11: Crafting Reports

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LESSON OBJECTIVES

- 1. Describe the purpose of using R Markdown as a communication and workflow tool
- 2. Incorporate Markdown syntax into documents
- 3. Communicate the process and findings of an analysis session in the style of a report

USE OF R STUDIO & R MARKDOWN SO FAR...

- 1. Write code
- 2. Document that code
- 3. Generate PDFs of code and its outputs
- 4. Integrate with Git/GitHub for version control

BASIC R MARKDOWN DOCUMENT STRUCTURE

- 1. YAML Header surrounded by on top and bottom
 - YAML templates include options for html, pdf, word, markdown, and interactive
 - More information on formatting the YAML header can be found in the cheat sheet
- 2. R Code Chunks surrounded by "on top and bottom + Create usingCmd/Ctrl+Alt+I'
 - Can be named {r name} to facilitate navigation and autoreferencing
 - Chunk options allow for flexibility when the code runs and when the document is knitted
- 3. Text with formatting options for readability in knitted document

RESOURCES

Handy cheat sheets for R markdown can be found: here, and here.

There's also a quick reference available via the Help-Markdown Quick Reference menu.

Lastly, this website give a great & thorough overview.

THE KNITTING PROCESS



- The knitting sequence
- Knitting commands in code chunks:
- include = FALSE code is run, but neither code nor results appear in knitted file
- echo = FALSE code not included in knitted file, but results are

- eval = FALSE code is not run in the knitted file
- message = FALSE messages do not appear in knitted file
- warning = FALSE warnings do not appear...
- fig.cap = "..." adds a caption to graphical results

WHAT ELSE CAN R MARKDOWN DO?

See: https://rmarkdown.rstudio.com and class recording. * Languages other than R... * Various outputs...

Documents Presentations Shiny etc.

*Can also create code chunks that are NOT R - can use Python as well (potentially) \rightarrow must have kernels in stalled (executables) in order to run the code

WHY R MARKDOWN?

<Fill in our discussion below with bullet points. Use italics and bold for emphasis (hint: use the cheat sheets or Help →Markdown Quick Reference to figure out how to make bold and italic text).>

- R is -not- open-use
- Can utilize non-R code
 - however, you must have these code kernels **installed**
- Can create more than just documents ability to knit to PowerPoint and other types
 - Easily incorporate plots and graphs within your PowerPoint
 - Can also include table formatting
- Creates ease for collaboration due to easy reading format and ability to push/pull through GitHub

TEXT EDITING CHALLENGE

Create a table below that details the example datasets we have been using in class. The first column should contain the names of the datasets and the second column should include some relevant information about the datasets. (Hint: use the cheat sheets to figure out how to make a table in Rmd)

Table 1: Leaf Litter Mass (g) - June 2016

collectDate	functional Group	dryMass
2016-06-16	Seeds	0.00
2016-06-16	Other	0.27
2016-06-16	Woody material	0.12
2016-06-16	Seeds	0.00
2016-06-16	Needles	1.11
2016-06-16	Leaves	0.00
2016-06-16	Leaves	0.00
2016-06-16	Seeds	0.00
2016-06-16	Twigs/branches	0.07
2016-06-16	Woody material	0.02

R CHUNK EDITING CHALLENGE

Installing packages

Create an R chunk below that installs the package knitr. Instead of commenting out the code, customize the chunk options such that the code is not evaluated (i.e., not run).

```
#can also edit output options in the little tool widget in the upper right corner of chunk
#don't want to fully knit in chunks that have install packages function
install.packages('knitr')
```

Setup

Create an R chunk below called "setup" that checks your working directory, loads the packages tidyverse, lubridate, and knitr, and sets a ggplot theme. Remember that you need to disable R throwing a message, which contains a check mark that cannot be knitted.

Load the NTL-LTER_Lake_Nutrients_Raw dataset, display the head of the dataset, and set the date column to a date format.

```
##
     lakeid lakename year4 daynum sampledate depth_id depth tn_ug tp_ug nh34 no23
## 1
          L Paul Lake 1991
                                140 1991-05-20
                                                          0.00
                                                       1
                                                                  538
                                                                         25
                                                                              NA
                                                                                    NA
## 2
                                                       2
          L Paul Lake
                       1991
                                140 1991-05-20
                                                          0.85
                                                                  285
                                                                         14
                                                                              NA
                                                                                    NA
          L Paul Lake
                                                       3
                                                          1.75
                                                                  399
                                                                              NA
## 3
                       1991
                                140 1991-05-20
                                                                         14
                                                                                    NA
## 4
          L Paul Lake
                      1991
                                140 1991-05-20
                                                       4
                                                          3.00
                                                                  453
                                                                         14
                                                                              NA
                                                                                    NA
## 5
          L Paul Lake
                       1991
                                140 1991-05-20
                                                       5
                                                          4.00
                                                                  363
                                                                         13
                                                                              NA
                                                                                    NA
## 6
                                140 1991-05-20
                                                       6
                                                          6.00
                                                                  583
                                                                         37
                                                                              NA
          L Paul Lake
                       1991
                                                                                    NA
     po4 comments
##
## 1 NA
## 2
      NA
## 3
      NA
## 4
      NA
## 5
      NA
## 6
      NA
```

Customize the chunk options such that the code is run but is not displayed in the final document.

Data Exploration, Wrangling, and Visualization

Create an R chunk below to create a processed dataset do the following operations:

- Include all columns except lakeid, depth_id, and comments
- Include only surface samples (depth = 0 m)
- Drop rows with missing data

Create a second R chunk to create a summary dataset with the mean, minimum, maximum, and standard deviation of total nitrogen concentrations for each lake. Create a second summary dataset that is identical except that it evaluates total phosphorus. Customize the chunk options such that the code is run but not displayed in the final document.

Create a third R chunk that uses the function kable in the knitr package to display two tables: one for the summary dataframe for total N and one for the summary dataframe of total P. Use the caption = " " code within that function to title your tables. Customize the chunk options such that the final table is displayed but not the code used to generate the table.

Table 2: Nitrogen content of Peter and Paul Lake

lakenar	mælept	hsample	dath34	no23	Mean.NM	34.N	H M ax.NHStanDev.	NMEMn.NO	28.N	
Peter Lake	0	1991- 06-04	21.533	3.818	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 25.351
Peter	0	1991-	14.579	6.827	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 21.406
Lake	U	06-11	14.013	0.021	23.00321	U	002.000 07.00040	41.40001	U	491.100 00.043041 21.400
Peter	0	1991-	5.749	2.429	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 8.178
Lake		06-18	01, 20				332.333 37.333 29			
Peter	0	1991-	5.817	1.510	29.53921	0	532.858 67.06840	41.46837	0	451.75880.0496477.327
Lake		06 - 25								
Peter	0	1991-	12.448	2.742	29.53921	0	532.85867.06840	41.46837	0	451.75880.04964715.190
Lake		07 - 02								
Peter	0	1991-	9.495	8.907	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 18.402
Lake		07-09				_				
Peter	0	1991-	24.334	5.071	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 29.405
Lake	0	07-16	15.050	0.000	00 50001	0	F00 0F0 0F 000 40	41 40005	0	451 550 00 04064500 050
Peter	0	1991-	17.350	3.003	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 20.353
Lake Peter	0	07-23 1991-	4.556	0.463	29.53921	0	532.858 67.06840	41 46827	0	451.758 80.049647 5.019
Lake	U	08-06	4.550	0.405	29.00921	U	552.656 07.00640	41.40007	U	451.756 60.049047 5.019
Peter	0	1991-	8.638	0.579	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 9.217
Lake	O	08-13	0.000	0.010	20.00021	Ü	002.000 01.000 10	11.10001	O	191.190 00.019011 9.211
Peter	0	1991-	9.608	1.294	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 10.902
Lake		08-20	0.000				332.333 37.333 29			
Peter	0	1992-	15.020	0.080	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 15.100
Lake		05-27								
Peter	0	1992-	8.160	1.360	29.53921	0	532.85867.06840	41.46837	0	451.75880.0496479.520
Lake		06 - 10								
Peter	0	1992-	10.810	1.810	29.53921	0	532.85867.06840	41.46837	0	451.75880.04964712.620
Lake		06-24								
Peter	0	1992-	7.580	5.370	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 12.950
Lake	0	07-08	0.010	1 000	20 50021	0	F00 0F0 0F 000 10	41 4000	0	451 550 00 040645 0 500
Peter	0	1992-	8.010	1.690	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 9.700
Lake	0	07-22 1992-	9.070	3.830	20 52021	0	532.858 67.06840	41 46997	0	451 759 90 04064719 900
Peter Lake	0	1992-	8.970	3.830	29.53921	U	332.838 07.00840	41.40657	0	451.758 80.049647 12.800
Peter	0	1992-	22.250	0.000	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 22.250
Lake	O	08-19	22.200	0.000	20.00021	Ü	002.000 01.000 10	11.10001	O	191.190 00.019011 22.290
Peter	0	1993-	0.000	5.497	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 5.497
Lake		05-19							_	
Peter	0	1993-	9.701	9.925	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964719.626
Lake		05 - 26								
Peter	0	1993-	10.638	11.537	29.53921	0	532.85867.06840	41.46837	0	451.75880.04964722.175
Lake		06 - 02								
Peter	0	1993-	20.739	39.475	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 60.214
Lake		06-09								
Peter	0	1993-	89.413	79.911	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 169.324
Lake	Ω	06-16	50 600	10 014	20 52021	Ω	599 050 <i>67</i> 0 <i>6</i> 040	41 ACO 27	0	451 750 00 040647 106 042
Peter Lake	0	1993- 06-23	აგ.იყ9	40.244	29.53921	0	532.858 67.06840	41.40837	0	451.758 80.049647 106.943
Peter	0	00-25 1993-	0.000	4 570	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 4.579
Lake	U	06-30	0.000	±.010	49.00 <i>9</i> 41	U	992.000 01.00040	41.40091	U	TO1.100 00.043041 4.013
Lanc		00-00								

lakenar	mælept	hsampleda	rtle34	no23	Mean.NN	B4 .NI	H M ax.NH S tanDev.	NVHeetan.NOO	2 ₿.N(OMBax.NOM3anDev.NSOM3N
Peter Lake	0	1993- 4 07-21	4.312	8.945	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 13.257
Peter	0	1993-	35.613	26.438	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964762.051
Lake Peter	0		6.303	30.800	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 37.103
Lake Peter	0	08-04 1993-	15.706	16.092	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 31.798
Lake Peter	0	08-11 1993-	4.847	6.293	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 11.140
Lake Peter	0	08-18 1993-	0.317	1.658	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 1.975
Lake		08-25								
Peter Lake	0	1993- (08-31	0.000	2.969	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 2.969
Peter Lake	0	1993- 09-07	1.364	2.506	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 3.870
Peter Lake	0		13.789	2.862	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964716.651
Peter	0	1994-	11.417	9.359	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964720.776
Lake Peter	0		15.810	10.064	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 25.874
Lake Peter	0	06-08 1994-	18.911	1.117	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 20.028
Lake Peter	0	06-15 1994-	14.800	7.688	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 22.488
Lake Peter	0	06-22			29.53921	0	532.858 67.06840	41 46927	0	451.758 80.049647 40.740
Lake		06-29								
Peter Lake	0	1994- 07-06	49.395	37.282	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 86.677
Peter Lake	0	1994- 2 07-13	22.593	49.247	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 71.840
Peter Lake	0		8.049	0.421	29.53921	0	532.858 67.06840	41.46837	0	451.75880.0496478.470
Peter	0	1994-	7.239	3.690	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964710.929
Lake Peter	0		3.017	2.053	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 5.070
Lake Peter	0	08-03 1994-	86.092	34.278	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 120.370
Lake Peter	0	08-10 1994-	94.697	49.864	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 144.561
Lake		08-17								
Peter Lake	0	08-24			29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 137.479
Peter Lake	0	1994- 08-31	111.259	991.963	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 203.222
Peter Lake	0		116.10′	799.193	29.53921	0	532.858 67.06840	41.46837	0	451.75880.049647215.300
Peter	0	1995-	10.342	72.863	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964783.205
Lake Peter Lake	0	05-24 1995- 05-31	9.860	63.721	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.04964773.581

lakena	mælept	hsample	dath34	no23	Mean.NN	B4 .N	H N4 ax.NHSManDev.	.NVHeedn.NVM	28.N	OM&ax.NO323anDev.NS0223.N
Peter	0	1995-	23.319	49.610	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 72.929
Lake	0	06-07	10.009	E0 040	20 52021	0	E22 0E0 67 06040	41 46027	0	4E1 7E0 00 04064770 022
Peter Lake	0	1995- 06-14	19.993	58.040	29.53921	0	532.858 67.06840	41.40837	0	451.758 80.049647 78.033
Peter	0	1995-	18 306	58 865	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 77.171
Lake	Ü	06-21	10.000	90.000	20.00021	O	002.000 01.00010	11.10001	Ü	101.100 00.0 100 11 11.111
Peter	0	1995-	34.268	66.545	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 100.813
Lake		06 - 28								
Peter	0	1995-	13.667	79.151	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 92.818
Lake	0	07-05	10 = 00	ao 4 5 0	20 50021	0	F00 0F0 0F 000 10	44 4000	0	4F1 FF0 00 04004 F F0 00F
Peter	0	1995-	13.762	62.473	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 76.235
Lake Peter	0	07-12 1995-	13 520	49 341	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 55.870
Lake	U	07-19	10.023	42.041	29.99921	U	002.000 01.00040	41.40007	U	401.100 00.043041 00.010
Peter	0	1995-	12.064	16.348	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 28.412
Lake		07-26								
Peter	0	1995-	5.748	5.642	29.53921	0	532.85867.06840	41.46837	0	451.75880.04964711.390
Lake		08-02								
Peter	0	1995-	8.216	7.193	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 15.409
Lake	0	08-09	2.010	4.940	00 52001	0	F20 0F0 67 06040	41 46097	0	4F1 7F0 00 040C477 9C0
Peter Lake	0	1995- 08-16	3.019	4.349	29.53921	0	532.858 67.06840	41.40837	0	451.758 80.049647 7.368
Peter	0	1995-	17 985	3.750	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 21.735
Lake	V	08-23	11.000	0.100	20.00021	Ü	002.000 01.00010	11.10001	Ü	1011100 0010 10011 211100
Peter	0	1996-	17.509	37.764	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964755.273
Lake		05 - 28								
Peter	0	1996-	230.89	5217.75	029.53921	0	532.85867.06840	41.46837	0	451.758 80.049647 448.645
Lake		06-25								
Peter	0	1996-	532.85	8451.75	829.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 984.616
Lake Peter	0	07-23 1997-	22 501	188 30	429.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 210.985
Lake	U	05-27	22.031	100.55	423.00321	U	552.050 07.00040	41.40037	U	401.700 00.043047 210.300
Peter	0	1997-	25.692	290.80	329.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 316.495
Lake		06 - 24								
Peter	0	1997-	10.216	317.93	129.53921	0	532.85867.06840	41.46837	0	451.75880.049647328.147
Lake		07 - 22								
Peter	0	1997-	6.642	272.33	529.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 278.977
Lake Peter	0	08-19 1998-	14 001	£ 022	20 52021	0	E22 0E0 67 06040	41 46027	0	4E1 7E0 00 04064710 0E4
Lake	0	1998- 05-26	14.621	5.055	29.53921	0	532.858 67.06840	41.40657	0	451.758 80.049647 19.854
Peter	0	1998-	15.322	0.819	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 16.141
Lake	v	06-23	10.022	0.010	_0.000_1	Ŭ	002.000 01.00010	11110001	Ü	1011,00 0010 1001, 101111
Peter	0	1998-	7.981	4.868	29.53921	0	532.858 67.06840	41.46837	0	451.75880.04964712.849
Lake		07 - 21								
Peter	0	1998-	6.349	0.988	29.53921	0	532.858 67.06840	41.46837	0	451.75880.0496477.337
Lake	^	08-25	4 2 2 2 2 2 2 2 2	0F 0==	00 5000:	^	F00 0F0 0F 000 10	44 4000=	^	4F4 FF0 00 0 100 1 FF0 000
Peter	0	1999-	15.550	35.375	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 50.925
Lake Peter	0	05-24 1999-	22 051	1 858	29.53921	0	532.858 67.06840	41 46837	0	451.758 80.049647 24.809
Lake	U	06-21	44.301	1.000	29.00321	U	992.000 01.00040	41.40001	U	101.100 00.043041 24.003
Peter	0	1999-	9.380	1.333	29.53921	0	532.858 67.06840	41.46837	0	451.758 80.049647 10.713
Lake		07-19								

lakenar	nælept	hsample	dath34	no23	Mean.N M	34.NI	H M ax.NI	B tanDev.	NVHeeth.NVX	B.N	OMBax.NO	23 nDev.]	NSQ 23. N
Peter	0	1999-	7.545	1.625	29.53921	0	532.858	67.06840	41.46837	0	451.758 8	80.049647	9.170
Lake		08-16											
Paul	0	1991-	18.981	10.299	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	29.280
Lake		05 - 27											
Paul	0	1991-	20.736	5.934	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	26.670
Lake		06-03											
Paul	0	1991-	20.303	11.381	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	31.684
Lake		06-10											
Paul	0	1991-	6.441	2.375	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	8.816
Lake		06-17											
Paul	0	1991-	19.559	1.550	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	21.109
Lake	0	06-24	01.050	11.054	10 40510	0	75 640	10.00005	0.00001	0	10.000 6	0.004010	00.010
Paul	0	1991-	21.958	11.954	13.42519	0	75.649	10.30827	3.68681	0	18.060 3	3.294013	33.912
Lake Paul	0	07-01 1991-	19 406	E 929	13.42519	0	75.649	10.30827	2 69691	0	19.060	3.294013	22 620
Lake	U	07-08	16.400	5.252	13.42319	U	75.049	10.30627	3.00001	U	10.000 6	3.294013	23.036
Paul	0	1991-	21.606	3 500	13.42519	0	75.649	10.30827	3 68681	0	18.060	3.294013	25 106
Lake	U	07-15	21.000	3.300	10.42013	U	10.043	10.00021	5.00001	U	10.000 (0.234010	20.100
Paul	0	1991-	20.225	3 863	13.42519	0	75.649	10.30827	3 68681	0	18 060	3.294013	24 088
Lake	V	07-22	20.220	0.000	10.12010	O	10.010	10.00021	0.00001		10.000	0.201010	21.000
Paul	0	1991-	8.904	2.993	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	11.897
Lake		07-29											
Paul	0	1991-	8.653	1.320	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	9.973
Lake		08-05											
Paul	0	1991-	16.211	0.314	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	16.525
Lake		08-12											
Paul	0	1991-	11.667	1.685	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	13.352
Lake		08-19											
Paul	0	1992-	6.220	0.000	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	6.220
Lake		05-27											
Paul	0	1992-	9.940	4.920	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	14.860
Lake	0	06-10	0.120	0.470	19 40510	0	75 640	10 20007	2 00001	0	10.000 4	2 20 40 12	10.600
Paul Lake	0	1992- 06-24	8.130	2.470	13.42519	0	75.049	10.30827	3.08081	0	18.000 .	3.294013	10.600
Paul	0	1992-	17 270	18.060	13.42519	0	75 640	10.30827	3 68681	0	18.060	3.294013	35 330
Lake	U	07-08	11.210	10.000	10.42013	U	10.043	10.30021	5.00001	U	10.000 .	0.234010	30.330
Paul	0	1992-	12 590	1 900	13.42519	0	75 649	10.30827	3 68681	0	18 060	3.294013	14 490
Lake	Ŭ	07-22	12.000	1.000	10.12010	Ŭ	.0.010	10.0002.	0.00001		10.000	J.=0 1015	11,100
Paul	0	1992-	10.530	2.320	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	12.850
Lake		08-05											
Paul	0	1992-	16.770	0.500	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	17.270
Lake		08-19											
Paul	0	1993-	0.000	1.147	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	1.147
Lake		05-20											
Paul	0	1993-	8.658	3.210	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	11.868
Lake		05-27											
Paul	0	1993-	4.374	2.118	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	6.492
Lake	^	06-03	44.0=:	0.400	10 105:0	^		10.0000	0.00001	^	10.000	0.00.40.10	44.4
Paul	0	1993-	11.071	3.403	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	14.474
Lake	0	06-10	7 604	E 10F	19 40510	0	75 640	10 20007	2 60601	0	10.060	2 20 40 12	10.000
Paul	0	1993-	1.084	5.125	13.42519	0	75.049	10.30827	0.08081	0	18.000	3.294013	12.809
Lake		06-17											

lakena	mælept	hsample	dath34	no23	Mean.NM	34.N	HM4ax.N	HSManDev.	NMMeMan.N0	012:8.N	OMBax.N	OSIGnDev.	NSQ23.N
Paul Lake	0	1993- 06-24	75.649	1.766	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	77.415
Paul	0	1993- 07-01	10.168	4.432	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	14.600
Lake Paul	0	1993-	9.121	0.789	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	9.910
Lake Paul	0	07-22 1993-	2.048	1.417	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	3.465
Lake Paul	0	07-29 1993-	11.436	1.763	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	13.199
Lake Paul	0	08-05 1993-	39.431	1.439	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	40.870
Lake Paul	0	08-12 1993-	0.000	0.000	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	0.000
Lake Paul	0	08-19 1993-	8.239	0.066	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	8.305
Lake Paul	0	08-26 1993-	0.000	2.026	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	2.026
Lake Paul	0	08-31 1993-	0.000	4.672	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	4.672
Lake Paul	0	09-07 1994-	13.631	3.664	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	17.295
Lake Paul	0	05-26 1994-	8.260	4.259	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	12.519
Lake Paul	0	06-09 1994-		1.848	13.42519	0		10.30827		0		3.294013	
Lake Paul	0	06-16 1994-	11.994		13.42519	0		10.30827		0		3.294013	
Lake		06 - 23											
Paul Lake	0	1994- 06-30	19.486		13.42519	0		10.30827		0		3.294013	
Paul Lake	0	1994- 07-07			13.42519	0		10.30827		0		3.294013	
Paul Lake	0	1994- 07-14	3.935	2.438	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	6.373
Paul Lake	0	1994- 07-21	5.831	4.901	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	10.732
Paul Lake	0	1994- 07-28	3.008	2.370	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	5.378
Paul Lake	0	1994- 08-04	9.548	2.125	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	11.673
Paul Lake	0	1994- 08-11	5.120	2.739	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	7.859
Paul Lake	0	1994- 08-18	9.403	1.428	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	10.831
Paul	0	1994-	9.775	2.348	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	12.123
Lake Paul	0	08-25 1994-	13.376	5.957	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	19.333
Lake Paul	0	09-01 1994-	10.272	4.390	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	14.662
Lake Paul Lake	0	09-06 1995- 05-25	6.253	2.059	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	8.312

Paul 0 1995 6.443 2.763 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 12.954 Lake	lakena	mælept	hsample	dath34	no23	Mean.NM	34.NI	H M ax.N	HStanDev.	NM San.NO	M28.N	OMBax.N	OMAnDev.	NSQ23 N
Paul 0 1995		0		16.443	2.763	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	19.206
Babe		0		0.070	4.075	19 49510	0	75 640	10 20027	2 60601	0	10.060	2 204012	19.054
Paul 0		U		0.019	4.075	13.42319	U	75.049	10.30627	3.00001	U	16.000	3.294013	12.994
Data Control Control		0		9 692	1 843	13 49519	Ο	75 649	10 30827	3 68681	0	18 060	3 204013	11 535
Paul 0		U		9.092	1.040	10.42013	U	10.043	10.50021	5.00001	U	10.000	0.234010	11.000
Name		0		12.210	0.539	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	12.749
Paul 0 1995							-							
Paul 0		0	1995-	21.643	5.331	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	26.974
Paul 0 1995	Lake		06-29											
Paul 0	Paul	0	1995-	26.361	6.323	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	32.684
Paul O														
Paul 0		0		16.969	5.912	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	22.881
Paul O		0		4 - 000	0.440	10 10 10	0		40.0000=	0.00001	0	10.000	0.00.404.0	22.404
Paul		0		17.282	6.119	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	23.401
Paul 0		0		10 207	0 691	19 49510	0	75 640	10 20027	2 60601	0	10.060	2 204012	11 010
Paul		U		10.387	0.031	13.42519	U	75.049	10.30827	3.08081	U	18.000	3.294013	11.018
Paul		0		13.018	0.023	13 /2510	Ω	75 640	10 30827	3 68681	0	18.060	3 20/013	13 0/1
Paul		U		19.010	0.525	10.42013	U	10.043	10.50021	5.00001	U	10.000	5.234015	10.541
Lake 08-10 9aul 0 1995 3.664 2.458 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 6.122 Lake 08-17 1995 7.465 2.005 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 9.470 Lake 08-24 1 0 1996- 6.768 2.193 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 8.961 Lake 05-27 1996- 7.141 7.825 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Lake 06-24 1 0 1996- 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.495 Lake 05-26 0 1997- 14.580 1.839 13.42519 0 75		0		10.487	1.257	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	11.744
Paul 0 1995- 08-17 3.664 2.458 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 6.122 Paul 0 1995- 7.465 2.005 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 9.470 Paul 0 1996- 6.768 2.193 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 8.961 Lake 06-24 - 7.141 7.825 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Lake 06-24 -				10,10,	1.20.	10.12010	Ŭ	10.010	10.0002.	0.00001		10.000	0.201010	111,11
Paul 0 1995- 08-24 7.465 0.05 13.42519 0.0 75.649 0.30827 0.368681 0 18.060 0.3294013 0.470 9.401 0.4081 9.401 0.40827 0.368681 0 18.060 0.3294013 0.470 8.961 0.40827 0.40		0		3.664	2.458	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	6.122
Lake 08-24 Paul 0 1996- 6.768 2.193 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 8.961 Lake 05-27 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Lake 06-24 0 1996- 24 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 07-22 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 05-26 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 0 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.932 Lake 06-23 0 1997- 10.342519 13.42519 0	Lake		08-17											
Paul 0 1996 6.768 2.193 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 8.961 Lake 05-27 7.141 7.825 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Lake 06-24 1996- 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 06-24 1997- 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 05-26 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 1997- 10.344 11.25 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594	Paul	0	1995-	7.465	2.005	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	9.470
Lake 05-27 Paul 0 1996- 06-24 7.141 7.825 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Paul 0 1996- 06-24 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 07-22 0 1997- 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 Lake 05-26 0 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 75.049 Lake 06-23 0 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 0 1997- 13.545 13.42519 0 75.649 10.30827 3.68	Lake		08-24											
Paul 0 1996- 06-24 7.141 7.825 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.966 Paul 0 1996- 07-22 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 07-22 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 Lake 05-26 0 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 0 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 1997- 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594		0		6.768	2.193	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	8.961
Lake 06-24 Paul 0 1996- 8.329 2.906 13.42519 0 75.649 10.30827 3.66881 0 18.060 3.294013 11.235 Lake 07-22 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 Lake 05-26 05-26 05-26 06-23 06-23 06-23 06-23 06-23 07.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 06-23 0 1997- 10.344 11.250 3.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649<														
Paul 0 1996- Lake 8.329 2.906 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 11.235 Lake 07-22 1997- 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 Lake 05-26 05-26 06-23 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 <td></td> <td>0</td> <td></td> <td>7.141</td> <td>7.825</td> <td>13.42519</td> <td>0</td> <td>75.649</td> <td>10.30827</td> <td>3.68681</td> <td>0</td> <td>18.060</td> <td>3.294013</td> <td>14.966</td>		0		7.141	7.825	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	14.966
Lake 07-22 Paul 0 1997- 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 Lake 05-26 <		0		0.200	2 000	12 40510	0	75 640	10 20007	2 60601	0	10.000	2 20 40 12	11 025
Paul 0 1997- 34.550 15.485 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 50.035 50.035 50.035 Paul 0 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 0 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 0 1997- 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 0 1998- 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 0		Ü		8.329	2.906	13.42519	U	75.049	10.30827	3.08081	U	18.000	3.294013	11.235
Lake 05-26 Paul 0 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23		0		34 550	15 485	13 42519	Ο	75 649	10 30827	3 68681	0	18 060	3 204013	50.035
Paul 0 1997- 16.580 0.839 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.419 Lake 06-23 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 05-25 05-25 05-25 05-25 05-25 06-22 06-22 06-22 06-22 06-22 06-22 06-22 06-22 06-22 06-22 06-22 06-20 06-20 07-20 <td></td> <td>O</td> <td></td> <td>04.000</td> <td>10.400</td> <td>10.42013</td> <td>U</td> <td>10.040</td> <td>10.00021</td> <td>0.00001</td> <td>O</td> <td>10.000</td> <td>0.254010</td> <td>00.000</td>		O		04.000	10.400	10.42013	U	10.040	10.00021	0.00001	O	10.000	0.254010	00.000
Lake 06-23 Paul 0 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 Paul 0 1997- 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 07-20 1998-<		0		16.580	0.839	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	17.419
Paul 0 1997- 13.505 2.448 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 15.953 Lake 07-21 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 0 1998- 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake </td <td></td> <td></td> <td></td> <td></td> <td>0.000</td> <td></td> <td>, and</td> <td></td> <td></td> <td>0.0000</td> <td></td> <td></td> <td>0.20 20 20</td> <td>_,,,_</td>					0.000		, and			0.0000			0.20 20 20	_,,,_
Paul 0 1997- 10.344 11.250 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 21.594 Lake 08-18 Paul 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 9 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 06-22 0 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 08-24 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630		0		13.505	2.448	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	15.953
Lake 08-18 Paul 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 Paul 0 1998- 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 Paul 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24	Lake		07 - 21											
Paul 0 1998- 24.666 4.178 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 28.844 Lake 05-25 Paul 0 1998- 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681		0	1997-	10.344	11.250	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	21.594
Lake 05-25 Paul 0 1998- 15.343 2.425 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 17.768 Lake 06-22 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1998- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Paul 0 1999-														
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Lake 06-22 Paul 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048														
Paul 0 1998- 13.237 1.151 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 14.388 Lake 07-20 Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24		0		15.343	2.425	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	17.768
Lake 07-20 Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		0		19.097	1 171	10 40510	0	75 040	10.20007	0.00001	0	10.000	2.004012	14900
Paul 0 1998- 24.279 5.386 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 29.665 Lake 08-24 Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		U		13.237	1.151	15.42519	U	75.049	10.30827	5.08081	U	18.000	<i>5.2</i> 94013	14.388
Lake 08-24 Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		Ω		24 270	5 386	13 //2510	0	75 640	10 30827	3 68681	Ω	18 060	3 20/1012	20 665
Paul 0 1999- 21.375 4.255 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 25.630 Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		U		44.219	0.000	10.42019	U	10.049	10.00041	0.00001	U	10.000	0.234010	<i>∆∂</i> .00∂
Lake 05-24 Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		0		21.375	4.255	13.42519	0	75,649	10.30827	3.68681	0	18.060	3.294013	25.630
Paul 0 1999- 26.973 5.075 13.42519 0 75.649 10.30827 3.68681 0 18.060 3.294013 32.048		V			1.200	_0.12010	3	. 0.010	_0.00021	3.00001	Ü	10.000	5.201010	20.000
		0		26.973	5.075	13.42519	0	75.649	10.30827	3.68681	0	18.060	3.294013	32.048
	Lake		06 - 21											

lakename	ælept	hsample	dath34	no23	Mean.N M	34 .N	H M ax.N	H S t4anDev.	NVHe3e4n.]	N 0 1218.N	OMBax.N	0 213 anDev.1	NSO 23 N
Paul	0	1999-	14.758	5.033	13.42519	0	75.649	10.30827	3.6868	1 0	18.060	3.294013	19.791
Lake		07 - 19											
Paul	0	1999-	11.579	3.994	13.42519	0	75.649	10.30827	3.6868	1 0	18.060	3.294013	15.573
Lake		08-16											

Table 3: Phosphorus content of Peter and Paul Lake

lakename	depth	sampledate	po4	Mean.PO4	Min.PO4	Max.PO4	StanDev.PO4
Peter Lake	0	1991-06-04	4.000	3.175346	0	12	2.803945
Peter Lake	0	1991-06-11	4.000	3.175346	0	12	2.803945
Peter Lake	0	1991-06-18	4.000	3.175346	0	12	2.803945
Peter Lake	0	1991-06-25	4.000	3.175346	0	12	2.803945
Peter Lake	0	1991-07-02	7.000	3.175346	0	12	2.803945
Peter Lake	0	1991-07-09	12.000	3.175346	0	12	2.803945
Peter Lake	0	1991-07-16	4.000	3.175346	0	12	2.803945
Peter Lake	0	1991 - 07 - 23	1.000	3.175346	0	12	2.803945
Peter Lake	0	1991-08-06	2.000	3.175346	0	12	2.803945
Peter Lake	0	1991-08-13	1.000	3.175346	0	12	2.803945
Peter Lake	0	1991-08-20	5.000	3.175346	0	12	2.803945
Peter Lake	0	1992 - 05 - 27	11.000	3.175346	0	12	2.803945
Peter Lake	0	1992-06-10	4.000	3.175346	0	12	2.803945
Peter Lake	0	1992-06-24	6.000	3.175346	0	12	2.803945
Peter Lake	0	1992-07-08	5.000	3.175346	0	12	2.803945
Peter Lake	0	1992 - 07 - 22	5.000	3.175346	0	12	2.803945
Peter Lake	0	1992-08-05	8.000	3.175346	0	12	2.803945
Peter Lake	0	1992-08-19	1.000	3.175346	0	12	2.803945
Peter Lake	0	1993-05-19	1.000	3.175346	0	12	2.803945
Peter Lake	0	1993-05-26	2.000	3.175346	0	12	2.803945
Peter Lake	0	1993-06-02	3.000	3.175346	0	12	2.803945
Peter Lake	0	1993-06-09	4.000	3.175346	0	12	2.803945
Peter Lake	0	1993-06-16	5.000	3.175346	0	12	2.803945
Peter Lake	0	1993-06-23	8.000	3.175346	0	12	2.803945
Peter Lake	0	1993-06-30	2.000	3.175346	0	12	2.803945
Peter Lake	0	1993-07-21	1.000	3.175346	0	12	2.803945
Peter Lake	0	1993-07-28	3.000	3.175346	0	12	2.803945
Peter Lake	0	1993-08-04	1.000	3.175346	0	12	2.803945
Peter Lake	0	1993-08-11	0.000	3.175346	0	12	2.803945
Peter Lake	0	1993-08-18	1.000	3.175346	0	12	2.803945
Peter Lake	0	1993-08-25	0.000	3.175346	0	12	2.803945
Peter Lake	0	1993-08-31	0.000	3.175346	0	12	2.803945
Peter Lake	0	1993-09-07	1.000	3.175346	0	12	2.803945
Peter Lake	0	1994 - 05 - 25	2.337	3.175346	0	12	2.803945
Peter Lake	0	1994-06-01	1.848	3.175346	0	12	2.803945
Peter Lake	0	1994-06-08	1.557	3.175346	0	12	2.803945
Peter Lake	0	1994-06-15	1.070	3.175346	0	12	2.803945
Peter Lake	0	1994-06-22	2.349	3.175346	0	12	2.803945
Peter Lake	0	1994-06-29	1.807	3.175346	0	12	2.803945
Peter Lake	0	1994-07-06	6.265	3.175346	0	12	2.803945
Peter Lake	0	1994-07-13	0.896	3.175346	0	12	2.803945
Peter Lake	0	1994-07-20	2.279	3.175346	0	12	2.803945

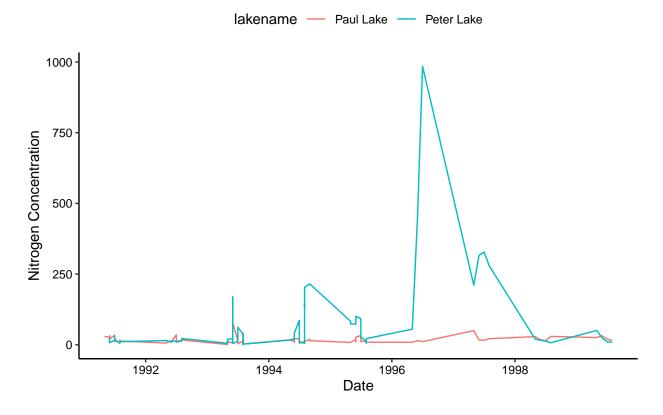
lakename	depth	sampledate	po4	Mean.PO4	Min.PO4	Max.PO4	StanDev.PO4
Peter Lake	0	1994-07-27	2.633	3.175346	0	12	2.803945
Peter Lake	0	1994-08-03	0.650	3.175346	0	12	2.803945
Peter Lake	0	1994-08-10	0.828	3.175346	0	12	2.803945
Peter Lake	0	1994-08-17	2.063	3.175346	0	12	2.803945
Peter Lake	0	1994-08-24	2.403	3.175346	0	12	2.803945
Peter Lake	0	1994-08-31	1.779	3.175346	0	12	2.803945
Peter Lake	0	1994-09-06	1.133	3.175346	0	12	2.803945
Peter Lake	0	1995-05-24	4.086	3.175346	0	12	2.803945
Peter Lake	0	1995-05-31	0.916	3.175346	0	12	2.803945
Peter Lake	0	1995-06-07	3.685	3.175346	0	12	2.803945
Peter Lake	0	1995-06-14	1.317	3.175346	0	12	2.803945
Peter Lake	0	1995-06-21	1.226	3.175346	0	12	2.803945
Peter Lake	0	1995-06-28	0.000	3.175346	0	12	2.803945
Peter Lake	0	1995-07-05	0.666	3.175346	0	12	2.803945
Peter Lake	0	1995-07-12	0.830	3.175346	0	12	2.803945
Peter Lake	0	1995-07-19	0.938	3.175346	0	12	2.803945
Peter Lake	0	1995-07-26	2.018	3.175346	0	12	2.803945
Peter Lake	0	1995-08-02	2.427	3.175346	0	12	2.803945
Peter Lake	0	1995-08-09	2.046	3.175346	0	12	2.803945
Peter Lake	0	1995-08-16	2.600	3.175346	0	12	2.803945
Peter Lake	0	1995-08-23	2.381	3.175346	0	12	2.803945
Peter Lake	0	1996-05-28	10.493	3.175346	0	12	2.803945
Peter Lake	0	1996-06-25	11.770	3.175346	0	12	2.803945
Peter Lake	0	1996-07-23	5.624	3.175346	0	12	2.803945
Peter Lake	0	1997-05-27	3.099	3.175346	0	12	2.803945
Peter Lake	0	1997-06-24	5.930	3.175346	0	12	2.803945
Peter Lake	0	1997-07-22	1.976	3.175346	0	12	2.803945
Peter Lake	0	1997-08-19	8.218	3.175346	0	12	2.803945
Peter Lake	0	1998-05-26	6.541	3.175346	0	12	2.803945
Peter Lake	0	1998-06-23	3.152	3.175346	0	12	2.803945
Peter Lake	0	1998-07-21	7.327	3.175346	0	12	2.803945
Peter Lake	0	1998-08-25	1.659	3.175346	0	12	2.803945
Peter Lake	0	1999-05-24	0.943	3.175346	0	12	2.803945
Peter Lake	0	1999-06-21	0.954	3.175346	0	12	2.803945
Peter Lake	0	1999-07-19	1.255	3.175346	0	12	2.803945
Peter Lake	0	1999-08-16	1.703	3.175346	0	12	2.803945
Paul Lake	0	1991-05-27	8.000	2.276544	0	10	2.133501
Paul Lake	0	1991-06-03	4.000	2.276544	0	10	2.133501
Paul Lake	0	1991-06-10	6.000	2.276544	0	10	2.133501
Paul Lake	0	1991-06-17	5.000	2.276544	0	10	2.133501
Paul Lake	0	1991-06-24	4.000	2.276544	0	10	2.133501
Paul Lake	0	1991-07-01	7.000	2.276544	0	10	2.133501
Paul Lake	0	1991-07-08	3.000	2.276544	0	10	2.133501
Paul Lake	0	1991-07-15	3.000	2.276544	0	10	2.133501
Paul Lake	0	1991-07-22	0.000	2.276544	0	10	2.133501
Paul Lake	0	1991-07-29	1.000	2.276544	0	10	2.133501
Paul Lake	0	1991-08-05	8.000	2.276544	0	10	2.133501
Paul Lake	0	1991-08-12	0.000	2.276544	0	10	2.133501
Paul Lake	0	1991-08-19	5.000	2.276544	0	10	2.133501
Paul Lake	0	1992-05-27	0.000	2.276544	0	10	2.133501
Paul Lake	0	1992-06-10	3.000	2.276544	0	10	2.133501
Paul Lake	0	1992-06-24	6.000	2.276544	0	10	2.133501

lakename	depth	sampledate	po4	Mean.PO4	Min.PO4	Max.PO4	StanDev.PO4
Paul Lake	0	1992-07-08	3.000	2.276544	0	10	2.133501
Paul Lake	0	1992-07-22	6.000	2.276544	0	10	2.133501
Paul Lake	0	1992-08-05	10.000	2.276544	0	10	2.133501
Paul Lake	0	1992-08-19	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-05-20	2.000	2.276544	0	10	2.133501
Paul Lake	0	1993-05-27	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-06-03	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-06-10	2.000	2.276544	0	10	2.133501
Paul Lake	0	1993-06-17	0.000	2.276544	0	10	2.133501
Paul Lake	0	1993-06-24	2.000	2.276544	0	10	2.133501
Paul Lake	0	1993-07-01	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-07-22	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-07-29	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-08-05	1.000	2.276544	0	10	2.133501
Paul Lake	0	1993-08-12	0.000	2.276544	0	10	2.133501
Paul Lake	0	1993-08-19	0.000	2.276544	0	10	2.133501
Paul Lake	0	1993-08-26	0.000	2.276544	0	10	2.133501
Paul Lake	0	1993-08-31	0.000	2.276544	0	10	2.133501
Paul Lake	0	1993-09-07	2.000	2.276544	0	10	2.133501
Paul Lake	0	1994 - 05 - 26	2.632	2.276544	0	10	2.133501
Paul Lake	0	1994-06-09	2.076	2.276544	0	10	2.133501
Paul Lake	0	1994-06-16	0.982	2.276544	0	10	2.133501
Paul Lake	0	1994-06-23	1.036	2.276544	0	10	2.133501
Paul Lake	0	1994-06-30	5.070	2.276544	0	10	2.133501
Paul Lake	0	1994-07-07	2.436	2.276544	0	10	2.133501
Paul Lake	0	1994-07-14	0.823	2.276544	0	10	2.133501
Paul Lake	0	1994-07-21	1.604	2.276544	0	10	2.133501
Paul Lake	0	1994-07-28	3.708	2.276544	0	10	2.133501
Paul Lake	0	1994-08-04	0.466	2.276544	0	10	2.133501
Paul Lake	0	1994-08-11	1.299	2.276544	0	10	2.133501
Paul Lake	0	1994-08-18	1.523	2.276544	0	10	2.133501
Paul Lake	0	1994-08-25	0.729	2.276544	0	10	2.133501
Paul Lake	0	1994-09-01	0.836	2.276544	0	10	2.133501
Paul Lake	0	1994-09-06	0.467	2.276544	0	10	2.133501
Paul Lake	0	1995-05-25	1.372	2.276544	0	10	2.133501
Paul Lake	0	1995-06-01	0.148	2.276544	0	10	2.133501
Paul Lake	0	1995-06-08	3.657	2.276544	0	10	2.133501
Paul Lake	0	1995-06-15	1.220	2.276544	0	10	2.133501
Paul Lake	0	1995-06-22	1.858	2.276544	0	10	2.133501
Paul Lake	0	1995-06-29	0.736	2.276544	0	10	2.133501
Paul Lake	0	1995-07-06	2.873	2.276544	0	10	2.133501
Paul Lake	0	1995-07-13	0.460	2.276544	0	10	2.133501
Paul Lake	0	1995-07-20	1.480	2.276544	0	10	2.133501
Paul Lake	0	1995-07-27	1.656	2.276544	0	10	2.133501
Paul Lake	0	1995-08-03	1.321	2.276544	0	10	2.133501
Paul Lake	0	1995-08-10	1.263	2.276544	0	10	2.133501
Paul Lake	0	1995-08-17	1.690	2.276544	0	10	2.133501
Paul Lake	0	1995-08-24	2.126	2.276544	0	10	2.133501
Paul Lake	0	1996-05-27	5.723	2.276544	0	10	2.133501
Paul Lake	0	1996-06-24	3.468	2.276544	0	10	2.133501
Paul Lake	0	1996-07-22	0.687	2.276544	0	10	2.133501
Paul Lake	0	1997-05-26	3.077	2.276544	0	10	2.133501

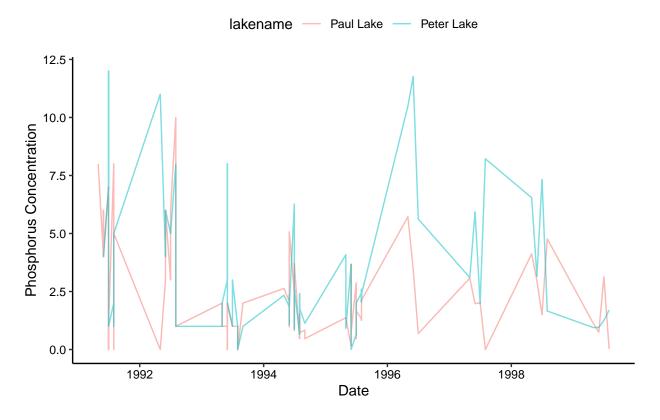
lakename	depth	sampledate	po4	Mean.PO4	Min.PO4	Max.PO4	StanDev.PO4
Paul Lake	0	1997-06-23	1.975	2.276544	0	10	2.133501
Paul Lake	0	1997-07-21	2.011	2.276544	0	10	2.133501
Paul Lake	0	1997-08-18	0.000	2.276544	0	10	2.133501
Paul Lake	0	1998-05-25	4.122	2.276544	0	10	2.133501
Paul Lake	0	1998-06-22	2.962	2.276544	0	10	2.133501
Paul Lake	0	1998-07-20	1.499	2.276544	0	10	2.133501
Paul Lake	0	1998-08-24	4.770	2.276544	0	10	2.133501
Paul Lake	0	1999-05-24	1.106	2.276544	0	10	2.133501
Paul Lake	0	1999-06-21	0.750	2.276544	0	10	2.133501
Paul Lake	0	1999-07-19	3.130	2.276544	0	10	2.133501
Paul Lake	0	1999-08-16	0.020	2.276544	0	10	2.133501

Create a fourth and fifth R chunk that generates two plots (one in each chunk): one for total N over time with different colors for each lake, and one with the same setup but for total P. Decide which geom option will be appropriate for your purpose, and select a color palette that is visually pleasing and accessible. Customize the chunk options such that the final figures are displayed but not the code used to generate the figures. In addition, customize the chunk options such that the figures are aligned on the left side of the page. Lastly, add a fig.cap chunk option to add a caption (title) to your plot that will display underneath the figure.

Nitrogen Concentrations over Time in Peter and Paul Lake



Phosphorus Concentrations over Time in Peter and Paul Lake



Communicating results

Write a paragraph describing your findings from the R coding challenge above. This should be geared toward an educated audience but one that is not necessarily familiar with the dataset. Then insert a horizontal rule below the paragraph. Below the horizontal rule, write another paragraph describing the next steps you might take in analyzing this dataset. What questions might you be able to answer, and what analyses would you conduct to answer those questions?

From our data wrangling, we see that Peter Lake has an overall higher mean concentration of nitrogen and phosphorus compared to Paul Lake. In particular, Peter Lake's nitrogen concentration is much higher than Paul Lake's - through the Nitrogen concentration plot by lake, we see that Peter Lake's concentrations have higher variability over time. Uniquely, Peter Lake had a huge peak in concentration between 1996-1997, but nitrogen levels decreased to "base levels" by 1998. With phosphorus concentrations, both Peter and Paul lakes have high variability with phosphorus concentrations over time. However, Peter Lake seems to have higher variability in comparison with Paul Lake. Phosphorus concentrations look to cycle through a boom-bust pattern with period of sudden peaks and then a sudden decrease. From 1993-1995, there was a period for Peter and Paul lakes where overall phosphorus levels were lower than previous and future levels.

Moving forward, I would run a time-series analysis to see if there are specific trends within nitrogen and phosphorus concentrations in Peter and Paul lakes over time. Next, I may pull for spatial datasets of Peter and Paul lakes and perform a GLM. A question I would like to explore is if the location of Peter and Paul lakes is impacting the nitrogen and phosphorus concentrations within each lake. In particular, I would like to see why Peter Lake's concentrations are so much higher than Paul lakes.

KNIT YOUR PDF

When you have completed the above steps, try knitting your PDF to see if all of the formatting options you specified turned out as planned. This may take some troubleshooting.

OTHER R MARKDOWN CUSTOMIZATION OPTIONS

We have covered the basics in class today, but R Markdown offers many customization options. A word of caution: customizing templates will often require more interaction with LaTeX and installations on your computer, so be ready to troubleshoot issues.

Customization options for pdf output include:

- Table of contents
- Number sections
- Control default size of figures
- Citations
- Template (more info here)

pdf_document:

toc: true

number_sections: true

fig_height: 3 fig_width: 4

citation_package: natbib

template: