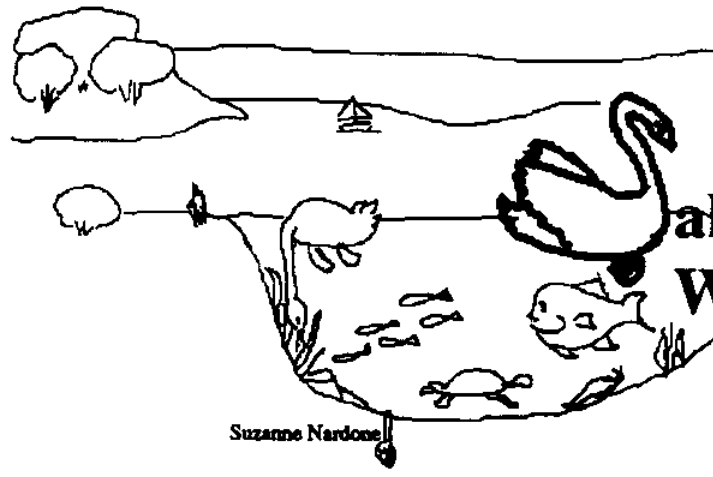

Salt Pond Watchers

Data Management Protocol

Coastal Resources Center
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RHODE ISLAND SEA GRANT

SALT POND WATCHERS
Data Management Protocol

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April 1992

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PROTOCOL FOR DATA PROOFREADING, ENTRY, AND DATABASE MANAGEMENT FOR THE SALT POND WATCHERS DATABASES

I. INTRODUCTION

This protocol is intended to make data proofreading, entry, and database management more systematic, and to define responsibilites more clearly for the volunteer Data Manager. Pond watcher data files are kept in Microsoft "Excel"™ files on Apple "Macintosh"™ computers at the URI Coastal Resources Center and by the volunteer Data Manager. Data comes from several sources: from the pond watcher's own field data sheets (temperature, depth, Secchi disk depth), from different laboratory analyses (done by the student assistant,) and in the case of rainfall, from the weather station in Kingston. The laboratory data should be proofread by the students before it is sent to the data manager, and it should be entered in a standardized fashion.

Currently, we have three types of databases: Bacteria, Water Chemistry, and Rainfall. Separate data files for Bacteria and Water Chemistry are kept for each pond. Additional databases, for eelgrass wasting disease, rainwater nutrient content, and well water nutrient levels may be set up in the future. Copies of data files are kept on the hard drive of the CRC computer and the Data Manager's computer, and on backup disks at CRC and the Data Manager's "office." Printouts of current data files are kept in notebooks at CRC and should also be kept by the Data Manager.

We will discuss each of the major types of data and guidelines for entering and proofreading them, and then present formats of databases for bacteria, water chemistry, and rainfall. Finally, we will describe how to update annual data summaries for bacteria and water chemistry Where information is specifically directed to the student, volunteer proofreader, or data manager, it will be noted in *italics*, many of the procedures, however, need to be understood by all of the people involved in the "data chain". Sections VI through VIII contain detailed instructions for updating databases, data summaries, and graphing for the volunteer data manager, and is available to others on request.

II. FIELD DATA

(*These notes mostly pertain to the pond coordinators, data manager, and volunteer proofreader. The student assistant should take note of potential problems with station numbers and dates.*) Pond watchers record date, temperature, depth, secchi disk depth, and the numbers and proximity of waterfowl on their field sheets. The first three variables are entered into the water chemistry data bases; waterfowl observations are entered in the bacteria data bases. In addition, other observations noted on the sheets, such as time of day, state or direction of the tide, presence of ice cover, major storms, unusual water color, etc., are not entered into the databases but may be needed for future analysis.

The *All-Ponds Coordinator* collects the field data sheets from the pond watchers and checks them for legibility and corrects inconsistent units or dates (eg. temperature in Fahrenheit, depth in feet, etc.) and then brings them to the Data Manager, who enters the data onto "Excel" spreadsheets together with the laboratory results. The data manager should proofread his or her own data entries. After the annual fall meeting, the data sheets are sent to CRC and stored in a notebook there. When the complete database is sent to CRC by the data manager, the field data in the completed databases will be proofed by a volunteer using the field data sheets.

A. **Station:** There have been some cases where people have confused bacteria and water chemistry stations. For example Bacteria Station 4 in Ninigret Pond is in the same location as Water Chemistry Station 14. At DEM's request we have used their station numbers and locations. In some cases the locations overlap with water chemistry stations and in some cases they do not. *Pond Coordinators* and the *All-Pond Coordinator* should check station numbers to be sure that they are correct.

1. *Data Manager:* Except for Point Judith Pond, Bacteria and Water Chemistry have completely different numbers in each pond, eg. Quonochontaug has Bacteria Stations 19 - 28 and Water Chemistry Stations 16 - 18, so erroneous station numbers can be resolved by checking the station map or the list of samplers and stations for that year.

B. **Date:** This should be simple but the vagaries of handwriting and memory can complicate things. Frequently dates on data sheets and nutrient and chlorophyll samples differ. The pond coordinator for each pond should check the samples and the data sheets to make sure that the dates correspond, and contact the pond watcher in case of a discrepancy. Pond watchers should be encouraged to check the dates before they give samples and data sheets to the *pond coordinators.* Sometimes a pond watcher will take some measurements, but may have a problem with filtration and will take another sample the next day. When this happens, it should be noted on the data sheet.

1. *Data Manager:* In the event of discrepancies, the data manager should use the date on the data sheet, if it is the most plausible. Enter dates as "dd-mmm-yy", using the option "Number" under "Format" in Excel. In cases where there are successive samples less than week apart, especially 1-3 days apart, the Data Manager should call the pond watcher to see if something was wrong with the first sampling.

2. *Student Assistant:* Dates on nutrient samples and chlorophylls should correspond. If there is confusion, check with the data manager to see what the date was on the field data sheet and use that date for the laboratory data sheet.

C. **Temperature (Water Chemistry):** Temperature is recorded in degrees Celsius. In the event someone uses a Fahrenheit thermometer and does not convert the data, data must be converted by the All-Ponds Coordinator. The data manager should also be on the alert for unconverted numbers. The formula for conversion is:$°C = (°F - 32) \times 0.555$.

1. Round off temperature to the nearest degree, eg. 23. Seawater (35 ppt) freezes at -1.9°C so negative numbers are possible in winter, particularly when the ponds are partly or entirely frozen. The minimum (freezing) temperature increases as the salinity goes down and is -1°C at 17 ppt and 0°C in fresh water. Maximum summer temperatures are around 22 - 24°C in the deeper, saltier ponds (eg. lower Point Judith, Quonnnie), and 25-28°C in shallow, more enclosed ponds and coves. A temperature over 30°C has yet to be recorded.

2. *Volunteer Proofreader and Data Manager*: Keep an eye out for unseasonable temperatures—they may be typos! Check them against the original data sheets.

D. **Dissolved Oxygen (Water Chemistry)**: Units are ml/l. Lamotte Kit results are good to one-tenth, eg. 9.7. Oxygen was not measured in 1991. Previous dissolved oxygen measurements were done in surface waters. In the summer of 1992, we will begin measurements in bottom waters. Bottom measurements need to be kept in a separate column from surface measurements, because they are not comparable and will usually be lower. The two columns should be called SDOX for surface and BDOX for bottom. in the 1985 - 1992 and later updates of the data base (See Formats, V, p. 6).

E. **Depth (Water Chemistry)**: Depth is recorded to nearest tenth of a meter (eg. 2.1 m). Pond coordinators and all-pond coordinators should check to see that results are given in meters. Pond watchers have sometimes used feet or inches. Coordinators should check for this, and convert results (1 inch = 2.54cm, 1 foot = 0.305m). Pond watchers have reported results as "units" or "knots" (0.1m). The coordinators need to remind pond watchers to record results in meters, to the nearest tenth of a meter. The data manager should also check the units before entering the data. Most pond watcher stations are 0.5 - 2.0m depth. Only Ninigret 12 and Quonnie 18 and some Great Salt Pond stations exceeed 3m, so numbers like 7.5 on a data sheet are probably tenths, or 0.75m.

1. *Data Manager:* Often only one of the two blanks is filled out for "Depth" and "Secchi". If only the "Secchi" blank is filled in, that number should be taken as "Depth", since most of the time, one can see to the bottom of the ponds.

F. **Secchi (Water Chemistry)**: Secchi disk depth is also recorded to the nearest tenth of a meter. The secchi depth is always less than or equal to the pond depth. The notes for "Depth" apply to "Secchi" also. For much of the year, one can see the Secchi disk on the bottom at all stations, so that the two depths are equal, but during phytoplankton blooms, especially in summer, Secchi disk depth may fall to 1 m or less.

G. **Waterfowl (Bacteria)** Pond watchers should note numbers and proximity of waterfowl (geese, swans, cormorants, gulls, etc.) within 100 feet of sampling stations . All samplers should record waterfowl, but only the bacteria database is annotated for waterfowl.

1. *Data Manager and Student Assistant:* Waterfowl observations are preferably recorded by distance, in feet, and number of birds in parentheses, eg for 4 birds between 10 and 50 feet away: 10-50(4). If birds have been noted only verbally, eg. "hundreds of cormorants everywhere", those notations should be entered also. If no birds are seen, type (0); "Excel" will not type a "zero" in parentheses.

III. LABORATORY MEASUREMENTS

Salinity, nitrate, phosphate, and chlorophyll will be analyzed monthly by the graduate student assistant. The assistant will copy the salinity and nutrient data by hand from printouts and lab notes onto a standard data form, and send it to the data manager. Chlorophyll data is calculated on an "Excel" worksheet and is copied onto a

new "Excel" worksheet and sent with the nutrient data. (See updated "Salt Pond Watchers Lab Protocol Manual For The URI Graduate Assistant".) Student assistants must proofread their own work carefully before mailing the data.

Estimates of precison for nutrient and chlorophyll measurements come from a quality control session on November 2, 1991 during the annual Fall Pond watcher meeting. Sixteen pond watchers filtered water samples from a single container of sea water.

Volunteer Proofreader: The proofreader will compare data entered by the data manager with the form sent by the student.

A. **Salinity (Water Chemistry)**: Units are parts per thousand (ppt). The measurement is accurate to about 1 ppt, so results should be given as whole numbers, eg. 24. Normal ranges for ponds are given below:

Point Judith 1	0 - 27
Point Judith 4 and 3A (and earlier mid and lower pond stations)	24 - 32
Potter	20- 30 (rarely to 14)
Trustom, not yet sampled, but earlier data, 1975 -80	~5 - 25
Green Hill	0 - 24
Ninigret 13 and 15	20 - 30
Ninigret 12 and 14	4 - 28
Quonochontaug	22 - 32 usually 28-32
Winnapaug	15 - 32 usually 25-32
Maschaug	4- 14
Great Salt Pond	17 - 33

1. Stations located near streams or springs such as PJ1, GH10, and NN12 and NN14 may have readings near 0 in spring or after heavy rains. In lower Point Judith Pond, Potter, Quonnie, and Winnapaug Ponds salinities below 20 should be double-checked. Readings above 34 are probably erroneous.

2. *Student Assistant*: Keep these ranges in mind when doing salinities; double-check when a result is anomalous, and remember to shake those bottles!

B. **Nitrate (Water Chemistry)**: Units are µM (micromolar). The measurement is made using an autoanalyzer. The precison is ~± 1% and the lower limit of detection is 0.07 µM. This measurement does not have to be corrected for salinity.

1. *Student Assistant:* The autoanalyzer printouts are kept in the "Nutrients" notebook, together with the salinity readings. When each month's data for salinity, nitrate, and phosphate are completed, they should be copied, neatly and legibly, proofread, and sent to the data manager.

2. *Data Manager and Volunteer Proofreader:* The data should be entered to two decimal places, eg. 1.23, using "0.00" under. "Number" in "Format."

3. Typical ranges are 0 - 5 µM in June - September, and 5 to 20 µM in October - April.

a. Nitrate levels are lowest at high salinity stations such as PJ3A, PT5, QN16A, and QN18, usually less than 1 µM in summer, and less than 6 µM in winter. In confined coves (PT6), areas with heavy freshwater inflow (PJ1, all of Green Hill, and NN14) and areas with possible sewage seepage (NN13, WP22), nitrate may exceed 5 µM in summer and 15-20 µM/l in winter. In the winter of 1986-87, when the breachway of Green Hill Pond was blocked, nitrate exceeded 100 µM/l at one station.

C. **Phosphate (Water Chemistry):** Units are µM. The measurement is made using an autoanalyzer. The precison is ± 10% and the lower limit of detection is 0.0.

1. *Student Assistant:* This measurement has to be corrected for salinity (refractive index). At low salinities (below 25 ppt), the raw readings may be negative. The correction which we use was determined by David Avery, who measured phosphate standards made up in water of different salinities. (See updated "Salt Pond Watchers Lab Protocol Manual For The URI Graduate Assistant.")

2. *Data Manager and Volunteer Proofreader:* The data should be entered to two decimal places, eg. 1.23, using "0.00" under. "Number" in "Format."

3. Typical ranges are 0.00 to 2.00 µM/l. Phosphate frequently reaches a peak in midsummer.

D. **Chlorophyll a (Water chemistry):** Units are µg/l (micrograms per liter or milligrams per cubic meter). Measurements are made using a fluorometer. The precison is ±3% and the lower limit of detection is 0.30 µg/l (Lowest reading in our records).

1. Chlorophyll readings in the ponds are usually below 10 µg/l but occasional readings, especially in the summer months have exceeded 50 µg/l. Readings above 10 are most likely at PJ1, at PT6, 7, and 8, at NN13 and 14, and WN19 and 21, stations with high nutrient inputs, located in fairly confined coves or basins.

2. *Student assistant:* (See updated "Salt Pond Watchers Lab Protocol Manual for the URI Graduate Assistant.") The raw fluorometer readings are entered into an "Excel" spreadsheet in which the calculation formula is pre-programmed. The assistant looks at the chlorophyll results for the replicates, and deletes any samples which were improperly processed or badly handled eg., not folded, etc., as well as any single readings which are extremely divergent from the other two in a set. The student should check the "mean chl a" column "Column M" to make sure that the "average" formula refers to the right row numbers. When the worksheet has been proofread and corrected, the student should make a new worksheet, pasting the dates and station numbers, together with the corresponding mean chlorophyll readings. This sheet should be sent to the data manager, either as a hard copy or on disk.

3. *Data Manager:* The chlorophyll data should be entered or pasted onto the data sheet, taking care that the dates match those for the nutrients and temperatures, as already noted.

E. **Fecal Coliforms (Bacteria):** Units are Most Probable Number per 100 milliliters (MPN/100 ml). Two methods have been used for estimating fecal coliforms. From 1985 through 1990, samples were run at the Rhode Island Department of Health (DOH) laboratory in Providence, using a multiple dilution method with a lower limit of 3 MPN/100ml and an upper limit of 2400 MPN/100ml (or 4800 in some cases). Negative results (no bacteria detected) were given as <3, while results above the limit (growth in all tubes) were given as >2400. From 1989 through 1990, some of the samples were done at the Food and Drug Administration (FDA) laboratory at Quonset Point, North Kingstown, using a single dilution test with a lower limit of 9 and an upper limit of 248. Results outside the these limits are given as <9 and >248. In 1991 all of the bacteria samples for the mainland ponds were run at the FDA lab.

1. Great Salt Pond, (Block Island) bacteria samples are run at the Block Island Sewage Treatment Plant. These data are not yet incorporated and the upper and lower limits of their measurements are not known, but a Great Salt Pond bacteria data file should be created and organized in the same way as those for the other ponds.

2. *Student assistant:* Results from each sampling date are entered in worksheets in a notebook kept at FDA, and copied onto a sheet of paper to be brought back to CRC. These results are copied onto data sheets which are organized by station and date and kept in a notebook. Copies of these sheets are sent to the data manager monthly, together with the field sheets. The lab bacteria data sheets should be proofread from the raw data before mailing.

3. *Data manager:* The coliform data should be entered as written, including the "<" and ">" signs in the annual data file and the permanent database file. For graphing and data summaries, (See VI A., p.8) these files should be copied to separate worksheets, and data with"<" and ">" signs replaced with:

   < n : use 1/2 n, rounded to nearest digit: eg. for < 9, use 5.

   > n: use n + 1: eg. for >248 use 249.

4. *Volunteer Proofreader:* Use original datasheets at CRC to check the annual file.

F. **Total Coliforms (Bacteria):** Units are Most Probable Number per 100 milliliters (MPN/100ml). Total coliforms were measured in samples processed at DOH from 1988 through 1990. The numbers are treated the same way as fecal coliforms. Currently, we are not measuring total coliforms in the mainland ponds, but some of the Block Island bacteria data may include total coliforms.

IV. RAINFALL

There are several sources of these data. One is the URI weather station at Kingston, run by the Department of Plant and Soil Science, and reporting to the National Weather Service. The others are rain gauges monitored by the pond watchers themselves. So far, only the Kingston rain data has been systematically entered. The pond watcher data tends to be more spotty because of vacations and other activities, but the more complete data sets should be entered into a standardized format similar to that used for the Kingston data. (We have compared one of the more complete sets from Quonochontaug Pond and found

agreement with the Kingston rainfall in monthly and overall totals. Further comparisons of this kind are desirable.)

Rainfall is measured in inches and recorded to two decimal places, eg. 1.23. Dates marked "T" for "trace" should be recorded as "0."

A. **Kingston Data:** Currently, copies of the Kingston monthly weather report are sent to the student assistant's mailbox and to Virginia Lee. Rainfall data are entered by the student assistant several times during the year, and the files sent on disk to the data manager at the end of the year. In the future, Kingston weather data could be sent directly to the data manager for entering. Copies of the finished data sheets would then be returned to CRC.

B. **Pond Watcher Data:** Rain gauge sheets are picked up by the Pond Coordinators with other data sheets and samples. Currently, they are brought to CRC and stored in a notebook, but they could be taken directly to the Data Manager, entered, and sent back to CRC.

V. DATA MANAGER AND VOLUNTEER PROOFREADER: DATABASE FORMATS

Two types of files are maintained for bacteria and water chemistry, an annual file for each year covering all ponds (eg. 1992 Bacteria, 1992 Water Chemistry) and permanent databases which contain all the data from 1985 onward for one pond (eg. PJ Bacteria 1985-1992). Only annual files are maintained for rainfall (eg. Rainfall 1992). Examples of formats are included in "Appendix A". Summaries of bacteria and water chemistry data by year for each pond have also been prepared and need to be updated yearly. Examples of these summaries are also included in "Appendix A."

A. **Timetable:** Printouts of the partially completed annual data set, up to August or September, should prepared for distribution at the annual meeting. The annual files and updated 1985-9n databases should be completed by early January and sent to CRC so that they can be proofread and sent to state agencies. (Updating the databases takes about five to ten hours of work, updating the summaries is about 15-20 hours of work).

B. **Data Storage:** Three sets of six disks containing the permanent data bases and data summaries for each pond are kept at CRC—a working copy, an archive copy, and a backup copy. The archive and backup disks should be updated every year but not used routinely. **Only the working disks should be used in the GSO Computer Center or elsewhere outside the CRC building!** The backup disks should be stored in a separate room or building from the other disks (in case of fire, viruses, or other accidents).

   1. The data manager must keep working copies of each permanent database file and at least one backup copy of each file.

C. ***Data Manager:*** **Technical hints ("Excel"):** *(Students new to "Excel" should look at these also.)*

   1. Headings can be enclosed in a box by selecting the desired area and using "Border" under "Format", and then picking "Outline." Use "Insert" to put

page headings at the top of each page, and "Page Preview," in the "Print" box, to check that headings are in the right place.

2. After you have used "Page Preview" once and "Cancelled" (2.2) or "Closed" (3.0), page breaks will be marked by dashed lines. You can use "Page Preview" and "% Reduction" in "Page Setup" to insure that all of the columns are on the same page. Use "Page Preview" also to check alignment, "Center" alignment is preferred; note that you can select a whole column or file to make the alignment uniform or select the upper left-hand cell to make the whole document uniform.

3. Early versions of the annual data files can be printed "the long way", with the columns across the length on the paper so that they are larger and more legible for proofreading.

4. The permanent data bases are so big that they should be printed with the colums across the top, "the normal way" (vertical).

5. Currently we use 70% reduction for permanent Bacteria data bases and 55% for permanent Water Chemistry, so that all the columns fit across the top of one page.

6. Numbers of decimal places (0,0.0,0.00) can be adjusted by choosing "Number" under "Format". This also controls the form of dates—we use dd-mmm-yy, eg. 12-jun-92. By selecting whole columns after data entry is complete, you can ensure that all the data are in the same format.

D. **Water Chemistry Format:** Note that the 1992 annual water chemistry format will contain a column BDOX for "bottom dissolved oxygen", and the 1985-1992 format will contain two dissolved oxygen columns, SDOX and BDOX, for surface and bottom dissolved oxygen. If any surface dissolved oxygens are done in 1992, this data set will have to have an SDOX column also. (See II D, p. 2).

E. **Rainfall formats:** Two types of files are prepared; the first is called "Rainfall yr (eg.92)" and consists of four columns: Date, Rainfall, Monthly Averages and Monthly totals. This file is awkward to print and read but is useful for analyses. A second file, called "Rainfall yr (eg. 92) Kingston" is printed with dates and rainfall for several months from May through October on one page. The data are copied and pasted from the first file and arranged in parallel columns. The example given is "Rainfall 90 Kingston".

1. Examples of formats are given in "Appendix A".

VI. DATA MANAGER

Updating the permanent database files: eg. "PJ H20 Chem 1985-91"; save as, call new file eg.,"PJ H20 Chem 1985-92".

A. Open annual file, eg. "1992 Water Chemistry."

B. Eg. for PJ 3A, last record is 2-Nov- 91; select about 12-15 complete rows (enough space for the 1992 PJ3A data) and "Insert." Go to the "1992 Water chemistry file, "Copy" the 1992 PJ3A data, and "Paste" it in the new space.

C. Delete any excess empty rows. Remember to leave a row between data from different stations.

D. Repeat until all the 1992 PJ water chemistry data are entered.

E. Now go to "Print Preview" under "Print." Notice that the headings are no longer at the tops of the pages, because they are offset by the inserted data.

1. Find the first page break with a displaced heading underneath it, and "Insert " two complete rows under the page break.

2. Scroll down to the heading, select it, and "Cut" it .

3. Now "Paste" it in the two rows just below the page break.

4. Go down to the two blank rows where the heading was and "Delete" them.

5. Use "Print Preview" to check that the headings are now at the top of the page.

6. Repeat until all the headings are at the tops of the pages.

F. Check alignment, numbers of decimal places, etc. Make sure all columns fit on one page and then "Print."

VII. DATA MANAGER

Updating Data summaries: These tables contain summary statistics of each year's data for each pond to permit easy comparisons among stations and years. Copies of these files are kept on archive and backup disks at CRC and by the data manager. Examples of data summaries are given in "Appendix A." Examples of files used in making the summaries are given in "Appendix B."

A. **Bacteria data** are summarized using medians, geometric means, the percent of samples exceeding a cutoff point over the sampling season.

1. Start with the annual file, eg. "1992 Bacteria." Save as, eg. "1992 Median Bacteria."

2. Select the whole "Fecal" column. Go to the "Formula" menu and select "Replace." In the "Find What" box, type "<9", and in the "Replace With" box type "5". This replaces all "<9's" with "5's." In the same fashion, replace all ">248's" with "249's."

3. Now, in what was the head of the "Total" column, eg. column D, type "LN Fecal." Next to the first "Fecal" number, eg. in column D, enter the formula =LN("Fecal Cell "), eg. =LN(C3). You can type in this formula or obtain it from the "Paste Function" menu, under "Formula." This calculates the natural logarithm of the "Fecal" number. "Copy" this cell and paste it next to each "Fecal" number.

a. If you paste the formula next to a dot or a blank, the cell will say "NUMBER!" Delete any rows with missing data, and clear any blanks which say "NUMBER!"

4. At the end of the first station's data, insert 4 complete rows. See the example, NN MED FEC 91.

   a. In the first cell two rows below your data, put the pond and station number, eg. NN4, cell A13. (You can put labels above each variable to help keep track of them.)

   b. The second cell to the right, eg. B13, is Water Quality Classification. All of our recent salt pond stations except for PJ20 and PJ21A are "SA"; the latter two stations, near the Port of Galilee are "SB."

   c. The third, eg. C13, is the year.

   d. The fourth cell, eg. D13 is labelled "#FEC" and is the number of samples. Enter the formula =COUNT ("Fecal Cells"), eg. =Count (C3:C10). (For a large number of cells, this is time-saver.)

   e. The fifth cell, eg. E13, is labelled "G MEAN FEC, and is the geometric mean of the "fecal numbers." This is the antilogarithm of the average of the logarithms. Enter the formula =EXP(AVERAGE ("LNFecal cells")), eg. =EXP(AVERAGE(D3:D10)).

   f. The sixth cell, eg. F13, is labelled "Med FEC" and is the median of fecal numbers. An easy way to determine the median is to use "Sort", under "Data". Select all the rows and columns containing data for this station, eg. rows 3:10, columns A:D. Sort by the "Fecal Column", eg. "C3", ascending. The fecal data will now be sorted from smallest to largest. If the number of cells is odd, the median is the number in the middle; if the number is even, the median is halfway between the two middle numbers, eg. =5+ 1/2(5-18) equals 12.5, rounded off to 13. These calculations can be done on a calculator, or on a blank "Excel" cell.

      (1) **Very Important!** Remember to select all the columns containing data for the station you are working on; otherwise the dates and logarithms will no longer correspond to the fecal numbers and the geometric means will change as data is sorted. After sorting data, it's a good idea to check to make sure that the dates and logarithms correspond to the fecal numbers, and that the geometric mean is the same as before sorting. Once the data is mis-sorted it is hard to unscramble, and in that case it's best to clear it and and "Paste" in unsorted data from the original file, eg. from "1992 Bacteria," and then sort again.

   g. The seventh cell, eg. G13, is labelled %>50 FEC, and is the percentage of readings greater than 50. This applies to "SA" waters. Count the number of fecal readings over 50, eg. one, C10, and divide by "#Fec," and multiply by 100 for percent, eg =(1/8)*100, which equals 13.

(1) It simplifies things to do this formula in a blank cell elsewhere on the sheet, delete it when done, and type the answer in the desired cell. (Otherwise there can be complications when pasting data onto another worksheet if the formulas are still active.)

(2) Point Judith Pond has an extra column for "%>500 FEC," to the left of %>50 FEC, which applies only to "SB" waters, at Stations 1, and 1A, (no longer sampled) and 20A and 21A. If there are any readings greater than 500, calculate the percentage as before, otherwise enter 0.

4. We won't have any more Total Coliform data, except perhaps from Block Island. If we did, it would be summarized in the same way, except that the cutoff points are 2300 for "SB" waters, and 330 for "SA" waters.

5. Now repeat these steps for the other stations in this pond.

6. The data summary also has cumulative statistics for the whole period since 1985, eg. 1985-1992. In order to update this:

   a. Open the updated permanent database file for this pond, eg. PJ Bacteria Data 1985-92. "Save as," eg. PJ Cum Bacteria 1985-92.

   b. For stations which have this year's (eg. 1992) data, insert 4 complete rows below the station. Go back to, eg., "PJ Median Bacteria" and select a block of cells with the summary statistics. Copy it and paste it into the space below the 1985 -1992 data.

   c. Make an "LN Fecal" column as before and paste the "=LN" formula into it, as before, being sure to delete any rows with dots or missing data.

   d. Adjust the row numbers and column numbers in the "#FEC" and "G Mean" formulas to cover the all "Fecal" data for that station, eg. from 1985 to 1992.

   e. Select the whole block of data, including dates and station numbers, and sort it as before to determine the median and % > 50.

   f. Repeat for each of the stations in this pond which have new data.

7. Now open the bacteria summary file for your pond. "Save as" eg. "Point Judith Bacteria 1985-92" and insert complete rows for this year's data.

8. Now go back to the "Median files", eg. "PJ MED FEC 92," select the cells with summary statistics from the year, eg. 1992, right through %>50, and "Copy" them.

9. Go to the bacteria summary file, and select the cell for the new year. Select "Paste Special" under the "Edit" menu and choose "Values." Then hit "OK", and the statistics will be pasted in. **Remember to use "Paste Special" and not simply "Paste."**

10. Go to the "Cum Bacteria" file and paste the statistics for the cumulative data, for, eg. 1985-92, into the corresponding place in the summary, again using "Paste Special."

11. Repeat for the other stations. When the summary is updated, move the headings so that they are under the page breaks. If necessary, insert rows to keep all of the data for one station on a page. Use "Print Preview" to check the position of the headings, alignment of the rows, etc.

    a. Cumulative data are distingished by underlining.

B. **Water chemistry data** is summarized for each year using averages for the "normal" sampling season, May or June through October or early November, for the winter period of peak nutrient levels, December-February, and for March-April. The "Dec-Feb" and "Mar-Apr" rows are shaded to distinguish them from the summer data. In order to add a new year's data:

1. To add a new years data: first open the annual file, eg. "1992 water chemistry" and "Save as" eg."1992 av "May-Nov water chem."

    a. Delete the columns with "Depth" and "Secchi."

2. Make a new worksheet; call it "1992 winter water chem", and "Cut" and "Paste" all the Dec.-Apr. data onto it, leaving only the May-November data on "1992 av May-Nov water chem."

    a. If November data is later than the first week of November, it should be deleted from the "May-November" average files, since our sampling season usually ends in the last week of October or the first week of November.

3. Now, on the "1992 av May-Nov" water chem, "Insert" four full rows at the end of the data for the first station, eg. "PJ1."

    a. Two rows below the end of the data, put the station number, eg, Sta. 1, in row A, eg. in cell A11.

    b. In the cell to the left, eg. B11, put the year, eg. 1992.

    c. In the next cell to the left (eg. C11), put the months sampled, eg. "May-Aug", or more usually "May-Oct" or "May-Nov."

    d. The next cell to the left (eg. D11), is average July-August temperature. (To avoid confusion, it's a good idea to label the cells above the means for this and the other averages.) Pull down the "Paste Function" menu under "Formula," and select "AVERAGE." Enter the cell numbers for temperatures on dates in July and August, eg. "=AVERAGE(D6:D8), and press "Enter" or "Return."

    e. The next cell to the left (eg. E11) is average May-November temperature. Enter the "AVERAGE" formula again, this time with the cell numbers for all the May-November temperatures, eg. =AVERAGE(D3:D8).

f. For the remaining variables, BDOX, SALT, N, P, CHL A, copy the cell with the May-November average temperature (eg. E11), and paste it in the 5 cells to the left (eg. E12:E16). This gives you May-November averages for these data.

4. Repeat this for the other stations.

5. You should also calculate an average for all of the stations in each pond for each variable.

   a. In Point Judith Pond, if Sta. 1 is sampled, this station is so different from the others that two all-pond averages should be calculated, one with and one without PJ1.

6. The procedure for the winter data is the same, except that you calculate two sets of averages, one for the December-February data, and one for March-April.

7. For the summary, you will also need to calculate cumulative averages, with standard deviations, from 1985 through the new year for each station with new data. To do this, open the updated pond database files (eg. PJ H2O Chem 1985-92), and save as, eg. "PJ cum av H2O Chem85-92."

   a. "Cut" out all the December-April data and paste them in a separate file (eg. PJ Winter Chem 85-92).

   b. For the first station with new data, "Insert" five full rows , and label as before, except that the date is now, eg. 1985-92. After the date, "Insert" two cells one above the other ("shift left") and label these "Mean" and "S.D."

   c. Now "Paste" in "Average" under "July-August" temperature and enter cell numbers for all dates in July and August, eg. =AVERAGE(D3:D6,D25:D29, etc.

   d. May-November temperature is easier, just an average of the whole row, eg. =AVERAGE(D3:D93).

   e. Paste this average to cells for the remaining variables, SDOX, BDOX, SALT, N, P, CHLA, moving across the columns.

   f. Now, for the row underneath, labelled S.D., you go to "Paste Function" under "Formula" and select "STDEV" and enter the same cell numbers as for the mean above it. Check to see that both formulas refer to identical cell numbers, eg. for May-November temperature, =STDEV(D3:D93).

8. Repeat for each station.

9. For each pond do a whole pond average for 1985 to the new year.

   a. On July/August temperatures for "All stations," we simply used averages of the averages, to save time and avoid entering 25-30 pairs of cell numbers.

b. For Point Judith Pond, calculate two averages, one with and one without PJ 1.

c. For each station and the whole pond there are two cumulative chlorophyll averages and standard deviations, one including all the data form 1985 through 1986, the other, "Chl a exc. 1986" excludes the anomalous "bloom" year of 1986.

8. Once all averages are complete for one pond, open the water chemistry summary file for that pond (eg."PJ Water Chem Summ 1985-91") and "Save as", eg. "PJ Water Chemm Summ 1985-92."

a. Insert rows for the new year's summer (May-Nov), winter (Dec-Feb), and spring (Mar-Apr) data, and paste the data from the corresponding data sheets using "Paste Special" and selecting "Values." **Again, remember to use "Paste Special" and not simply "Paste."**

b. Use "Insert" and "Cut" to align data in their proper rows. Insert whole rows, not just single cells.

c. Missing data, such as "Jul-Aug Temperature" in a Dec-Feb. row are marked with periods (.). Mar-Apr temperature is not entered.

d. Temperature, salinity, and oxygen in the summaries are given to one decimal place, (eg. 10.1), N, P, and Chl a are given to two decimal places. (Averages can be given to one more decimal place than the original data).

e. When the summary is updated, move the headings so that they are under the page breaks. If necessary, insert rows to keep all of the data for one station on a page. Use "Print Preview" to check the position of the headings, alignment of the rows, etc.

f. Shade the winter and spring data using "Border" under the "Format" menu.

g. For "all stations" averages, note at the right the stations sampled in each sampling season that year—use shading to distinguish winter and spring stations from summer ones.

VIII. DATA MANAGER

Graphing. Examples of files used in making graphs and examples of finished graphs are given in "Appendix C." We use column graphs for annual presentations of all types of data except Secchi Disk depths.

A. Setup
   1. In order to make graphs of the data on a worksheet first set up a copy of the data in a new worksheet.

   2. Save it under the name of the main unit to be graphed. eg.: ghp h2o ew 91(for Green hill pond, Water chemistry, "Excel" worksheet in 1991).

B. Rows and Columns
   1. Set up the graphing area with row headings: eg.: temp/station 9/station 10/station 11.

   2. Copy one set of dates from a **column** to be graphed (one that seems to be complete) and paste it onto a new worksheet in the following fashion.

      a. Highlight date column/then copy it/then move the cursor to a new cell with several rows and columns of clear space

      b. Paste it in. (Only a single cell need be designated when pasting, being careful not to overide other information.)

C. Data transfer
   1. On the worksheet, column by column, cut and paste the data into each station column as it matches its heading. Do the same for salinity, nitrate, phosphate, chlorophyll and dissolved oxygen, if there is any.

      a. Put dates in m/d format.

   2. To create a graph: Select group, such as temp and stations, go to file in menu bar/new/chart/ok (or "Enter"). A chart,with columns, will appear. (If you don't want a column format, see gallery below.)

   3. Dressing up the graph.
      a. Title
         (1) In menu bar, select Chart/attach text/chart title/ok. ("title" appears with squares around it, showing that it is selected.)
         (2) Type in the title, eg. Green Hill Pond, 1991/ok.
         (3) While title is still selected: in the menu. bar/format/font/type/size/Bookman/18/bold/ok

      b. Legend
         (1) Chart/add legend/(select legend if font/size needs changing)/ok.

      c. Value axis: (y axis)
         (1) Select left axis/format/scale/maximum 30/major unit 5 (basically the only set of numbers needed)/ok/font/bookman 10/chart/attach text/value axis/ok/type C (for Celsius, and pressing "shift option 8"

for the degree sign, or "option m" for μ)/ format/ font: Bookman/size, 14/bold/ok.

d. Category axis: (x axis)
   (1) Select bottom axis (Category axis)/format/scale/between tick labels/1/ok/chart/attach text/category/ok/type in "Week of/ok." (If the "series" appears in the data line, you have selected the columns instead of the "category" line, reselect category.)
   (2) The date line should be uniform in appearance (use largest font that gives you a single line with horizontal dates; Times 10 or 9 may be used if necessary). If you have trouble getting dates in a single line, try using "page setup" to print the graph horizontally.

e. Set preferred.
   (1) Gallery/select "set preferred."
   (The "set preferred" need only be done once for the remaining graphs; adjustments may still be made for each graph, but the font/size/style will be set.)

   SAVE/label/ghp temp eg92: (Green Hill Pond, Water Temperature, Excel graph, 92)

f. Gallery: to change the bar graph to another format.
   (1) Select Gallery/scatter (or whatever)/ok.

g. Not quite done.
   (1) Select Green Hill Pond, 1991/in data line insert "Water Temperature" between "," and "1991." **Do not** go back to Set Preferred.

Save/close graph/proceed to next graph, repeating procedures.

h. Scale adjustments for each field:

Title	Scale	y axis
Temperature	30	C°
Salinity	35	ppt
Chorophyll a	30	μg/l
Nitrate	10	μM
Phosphate	2	μM
Bacteria	50	MPN/100ml

D. Re-opening and modifying Graphs in "Excel." When you open an "Excel" file after closing it, remember to open the corresponding worksheet also. Otherwise the dates come out as numbers (the number of days since Jan-1-1904!).
   1. When opening the file, a box will ask "Update references to unopened documents". Click "no." The results from "yes" can be unpredictable.

   2. Minor changes in the graph (filling in missing values, changing format of dates, changing the legend etc.) may be made by making changes in the worksheet. If the x-axis needs to be extended, a new graph will have to be plotted.

E. General rules for column graphs.

1. Avoid solid white or black bars; they xerox poorly.

    a. In Excel 3.0, sometimes white bars can't be changed; they may have to be modified in MacDraw II. (See Below).

2. Bars going offscale, eg. 250 MPN/100ml bacteria should be labelled with the value in brackets, eg. [250]. "Excel" will not type parentheses.

3. For Water Chemistry graphs keep bar patterns consistent for each station.

4. For Bacteria graphs, copy into MacDraw II.1, and add dash lines at 15 MPN/100ml for the median limit for shellfishing. Add an arrow and appropriate labels ("median safety limit for shellfishing").

F. Secchi disk data should be plotted only for those stations at which Secchi depth is frequently less than station depth; eg. PJ1, QN18, but reduced Secchi disk visibility has occurred even at shallow stations (GH10, PT6) during phytoplankton blooms. Line plots with Secchi and pond depths as negative numbers are a good way to show when visibility is reduced in the ponds; i.e. when Secchi depth is less than bottom depth. Make one plot for each station with significantly reduced visibility.

1. Cut and paste in adjacent columns: Date, Secchi and Depth data, with headings.

    a. In the next blank column to the right, in the row containing the first data, enter "=(row number, column number of Secchi data)*-1. Press "Enter" or "Return." (This multiplies Secchi data by -1.)

    b. "Copy"—select this column, and the next one to right, making a selected space of two columns with same number of rows as original data and "paste." You now have Secchi and Depth as negative numbers.

    c. Copy the negative Secchi and Depth numbers and "**Paste Special**/values/ok" back over the original data. You now have three columns: "Date," "Secchi" (negative numbers), and Depth (negative numbers).

2. Now create a chart: new/chart/ok; gallery/line/(pick first option at top left of box, squares connected by line with no grid). Go back to worksheet, select data/copy. Go to chart and "Paste."

3. You now have a line graph with the scale at the top, and Secchi and Depth lines underneath. Chart/addlegend. Format/legend/bottom.

    a. Select a symbol on the "Depth" line. Format/patterns/line/weight; make the depth line heavy and black. In the same fashion, make the "Secchi" line thin and dashed.

4. Note that "Date" labels are under x axis, overlapping with y axis labels. This can be changed by copying into "MacDraw II.1". (See instructions below).

5. For the finished version of the graph, a line plot of chlorophyll a concentration (as positive numbers) for the same data will be pasted over the Secchi plot using MacDraw II.1. (See Appendix C,6.)

   a. Go to the data work sheet, copy data and chlorophyll data, and paste them side by side. Make a new line chart (copy/gallery/line, {first option, boxes connected by squares}, go to worksheet, copy, go to chart, paste. Click on a chart symbol, choose a symbol and line type different from those in Secchi graph.

F. Modifying "Excel" graphs with Claris "MacDraw II.1.™" "Excel" graphs can be copied into "Draw" and "Paint" programs in order to put more than one graph on a page and in order to make modifications which are not possible within the "Excel" program. We have used "MacDraw II.1" for this purpose, but other "Draw " and "Paint" programs could be used.

1. It is preferable to have enough memory on your computer to open "MacDraw II.1" and "Excel" simultaneously using "Multifinder."

   a. Open "MacDraw II.1," Layout/turn autogrid off. ("Autogrid" permits motion only in discrete jumps.)
   b. Layout/drawing size width 15, height 20. File/Page Setup/50%.

2. Open "Excel" chart and corresponding worksheet. With the chart window on the screen, select "Edit/Copy." The graph will be surrounded by a dotted line. Pull down the menu under the apple, click on "MacDraw II.1." Click on the worksheet and "Paste." The graph will be pasted onto the "MacDraw" worksheet." Save the file under a new name.

   a. In order to position and manipulate the size and shape of the whole graph, press the mouse button and drag the cursor diagonally. By doing this a dash-line box will appear around the graph and the graph will be selected. Arrange/Group to manipulate the graph as a unit. Drag graph by clicking and holding down mouse on any element near graph's center to move it. Once graph is selected, drag any corner in or out to change the shape.

   b. In order to change particular elements, click on the graph and Arrange/Ungroup. **Before selecting the individual elements to work with, click somewhere else on the screen to deselect the whole graph. This is very important. If delete is chosen while the the whole graph is selected, the whole graph will be deleted! Edit/Undo is handy for correcting this and other mistakes, but this can only be used <u>immediately</u> after the mistake is made and before any other edit has been chosen.**

      (1) Elements of a graph are grouped hierarchically. For example, when a graph is "ungrouped," and an axis is selected, the tick marks are grouped with the line. To change the tick marks indvidually, select the axis again and "ungroup."

(2) Change text by clicking "A" on the block of text to select it, clicking on the tool bar, and clicking on the text again. The text will now be in a box with a blinking cursor. An element containing text must be ungrouped, such as a legend box, in order to select the text block and change the text.

(3) Add lines, or other figures by clicking the appropriate icons in the toolbox. Line thickness, dashes, arrows, etc. can be changed using the "Pen" menu. Extend or straighten a line by dragging on the end. Move the whole line by dragging near the middle. Boxes can be filled or the pattern in bars changed by selecting the element and clicking on the apprpriate box in the "Pattern" bar at the top of the screen.

3. Bars in "Excel" charts which extend offscale will be shown in their full length in "MacDraw." Pull them back down back to scale by dragging on the tops of the bars.

4. When the graph is ready, copy the next graph and paste it in. **Save** after bringing in each new graph. Draw temporary lines to use as measuring rods to keep graphs a uniform size and to align them on the page. Change the magnification of graph by using the two buttons in the lower left corner of the screen.

5. For the Secchi plot example, (Appendix C,6) a second graph of chlorophyll a concentration was copied into MacDraw II.1 and stretched to match the original plot in length and height.

   a. The scale was "Grouped" and "Cut" and moved to the right side of the graph.
   b. The chlorophyll graph was then moved onto the Secchi graph, taking care to align dates.
   c. The legend was stretched and a portion of the chlorophyll line and symbol was copied.

G. *Student Assistant and Data Manager* :Specialized Graphs for Data Analysis: The preceding discussion has concerned graphing annual time series data for routine presentation of one year's data, for pond watcher annual reports, and for submission to state agencies. More specialized graphic analysis of data may be needed to answer specific questions about the interrelations of environmental factors. This work has usually been done by the student assistants, although much of this could be done by the data manager if clear instructions are given. The suggestions given below come from experiences in preparing figures for a report "Water Quality in Rhode Island Salt Ponds, 1985-1990." Several graphics programs are mentioned below, but for detailed instructions on graphing, see the manuals for each program.

1. Seasonal Change: Graphs showing generalized patterns of seasonal change can be prepared by showing monthly averages over a number of years. One way to do this is to copy a block of data for one or several stations over several years in "Excel" and "Paste" it into a worksheet. Change the years in dates so that all of the dates belong to one year. Select the whole block of data and sort by date, averaging the data by month. Plot the data using "Gallery/Scatter." Use "Scale" to adjust the length of the axes and the

number of tick marks. Monthly averages are assigned a date of the 15th of each month. Individual data points were plotted together with monthly averages in order to show the degree of annual variation around the mean for such variables as temperature, salinity, nitrate, phosphate, and chlorophyll. Similar graphs can be done for fecal coliforms; though column graphs were used rather than scatter plots. Monthly medians or geometric means are preferable to averages for plots of fecal coliforms.

2. Long-term Time Series: The "Excel" "Column " and "Line" graph options treat dates as categories, so that gaps with missing data are not shown. The "Scatter" (under Gallery) option does treat time as a number and shows missing values and varying intervals between samples. A sub-option connects the dots between points, provided non-numerical symbols (the periods{.} which we use as fillers) are removed from spaces with missing data. Up to six years of data was plotted by this method, but this leaves room for only two date tickmarks per year and provides limited resolution for summer data, since data points may overlap when sampling is frequent. Deltagraph™ (Deltapoint Inc.) also treats dates numerically, but graphing long time-series with this program has not yet been tried. Cricket Graph™ (Cricket Software) does not treat dates numerically, so if monthly or weekly data are unevenly spaced, it must be plotted by month or week numbers, and month or date letters pasted over tthe numbers. However, this can be done once and then the format can be saved for later graphs.

    a. Long-term data has been treated more frequently by calculating seasonal (Jun-Sep, Dec-Feb) averages for each year and plotting them as column graphs using "Excel," "Cricket Graph 1.32," or "Delta Graph."

3. Spatial variation: One way to show spatial variation is to use column graphs of mean values (or median values for bacteria), for each station, and arrange them geographically or in relation to an environmental gradient. For the salt ponds report, stations were arranged according to approximate distance from the breachway.

    a. It is sometimes useful to plot data on maps using special symbols to mark "trouble spots," eg. stations with coliform concentrations exceeding regulatory limits. Nutrient concentrations could be shown by using symbols of different sizes. We have maps of each of the salt ponds which have been scanned into MacDraw II.1 files. These maps are updated each year to indicate which stations are being sampled.

4. Interrelation of variables: Scatter plots are one of the easiest ways to investigate correlation among environmental variables. For example, winter nitrate and summer concentrations were plotted against salinity of the different ponds and strong linear correlations were found. Nitrate was also found to be correlated with housing density in five of the six ponds. Most scatter plots were done using Cricket Graph 1.32, and using "Simple " (Linear regression) under "Curve fit".

    a. **A word of caution: Earlier versions of "Cricket Graph" did not move the regression line as the axes were altered, and in the present version errors have been noted in exponential and polynomial curve equations. In version 1.3.2, linear**

regressions appear to be correct. Equations should be checked with a calculator to make sure that they fit the line shown on the graph. "DeltaGraph" seems to give correct curve fits, but if equations are to be used for extrapolation or interpolation, they should be checked with a calculator or a specialized statistics program first.

b. "Cricket Graph" gives the option of printing several graphs on a page simply by opening the files before selecting "Print." Graphs made in "Cricket Graph" can be moved into "MacDraw II.1" by "Saving as" a "Pict" file. "Pict" files cannot be reopened in "Cricket" and take up a lot of disk space, so it is better to discard them after using them in "MacDraw" and save the original Cricket file in case further changes are needed.

c. "DeltaGraph" files can also be copied and pasted into MacDraw II.1 in order to print several graphs on a page or to make changes.

Detection limits and Precision in pondwatcher measurements

	Method	Limits of detection	Precision	Significant Figures	Notes
Temperature	Field thermometer, 1 degree markings	.	± 5 ° C	0	1
Depth and Secchi depth	Marked line, knotted at 0.1 m intervals	.	± 0.10 m	0	1
Dissolved Oxygen	Azide modification of Winkler titration La Motte Co. Kit	0.3ml/L	± 0.9ml/L	0.0	
Salinity	Hand- held refractometer	~ 1 ppt	± 1 ppt	0	1
Nitrate	Autoanalyzer	0.07µM	± 1%	0.00	2
Phosphate	Autoanalyzer	0.07 µM	~ ± 10%	0.00	2
Chlorophyll a	Fluorometer after acetone extraction	0.31 µg	—+ 3%	0.00	2,3
Fecal and Total coliforms RIDOH	Most Probable number, Multiple dilution method LST medium	3 MPN / 100 ml, lower limit 2400 or 4800 MPN / 100 ml	.	0	4
Fecal coliforms FDA	Most Probable number, Single dilution method Modified A-1 medium	9 MPN / 100 ml, lower limit 248 / 100 ml upper limit	.	0	4

Notes:

1. Based on instrument scale

2. Based on quality control session, 11-2-1991. 16 pondwatchers filtered samples from the same bucket of water.

3. Lowest reading in our database

4. Method used at Rhode Island Department of Health. Table of confidence intervals for each combination of positive and and negative tubes, p. 924, "Standard Methods for the Examination of Water and Wastewater ".American Public Health Association, 1989

5. Method used at Food and Drug Administration Lab, Quonset. Table of confidence intervals., p. 125 in Springer, J. , 1974, "Statistical considerations in using the twelve-tube MPN test for routine monitoring of shellfish waters." Proceedings, 8th National Shellfish Sanitation Workshop, D. S. Wiet, ed. U.S. Department of Health, Education, and Welfare, Public Health Service, Food and Drug Administration

Notes on units:

Measurement	Unit	Abbreviation	Explanation:
Temperature	Degrees Celsius	°C	0 is freezing point of water (32°F); 100 is boiling point of water. 20 is "room temperature" (68°F)
Dissolved Oxygen	Millliliters per liter	ml/l	Mililiters of gas (at 20°C, 1 atmosphere pressure) dissolved in liter of water (1 ml/1 = 10 parts per million, ppm)
Salinity	Parts per thousand	ppt	Equivalent to one-tenth of one percent salt by weight, or one gram per kilogram (or approximately one liter) of water Ocean seawater is about 35 ppt; fresh water is 0 - 0.5 ppt.
Nitrate and Phosphate	Micromolar	µM	Millionths of a mole per kilogram (approximately one liter) of solution One mole is equivalent to the weight of 6.02 times ten ,raised to the twenty-third power, of molecules or ions of a given compound. 1 µM of Nitrate =14.00 µg/l, or parts per million, ppm 1 µM of Phosphate = 30.97 µg/l
Chlorophyll a	Micrograms per liter	µg/l	Millionths of a gram per liter
Total and Fecal Coliforms	Most Probable Number per 100 milliliters	MPN/100 ml	The most probable concentration of bacteria colonies associated with a given frequency of positive results (visible bacterial growth) in a set of test tubes innoculated with a specific dilution of a sample

Salt Pond Watchers' Data Management Protocol

Appendix A.

Formats for Databases and Data Summaries

Salt Pond Watchers' Data Management Protocol

Appendix A.

Formats for Databases and Data Summaries

1. Annotated format for annual bacteria database, eg. "1992 Bacteria Data"
2. Annotated format for annual water chemistry database, eg. "1992 Water Chemistry"
3. Annotated format for long-term bacteria database, eg. "1985-1992 "Bacteria Data"
4. Annotated format for long-term water chemistry database, eg. "1985-1992" Water Chemistry
5. Rainfall format—Example of format for initial entry of rainfall data
6. Rainfall 90 Kingston—Example of compact format for easier reading
7. Pt. Judith Bacteria, 1985-91—Example of data summary for bacteria
8. Point Judith Water Chemistry Summary, 1985-1991—Example of data summary for water chemistry

1. Annotated format for annual bacteria database, eg. "1992 Bacteria Data"

Annual Bacteria Data Format

POND	STATION	DATE	FECAL	TOTAL	WATERFOWL DISTANCE, FT (NUMBER)
PJ	1	13-May-92	9	.	40(10)
PJ	1	27-May-92	<9	.	(O)
PJ	1	10-Jun-92	41	.	"Hundreds of cormorants everyhwere"
PJ	1	29-Jun-92	>248	.	(O)
Note break between stations.					
GSP	2	29-Jun-92	.	2400	

Pond Names:
PJ
PT
CR (Cards)
TR (Trustom)
GH
NN
QN
WP
MS
GSP

dd-mmm-yr

0

Type < and > signs

.

Normal notations are bird distance and numbers in parentheses.
If the notes are only words, type these also.

If no birds in 1988 to present date, use (O).
(Excel will not type a "zero" in parentheses).

Print "long way" for proofreading and for pondwatchers;
final version should be printed the "normal" way with the narrow side of the paper at the top.

2. Annotated format for annual water chemistry database, eg. "1992 Water Chemistry".

Annual Water Chemistry File Format

POND	SITE	STATION	DATE	TEMP	SDOX	SALT	N	P	CHLA	SECCHI	DEPTH
PJ	ON	1	5-Aug-92	23	.	21	1.23	1.23	22.56	1.2	2.1
PJ	ON	1	12-Aug-92	25	7	32	23.14	0.12	.	2.1	2.1
PJ	ON	1	19-Aug-92	22	9	18	0.12	0.03	18.97	1.2	2.1
Note break between stations.											
PJ	ON	2	12-Aug-92	23	5	32	23.14	0.12	.	2.1	2.1
PJ	ON	2	19-Aug-92	24	8	18	0.12	0.03	1.23	1.2	2.1
Pond Names:			Number(Format)								
PJ	On: On station		dd-mmm-yr	0	0	0	0.00	0.00	0.00	0.0	0.0
PT	using boat										
CR (Cards)					Bottom						
TR (Trustom)	Off: From dock or				dissolved						
GH	shore				oxygen						
NN											
ON					(If any are taken					Note: Secchi is always equal to	
WP					at surface,					or less than depth	
MS					make a new					If only "Secchi" is marked	
GSP					column: SDOX)					on data sheet, enter number	
										as "Depth"	

Print "long way" for proofreading and for pondwatchers; final version should be printed the "normal" way with the narrow side of the paper at

3. Annotated format for long-term bacteria database, eg. "1985 - 1992 "Bacteria Data."

1985-199n Bacteria File Format

(One file per pond, but combine Cards and Trustom, Winnapaug and Maschaug)

POND	AREA	OLDST	NEWST	DATE	FECAL	TOTAL	WATERFOWL DISTANCE, FT (NUMBER)
PJ	NB	1	1	13-Jul-87	93	.	.
PJ	NB	1	1	27-Jul-87	9	.	.
PJ	NB	1	1	24-Aug-87	9	.	.
PJ	NB	1	1	21-Sep-87	93	.	.
PJ	NB	1	1	5-Oct-88	43	84	(O)
PJ	NB	1	1	19-Oct-88	7	>2400	50(8)
Note break between stations.							
PJ	NB	1	1A	8-Jul-85	4	.	.
PJ	NB	1	1A	22-Jul-85	43	.	.

Pond Names:	Area:	OLDST	NEWST		Number(Format)		
PJ							
PT	use regions	use table	use current	dd-mmm-yr	0	0	Normal notations are bird distance and numbers in parentheses
CR (Cards)	in 1985-88	in 1985-88	station number				
TR (Trustom)	database	database			Type < and > signs		If the notes are only words, type these also.
GH	notes	notes					Bird notations were not recorded before 1988: use " ."
NN	(M. Castro)	(M. Castro)					If no birds in 1988 to present date, use (O).
QN							(Excel will not type a "zero" in parentheses).
WP							
MS							
GSP							

Final version should be printed the "normal" way with the narrow side of the paper at the top.

4. Annotated format for long-term water chemistry database, eg. "1985-1992" Water Chemistry.

1985-199n Chemistry File Format

(One file per pond, but combine Cards and Trustom, Winnapaug and Maschaug)

POND	SITE	STATION	DATE	TEMP	SDOX	SDOX	SALT	N	P	CHLA	SECCHI	DEPTH
PJ	ON	1	5-Aug-85	23	8.6	.	21	1.23	1.23	22.56	1.2	2.1
PJ	ON	1	12-Aug-85	25	6.7	.	32	23.14	0.12	.	2.1	2.1
PJ	ON	1	19-Aug-85	22	8.3	.	18	0.12	0.03	18.97	1.2	2.1
Note break between stations.												
PJ	ON	4	12-Aug-92	23	.	5.0	32	23.14	0.12	.	2.1	2.1
PJ	ON	4	19-Aug-92	24	.	8.4	18	0.12	0.03	1.23	1.2	2.1
Pond Names:			Number(Format)									
PJ	On: On station		dd-mmm-yr	0	0.0	0.0	0	0.00	0.00	0.00	0.0	0.0
PT	using boat											
CR (Cards)					Surface	Bottom						
TR (Trustom)	Off: From dock or				dissolved	dissolved						
GI	shore				oxygen	oxygen						
NN												
ON												
WP												
MS												
GSP												

Note: Secchi is always equal to or less than depth
If only "Secchi" is marked on data sheet, enter number as "Depth"

Final version should be printed the "normal" way with the narrow side of the paper at the top.

5. **Rainfall format: Example of format for initial entry of rainfall data.**

Rainfall Format			
	KINGSTON		
	WEATHER		
	STATION		
		MONTHLY	MONTHLY
DATE	RAIN (inches)	AVERAGE	TOTAL
1-Jan-92	0.00		
2-Jan-92	0.00		
3-Jan-92	0.00		
4-Jan-92	1.48		
5-Jan-92	0.11		
6-Jan-92	0.00		
7-Jan-92	0.00		
8-Jan-92	0.00		
9-Jan-92	0.10		
10-Jan-92	0.07		
11-Jan-92	0.00		
12-Jan-92	0.00		
13-Jan-92	0.00		
14-Jan-92	0.66		
15-Jan-92	0.00		
16-Jan-92	0.04		
17-Jan-92	0.00		
18-Jan-92	0.00		
19-Jan-92	0.00		
20-Jan-92	0.03		
21-Jan-92	0.00		
22-Jan-92	0.04		
23-Jan-92	0.00		
24-Jan-92	0.00		
25-Jan-92	1.28		
26-Jan-92	0.60		
27-Jan-92	0.00		
28-Jan-92	0.00		
29-Jan-92	0.00		
30-Jan-92	0.00		
31-Jan-92	0.00	0.14	4.41

6. Rainfall 90 Kingston: Example of compact format for easier reading.

	A	B	C	D	E	F	G	H
1			RAINFALL 1990 KINGSTON STATION					
2	DAY/MONTH	RAINFALL	DAY/MONTH	RAINFALL	DAY/MONTH	RAINFALL	DAY/MONTH	RAINFALL
3	MAY	IN.	JUNE	IN.	JULY	IN.	AUGUST	IN.
4	1-May-90	1.11	1-Jun-90	0	1-Jul-90	0.17	1-Aug-90	0
5	2-May-90	0	2-Jun-90	0	2-Jul-90	0.48	2-Aug-90	0
6	3-May-90	0	3-Jun-90	0	3-Jul-90	0	3-Aug-90	0
7	4-May-90	0	4-Jun-90	0.07	4-Jul-90	0	4-Aug-90	0
8	5-May-90	0.98	5-Jun-90	0	5-Jul-90	0	5-Aug-90	0
9	6-May-90	0.01	6-Jun-90	0	6-Jul-90	0	6-Aug-90	0
10	7-May-90	0.03	7-Jun-90	0.34	7-Jul-90	0	7-Aug-90	0.2
11	8-May-90	0.36	8-Jun-90	0	8-Jul-90	0	8-Aug-90	0.27
12	9-May-90	0	9-Jun-90	0.06	9-Jul-90	0	9-Aug-90	0
13	10-May-90	0	10-Jun-90	0.04	10-Jul-90	0	10-Aug-90	0.12
14	11-May-90	0.92	11-Jun-90	0.03	11-Jul-90	0	11-Aug-90	0.09
15	12-May-90	0	12-Jun-90	0	12-Jul-90	0.14	12-Aug-90	0.02
16	13-May-90	0.03	13-Jun-90	0	13-Jul-90	1.09	13-Aug-90	0
17	14-May-90	0.69	14-Jun-90	0	14-Jul-90	0	14-Aug-90	0
18	15-May-90	0	15-Jun-90	0	15-Jul-90	0	15-Aug-90	0
19	16-May-90	0.11	16-Jun-90	0	16-Jul-90	0	16-Aug-90	0
20	17-May-90	0.51	17-Jun-90	0	17-Jul-90	0	17-Aug-90	0
21	18-May-90	0.17	18-Jun-90	0	18-Jul-90	0	18-Aug-90	0
22	19-May-90	0	19-Jun-90	0	19-Jul-90	0	19-Aug-90	0
23	20-May-90	0	20-Jun-90	0	20-Jul-90	0	20-Aug-90	0.12
24	21-May-90	0.45	21-Jun-90	0	21-Jul-90	0	21-Aug-90	0
25	22-May-90	0.08	22-Jun-90	0	22-Jul-90	0.17	22-Aug-90	0
26	23-May-90	0	23-Jun-90	0.02	23-Jul-90	0.16	23-Aug-90	0
27	24-May-90	0.02	24-Jun-90	0	24-Jul-90	0.9	24-Aug-90	1.17
28	25-May-90	0	25-Jun-90	0	25-Jul-90	2.42	25-Aug-90	0.3
29	26-May-90	0.01	26-Jun-90	0	26-Jul-90	0.01	26-Aug-90	0
30	27-May-90	0	27-Jun-90	0	27-Jul-90	0.52	27-Aug-90	0
31	28-May-90	0	28-Jun-90	0	28-Jul-90	0.39	28-Aug-90	0
32	29-May-90	0.32	29-Jun-90	0	29-Jul-90	0	29-Aug-90	0
33	30-May-90	0.58	30-Jun-90	0.48	30-Jul-90	0	30-Aug-90	0
34	31-May-90	0			31-Jul-90	0	31-Aug-90	0
35	TOTALS	6.38		1.04		6.45		2.29
36								

RAINFALL 90 KINGSTON

	A	B	C	D	E	F	G	H
37			RAINFALL 1990 KINGSTON STATION					
38	DAY/MONTH	RAINFALL	DAY/MONTH	RAINFALL				
39	SEPTEMBER	IN.	OCTOBER	IN.				
40	1-Sep-90	0	1-Oct-90	0				
41	2-Sep-90	0	2-Oct-90	0				
42	3-Sep-90	0	3-Oct-90	0				
43	4-Sep-90	0	4-Oct-90	0				
44	5-Sep-90	0	5-Oct-90	0.18				
45	6-Sep-90	0	6-Oct-90	0				
46	7-Sep-90	0.01	7-Oct-90	0				
47	8-Sep-90	0	8-Oct-90	0				
48	9-Sep-90	0	9-Oct-90	0.11				
49	10-Sep-90	0.19	10-Oct-90	0				
50	11-Sep-90	0	11-Oct-90	0.03				
51	12-Sep-90	0	12-Oct-90	0.1				
52	13-Sep-90	0	13-Oct-90	0.75				
53	14-Sep-90	0	14-Oct-90	0.31				
54	15-Sep-90	1.2	15-Oct-90	0				
55	16-Sep-90	0	16-Oct-90	0				
56	17-Sep-90	0.19	17-Oct-90	0				
57	18-Sep-90	0	18-Oct-90	0				
58	19-Sep-90	0	19-Oct-90	0.52				
59	20-Sep-90	0.33	20-Oct-90	0				
60	21-Sep-90	0	21-Oct-90	0				
61	22-Sep-90	0.06	22-Oct-90	0				
62	23-Sep-90	1.07	23-Oct-90	0.12				
63	24-Sep-90	0	24-Oct-90	0.85				
64	25-Sep-90	0	25-Oct-90	0				
65	26-Sep-90	0	26-Oct-90	0.15				
66	27-Sep-90	0.19	27-Oct-90	0.15				
67	28-Sep-90	0	28-Oct-90	0.19				
68	29-Sep-90	0	29-Oct-90	0.03				
69	30-Sep-90	0	30-Oct-90	0				
70			31-Oct-90	0				
71	TOTALS	3.24	TOTALS	3.49				

7. Pt. Judith Bacteria, 1985-91. Example of data summary for bacteria.

PT JUDITH BACTERIA 1985-91, BY YEARS AND CUMULATIVE (UNDERLINED)

STATION	CLASS	YEAR	# FEC	GEO MEAN FEC	MED FEC	%>=500 FEC SB	% >=50 FEC SA	# TOT	GEO MEAN TOT	MED TOT	% > 2300 TOT SB	% > 330 TOT SA
1	SB	1987	10	20	24	0	17	0	.	.	.	.
1	SB	1988	12	98	221	25	58	12	330	496	8	25
1	SB	1987-88	22	57	42	14	41	12	330	496	8	17
1A	SB	1985	9	30	39	11	88	0	.	.	.	.
1A	SB	1986	13	89	93	0	20	0	.	.	.	.
1A	SB	1985-86	22	69	43	5	41	0				
2	SA	1987	10	23	21	0	64	10	.	.	.	.
2	SA	1988	12	72	146	0	22	12	390	460	8	75
2	SA	1989	11	50	75	0	45	7	577	460	14	86
2	SA	1990	12	55	60	0	50	12	300	460	0	58
2	SA	1987-90	25	62	75	0	56	24	388	460	4	67
3	SA	1987	10	14	17	0	10	.	.	.	.	.
3	SA	1988	12	61	93	0	7	12	253	240	8	83
3	SA	1987-88	22	31	23	0	36	13	253	240	8	67
4	SA	1987	10	9	8	0	10	0	.	.	.	.
4	SA	1988	12	28	34	8	25	12	138	97	8	42
4	SA	1987-88	22	16	9	5	18	12	138	97	8	42
5	SA	1987	10	8	8	0	10	0	.	.	.	.
5	SA	1988	12	10	7	0	8	12	37	34	0	8
5	SA	1989	9	15	23	0	11	8	200	240	0	25
5	SA	1990	11	27	43	0	18	11	104	93	0	9
5	SA	1991	9	9	9	0	0	.	.	.	.	.
5	SA	1987-91	51	13	9	0	10	31	82	93	0	13
5A	SA	1988	9	17	11	11	11	0	.	.	.	.
6	SA	1987	10	9	7	0	10	0	.	.	.	.
6	SA	1988	12	7	4	0	8	12	31	23	0	8
6	SA	1987-88	22	8	4	0	9	12	31	23	0	8
7	SA	1987	10	9	9	0	0	0	.	.	.	.
7	SA	1988	12	7	7	0	8	12	17	18	0	0
7	SA	1989	8	12	15	0	13	7	77	122	0	0
7	SA	1990	11	10	9	0	0	11	33	43	0	0
7		1987-90	41	9	4	0	5	30	31	23	0	0

PT JUDITH BACTERIA 1985-91, BY YEARS AND CUMULATIVE (UNDERLINED)

STATION	CLASS	YEAR	# FEC	GEO MEAN FEC	MED FEC	%>500 FEC SB	% >50 FEC SA	# TOT	GEO MEAN TOT	MED TOT	% > 2300 TOT SB	% > 330 TOT SA
8	SA	1987	10	8	8	0	10	0	.	.	.	.
8	SA	1988	12	8	6	0	8	12	28	19	0	8
8	SA	1989	8	11	12	0	0	7	38	43	0	13
8	SA	1990	11	7	9	0	0	11	21	23	0	0
8	SA	1987-90	41	8	9	0	5	30	27	23	0	7
9	SA	1987	10	7	6	0	0	0	.	.	.	.
9	SA	1988	12	6	4	0	0	12	15	23	0	0
9	SA	1987-88	21	6	4	0	0	12	15	23	0	0
10	SA	1987	10	9	9	0	10	0	.	.	.	.
10	SA	1988	11	5	4	0	0	11	9	7	0	0
10	SA	1989	9	9	15	0	11	9	39	43	0	11
10	SA	1990	12	6	4	0	0	12	20	23	0	0
10	SA	1987-90	41	7	4	0	5	32	18	22	0	3
12	SA	1987	10	8	7	0	0	0	.	.	.	.
12	SA	1988	11	5	4	0	0	11	9	9	0	0
12	SA	1989	9	6	4	0	11	9	33	23	0	11
12	SA	1990	12	3	3	0	0	12	20	9	0	8
12	SA	1987-90	41	5	4	0	2	32	18	15	0	6
15	SA	1987	8	6	4	0	0	0	.	.	.	.
15	SA	1988	7	3	2	0	0	7	6	4	0	14
15	SA	1989	10	6	3	0	10	10	36	93	0	10
15	SA	1990	9	4	4	0	0	9	9	9	0	0
15	SA	1987-90	43	5	4	0	2	24	16	6	0	8
15A	SA	1988	10	5	4	0	0	10	10	4	0	0
15A	SA	1989	9	4	3	0	0	9	7	4	0	0
15A	SA	1990	10	4	4	0	0	10	15	23	0	0
15A	SA	1987-90	28	5	4	0	0	28	9	9	0	0
15B	SA	1988	8	8	9	0	0	8	34	43	0	0
15C	SA	1988	10	5	4	0	0	0	.	.	.	.
16	SA	1987	8	6	6	0	0	0	.	.	.	.
16	SA	1988	7	3	2	0	0	7	4	3	0	0
16	SA	1987-88	15	4	3	0	0	7	4	2	0	0

PT JUDITH BACTERIA 1985-91, BY YEARS AND CUMULATIVE (UNDERLINED)

STATION	CLASS	YEAR	# FEC	GEO MEAN FEC	MED FEC	%>500 FEC SB	% >88 FEC SA	# TOT	GEO MEAN TOT	MED TOT	% > 2300 TOT SB	% > 330 TOT SA
16A	SA	1985	7	26	23	0	28	0	.	.	.	.
16A	SA	1986	9	26	23	0	22	0	.	.	.	.
16A	SA	1987	9	8	9	0	22	0	.	.	.	.
16A	SA	1988	7	22	15	0	0	7	44	23	0	14
16A	SA	1989	9	5	3	0	22	8	49	93	0	13
16A	SA	1990	8	4	4	0	0	8	14	13	0	0
16A	SA	1991	5	6	5	0	0	.	.	.	.	.
16A	SA	1985-91	52	12	8	0	13	23	34	23	0	9
16B	SA	1987	5	19	21	0	20	0	.	.	.	.
16B	SA	1988	7	4	7	0	28	7	49	43	0	14
16B	SA	1989	6	6	5	0	0	5	74	93	0	0
16B	SA	1990	4	13	16	0	0	4	42	60	0	0
16B	SA	1985-90	22	12	8	0	14	16	53	85	0	6
17	SA	1987	10	8	9	0	0	0	.	.	.	.
17	SA	1988	11	6	4	0	0	11	13	9	0	0
17	SA	1989	8	10	9	0	0	8	37	34	0	12
17	SA	1990	12	4	4	0	0	12	15	12	0	0
17	SA	1987-90	41	6	4	0	0	31	18	15	0	3
19	SA	1987	9	14	9	0	11	0	.	.	.	.
19	SA	1988	11	14	23	0	18	11	28	43	0	0
19	SA	1989	8	8	9	0	0	8	60	43	0	13
19	SA	1990	12	14	15	0	0	12	52	43	0	8
19	SA	1987-90	40	13	14	0	8	31	43	43	0	10
20	SB	1986	10	23	13	0	20	0	.	.	.	.
20	SB	1987	10	7	6	0	0	0	.	.	.	.
20	SB	1988	12	6	6	0	0	12	15	22	0	0
20	SB	1987-90	32	10	9	0	6	12	15	22	0	0
20A	SB	1989	10	5	4	0	0	10	28	22	0	10
20A	SB	1990	10	8	9	0	0	10	29	31	0	10
20	SB	1989-90	20	6	6	0	0	20	29	23	0	10
21	SB	1987	10	7	9	0	0	0	.	.	.	.
21	SB	1988	12	5	4	0	0	12	9	9	0	0
21	SB	1987-88	22	6	6	0	0	12	8	8	0	0

PT JUDITH BACTERIA 1985-91, BY YEARS AND CUMULATIVE (UNDERLINED)

STATION	CLASS	YEAR	# FEC	GEO MEAN FEC	MED FEC	%>500 FEC SB	% >88 FEC SA	# TOT	GEO MEAN TOT	MED TOT	% > 2300 TOT SB	% > 330 TOT SA
21A	SA	1989	10	12	13	0	0	10	43	43	0	0
21A	SA	1990	10	21	23	0	20	10	39	34	0	0
21A	SA	1991	6	33	41	17		0	.	.	.	.
21A	SA	1989-91	<u>26</u>	<u>19</u>	<u>23</u>	<u>0</u>	<u>8</u>	<u>20</u>	<u>41</u>	<u>43</u>	<u>0</u>	<u>0</u>

8. Point Judith Water Chemistry Summary, 1985-1991. Example of data summary for water chemistry.

Station		Year	Months sampled	Temperature July-Aug	Temperature May-Nov	Temperature Dec-Feb	Dissolved O2 Mean	Salinity Mean	N Mean	P Mean	Chl a Mean	Chl a excluding 1986
Sta 1		1985	Aug - Nov	23.0	16.2		9.6	22.2	7.84	0.60	7.74	
		1986	May - Oct	18.8	17.9		9.8	24.0	3.96	0.52	34.69	
		1987	May - Oct	22.0	16.1		9.0	23.4	5.32	0.85	7.01	
		1988	May -Nov	23.3	17.6		8.8	24.6	4.10	0.76	5.87	
		1988-89	Dec-Feb					28.7	6.58	0.60	4.81	
		1989	Mar-Apr					19.0	4.39	0.53	1.48	
		1989	May -Nov	22.5	18.4		7.6	18.3	2.75	0.42	11.05	
		1989-90	Dec-Feb			2.3	8.7	11.7	7.44	0.52	8.85	
		1990	Mar-Apr				11.1	19.6	6.75	0.38	6.19	
		1990	May - Oct	22.0	18.6		7.9	22.9	3.14	0.28	7.49	
		1990-91	Dec-Jan			5.8		23.6	10.71	0.65	8.20	
		1991	Mar-Apr					8.9	23.90	0.29	4.96	
		1991	May -Aug	23.3	20.6			24.0	3.66	0.42	8.62	
	MEAN	1985 - 90	May -Nov	21.6	17.9		8.9	22.6	4.05	0.56	9.85	7.83
	S.D.			2.9	4.64		1.6	6.1	3.69	0.41	10.63	6.31
	MEAN	1989-90	Dec-Feb			2.8	8.7	19.3	7.66	0.62	4.38	
	S.D.					2.4	4.8	10.3	2.80	0.18	4.24	
	MEAN	1989-90	Mar-Apr				11.1	18.3	11.37	0.38	2.53	
	S.D.						0.8	7.0	9.29	0.12	2.22	
Sta 2		1985	Jul - Nov	22.2	20.7		12.3	28.7	0.87	0.53	4.84	
		1986	May - Oct	20.3	18.9		8.9	29.4	0.35	0.76	17.92	
		1987	May - Oct	20.0	17.7		8.6	29.7	0.30	0.67	2.03	
		1988	May - Oct	20.0	17.7		8.9	30.3	0.28	0.96	1.05	
	MEAN	1985 - 90		20.8	18.6		9.8	29.7	0.35	0.77	3.99	2.20
	S.D.			2.0	3.1		2.2	1.5	0.38	0.27	7.27	1.69
Sta. 2A		1987	May - Oct	21.4	19.5		7.8	28.6	0.18	0.75	2.96	
		1988	May - Oct	22.4	19.8		7.7	29.1	0.33	1.30	1.36	
		1990	May - Oct	24.3	22.9		6.2	28.6	0.37	0.34	1.74	
	MEAN	1987 - 90		22.8	20.2		7.3	28.9	0.30	0.82	2.13	
	S.D.			2.7	3.8		1.5	2.0	0.22	0.70	1.59	
Sta 2B		1987	May - Oct					26.7	1.18	0.82	6.44	
		1988	Jun - Nov	22.8	17.3		8.0	28.9	1.72	0.94	5.88	
		1988-89	Dec-Feb			1.5		24.3	6.02	0.48	6.34	
		1989	Mar-Apr					27.9	0.16	0.31	6.13	
		1989	Jun - Nov	20.0	16.3		8.7	20.8	1.82	0.33	8.48	
	MEAN	1985 - 90	May-Nov	21.9	16.7		8.3	25.4	1.52	0.74	6.92	
	S.D.			2.3	5.4		1.0	4.6	1.29	0.52	5.38	
Sta. 2C		1987	Jul - Oct	20.2	18.2		8.3	28.9	0.37	0.88	1.44	
		1988	Jul - Oct	21.2	19.3		7.0	28.9	0.38	1.26	0.97	
	MEAN	1985 - 90		20.7	18.8		7.7	29.9	0.38	1.07	1.21	
	S.D.			2.3	3.2		1.5	0.9	0.30	0.34	0.67	

Point Judith Water Chemistry Summary, 1985 - 1991

Station		Year	Months sampled	Temperature			Dissolved O2	Salinity	N	P	Chl a	Chl a
				July-Aug	May-Nov	Dec-Feb	Mean	Mean	Mean	Mean	Mean	excluding 1986
Sta. 3		1985	Aug - Nov	23.0	16.7		11.6	30.8	1.35	0.89	1.77	
		1986	May - Oct	19.4	16.6		12.0	30.4	0.24	0.81	4.90	
		1987	May - Oct	20.0	15.8		12.0	30.4	0.43	0.91	1.64	
		1988	May - Oct	19.0	15.8		12.0	30.4	0.43	0.91	1.64	
		[illegible]	[illegible]	[illegible]	[illegible]	4.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	MEANS	1985 - 89	May-Nov	20.1	16.4		11.4	30.3	0.51	0.74	2.36	1.65
	S.D.			2.0	3.6		1.5	1.3	0.94	0.28	2.96	1.24
	MEANS	[illegible]	[illegible]	[illegible]	[illegible]	4.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	S.D.			[illegible]	[illegible]	1.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	MEANS	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	S.D.			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Sta. 3 A		1990	May - Oct	21.6	19.4			30.1	0.27	0.34	2.28	
		[illegible]	[illegible]	[illegible]	[illegible]	7.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		1991	May-Nov	21.0	18.6			28.4	0.91	0.62	1.88	
	MEANS	1990-91	May-Nov	21.3	19.0			29.3	0.59	0.48	1.98	
	S.D.			0.9	11.9			2.8	0.69	0.22	1.26	
Sta. 4		1987	May - Oct	21.0	18.8		8.8	28.6	0.20	0.71	2.05	
		1988	May - Oct	20.4	17.5		9.0	27.8	0.51	0.85	5.03	
		1989	May - Oct	21.8	19.0			28.5	0.38	0.12	2.98	
		1991	Jul-Oct	19.5	17.9			29.2	0.63	0.66	1.52	
	MEAN	1987 - 1991		20.7	18.3		8.9	28.4	0.41	0.59	3.09	
	S.D.			1.7	3.2		1.2	2.2	0.40	0.39	5.79	
ALL STATIONS		1985	Jul-Nov	22.7	17.5		11.0	27.7	2.99	0.74	5.02	
		1986	May-Nov	19.4	17.8		10.4	28.1	1.47	0.82	17.05	
		1987	May-Nov	20.8	18.1		8.7	26.0	1.20	0.75	3.44	
		1988	May-Nov	21.2	17.8		8.8	28.2	1.23	0.98	3.27	
		[illegible]	[illegible]	[illegible]	[illegible]	6.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		1989	May-Nov	21.7	17.8		8.1	22.1	1.75	0.29	7.72	
		[illegible]	[illegible]	[illegible]	[illegible]	8.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		1990	May-Oct	22.4	19.7		7.3	28.9	1.38	0.32	4.60	
		[illegible]	[illegible]	[illegible]	[illegible]	5.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		1991	May-Nov	21.1	18.9			27.4	1.58	0.57	3.53	
	MEAN	[illegible]	[illegible]	[illegible]	[illegible]	4.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	S.D.			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	MEAN	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	S.D.			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	MEAN	1985-91	May-Nov	21.3	18.1		9.2	27.3	1.44	0.69	5.06	3.86
	S.D.			1.5	4.1		2.0	4.8	2.54	0.44	7.40	5.01

STATIONS SAMPLED
1,2,3
1,2,3
1,2,2A,2B,2C,3,4
1,2,2A,2B,2C,3,4
[illegible]
[illegible]
1,2B,4
[illegible]
[illegible]
1,2A,3
[illegible]
[illegible]
1,3A,4

Station	Year	Months sampled	Temperature			Dissolved O2	Salinity	N	P	Chl a	Chl a	
			July-Aug	May-Nov	Dec-Feb	Mean	Mean	Mean	Mean	Mean	excluding 1986	
ALL STATIONS	1985	Jul-Nov	22.6	18.4		11.9	30.2	1.22	0.79	3.09		2,3
EXC PJ1	1986	May-Nov	19.4	17.5		10.7	30.0	0.28	0.67	8.91		2,3
	1987	May-Nov	20.8	18.2		8.6	28.9	0.42	0.73	2.76		2,2A,2B,2C,3,4
	1988	May-Nov	21.3	17.8		8.8	29.0	0.62	1.02	2.71		2,2A,2B,2C,3,4
	1988-89	Dec-Feb	.	.	5.8	.	30.8	3.09	0.56	1.97		2B,3
	1989	Mar-Apr	.	.	.	.	29.6	0.40	0.40	8.92		2B,3
	1989	May-Nov	21.7	17.4		8.8	25.2	0.99	0.21	5.42		2B,4
	1989-90	Dec-Feb	.	.	4.7	.	30.8	2.70	0.35	0.75		3
	1990	Mar-Apr	.	.	.	.	31.0	0.94	0.28	8.98		3
	1990	May-Oct	22.5	20.5		6.3	29.4	0.34	0.34	2.13		2A,3
	1990-91	Dec-Feb	.	.	7.3	.	28.3	4.84	0.82	1.84		3A
	1991	Mar-Apr	.	.	.	.	28.5	2.01	0.28	1.51		3A
	1991	May-Nov	20.3	17.3			26.9	0.76	0.60	1.53		3A,4
MEAN	1985-1991	May-Oct	21.0	18.15		9.38	28.82	0.58	0.73	3.33	2.67	
S.D.			1.4	3.84		2.20	2.86	0.82	0.45	4.94	3.83	
MEAN	1988-1991	Dec-Feb	.	.	4.9	.	29.9	3.65	0.65	1.89		
S.D.			.	.	2.5	.	3.3	1.96	0.22	2.12		
MEAN	1989-91	Mar-Apr	.	.	7.5	.	31.6	0.83	0.56	0.72		
S.D.			.	.	0.7	.	1.0	0.58	0.29	0.58		