7.7
15	10.2		

BACTERIA

Total and fecal coliform bacteria measured in water samples gives an indicator of sewage contamination of the salt ponds and is used by the state Department of Environmental Management (DEM) to determine safety of these waters for such activities as shellfishing and swimming.

Measurement of coliform bacteria have been adopted as a standard test of water contamination because they are indicators of human and animal waste reaching ground water or a water body; they are easy to monitor; they survive both in fresh and salt water; and they do not reproduce in the receiving waters. The principle potential sources of fecal coliform to ground water and surface waters include leachate from failed septic systems, direct discharges of untreated sewage, malfunctioning sewage treatment plants and leaking sewers, sanitary landfills, and pet, livestock, and waterfowl excrement. Bacterial contamination of coastal waters near suburban areas, as is the case surrounding the salt ponds, is associated with failing septic systems, broken sewer lines, large volumes of storm water runoff, and animal waste.

Coliform bacteria originate from a number of sources ranging from decaying vegetation in soils to feces of many kinds of organisms. Fecal coliform bacteria is the measure used by the Federal Food and Drug Administration as an indicator of sewage contamination of a water body. Because fecal coliform bacteria originate in the guts of warm-blooded animals, fecal coliform measurement is not a completely precise test for human fecal pollution. There is no way of differentiating that proportion due to human sewage from wstes from other warm-blooded animals like waterfowl, livestock, and family pets. Concentrations in the receiving water are influenced by light, temperature, salinity, nutrients, and predators.

Several different methods are used by state and federal agencies for analyzing coliform bacteria. The method used in Rhode Island both by D.O.H. and federal F.D.A. is based on the most probable number (MPN) of bacteria cells in 100 ml. water sample. Rhode Island DEM has the authority to close an area for shellfishing where the median total coliform levels consistently exceed acceptable levels (15mpn/100ml). DEM can only recommend to the towns that an area be closed to recreational water contact use.

Median bacterial concentrations should not exceed the following levels for safe shellfishing and swimming in Rhode Island tidal waters:

	TOTAL COLIFORM mean MPN/100 ml	FECAL COLIFORM mean MPN/100 ml
SHELLFISHING	70	15
RECREATION (water contact)	700	50

RAIN GAUGE

Rainfall is a source of nutrient addition to the salt ponds. Precipitation carries very little phosphate, too little to be measured. Contributions of nitrogen can be significant, however. By keeping track of the amount of precipitation falling on the ponds from your rain gauges, and then measuring nitrates in the rainwater, we can better narrow down the source of the nutrients that we see in the ponds.

You have all heard about the problems of acid rain. (We will be measuring pH levels in rainwater samples as well.) Precipitation which has a low pH level is not only acid, but also carries high levels of sulfur dioxide and nitrogen oxides. While both can affect the health of aquatic environments, nitrogen oxides can add to the nitrogen cycle. Where nutrient levels are already high such as in coastal waters near highly developed shorelines, this can contribute to eutrophication.

Rainfall is also a source of stormwater runoff the salt ponds and any pollutants that are carried by water funning off roads, roofs and parking lots. High concentrations of fecal coliform bacteria often occur after rainstorms in the upper reaches of the salt ponds.

EELGRASS WASTING DISEASE

Eelgrass wasting disease was responsible for virtually eliminating eelgrass from coastal waters throughout the North Atlantic in the 1930's. By the 1960's eelgrass populations had largely been restored, but in the past decade, the characteristic symptoms of eelgrass wasting disease have again developed and are spreading.

Infection of wasting disease is characterized by dark, decaying lesions on both young and old eelgrass blades. The infection of wasting disease takes place in two stages: 1) the initial infection and development of the lesions; and 2) mass mortality of eelgrass. The current infection has spread throughout New England, but dieoffs have been restricted to localized areas.

Eelgrass wasting disease has been traced to a slime mold-type pathogenic protist called *Labarinthula*. This microorganism evidently flourishes in high saline waters. Eelgrass growing in low salinity waters seems to be less susceptible to infection.

Mass mortality of eelgrass in the 1930's was associated with loss of productivity in estuarine and coastal waters. The eelgrass loss had a devastating effect on migratory waterfowl and commercial fisheries habitat. Some locations were permanently altered, and eelgrass never returned.

Not all eelgrass decline is due to wasting disease. Disappearance of eelgrass in estuaries in both North American and Europe has been attributed to pollution of coastal waters. Eelgrass can also be killed by shading of the bottom by dense surface plankton blooms associated with high eutrophic waters. If surface algae is dense enough, it can prevent light from reaching the eelgrass plants causing them to die back. The combined effects of wasting disease and pollution could devastate eelgrass populations.

HOW TO DO THESE TESTS

(Sampling Protocols and Preparation)

WATER TEMPERATURE PROTOCOL

Temperature of pond water is measured by

1. Keep the thermometer suspended about 6 inches (locm) below the water surface for at least two minutes. You may have the thermometer hung by a string while you go on to other sampling.

2. Read the thermometer while it is still suspended just below the surface or immediately after removing it from the water. Any wind or direct sunlight on the thermometer once it is in the air will change the reading rapidly and give you an incorrect measurement.

3. Record the value on your field data sheet.

WATER CLARITY

The Secchi disk is a convenient method for measuring light penetration below the water surface, or the limit of visibility of the water. The Secchi disk is an all-white or white and black disk made to specifications which is weighted and attached in the center of a measured and marked rope. (See Secchi disk protocol for making a Secchi disk.) The weighted disk is lowered slowly straight down into the water from a boat or dock. The disk is lowered until it disappears from view and then slowly raised until it just reappears. This depth is recorded and is known as the "Secchi disk transparency." The less algae and silt in the water, the deeper the Secchi disk will be visible. Alternately, shallow readings will occur in turbid water with large amounts of suspended algae and silt.

To read the secchi disk:

1. Take readings from a boat or off a dock.
2. Anchor the boat or have an assistant paddle to keep the boat in a fixed position to ensure that the Secchi disk is observed straight down, instead of at an angle.
3. Take readings on station and at roughly the same time of day each time. This is

important to ensure comparable data.

4. To measure the Secchi transparency, lower the Secchi disk on the shady side of the boat, until it just goes out of sight and note the depth. Lower the disk further and then bring it up, noting where it comes into view again.
5. Record the average of the two depths on your field data sheet.
6. If the disk is resting on the bottom and still visible, please make a note of it

To make a secchi disk:

1. Cut a disk 20 centimeters (8 inches) in diameter from a piece of plywood, metal, or plastic and paint it white with black quarter pie wedges.
2. Drill a hole in the center of the disk through which an eye bolt can be fitted.
3. Turn a nut onto the eye bolt.
4. Slip a lock washer and then a flat washer onto the bolt.
5. Slip the disk onto the bolt, white side toward the eye of the bolt.
6. Slip flat washer and weights onto the bolt. Weights need only be sufficient to counteract the buoyancy of the disk so that it will sink.
7. Slip a lock washer and nut onto the bolt and tighten it.
8. Attach one end of about 20 feet of cord to the eye bolt.
9. From the top surface of the Secchi disk, measure every 5 centimeters (2.5 inches)and mark the cord with waterproof ink.
10. Cut small niches on the edge of the disk to hold the rope when the disk is not in use. Wrap the rope around the disk at these cuts after each use to help protect the disk and to keep the cord clean and orderly.

This is a design that has been successfully reproduced by many pond watchers. It is not the only way to put together a Secchi disk. The most important criterion is that it is cut to an 8 inch diameter, painted white, and that the depth can be clearly and accurately read off the cord.

WATER CHEMISTRY

Water Chemistry Supplies

Each pond watcher kit contains the following for water chemistry sampling:

1 syringe
3 nucleopore filter assemblies
approximately 25 glass fiber filters
1 sharpie pen (waterproof ink)
2 pair of plastic forceps
1 piece (10 inches long) tygon tubing
13 nutrient bottles
1 roll of label tape
a schedule of sample dates
a list of pond watchers & sample stations
maps of sample locations-all ponds
protocols
data sheets

POND WATCHER WATER CHEMISTRY SAMPLING FIELD PROTOCOL

Preparation (at home)

Everyone will be taking 3 chlorophyll samples and 1 nutrient sample

1) Fill in field data sheet:
Include your name, date, time, pond, station.

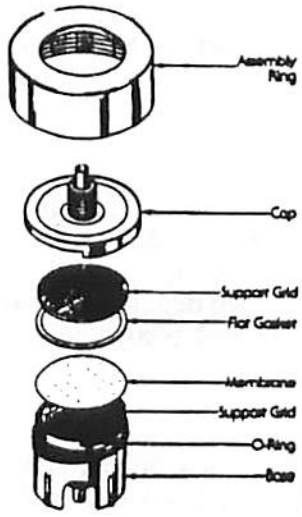
2) Make foil packets for chlorophyll filters (make 3). Take care not to touch the inside of the foil where the filter will be placed. Put one filter in each foil packet after filtering is completed

3) Make tape labels for each foil packet, and one nutrient bottle (4 labels all together)
Include your name, date, pond, station: i.e. Craig
3/3/89
Potter 23

Please **DO NOT** write directly on the foil packets. Ink from the pens has gotten onto some of the filters and the samples were ruined.

Label foil packet s #1, #2, and #3.

4) Load the chlorophyll filter heads:
Label filter heads #1, # 2 and #3 and use # 3 to collect the nutrient sample.



Expanded view of Swin-Lok Holder

a) unscrew assembly ring and remove cap

b) make sure the O-ring (black ring) is properly seated in the base by pressing O-ring into molded groove with fingers

c) to install O-ring, remove the base support grid (unbend a paper clip and insert the end through the base and gently push on the grid to pop it out of the base). Install O-ring around the outside of grid and place the grid-O ring assembly into base with smooth side of grid facing up.

d) nstall second support grid into position in cap. (there is no O ring here), with smooth side of grid facing up.

e) Using forceps, carefully place a filter on top of the base grid. **THE "GRIDDED", DISTINCTLY WAFFLED SIDE OF THE FILTER IS TO LIE FLAT AGAINST THE SUPPORTING GRID** -- be sure filter completely covers the O-ring.

f) Place flat gasket (gray ring) over filter. Be sure gasket covers filter and O-ring.

g) Mate the cap and base so the tabs interlock. Its important that the gasket does not get caught between the cap and base - the filter head will leak if it does.

h) Screw assembly ring tightly onto base.

i) Load three (3) filter heads. (Repeat steps a-h).

Field Sampling Procedure (on station)

1) Water temperature:

   a) Measure for at least 1 minute, 1 foot below the surface, and record immediately on data sheet. (NOTE: tie a string to the thermometer and tie a loop into string to suspend it, one foot below surface, from boat oarlock--this way you will always measure at same depth).

2) Turbidity (Secchi disk):

   a) On shady side of boat, lower Secchi disk until it just becomes invisible and note to nearest unit where rope breaks water surface;
   b) Slowly raise disk and note rope unit at surface where disk just reappears;
   c) Take the average of those two depths and record as Secchi disk depth on data sheet (one unit=1/10 meter). Record as rope units and convert to meters at home.

3) Water depth:

   a) Measure depth when Secchi disk or lead line hits bottom.
   b) Make sure line drops <u>straight</u> down and record depth on data sheet (one unit or knot = 1/10 meter). Record as rope units and convert to meters at home.

4) Chlorophyll and Nutrients:

   a) Empty distilled water from labelled nutrient bottle. Shake out excess water.
   b) Attach tubing to syringe and draw pond water from 10" below water surface.

   NOTE: DO NOT draw water from pond through filter, it will rupture the filter.

   c) <u>Slowly</u> pull back plunger and completely fill syringe.

d) Remove tubing. Hold syringe upright (Pointed end up) tap large bubbles to top--depress plunger slowly and force the bubbles out of the syringe.
e) Once bubbles are removed push plunger to the 50 ml mark, if you overshoot, re-do (Volume is very important).
f) Attach a filter head to syringe. Apply slow steady pressure to plunger to force sample water through the filter.
g) Fill nutrient bottle, cap it and rinse bottle, remove cap and shake out excess water.
h) Remove filter head. Draw back plunger of syringe and fill with approximately 50 mls of air. Reattach the filter head to the syringe and slowly depress the plunger, forcing air through the sample filter. This helps reduce excess water on the filter. Remove filter head, store upright and **protect from the light in field box.**
i) Replace tubing, repeat process two more times. Save the third filtered water sample as the nutrient sample. Total number of samples equals 3 chlorophyll filters and 1 nutrient sample bottle.

5) Record field observations on data sheet. **(Please note presence of nearby ducks, swans or other waterfowl)!**

SAMPLE PROCESSING AND STORAGE (at home)

1) Nutrients:

a) Freeze **labelled** nutrient bottle **upright**. Once frozen these bottles may be kept frozen in a plastic bag. Label with waterproof ink on label tape and be sure nutrient bottle is labelled to correspond to the filter it was filtered through (#3).

NOTE: These samples are sensitive to the light and should be transported on ice in a closed cooler until they can be stored in a freezer.

2) Chlorophyll:

a) Carefully unscrew the lid and remove the top from the base.
b) With forceps (use 2) grip the edges of the filter and fold it evenly in half so the green side of filter folds in and you get a neat semi-circle. Use the edge of the base to keep the filter from sliding.off the base. Remove filter from base and place in tin foil. Place filter from the filter assembly labelled "3" into the foil packet labelled "3".
c) Put chlorophyll packet labelled with tape and waterproof ink, in freezer in baggie.

NOTE: **DO NOT** write on the foil packet once the filter is in it. The foil can rip and the filters get contaminated, use label tape.

3) Data sheets:

Fill in final observations and check that they are complete.

4) Clean up:

a) Rinse all gear with distilled water or bottled water. **DO NOT USE SOAP.**
b) Disassemble filter holder. Rinse with distilled water and air dry.
c) Store disassembled holder in plastic bag or other clean container.

DISSOLVED OXYGEN PROTOCOL

Please read all the materials enclosed in your LaMotte kit before beginning!

Safety Note: Some of the chemicals used in this test are toxic and the final compound is an acid. Becareful with the procedure and observe warning labels on all chemical bottles.

SAMPLE COLLECTION (in field)

NOTE: All DO reagents will degrade when exposed to light. To ensure quality of the chemicals wrap the bottle in black electrical tape so that light does not enter bottle, leaving chemical identification and safety information label visible.

1) Rinse sample bottle two (2) times with pond water to be sampled.

2) Tightly cap the mouth of the bottle, submerge the bottle six (6) inches underwater, remove the cap, tilt the bottle slightly and allow it to fill slowly.

3) Tap the sides of the submerged bottle to dislodge any air bubbles clinging to the inside of the bottle. Replace the cap while the bottle is still submerged.

4) Retrieve the bottle and examine it carefully to make sure that no air bubbles are trapped inside. Redo if air bubbles are present.

5) Repeat sampling procedure so that two separate D.O. samples are taken.

   NOTE: Be careful not to introduce air into the sample while adding the reagents in Steps 6 and 7. Simply drop the reagents into the test sample, cap carefully, and mix thoroughly.

6) Add eight (8) drops of manganous sulfate solution (# 1) and then add eight (8) drops of alkaline potassium iodide solution (# 2) to the sample. Hold the reagent dropper bottles vertically when adding drops of reagents to sample. These reagents are added in excess so the precise number of drops is not critical, i.e. if you add 9 or 10 drops you do NOT have to start over. However, it is necessary to add the manganous sulfate first. Cap the bottle and mix by inverting gently several times. A precipitate will form. Allow the precipitate to settle below the shoulder of the bottle before proceeding.

7) Repeat procedure for second water sample.

   NOTE: The water samples will degrade in light so they must be kept in the dark.

Dissolved Oxygen (continued)

Test Procedure (at home)

The test must be completed within 8 hours of sampling

1) Invert the bottle again, to mix precipitate and allow it to settle. (Let settle until the precipitate settles below the shoulder of the bottle).

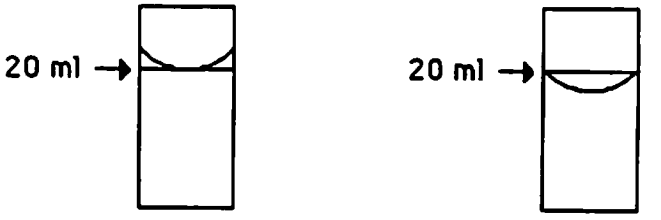
2) Using the 1 gram measuring spoon, add one (1) level measuring of sulfamic powder to the sampling bottle. The sulfamic acid crystals are added in excess so the amount is not critical. You can spill a few grains and do not have to start over.

3) Cap the bottle and invert the bottle several times to mix, until both the reagent and precipitate have dissolved. The sample is now fixed. A **clear** yellow to brownish-orange color will develop, depending on the oxygen content of the sample. (The more orange the sample, the higher the oxygen content). The addition of the acid will dissolve the flocculent. If a few grains of acid do not go into solution and all the floc is dissolved, you may continue the titration. You may at times find that organic material or sediment in the water do not dissolve either. This will not effect the tests results.

   NOTE: Samples should be kept out of direct light at all times.

TITRATION

4) Fill the titration bottle to the 20 ml etched line with the "fixed" sample and cap the titration bottle. The amount of sample (20 mls) to be titrated is **CRITICAL.** Measure carefully. The bottom of the meniscus should rest on top of the white line on the titration bottle. (A meniscus is a curved upper surface of a liquid column that is concave when the containing walls are wetted by the liquid). **MAKE SURE THE TITRATION BOTTLE IS COMPLETELY DRY BEFORE YOU RUN THE TEST.**



correct **not correct**

5) Depress plunger of titrator syringe to expel air. Insert titrator syringe into plastic fitting of the titrating solution bottle (#3). To fill the syringe invert the bottle and slowly withdraw the plunger until the bottom of the plunger is opposite the zero mark on the scale.

   NOTE: A small air bubble may appear in the syringe barrel. Expel the bubble by partially filling the barrel and pumping the titration solution (sodium thiosulfate), back into the inverted reagent container. Repeat this pumping

action until the bubble disappears. Turn the bottle right-side up and remove the syringe.

6) Dry off the outside of the titrator syringe making sure no liquid is pulled out of the titrator tip when drying off the outside drops. Insert titrator into the center hole of the titration bottle cap. Add one drop at a time to sample. The plunger is very sensitive, so press gently--it is very easy to overshoot. Swirl sample between each addition to knock any partial drops off the titrator syringe tip and to mix sample. Continue to add thiosulfate until the color of the sample is a faint yellow.

NOTE: The titration is extremely **CRITICAL**. Be sure that all water is removed (shake the syringe and plunger) before filling with titrant, sodium thiosulfate solution. Make sure there are no air bubbles in the syringe. When the amount of D.O. is above 10 mg/l, you will have to refill the syringe. For accurate results, refill to 0 mark and continue titration. Read the test results from the second syringe and add it to the 10 mg from the first syringe.

7) When the color is a faint yellow, remove titrator along with the cap. Be careful not to disturb the titrator plunger, the sample is not completely titrated yet. Using the plastic eye dropper, add 4 drops (4) of starch solution (4170) to the sample, which will cause a color change (to blue). Replace the cap and titrator and continue titrating by adding drops of sodium thiosulfate (#3) very carefully until sample just turns clear.

If the color of the fixed sample (after the sulfamic powder has been added), is already a faint yellow, skip step 5, perform step 7 and begin titration at step 8. A faint yellow color means there is very little oxygen present in the sample. You will only need to add a small amount of titrating solution to determine the oxygen concentration.

After you have done a few DO tests you will know what we mean by a faint yellow. This is the point when the sample is still clearly discernible as having a yellow tint but when it is on the verge of turning clear. It is better to add the starch too early than too late, but don't jump the gun.

8) Continue titrating and swirling the sample until the blue color just disappears. The first complete disappearance of blue color is the endpoint. Do this against a pure white background so that you can see the color change from light blue to clear.

9) Where the plunger tip meets the titrator scale on the syringe, read the test result in mg/L (same as ppm {parts per million}) dissolved oxygen.

10) Complete two (2) titrations, one from each water sample, and write down the numbers. If the difference between the two titrations is greater than 0.6 mg/L then do a third titration of either of the sample bottles. Record all three values and average the two closer values. If replicates have a difference greater than 0.68 for two sample dates in a row, please notify the graduate student coordinator of the program to determine the cause of the problem. Equipment and procedures may need replacement and/or review.

11) Pour the sample down the sink drain with the tap water running to dilute it.

12) Rinse the sample bottle and titrator bottle in tap water and store for next sampling.

EVERYTHING YOU EVER WANTED TO KNOW ABOUT DISSOLVED OXYGEN TITRATION!

The following notes will hopefully enable everyone to do a dissolved oxygen titration efficiently and **ACCURATELY**.

* Be sure the sample bottle is clean and rinsed **TWICE** with water to be tested. Check carefully for bubbles.

* Hold dropper bottles vertically when adding drops of Manganese Sulfate and Alkaline Potassium Iodide solutions. These reagents are added in excess so the precise number of drops is not critical, i.e. if you add 9 or 10 drops you do **NOT** have to start over. However, it is necessary to add the Manganese Sulfate first.

* You may add these two solutions to the sample in the field and then go back home to complete the test. The test must be completed within 8 hours.

* The sulfamic acid crystals are added in excess so the amount is not critical. You can spill a few grains and do not have to start over. The addition of the acid will dissolve the flocculent. If a few grains of acid do not go into solution and all the floc is dissolved, you may continue the titration. You may at times find that organic material or sediment in the water do not dissolve either. This will not affect the test results.

* The amount of sample (20 mls) to be titrated is **CRITICAL**. Measure carefully. The bottom of the meniscus should rest on top of the white line on the titration tube. (A meniscus is a curved upper surface of a liquid column that is concave when the containing walls are wetted by the liquid).

* The titration is also extremely **CRITICAL**. Lubricate the syringe plunger with water. Be sure that all water is removed (shake syringe and plunger) before filling with titrant, sodium thiosulfate solution. Make sure there are no air bubbles in the syringe. When the amount of DO is above 10 mg/L you will have to refill the syringe. For accurate results, refill to 0 mark and continue titration. Read the test results from the second syringe and add it to the 10 mls from the first syringe.

* When and how much Starch solution is added is not critical. The important thing is that the sample turns blue. Simply add titrant until the sample is light yellow; add Starch solution and continue adding drops "**very carefully**" until solution just turns clear. The first complete disappearance of blue color is the endpoint. (If you see the solution turn blue again, ignore it!)

* You are required to run titrations on two samples. Record the results of the two tests in the margin on the data sheet. If the amount of D.O. recorded for the second test is more than 0.6 mg/L different than the first test, you must do a third test. Record all values on data sheet. Average the two closest values and record in the appropriate place.

FINALLY, if you have any further questions, please let us know. Testing for the amount of dissolved oxygen is very important and we want to know we are getting accurate numbers!

BACTERIA SAMPLING PROTOCOL

BACTERIA SUPPLIES

FIELD DATA SHEETS (one for each sampling time on each station)

LAB SUBMISSION FORMS (filled out in triplicate for each station)

SAMPLE JARS (distributed throughout the season)

DOWL OR STICK (taking water sample 2 feet below surface)

INITIAL PREPARATION--AT HOME

1. Label the sterile sample bottle with the waterproof pen. Include pond, station number, and date and mark 150 ml level (this can also be done in the boat).
2. Fill out the field data sheet with the pond, station number, your name, date, time, weather, etc.

FIELD PROCEDURES--ON STATION

1. Make sure the label on jar matches your station location. Then remove the lid.
2. Place bottle in sample holder (attached to sampling stick).
3. Sample 2 feet below the water surface by positioning the mouth of the bottle into the current (from the side of the boat).
4. If the water is static, a current can be created by moving the boat slowly through the water or moving the bottle horizontally under the surface.
5. Tip the bottle up slightly to allow air to escape and water to fill the bottle.
6. Bring the bottle to the surface and pour off excess sample to 150 ml mark.
7. Tightly cap the bottle.
8. Place the bottle in an ice chest. Bacteria samples must be iced or refrigerated at a temperature of 1 to 4°C during transit to the laboratory.
   Make sure the sample bottles are NOT totally immersed in water during transit or storage.
9. Samples must be analyzed within 6 hours of sampling. Therefore samples should be taken between 7 am and 9 am for pickup by 9:30 am and analysis by 12 am.
10. Note on field data sheets the presence of any water fowl, swans, geese and their distance from the station.
11. Note on field data sheets any rain fall within the last 48 hours prior to sampling.
12. THINGS TO AVOID:
    a) stirring up the bottom with oar, prop or sampling stick
    b) algae mats or debris on water surface
    c) oil slicks or scum
    d) water fowl or other bird droppings
    e) prop wash (move station location if necessary)

FINAL PREPARATION - AT HOME

1. Place samples in a cooler with ice or refrigerate until they are picked up. It is important that samples be kept cold but not frozen because the bacteria will die.
2. Fill out one laboratory sheet for each sample. Put your name, date, pond and time on the lines provided and put the station number in the upper right hand corner. This is in addition to the field data sheet.
3. Please leave both a **field data sheet** and a **laboratory sheet** for each sample with your samples for pick up by 9:30 am.

RAIN GAUGE PROTOCOL

SETTING UP A RAIN GAUGE

1. Rain gauges should be plastic. Metal gauges can react with the chemistry of acidic rainwater and alter its pH level.
2. You need a large open area away from trees, buildings, etc.
3. Place rain gauge approximately three times as far away as the height of the buildings or trees. This means if your house is 30 feet high, you should place the gauge 90 feet from the house.
4. Try to place gauge as close to the pond as you can while remembering to keep the right distance from trees and houses.
5. The gauge should be mounted on a post (a 4x4 is good) and it should be mounted so the top of the gauge is level and 6 feet higher than the top of the post.

USE OF THE RAIN GAUGE

6. The top funnel catches the rain and delivers it to the measuring tube. This tube has a capacity of one inch. Rainfalls of less than one inch can be read directly from the measuring tube. To do this, stand the measuring tube on a level surface and read the amount to the nearest 100th of an inch. Record the rainfall in your log for each day.
7. If rainfall exceeds one inch, the excess flows into the outer cylinder. To measure the excess, empty the measuring tube containing the first one inch. Place the funnel into the measuring tube and pour in the excess rainwater from the outer cylinder. Add this number to the first one inch to the total rainfall. Record final number on daily data log.
8. In cold weather only the outer cylinder is used. To measure amount, melt snow and measure volume of water in the measuring tube. Please do not let water freeze in gauge--it will crack it.

DAILY LOG

9. Measurements should be made daily. If you are away, please write down total rainfall over the days you were gone and note this under remarks.
10. Whenever possible, take readings at the same time each day. Record readings in daily log, noting the date and hour that the readings were taken.

SAVING RAINWATER SAMPLE

11. Keep a labeled one liter bottle of rainwater sample in your freezer.
    Label with your home address, phone number and pond.

12. Each day after recording measurement, pour the day's rainwater in the bottle containing frozen rainwater sample. Recap and return to freezer.
13. Accumulate rainwater over a month-long period or until it is filled. Carefully label the beginning and ending date of sample.
14. Rainwater collection bottles will be collected approximately every month during the summer with the water chemistry samples. Turn in a copy of your daily log with the collection bottle.

EELGRASS WASTING DISEASE PROTOCOL

Introduction: The purpose of the wasting index method is to have an easy and quick way to determine the amount of disease on an eelgrass shoot. This procedure should be followed in the area around each station (provided that there is eelgrass present) once each growing season. Eelgrass in the salt ponds is at its most vigorous state in June and July before the shallow waters warm past 25 degrees °C. These months are the best time to estimate wasting disease.

Steps

1. Collect 10 plants from an eelgrass bed at or near your regular sampling station. Each plant is called a shoot. As you collect each shoot, pull them up by the roots to make sure you have gotten the whole plant. If the eelgrass bed is large, take shoots randomly around the whole bed; if the bed is a very small clump with few shoots, scale down the number of shoots taken to minimize impact to the plant community. Make a note of how far off and in what direction the eelgrass bed is in relation to your regular sampling station.

2. Information from each shoot is entered in a new box on the data sheet for each sampling site and date.

3. Enter the date the plants were collected under "Date", the location and site the plants were collected under "Location/Site", and the person collecting and recording information under "Person".

4. Select and number a plant. Enter the number on the data sheet under "Shoot #".

5. Measure the width of the base of the shoot in millimeters and enter under "Width".

6. Measure the height of the sheath in centimeters and enter under "SH".

7. Number the leaves of each shoot from youngest to oldest. The number does not usually exceed 6.

8. Measure the length of each leaf in centimeters and enter under "Length".

9. Estimate the percentage of disease cover on each leaf. To estimate cover, look at the whole leaf from the top of the sheath to the leaf tip and refer to the "Wasting Index Key" on the next page. The Key shows wasting disease covering 0, 1, 10, 20, 50, and 100 percent of the leaf. Estimate where the leaf you are looking at stands on this scale. Interpolate coverage that falls between the percents illustrated on the scale. Enter the percentage of disease on each leaf under "Index".

10. Enter anything that seems abnormal, that has changed, or that seems to be worthy noting under "Comments".

Monitoring of eelgrass wasting disease involves harvesting leaves from several plants in an area and estimating the percent cover of dark, decaying tissue on each leaf. We will be collecting eelgrass leaves once during the high point of the eelgrass season (June and July) to analyze the leaves for wasting disease. Estimates of wasting disease cover should be made following the guidelines in the protocols below.

Index created by: Dr. Fred Short
Jackson Estuarine Lab.
Adams Point Rd.
Durham, N.H. 03824

EELGRASS WASTING INDEX DATA SHEET

DATE: ____________ LOCATION/SITE ____________ PERSON ______

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

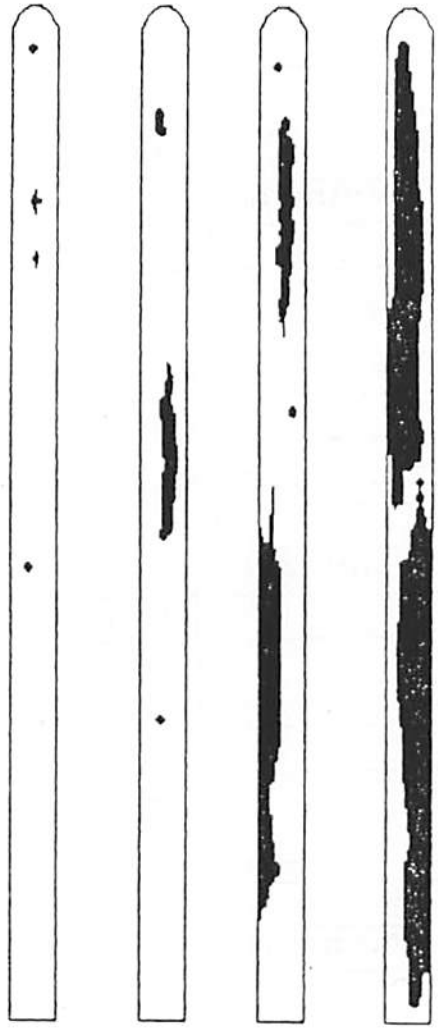
SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

SHOOT #	Width=	Sh=	
	Length	Index	Comments
Leaf #1			
Leaf #2			
Leaf #3			
Leaf #4			
Leaf #5			
Leaf #6			

WASTING INDEX

EELGRASS, *Zostera marina*



APPENDIX

RHODE ISLAND POND WATCHER FIELD DATA SHEET, 1991

(Please fill out a data sheet for each station, fill it out on the pond, it is OK if it is messy)

NAME_____ POND_____ STATION_____

DATE____/____/____ TIME_____AM or PM

TYPE OF SAMPLE (Please check if sampled)

BACTERIA___ CHLOROPHYLL A___ NUTRIENTS___ D.O.___ RAINWATER___

STATION AREA DESCRIPTION (Please fill in appropriate information)

I. PHYSICAL CHARACTERISTICS

1. Water Temperature (°C)_____

2. Dissolved Oxygen: Test 1:_____ Test 2:_____ Average:_____mg/l (ppm)

II. WEATHER AND TIDE (within last 24 hours)

1. Raining_____ Clear _____ Calm_____ Light_____ Stormy_____

2. Tide or Pond level: low medium high

3. Tide direction: ebb flood

III. POND CONDITIONS

1. Pond surface calm ripple waves white caps

2. Sea grass (condition): clean green fouled brownish

3. Water color if turbid*

4. Macroalgae

IV. POND AND SHORELINE ACTIVITY

1.	Birds within Number	0-10ft ____	10ft ____	-50ft ____	>50ft ____
2.	Fishing		lots	some	none
3.	Motor boating		lots	some	none
4.	Shoreline construction		lots	some	none
5.	Road runoff or discharges observed		Yes	No	

V. OTHER COMMENTS ABOUT POND CONDITIONS (Please use back of page for more comments if needed.)

* If signs of a phytoplankton bloom are seen, bacteria samplers should inform sample.

WATER SAMPLE SUBMISSION FORM - A

RHODE ISLAND DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES

LOCAL SAMPLE ☐

SOURCE

LOCATION: _____ TOWN: _____

SAMPLE TYPE: Pond water

ROUTINE: _____ FOLLOW-UP NO.: _____ CHECK: _____

OWNER

NAME _____

ADDRESS: _____ TOWN: _____

SAMPLE COLLECTED

BY: _____

DATE: _____

TIME: _____

REPORT TO: Virginia Lee

ADDRESS: CRC, URI

TOWN: Narragansett RI02882

WATER SUPPLY (DH)

☐ D.W.-11

☐ Pools-12

WATER RESOURCES (DEM)

☐ MWTF-21 ☐ IWTF-22 ☐ HW-23

☐ OIL-24 ☐ SGAM-25 ☐ NBAM-26

☐ COMP-27

PRIVATE WELLS ☐ -31

OTHER _____

SPECIAL INSTRUCTIONS

WATER CHEMISTRY LAB

SANITARY CHEMISTRY AND METALS (in mg/l)

____	TURBIDITY	____	____	CYANIDE*	____	____	MANGANESE	____	____ MERCURY ____
____	SEDIMENT	____	____	PHOSPHATE AS P	____	____	SODIUM	____	____ NICKEL ____
____	ODOR	____	____	pH	____	____	POTASSIUM	____	____ SELENIUM ____
____	COLOR	____	____	RESIDUAL CHLORINE	____	____	CALCIUM	____	____ SILVER ____
	SOLIDS		____	FREE AMMONIA AS N*	____	____	MAGNESIUM	____	____ ZINC ____
____	TOTAL	____	____	NITRITE AS N	____	____	SULFATE	____	____ PHENOLS* ____
____	LOSS ON IGN	____	____	NITRATE AS N	____	☐	HEAVY METALS		____ OIL & GREASE* ____
____	SUSPENDED	____	____	ALKALINITY	____	____	ARSENIC	____	____ MBAS ____
____	SETTLEABLE	____	____	ACIDITY	____	____	BARIUM	____	____ ____ ____
____	DISSOLVED OXYGEN	____	____	CHLORIDE	____	____	CADMIUM	____	____ ____ ____
____	BOD (5 day)*	____	____	FLUORIDE	____	____	CHROMIUM	____	____ ____ ____
	Expected Range		____	HARDNESS	____	____	COPPER	____	____ ____ ____
	____ to ____		____	IRON	____	____	LEAD	____	____ ____ ____

ORGANIZATIONAL HEALTH LAB

☐ TRIHALOMETHANES (μg/l)*

BROMODICHLOROMETHANE ____ CHLOROFORM ____ TTHM ____

BROMOFORM ____ DIBROMOCHLOROMETHANE ____

RADIATION (in pCi/l)

____ Gross Alpha ____ ____ Gross Beta ____ ____ Radium 226 ____ ____ Radium 228 ____

PESTICIDES LAB

PESTICIDES AND PCBs*

☐ INSECTICIDES (in μg/l)

____	ALDRIN	____	____	ENDRIN	____	____	METHOXYCHLOR	____	____ 2,4-D ____ ____ ____
____	CHLORDANE	____	____	HEPTACHLOR	____	____	TOXAPHENE	____	____ 2,4,5-TP SILVEX ____ ____ ____
____	DDT	____	____	HEPTACHLOR EPOXIDE	____				
____	DIELDRIN	____	____	LINDANE	____				

☐ HERBICIDES (in mg/l) ☐ PCBs (in μg/l)

SANITARY MICRO LAB

SANITARY MICROBIOLOGY

MPN: Tot. Col. ____ No. of tubes ____ Dilu. ____ through ____ Fecal Col. ✓

MF: ✓ Tot. Col. ____ Est. Range ____ Fecal Col. ____ Est. Range ____

SPC: _____

*MUST BE SCHEDULED IN ADVANCE

LEGAL SAMPLE ___

SAMPLE SUBMISSION FORM
R.I. DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES

Program: URICRC SysID# _____ Date 10/11/89 Time: 0734

Sample Type: Water XX Soil ___ Other _____

Collector: Morgan & Lemelder

Class _____ Orig# _____ pH _____ Cl.res. _____

Collection Point(tap etc) Wunnapang 33
POND NAME STATION #

Establishment Name _____

Street _____

Town _____ Zip _____

Mail Report To Virginia Lee

Street Coastal Resources Center, URI

City Narragansett, St Rhode Island Zip 02882

Report To(Agency/Person) _____

Special Instructions:

WATER CHEMISTRY LAB

__WLA-C+
__WLB-Private Wells/San. Chem.
__WLC-Group II--DEM
__WLD-User Fee (UF)
__WLE-Solid & Hazardous Wastes
__WLF-Heavy Metals
__WLG-Physicals
__WL_____
__WL_____
__WL_____
__WL_____
__WL_____

==========

TRACE ORGANICS LAB

__TO1-8REG VOCs(524)
__TO2-THM(502.1)
__TO3-PWVOC(524)
__TO4-PET HCs + T09
__TO5-B/N EXTR(625)
__TO6-TOT.EXTR.(625)
__TO7-PHENOLS(625)
__TO8-PAHs(625)
__TO9-MTBE + T03
__TO10-LFVOC(624)
__TO11-UFVOC(624/603)
__TO12-WQVOC(524)
__TO13-OTHER ORGANICS

==========

RADIATION CHEMISTRY LAB

__RA1-Gross Alpha
__RA2-Gross Beta
__RA3-Radon in water
__RA4-Radium 226
__RA5-Radium 228
__RA_____
__RA_____
__RA_____
__RA_____

==========

PESTICIDE LAB

__PE1-Insecticides
__PE2-Herbicides
__PE3-PCBs
__PE4-Carbamates
__PE_____
__PE_____

==========

SANITARY MICROBIOLOGY LAB

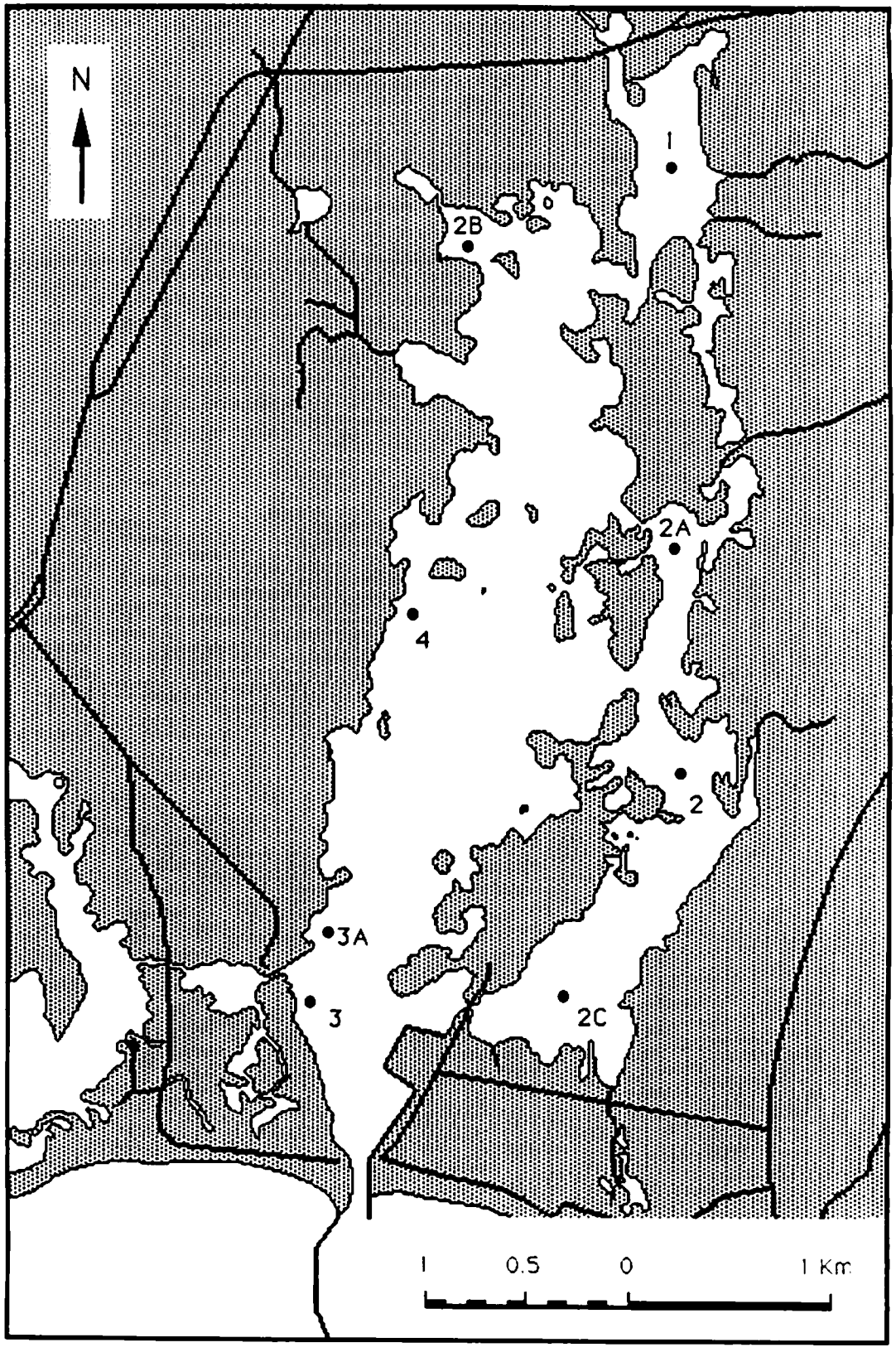
XXSM1-MPN # of tubes 3 dil. 10 thru 10-2 fecal col. ___
__SM2-MF total col.
__SM3-SPC

MICROBIOLOGICAL

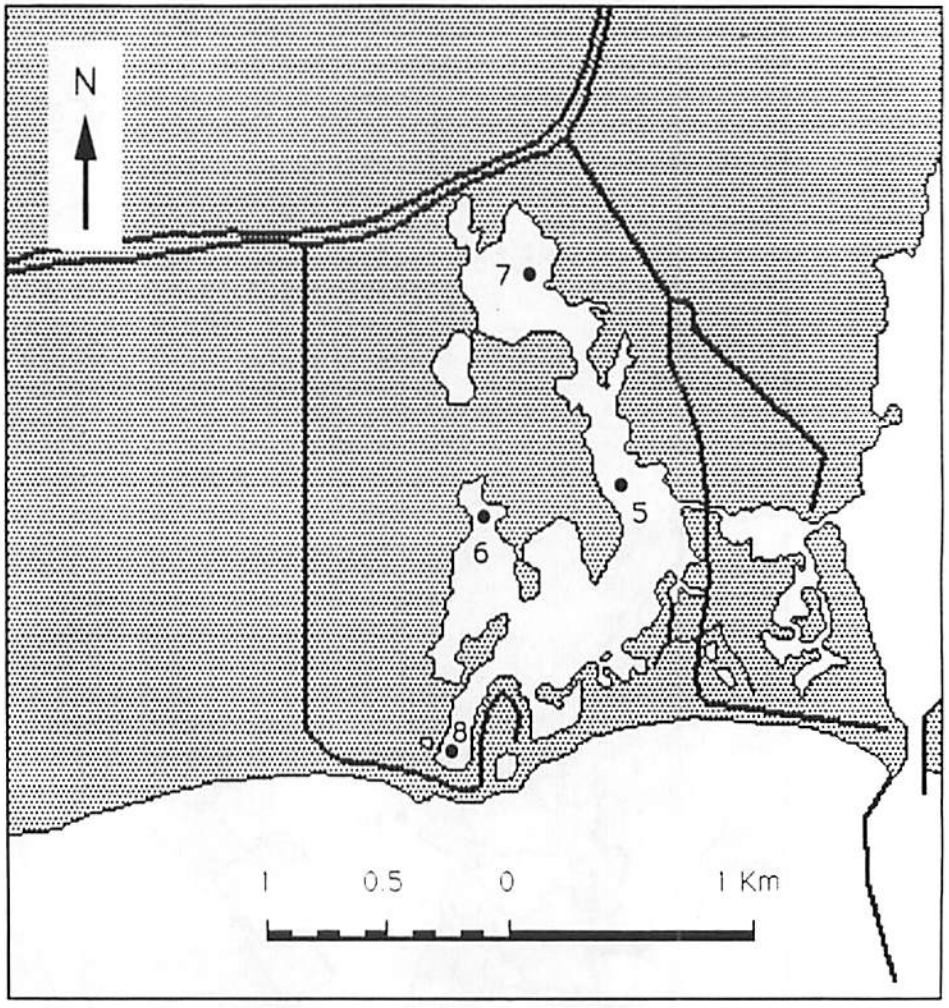
COLIFORM BACTI	10ml	1.0ml	0.1ml	0.01ml				M.F.	SPC
PRESUMPTIVE 24 HRS									
PRESUMPTIVE 48 HRS									
CONFIRMED									
FECAL									
COMPLETED									

rev.5/5/89

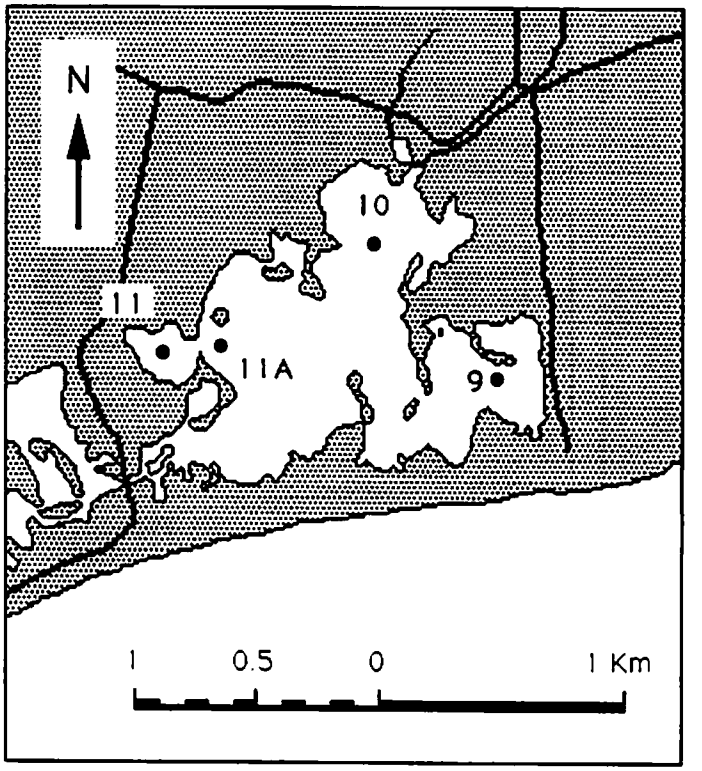
POINT JUDITH POND
Water Chemistry Stations 1985-1990



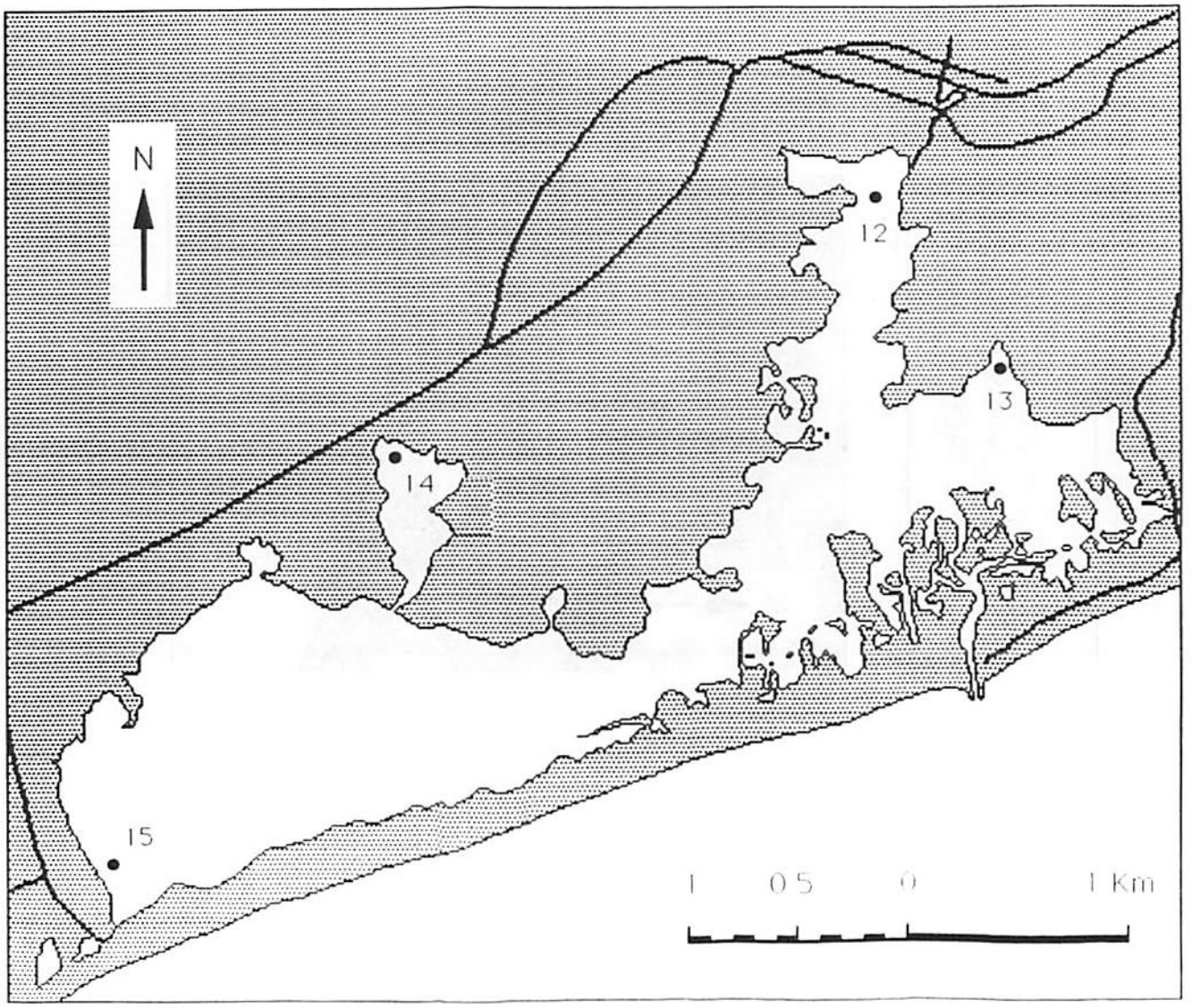
POTTER POND
Water Chemistry Stations 1985 - 1990



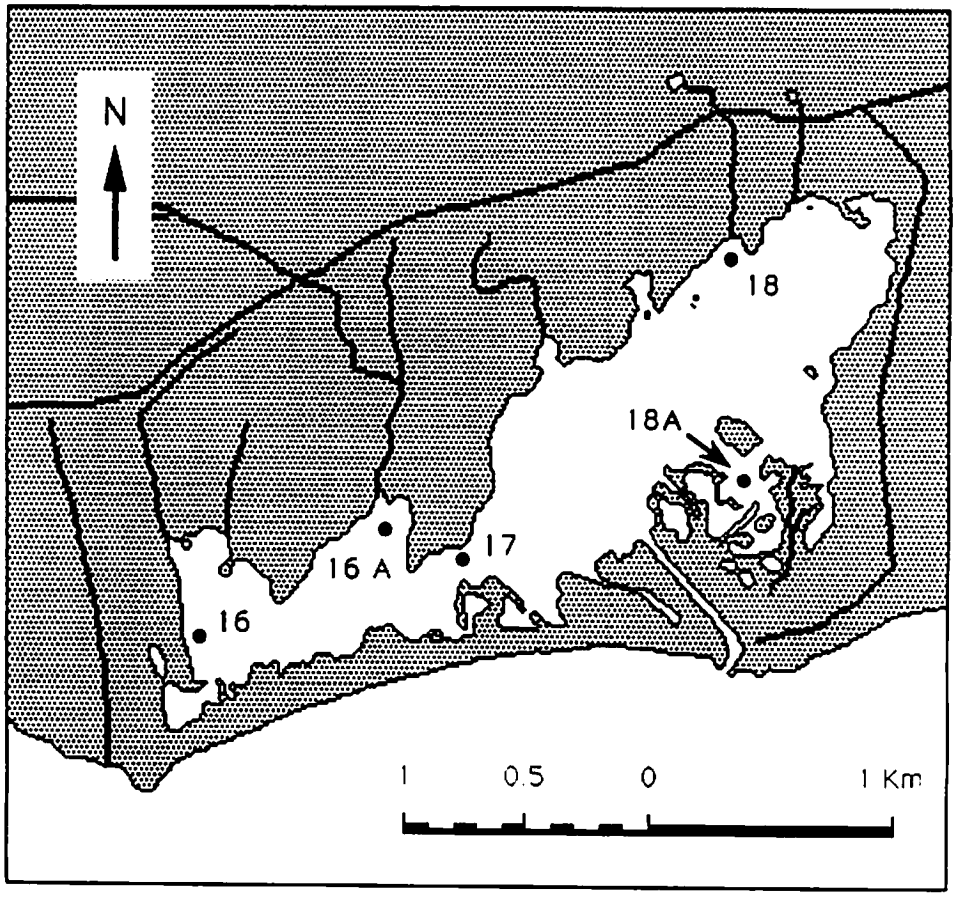
GREEN HILL POND
Water Chemistry Stations
1985 - 1990



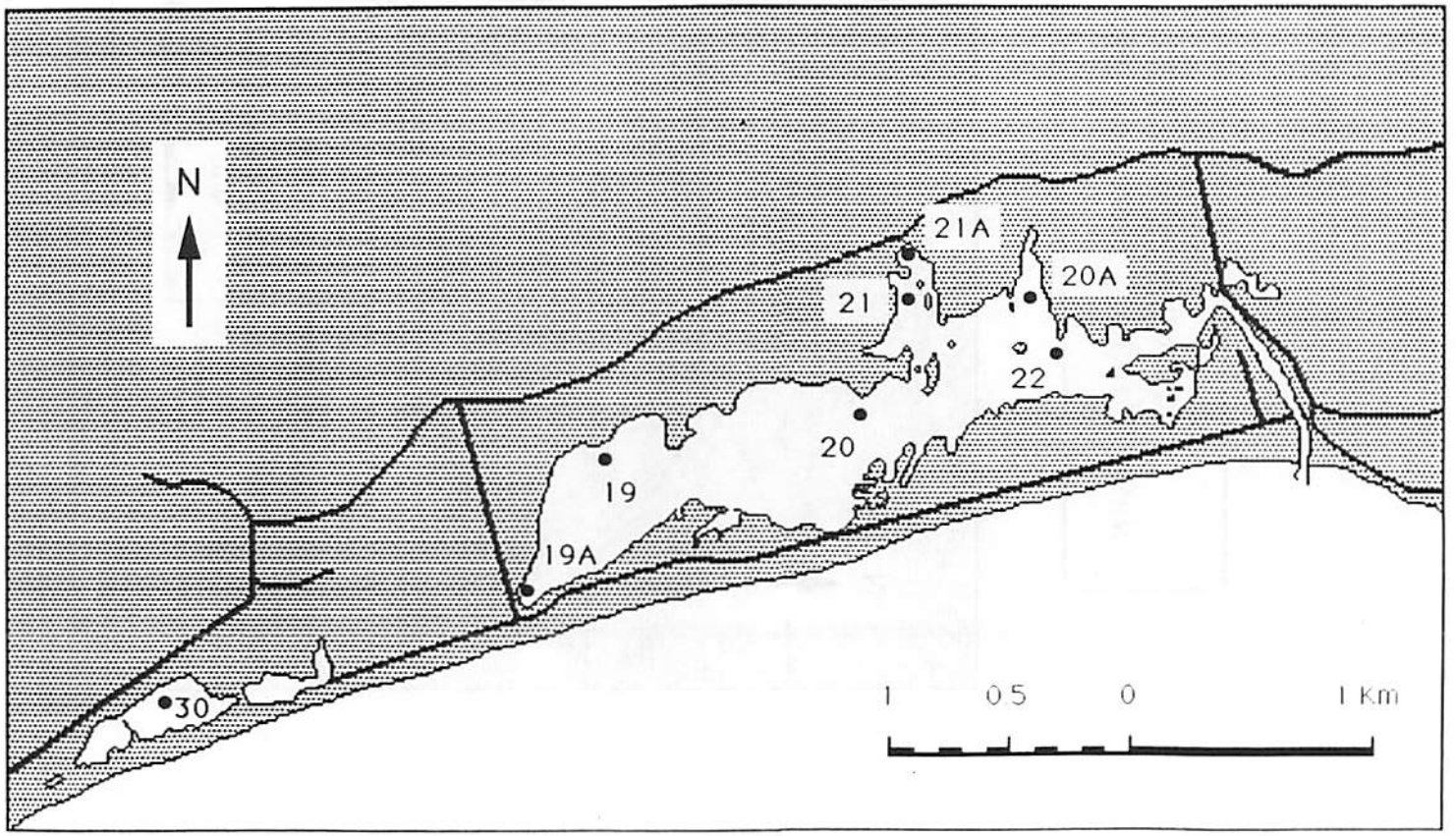
NINIGRET POND
Water Chemistry Stations 1985 - 1990



QUONOCHONTAUG POND
Water Chemistry Stations 1985 - 1990

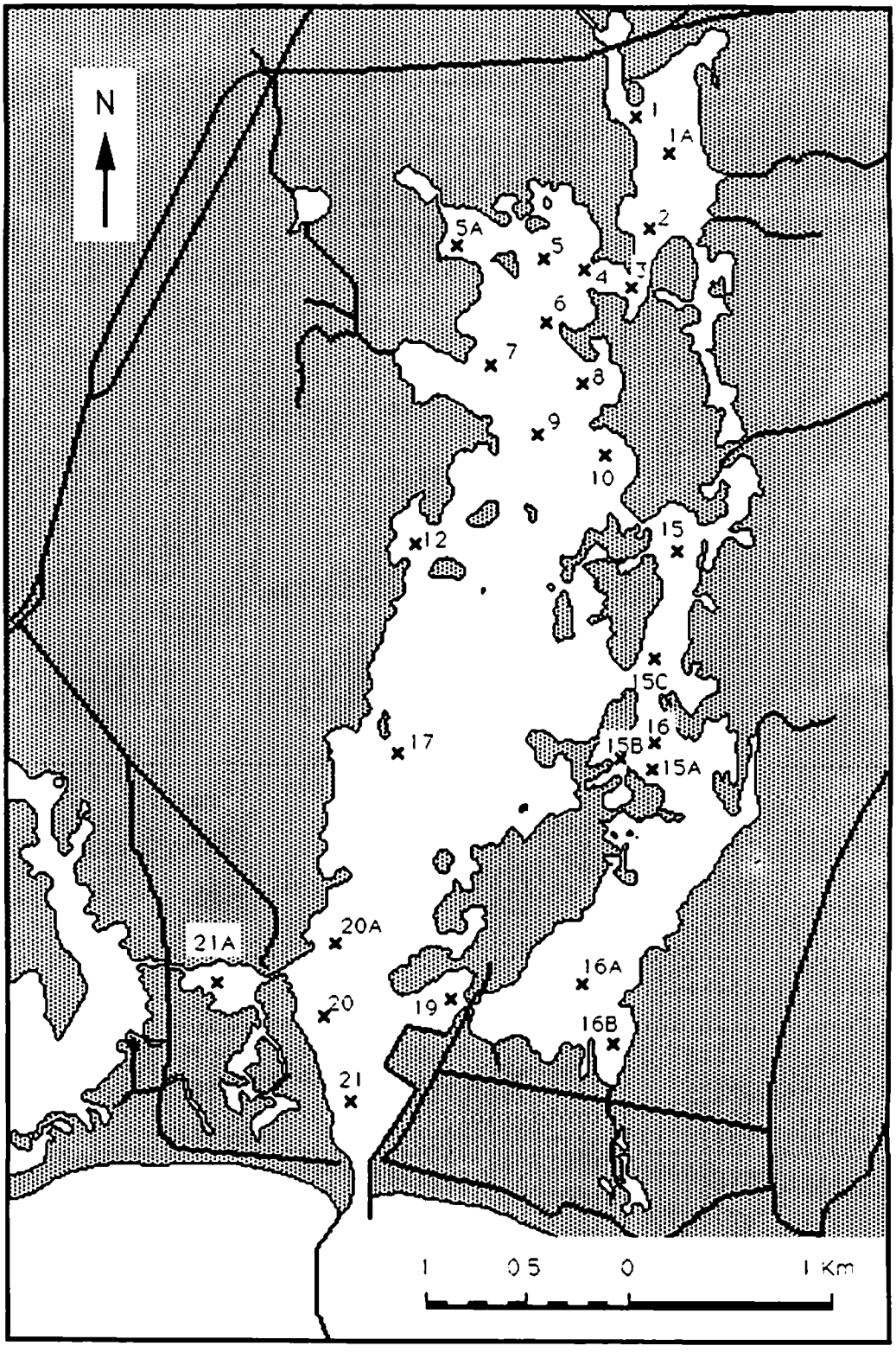


WINNAPAUG AND MASCHAUG PONDS
Water Chemistry Stations 1985 - 1990



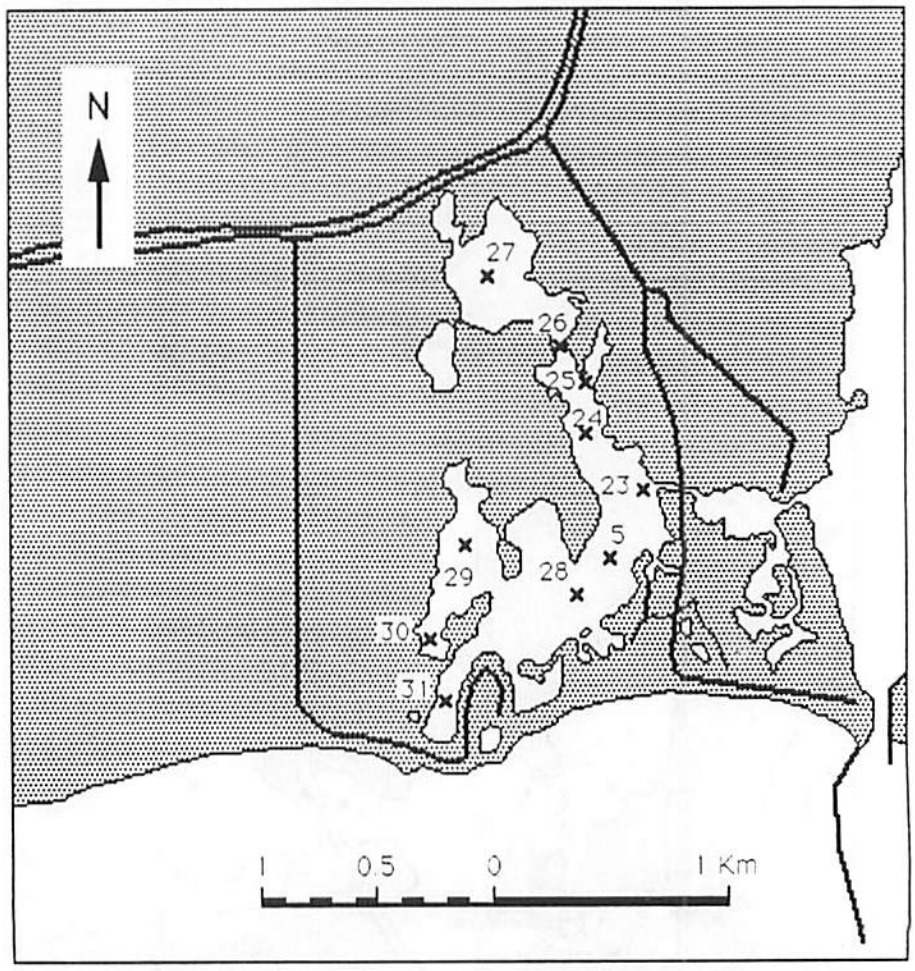
POINT JUDITH POND

BACTERIA STATIONS 1985-1990



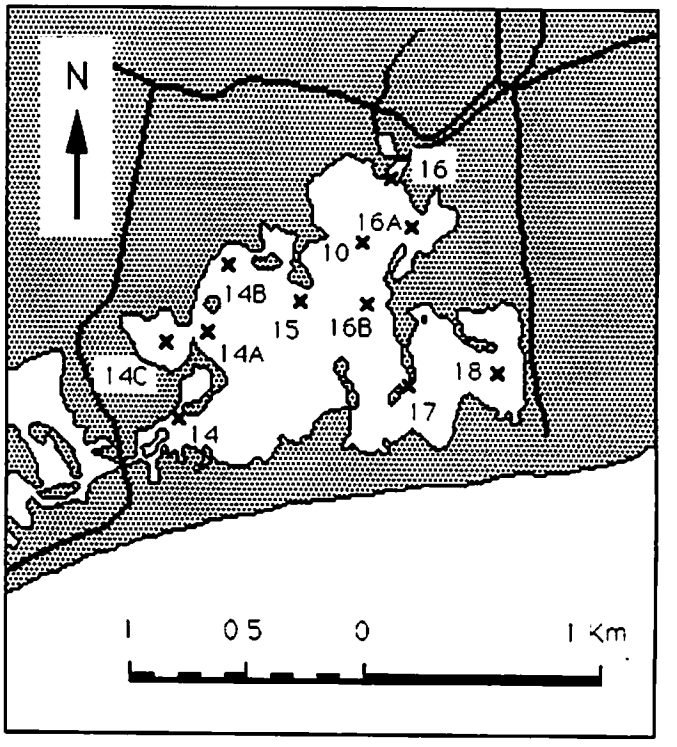
POTTER POND

BACTERIA STATIONS 1985-1990



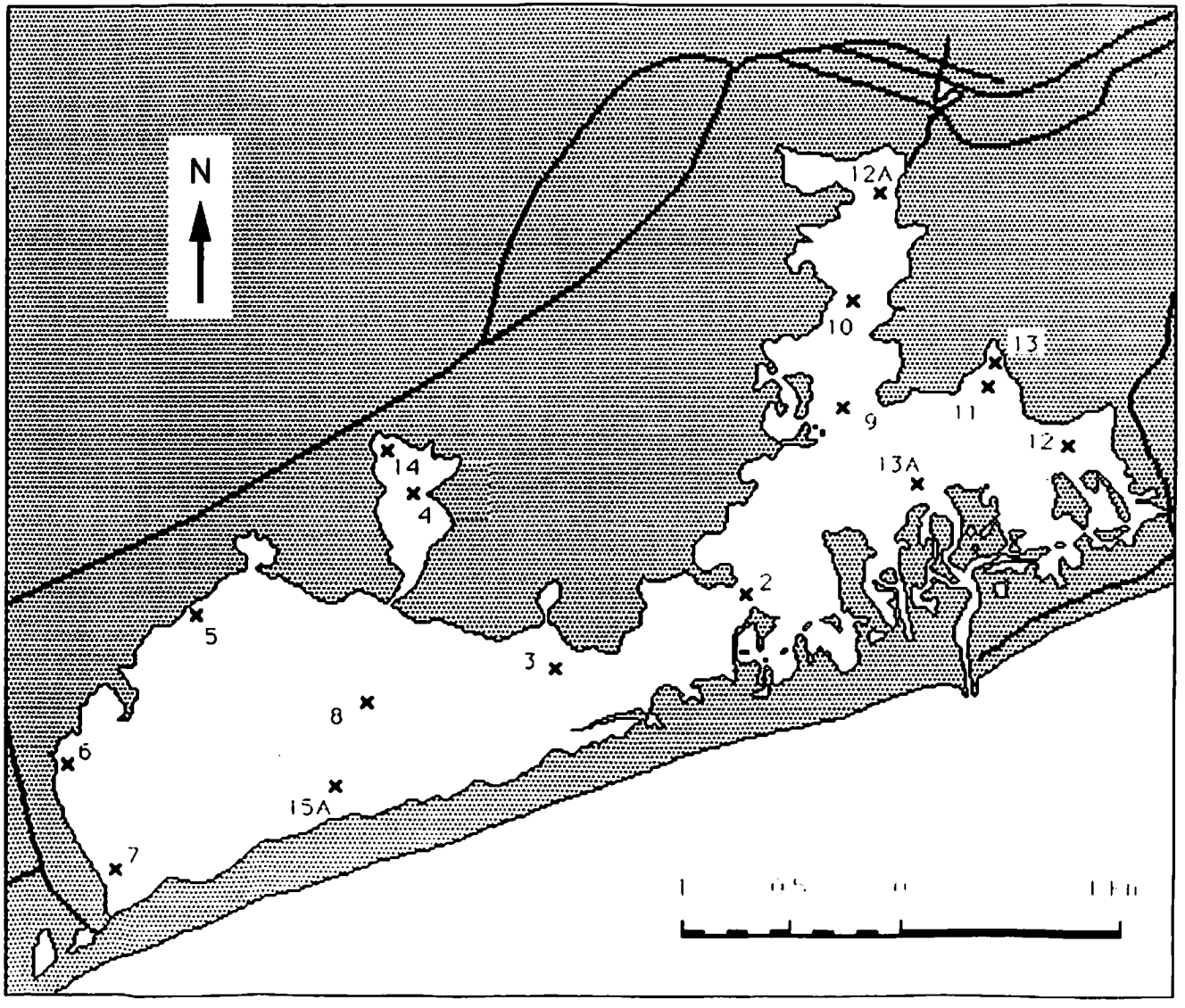
GREEN HILL POND

BACTERIA STATIONS 1985-1990



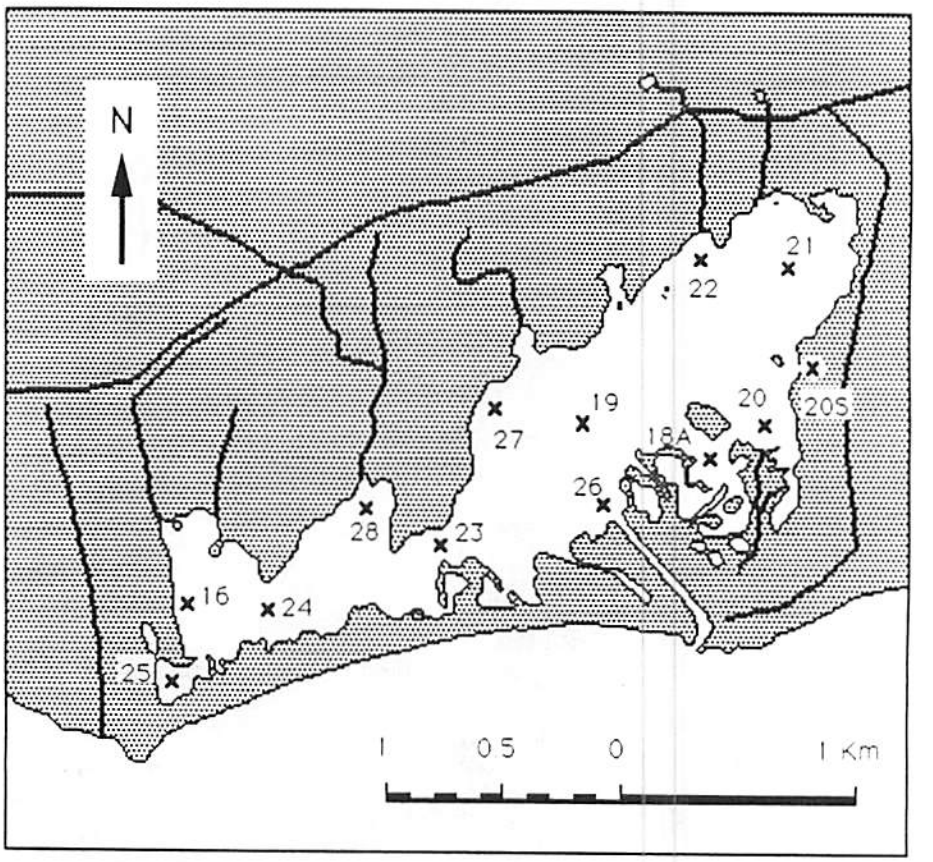
NINIGRET POND

BACTERIA STATIONS 1985 1990



QUONOCHONTAUG POND

BACTERIA STATIONS 1985-1990



WINNAPAUG AND MASCHAUG PONDS

BACTERIA STATIONS 1985 - 1990