South Carolina Ambient Surface Water Monitoring:
Our Discovery of R

Presented by Bryan Rabon
& David Chestnut

South Carolina Department of Health and Environmental Control

Promoting and Protecting the Health of the Public and the Environment   *www.scdhec.gov*

SCDHEC Water Quality Monitoring and Modeling Section

- Design for State Ambient Surface Water Quality Monitoring Program (P/Chem & Bact)
- Special Studies and Reports
- §303(d) & §305(b) Data Assessment
- Beach Act – Grant Oversight
- STORET data uploads for Beach and Ambient data
- Review Monitoring Plans and QAPP's
- Wasteload modeling

SCDHEC Water Quality Monitoring and Modeling Section

- Design monitoring on a yearly basis
  - 90 probability-based sites selected randomly
  - 245 fixed ambient monitoring sites
  - Reconn 50 to 100 stream sites a year
- QA data from SCDHEC Lab
- Merge outside data and other DHEC program data with Ambient P/Chem & Bact data for assessment
- Assess available data
  - Assessment for aquatic life use, recreational use (pathogens)
  - Freshwater streams and lakes and saltwater estuaries
  - Beaches for the beach act

Way We Used to Do it

- Advent of Modern STORET lost the tools built into Legacy STORET
  - Agency programmer built a tool in C that did what he thought we were asking for.
  - Then a section statistician built an assessment in SAS that he thought did what we were asking for.
- Trends run in WQHydro
  - Lost software to fire…
- Relied on others with little knowledge of the area to produce a product that we were responsible for

Stress Reduction

Bang
Head
Here

Directions:
1. Place on FIRM surface.
2. Follow directions in circle.
3. Repeat step 2 as necessary, or until unconscious.
4. If unconscious, cease stress reduction activity.
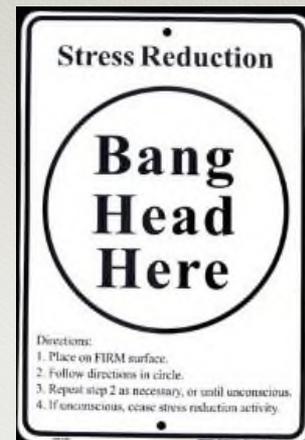
Powerful and Flexible

- Started with random survey
- Moved to simple assessment
  - Used in Pathogen study to get regression
  - NEEU to get some overall estuarine statistics based on salinity zones
- Developed trend analysis
  - Example of taking an existing tool and fitting it to our needs
- Water quality atlas
- Then combined to do the full 303d/305b assessment
- Used to re-format data from LIMS for FOI request

Turn It Over To Dave

Federal Reporting Requirements

- **§305(b) Report**
  - General statement of water quality condition of the whole State
  - Submitted to EPA every two years
- **§303(d) List**
  - Listing of impaired waters
  - Submitted to EPA every two years

§305(b) State-Scale Statistical Survey Site Selection

SC Statistical Survey Component

- **Survey Sites**
  - Sampled monthly for 1 year
- **Make comprehensive statements about <u>state-scale</u> WQ conditions (§305(b) use support)**
  - "Unbiased random sample" of water resources (like a phone survey or election poll)
  - Represents entire resource **("All Waters")**
  - Known confidence of condition estimates
- **Sample previously unsampled locations**
  - Identify new §303(d) candidates

How?

Generalized Random Tessellation Stratified (GRTS) Survey Design

EPA Aquatic Resources Monitoring –
General Overview of Probabilistic Surveys

- Probability sample producing design-based estimators and variance estimators

- Gives another option to simple random sample and systematic sample designs

- Emphasize spatial-balance

  - Every replication of the sample exhibits a spatial density pattern that closely mimics that of the resource

Statistical Magic

- It requires around 50 to 60 sites to make a population statement around ± 10% with 90% confidence

- We sample 30 sites per year in each waterbody type

- Currently we compile 5 years of data for each waterbody type to make a statewide statement around ± 6% with 95% confidence

Resource Types Assessed Using Statistical Survey Approach

- **Streams**

- **Lakes**

- **Estuaries**
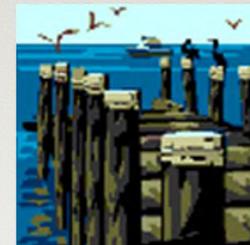
Streams Example

Targeted Categories for Statistical Survey Sites

- **Streams**
- 30 sites sampled monthly
  - 8 first order streams
  - 10 second & third order streams
  - 12 fourth order & greater streams
- Unequal weights

SCDHEC Random Stream Population
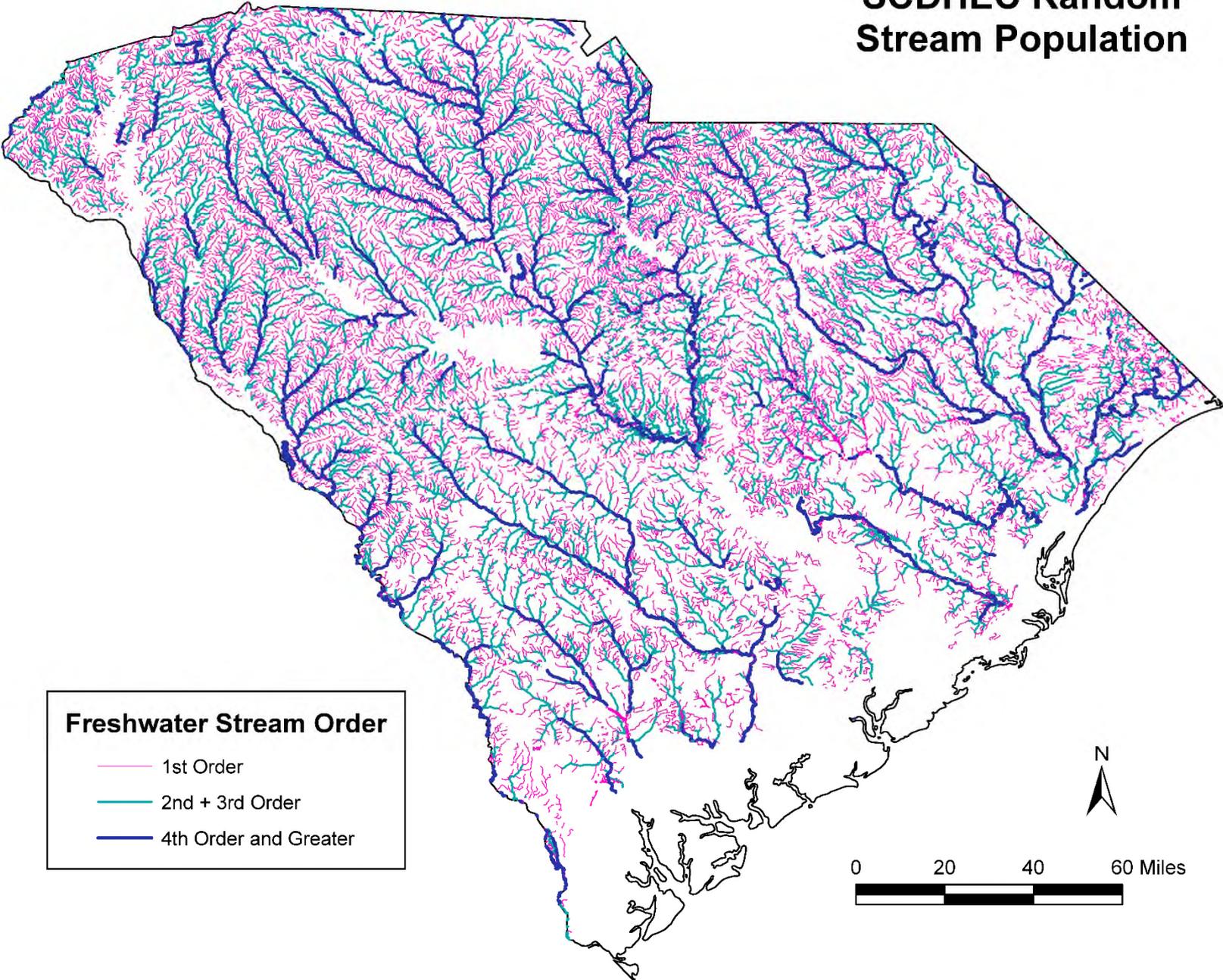
Freshwater Stream Order

— 1st Order
— 2nd + 3rd Order
— 4th Order and Greater

N

0   20   40   60 Miles

TblUID	siteID	xcoord	ycoord	mdcaty	wgt	stratum	panel	CU	SEG	MILE	Rec_Order	CODE	STRAHLER	HIER_ID
1	SCS2010-001	450030.2341	3741798.899	1st	738.3236844	FW	Panel_1	3050203	501	0.6	0	R	1	1730100.758
2	SCS2010-002	361571.0094	3881891.834	2nd&3rd	258.0700158	FW	Panel_1	3050109	139	0	2	R	2	1721110.727
3	SCS2010-003	573236.3007	3745524.591	2nd&3rd	258.0700158	FW	Panel_1	3040205	2482	1.63	0	R	3	1712303.727
4	SCS2010-004	596081.1716	3843182.645	2nd&3rd	258.0700158	FW	Panel_1	3040201	90	2.03	0	R	2	1712003.707
5	SCS2010-005	395411.1207	3758775.389	4th+	86.0780131	FW	Panel_1	3060107	23	7.66	4	R	4	1730031.707
6	SCS2010-006	452827.5578	3848804.078	1st	738.3236844	FW	Panel_1	3050106	69	3.51	1	R	1	1712220.727
7	SCS2010-007	599810.6256	3677274.915	2nd&3rd	258.0700158	FW	Panel_1	3050201	904	0.76	0	R	2	1713220.727
8	SCS2010-008	591409.5826	3796061.24	2nd&3rd	258.0700158	FW	Panel_1	3040201	46	8.53	0	R	3	1712033.727
9	SCS2010-009	340377.2326	3857035.484	4th+	86.0780131	FW	Panel_1	3060101	27	2.52	0	R	4	1721113.767
10	SCS2010-010	366511.2656	3884715.173	4th+	86.0780131	FW	Panel_1	3050109	69	13.37	4	R	4	1721110.727
11	SCS2010-011	683368.3186	3743735.943	2nd&3rd	258.0700158	FW	Panel_1	3040206	1791	0	0	R	2	1712112.718
12	SCS2010-012	532821.9961	3799020.314	1st	738.3236844	FW	Panel_1	3050104	1216	0	1	S	1	1712210.747
13	SCS2010-013	415024.9842	3774539.533	2nd&3rd	258.0700158	FW	Panel_1	3050109	1307	0	2	R	1	1730013.718
14	SCS2010-014	494286.2136	3764290.298	4th+	86.0780131	FW	Panel_1	3050106	1	0	8	W	8	1712322.717
15	SCS2010-015	484106.6373	3635901.451	2nd&3rd	258.0700158	FW	Panel_1	3050208	17	1.5	0	R	3	1731023.727
16	SCS2010-016	502824.1883	3821523.143	1st	738.3236844	FW	Panel_1	3050103	95	2.7	1	R	1	1712203.737
17	SCS2010-017	416884.0006	3756967.677	2nd&3rd	258.0700158	FW	Panel_1	3060107	18	4.56	2	R	2	1730013.747
18	SCS2010-018	409363.7017	3835806.373	4th+	86.0780131	FW	Panel_1	3050108	8	0	5	R	5	1712222.757
19	SCS2010-019	584061.7148	3708522.396	2nd&3rd	258.0700158	FW	Panel_1	3050112	1525	0	0	R	3	1712312.747
20	SCS2010-020	627114.7904	3839293.234	1st	738.3236844	FW	Panel_1	3040201	3721	3.7	0	S	1	1712001.747
21	SCS2010-021	455796.9782	3687669.474	2nd&3rd	258.0700158	FW	Panel_1	3050207	1072	0	0	R	2	1730130.737
22	SCS2010-022	393082.7921	3813821.387	2nd&3rd	258.0700158	FW	Panel_1	3050109	1031	0	2	R	2	1730003.727
23	SCS2010-023	637361.5655	3705100.407	4th+	86.0780131	FW	Panel_1	3040205	37	1.23	0	R	6	1712311.727
24	SCS2010-024	515303.6413	3850543.63	1st	738.3236844	FW	Panel_1	3050103	595	0	1	S	1	1712022.757
25	SCS2010-025	315693.9159	3844332.908	1st	738.3236844	FW	Panel_1	3060101	91	4.11	0	S	1	1721131.708
26	SCS2010-026	487693.9529	3658227.472	4th+	86.0780131	FW	Panel_1	3050207	26	2.72	0	R	4	1731020.727
27	SCS2010-027	595178.8225	3757225.043	1st	738.3236844	FW	Panel_1	3040205	2175	0	0	S	1	1712122.748
28	SCS2010-028	585338.5074	3770407.492	1st	738.3236844	FW	Panel_1	3040202	1432	2.74	0	S	1	1712300.727
29	SCS2010-029	401839.3917	3857622.809	2nd&3rd	258.0700158	FW	Panel_1	3050107	33	0	2	R	2	1703333
30	SCS2010-030	506122.9965	3745235.632	1st	738.3236844	FW	Panel_1	3050110	492	0	0	S	1	1712323.717
31	SCS2010-031	521597.6849	3635985.578	1st	738.3236844	FW	Panel_1	3050208	7	12.04	0	R	1	1731003.708
32	SCS2010-032	470748.9665	3782472.374	1st	738.3236844	FW	Panel_1	3050106	9000	0	1	R	0	1712233.717
33	SCS2010-033	439163.3752	3732222.894	4th+	86.0780131	FW	Panel_1	3050204	28	4.23	0	R	4	1730102.747
34	SCS2010-034	417327.9966	3845061.635	4th+	86.0780131	FW	Panel_1	3050107	24	2.55	5	R	5	1712222.718
35	SCS2010-035	565259.5017	3661011.585	1st	738.3236844	FW	Panel_1	3050202	1841	2.01	0	S	1	1713222.738
36	SCS2010-036	644175.2466	3803488.249	4th+	86.0780131	FW	Panel_1	3040204	25	16.36	0	R	4	1712013.727
37	SCS2010-037	435250.909	3702072.758	1st	738.3236844	FW	Panel_1	3060106	98	3.42	0	R	1	1730130.76
38	SCS2010-038	361814.8363	3782451.759	4th+	86.0780131	FW	Panel_1	3060103	30	2.59	0	R	4	1730030.768
39	SCS2010-039	669490.9963	3723409.36	1st	738.3236844	FW	Panel_1	3040201	2742	0	0	S	1	1712130.738
40	SCS2010-040	510416.7613	3870666.795	4th+	86.0780131	FW	Panel_1	3050103	25	2.26	4	R	4	1703133.747
41	SCS2010-041	466373.8305	3790766.843	2nd&3rd	258.0700158	FW	Panel_1	3050106	47	2.7	2	R	2	1712232.737
42	SCS2010-042	493942.6187	3691469.484	4th+	86.0780131	FW	Panel_1	3050204	1	13.11	0	R	5	1730113.717

SCDHEC Potential
Random Stream Sites
2011-2015
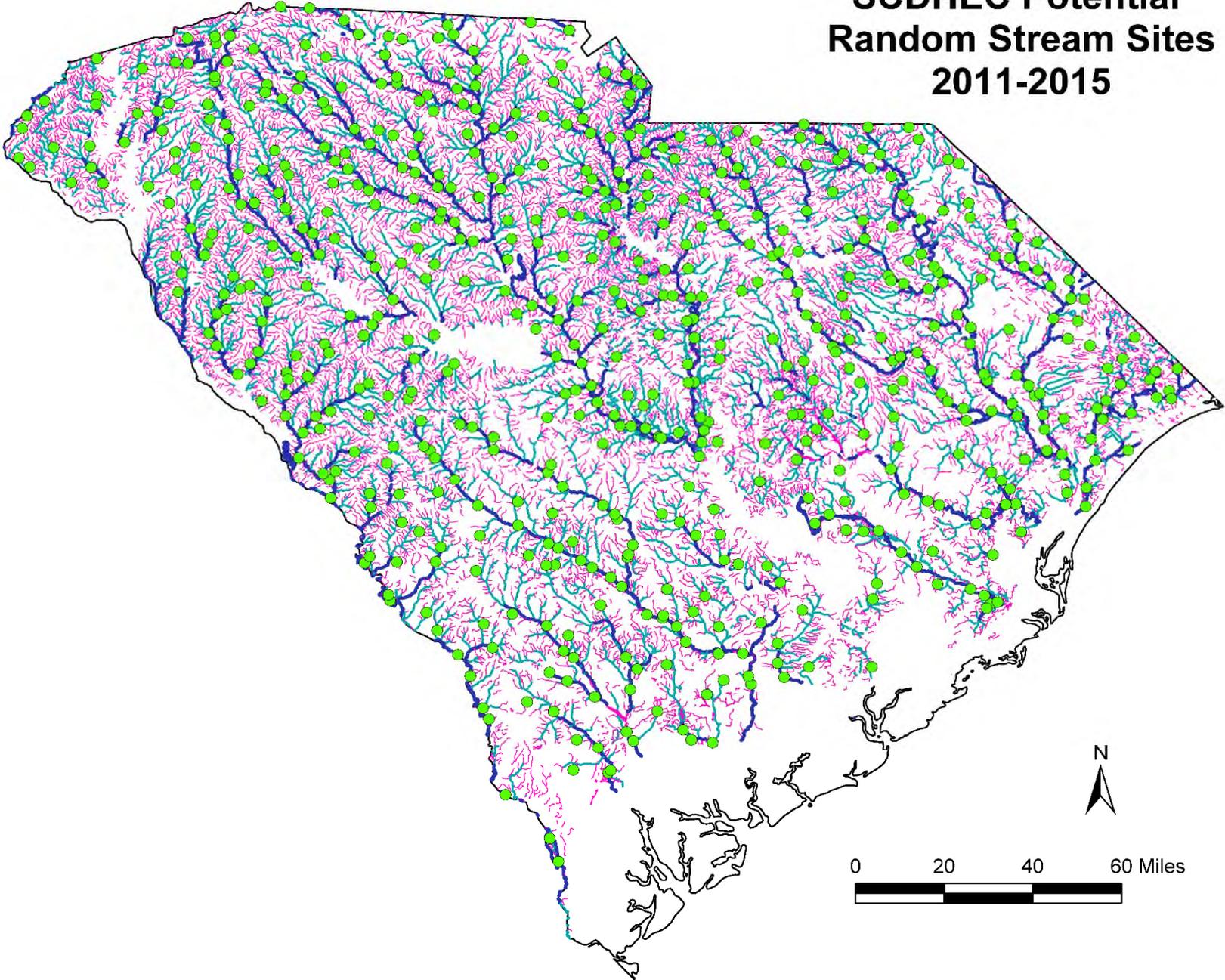
0   20   40   60 Miles

SCDHEC 2010
Reconnaissance
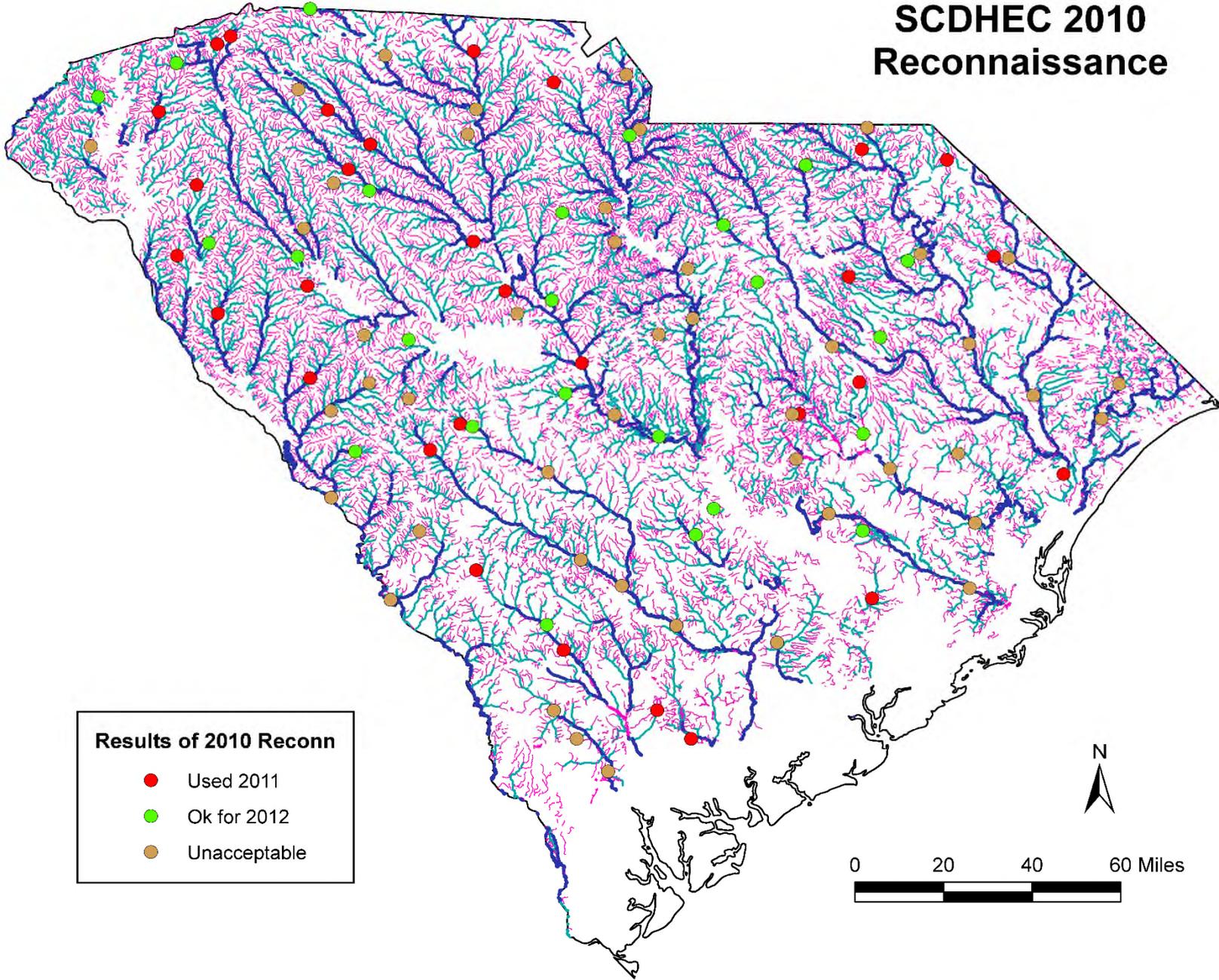
Results of 2010 Reconn

- 🔴 Used 2011
- 🟢 Ok for 2012
- 🟤 Unacceptable

N

0   20   40   60 Miles

Important Considerations

- It is necessary to keep track of every selected site that can't be sampled and why because it affects the estimate of the total resource size
    - Target Population
        - No acceptable access
        - Physical barrier or dangerous conditions
    - Non-Target (sample frame errors – GIS   layer wrong)
        - No stream present
        - Intermittent, no flow
        - Impoundment or immediate outflow
        - Saltwater

§305(b) Analytical Results

Type	Subpopulation	Indicator	Category	NResp	Estimate.P	StdError.P	LCB95Pct.P	UCB95Pct.P	Estimate.U	StdError.U	LCB95Pct.U	UCB95Pct.U
State	South Carolina_2006_2010	RECUSE	F	80	47.26	4.07	39.28	55.24	11,695	1,008	9,720	13,671
State	South Carolina_2006_2010	RECUSE	P	12	8.00	2.21	3.67	12.33	1,979	547	908	3,051
State	South Carolina_2006_2010	RECUSE	N	57	44.75	4.21	36.50	53.00	11,075	1,042	9,033	13,116
State	South Carolina_2006_2010	RECUSE	NIMP	80	47.26	4.07	39.28	55.24	11,695	1,008	9,720	13,671
State	South Carolina_2006_2010	RECUSE	IMP	69	52.74	4.07	44.76	60.72	13,054	1,008	11,079	15,029
State	South Carolina_2006_2010	RECUSE	Total	149	100.00	NA	NA	NA	24,749	NA	NA	NA
State	South Carolina_2006_2010	ALUSE	F	121	82.70	2.96	76.89	88.50	20,467	733	19,029	21,904
State	South Carolina_2006_2010	ALUSE	P	15	6.87	1.50	3.94	9.81	1,701	371	974	2,428
State	South Carolina_2006_2010	ALUSE	N	13	10.43	2.76	5.03	15.84	2,582	682	1,245	3,919
State	South Carolina_2006_2010	ALUSE	NIMP	121	82.70	2.96	76.89	88.50	20,467	733	19,029	21,904
State	South Carolina_2006_2010	ALUSE	IMP	28	17.30	2.96	11.50	23.11	4,283	733	2,845	5,720

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Turn It Over To Bryan

Pathogen Indicator Study

- Need for change of freshwater pathogen indicator

- Designed a sampling program of 73 sites to be sampled weekly for a year

- Sampled for Fecal Coliform, Enterococci, and *E. coli*

- First did Pearson's Product-Moment Correlation

- Log data with censored data removed

Correlation test on full Dataset

Fecal vs Ecoli

Pearson's product-moment correlation

data: ECOLIFECAL$FECAL and ECOLIFECAL$ECOLI
t = 47.8311, df = 3586, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
0.6037008 0.6436722
sample estimates:
cor
0.6240947

Log Fecal vs Log Ecoli

Pearson's product-moment correlation

data: ECOLIFECAL$logfecal and ECOLIFECAL$logecoli
t = 119.2375, df = 3586, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
0.8868434 0.9000367
sample estimates:
cor
0.893633

Correlation on dataset with NO LT GT EST

Fecal vs Ecoli

Pearson's product-moment correlation

data: ECOLIFECAL$FECAL and ECOLIFECAL$ECOLI
t = 70.6947, df = 2615, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
0.7966616 0.8230105
sample estimates:
cor
0.810245

Log Fecal vs Log Ecoli

Pearson's product-moment correlation

data: ECOLIFECAL$logfecal and ECOLIFECAL$logecoli
t = 93.0877, df = 2615, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
0.8672679 0.8850529
sample estimates:
cor
0.876459

What Next

- Used an Orthogonal Regression
  - Had been used previously for this same analysis in another state
- Optimized the regression

```
#seting the starting point for the optimization
 x <- c(0,1)
#The orthaginal regression function
 elllog <- function(x) {sum((((fecal$logfecal - (x[1] + x[2]*ecoli$logecoli))^2)/(1+x[2]^2))}

#Running the optimiztion
elllogopt <- optim(x,elllog,lower =c(0,0), hessian = TRUE, method = "L-BFGS-B")

#Inverting the hessian matrix
 invellogopt <- solve(elllogopt$hessian)

##LOG PLOT
scatterplot(logecoli~logfecal, reg.line=FALSE, smooth=FALSE, labels=FALSE,
            boxplots=FALSE, span=0.5, xlab="Fecal", ylab="Ecoli",
            data=ECOLIFECAL) title("LOG FECAL vs LOG ECOLI")

#Adding the regression line to the plot
abline(elllogopt$par[1],elllogopt$par[2])
 #Adding the formula to the plot
equaplot <- paste("y= ",elllogopt$par[1], " + ",elllogopt$par[2], "x")
            text(1.5, 3.5, equaplot)
```

LOG FECAL vs LOG ECOLI no LT GT EST

y= 0.0519396376003073 + 0.95730848229224 x
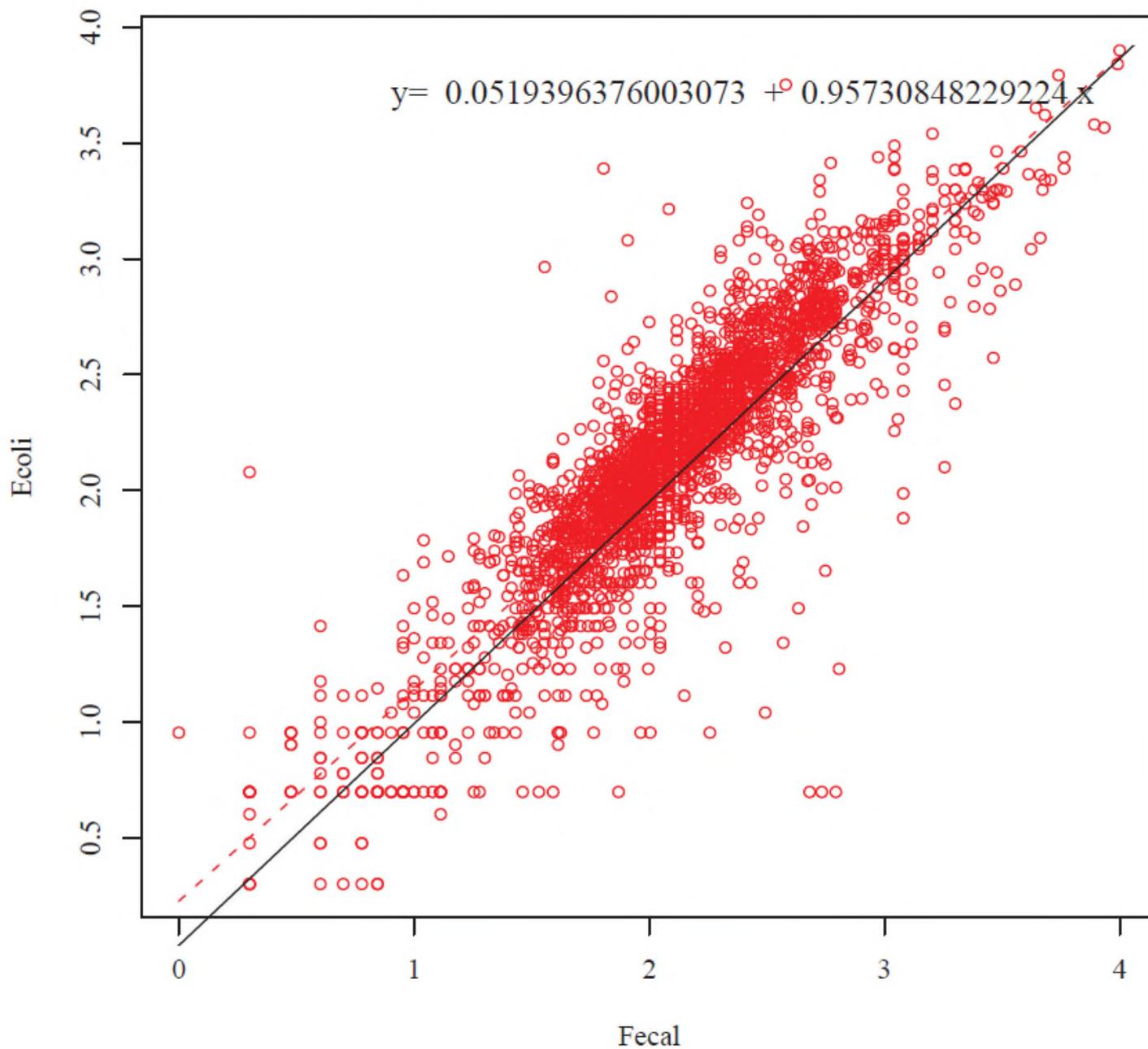
Seasonal Kendall's Tau

- Monthly sampling frequency
- Months with multiple samples are averaged
- We require a minimum of 30 results

	A	B	C
	Station	Date	FCMPN
	09B-02	1/22/2013	4.5
	09B-02	1/23/2012	4.5
	09B-02	1/19/2011	6.8
	09B-02	1/27/2010	35
	09B-02	1/5/2010	7.8
	09B-02	1/13/2009	49
	09B-02	1/28/2008	4
	09B-02	1/2/2007	33
0	09B-02	1/24/2005	2
1	09B-02	1/13/2004	2
2	09B-02	1/15/2003	7
3	09B-02	1/18/2002	2
4	09B-02	1/10/2001	2
5	09B-02	1/5/2000	4
6	09B-02	1/6/1999	46
7	09B-02	1/20/1998	14
8	09B-02	1/14/1997	7
9	09B-02	1/15/1996	1.9
0	09B-02	2/4/2013	1.7
1	09B-02	2/1/2012	6.8
2	09B-02	2/1/2011	13
3	09B-02	2/1/2010	6.1
4	09B-02	2/2/2009	5
5	09B-02	2/11/2008	11

	A	B	C	D	E	F	G
1	STAT	Trend	sen.slope	sen.slope.	p.value	Z	seasonalTau
2	09B-02	D	-0.01667	-0.07243	0.053974	-1.92705	-0.09269
3	09B-04	D	-0.375	-0.42518	0.004916	-2.81247	-0.1365
4	09B-05	D	-0.68095	-1.42008	0.004027	-2.87604	-0.1396
5	09B-06	NS	-0.05556	-0.07809	0.42999	-0.78921	-0.05168

Separate data set from Assessment – 15 years

Seasonal Trend for Others
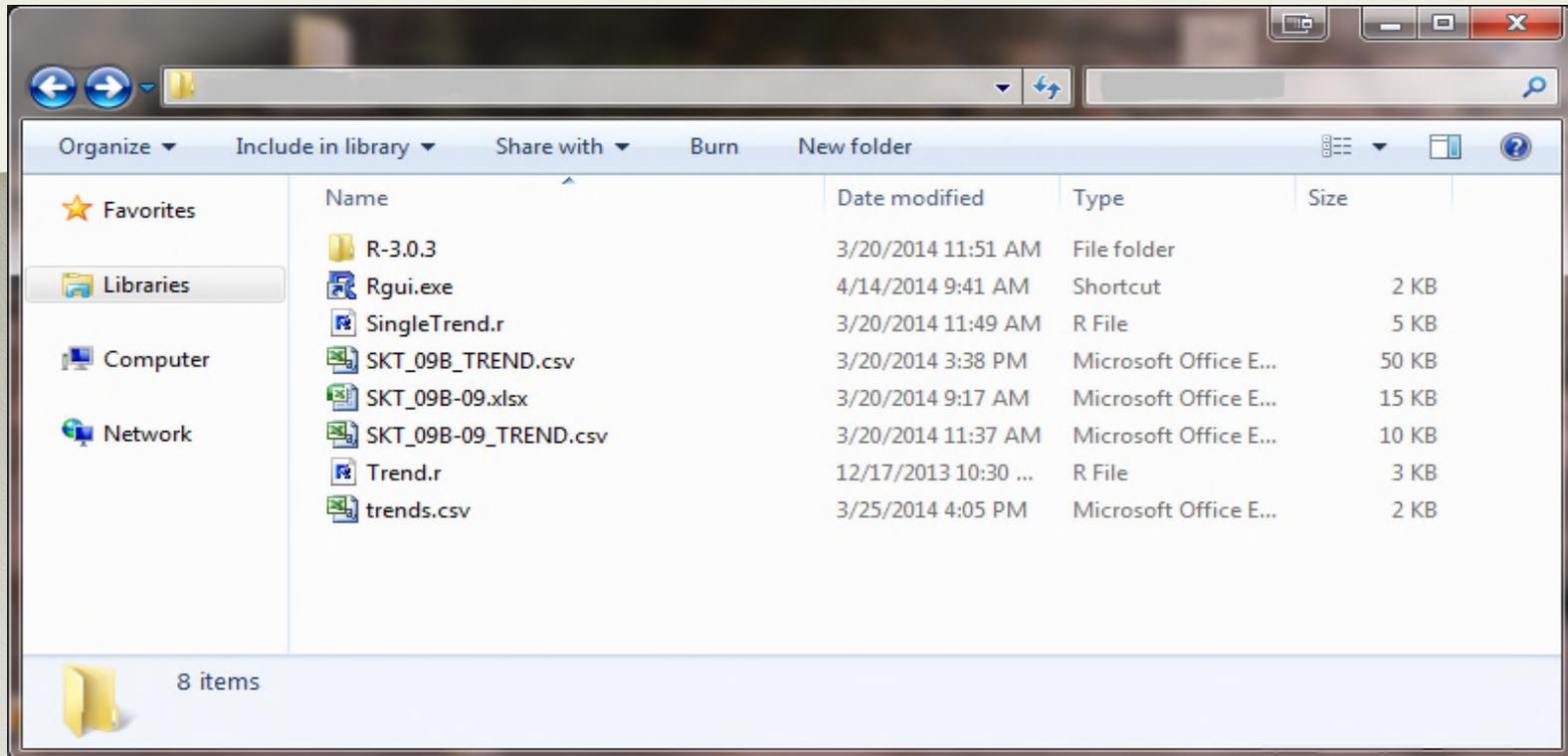
- Portable - runs from a flash drive
- Sets time series based on the dataset
- Only one parameter at a time
- Multiple stations or locations

Water Quality Atlas

- Five years of data
- By Basin and by Ecoregion
  - Within each by water body type
  - Each parameter with data is done
- What's Reported
  - Total Samples
  - Number above and below detection limit
  - Percentiles and Means

SAVANNAH

Phosphorus

Estuaries

Total analysis   181
Number less then DL   16   (8.84) %
Number equal to DL but no Remark code   1   (0.55) %
Number greater the DL   164   (90.61) %
Therefore, 9.39% of the analytical results were at or below the reporting limit

	N	50th	75th	90th	95th	99th	Range	Mean
All Values	181	0.06	0.08	0.12	0.17	0.27	0.02 - 0.48	0.07
Reportable Values	165	0.06	0.08	0.14	0.17	0.27	0.02 - 0.48	0.07
Values Greater than Reporting Limit	164	0.06	0.09	0.14	0.17	0.27	>0.02 - 0.48	0.07

Lakes

Total analysis   1013
Number less then DL   730   (72.06) %
Number equal to DL but no Remark code   23   (2.27) %
Number greater the DL   260   (25.67) %
Therefore, 74.33% of the analytical results were at or below the reporting limit

	N	50th	75th	90th	95th	99th	Range	Mean
All Values	1013	0.02	0.02	0.04	0.06	0.14	0.02 - 0.5	0.03
Reportable Values	283	0.03	0.05	0.08	0.13	0.24	0.02 - 0.5	0.05
Values Greater than Reporting Limit	260	0.03	0.05	0.08	0.13	0.25	>0.02 - 0.5	0.05

Streams

Total analysis   1125
Number less then DL   258   (22.93) %
Number equal to DL but no Remark code   11   (0.98) %
Number greater the DL   856   (76.09) %
Therefore, 23.91% of the analytical results were at or below the reporting limit

	N	50th	75th	90th	95th	99th	Range	Mean
All Values	1125	0.04	0.07	0.13	0.17	0.28	0.02 - 2.7	0.06
Reportable Values	867	0.05	0.09	0.14	0.19	0.28	0.02 - 2.7	0.07
Values Greater than Reporting Limit	856	0.05	0.09	0.14	0.19	0.28	>0.02 - 2.7	0.07

Details about the Code and Output

- Report is 370 pages long
- 3 scripts
  - Main script has 34 lines of code
  - Report template has 151 lines of code
  - Function to create table has 48 lines of code
- The LaTex document has 36,660 lines
  (Does include white space)
- Other libraries for Word and PowerPoint

Standards Assessment

- Scripted into module's
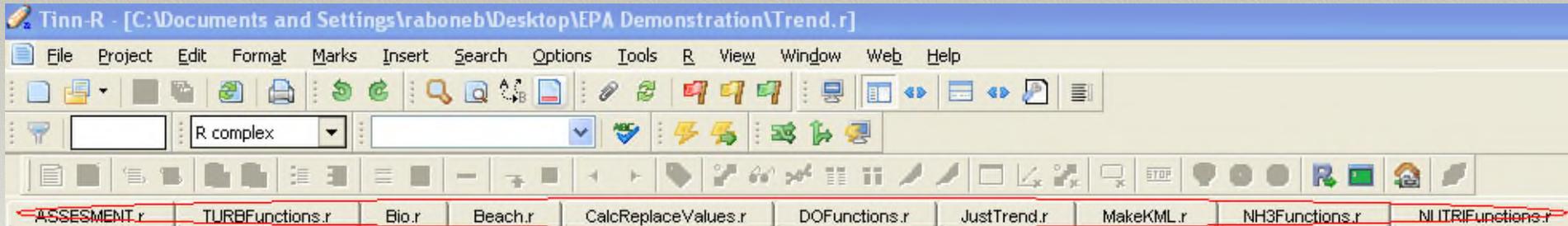
Necessary Information for Standards Assessment Criterion

- Table of Water Quality Criteria
  - Depending on different combinations of:
    - Waterbody Classification
    - Waterbody Type
    - Ecoregion

File Edit View Insert Format Records Tools Window Help

Type a question for help

Assessment : Database (Access 2000 file format)

Criterion : Table

PARM	CLASS	WBODY	ECOREGION	LT	GT	CHRONIC	ACUTE	Units
Enterococcus	SA				104			cfu/100ml
Enterococcus	SFH				104			cfu/100ml
Enterococcus	SB				501			cfu/100ml
Escherichia coli					349			cfu/100ml
Enterococcus	SA-SP				104			cfu/100ml
Enterococcus	SB-SP				501			cfu/100ml
Nitrogen		L	SOUTHERN COASTAL PLAIN		1.5			mg/l
Chlorophyll a, corrected for pheophytin		L	SOUTHERN COASTAL PLAIN		40			ug/l
Phosphorus		L	SOUTHERN COASTAL PLAIN		0.09			mg/l
Turbidity	FW	L			25			NTU
Turbidity	FW	S			50			NTU
Turbidity	FW	SE			50			NTU
Turbidity	FW-SP	L			25			NTU
Turbidity	FW-SP	S			50			NTU
Turbidity	FW-SP	SE			50			NTU
Turbidity	SA				25			NTU
Turbidity	SA-SP				25			NTU
Turbidity	SB				25			NTU
Turbidity	SB-SP				25			NTU
Turbidity	SFH				25			NTU
Turbidity	TN				10			NTU
Turbidity	TPGT				10			NTU
Turbidity	TPGT-SP				10			NTU
Turbidity	TPT				10			NTU
Dissolved oxygen (DO)	FW-SP			4				mg/l
Dissolved oxygen (DO)	FW			5				mg/l
Dissolved oxygen (DO)	SA			5				mg/l
Dissolved oxygen (DO)	SA-SP			4				mg/l
Dissolved oxygen (DO)	SB			4				mg/l
Dissolved oxygen (DO)	SB-SP			5				mg/l
Dissolved oxygen (DO)	SFH			5				mg/l
Dissolved oxygen (DO)	TN			6				mg/l
Dissolved oxygen (DO)	TPGT			6				mg/l
Dissolved oxygen (DO)	TPGT-SP			5				mg/l
Dissolved oxygen (DO)	TPT			6				mg/l
pH	FW			6	8.5			None
pH	FW-SP			5	8.5			None
pH	SA			6.5	8.5			None
pH	SA-SP			6.5	8.5			None
pH	SB			6.5	8.5			None
pH	SB-SP			6.5	8.5			None
pH	SFH			6.5	8.5			None
pH	TN			6	8			None
pH	TPGT			6	8.5			None
pH	TPGT-SP			6	8.5			None

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Datasheet View

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File Edit View Insert Format Records Tools Window Help

Type a question for help

Assessment : Database (Access 2000 file format)

ParamterYearAssess : Table

PARM	ShortName	YearsAsses	SortOrder	USE	TREND	TRENDONLY	TOXIC	NUTRIENT
Turbidity	TURB	5	5	AL	Y			Y
Dissolved oxygen (DO)	DO	5	2	AL	Y			
pH	PH	5	4	AL	Y			
Nitrogen	TN	5	7	AL	Y			Y
Ammonia	NH3	3	10	AL			Y	
Phosphorus	TP	5	8	AL	Y			Y
Cadmium	CD	3	11	AL			Y	
Chromium	CR	3	12	AL			Y	
Copper	CU	3	13	AL			Y	
Lead	PB	3	14	AL			Y	
Nickel	NI	3	16	AL			Y	
Zinc	ZN	3	17	AL			Y	
Fecal Coliform	FECAL	5	18		Y			
Chlorophyll a, corrected for pheophytin	CHLA	5	9	AL	Y			Y
Mercury	HG	3	15	AL			Y	
Temperature, water	WTEMP	3	1		Y	Y		
Salinity	SAL	3						
Enterococcus	ENT	5	20	REC	Y			
Escherichia coli	ECOLI	5	19	REC	Y			
Biochemical oxygen demand, standard	BOD		3		Y	Y		
Total suspended solids	TSS		6		Y	Y		
BACT	BACT		0					
BEACH	BEACH		0	REC				
BIO	BIO		0	AL				
			0					

Record: I◄ ◄ | 1 | ► ►I ►* of 24

Datasheet View

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Necessary Information for Standards Assessment Stations

- Station
  - Could also be a whole assessment unit with all data combined
- Waterbody
  - i.e. (L)ake, (S)tream, (E)stuary
- Class(es)
- Ecoregion
- Longitude and Latitude

High Points

- Reads data straight from STORET zip file
- Can accept data from other sources in the specified format
- Calculates the average of the standards exceedances
- pH – Calculates the average of both upper and lower exceedances
- Trends for all parameters, where there are data
  - It determines whether or not there is a significant trend
    - Statistic values are hidden
  - And whether it is increasing or decreasing
- Toxics – Both chronic and acute assessed
- Biology – Only the most recent assessment is used

Ammonia

- Calculates a criterion for each individual result based on necessary ancillary field measurements
  - pH & temp for freshwater
  - pH, temp, & salinity for saltwater
- Missing field values
  - If there are other measurements within a sample month those values are averaged and used
  - If not the data from the preceding and trailing months are averaged and used
  - If there are no data that fits these criteria the NH3 value is not assessed
- Individual Criterion Calculations are stored in a separate file

File   Edit   View   Insert   Format   Records   Tools   Window   Help

Type a question for help

STAT	CLASS	DATETIME	NH3	WBODY	PH	TEMP	SAL	MONTH	YEAR	PHCALC	TEMPCALC	SALCALC	ACUTE	CHRONIC
B-005A	FW	2011-09-08 12:39:00	0.11	S				9	2011	C	C			
B-014	FW	2010-02-18 14:10:00	0.062	S	6.61	6		2	2010				46.6290478	6.55403401
B-014	FW	2010-04-06 09:25:00	0	S	6.5	17		4	2010	M			48.8280886	5.68071415
B-014	FW	2010-06-07 12:55:00	0.1	S	7.14	24		6	2010				31.5380358	3.01726580
B-014	FW	2010-08-09 12:55:00	0.057	S	7.23	26.9		8	2010				28.5378492	2.38528866
B-014	FW	2010-10-12 13:25:00	0.061	S	7.14	17.5		10	2010				31.5380358	4.58789606
B-014	FW	2011-01-24 13:50:00	0	S	6.61	4.4		1	2011				46.6290478	6.55403401
B-014	FW	2011-03-22 14:27:00	0.076	S	6.82	16		3	2011				41.4492524	5.69131652
B-014	FW	2011-05-11 15:10:00	0.5	S	6.79	25		5	2011				42.2658581	3.21066673
B-014	FW	2011-07-20 15:10:00	0.077	S	6.53	27.1		7	2011				48.2631801	2.94959065
B-014	FW	2011-09-13 14:55:00	0.064	S	7.19	22.4		9	2011				29.8727957	3.26002284
B-014	FW	2011-11-28 14:55:00	0	S	6.5	13.8		11	2011	M			48.8280886	6.66622233
B-014	FW	2012-01-26 11:25:00	0.057	S	6.76	9.1		1	2012				43.0578309	6.35702679
B-014	FW	2012-03-22 09:52:00	0	S	6.75			3	2012		C		43.3162214	
B-014	FW	2012-05-22 12:18:00	0	S	7.12	22		5	2012				32.2008078	3.46593728
B-014	FW	2012-07-12 12:20:00	0.071	S	6.83	23.6		7	2012				41.1717221	3.47727325
B-014	FW	2012-09-20 11:55:00	0.05	S	6.76	20		9	2012				43.0578309	4.46454479
B-014	FW	2012-11-15 12:15:00	0	S	6.76	10		11	2012				43.0578309	6.35702679
B-018A	FW	2010-02-18 13:35:00	0.063	S	6.6	6		2	2010				46.8435907	6.56526992
B-018A	FW	2010-04-06 10:00:00	0	S	7.29	18.5		4	2010				26.5440653	3.95315750
B-018A	FW	2010-06-07 12:30:00	0.064	S	7.19	24		6	2010				29.8727957	2.94049634
B-018A	FW	2010-08-09 12:30:00	0.087	S	7.36	26.8		8	2010				24.2533191	2.20834401
B-018A	FW	2010-10-12 13:00:00	0.078	S	7.1	17.7		10	2010				32.8606442	4.61614269
B-018A	FW	2011-01-24 12:35:00	0.39	S	6.8	3.2		1	2011				41.9963536	6.29458928
B-018A	FW	2011-03-22 12:58:00	0.24	S	6.8	15.5		3	2011				41.9963536	5.90868095
B-018A	FW	2011-05-11 13:45:00	0	S	6.75	24		5	2011				43.3162214	3.45776197

Record: I◄ ◄ 1 ► ►I ►* of 8956

Datasheet View   NUM

Assesment

- (F)ull , (P)artial , (N)ot supporting
  - Bacteria and Conventional Parameters
    - F = ≤ 10% of sample exceeds
    - P = >10% and ≤ 25% of sample exceeds
    - N = >25% of sample exceeds
  - Toxics
    - F = no more than 1 exceedence
    - P = 2 or more exceedence ≤ 10%
    - N = 2 or more and > 10%
- Partial and Not Supporting are considered "impaired" for §303d list

Assessment Output

Beaches

- Beach assessment
  - Done for all stations
  - 10% exceedance calculation
  - Rolling 30 day window for calculating a geometric mean
    - Once a data point is used in one geomean its not used again

Beach Assessment Output

| STAT	BEACH_N	BEACH_N_EX	BEACH_perX	BEACH_AVGX	BEACH_SUP_SSM	BEACH_N_GEO	BEACH_N_GEOX	BEACH_per_GEOX	BEACH_SUP_GEO	BEACH_S
WAC-004	76	4	5.263	304.25	F	12	0	0	F	F
WAC-005	81	6	7.407	4301.5	F	13	0	0	F	F
WAC-005A	72	3	4.167	199	F	12	0	0	F	F
WAC-006	76	2	2.632	133.5	F	12	0	0	F	F
WAC-010	84	5	5.952	537	F	14	2	14.286	P	P
WAC-011	82	4	4.878	380.5	F	13	1	7.692	F	F
WAC-012	85	5	5.882	2851.8	F	13	0	0	F	F
WAC-013	85	6	7.059	513.333	F	14	0	0	F	F
WAC-016A	236	56	23.729	1046.25	P	44	14	31.818	N	N
WAC-017	227	14	6.167	324.786	F	42	5	11.905	P	P
WAC-001	77	1	1.299	173	F	12	0	0	F	F
WAC-002	77	1	1.299	122	F	12	0	0	F	F
WAC-003	72	0	0	0	F	12	0	0	F	F
WAC-007	90	6	6.667	440.5	F	15	0	0	F	F
WAC-015	97	12	12.371	635.667	P	18	3	16.667	P	P
WAC-015A	231	50	21.645	580.64	P	41	15	36.585	N	N
WAC-016	220	18	8.182	268.056	F	44	5	11.364	P	P
WAC-019	225	31	13.778	400.387	P	43	8	18.605	P	P
WAC-025A	243	55	22.634	1122.327	P	45	16	35.556	N	N
WAC-026	84	6	7.143	578.833	F	12	0	0	F	F
WAC-027	86	6	6.977	551.5	F	13	1	7.692	F	F
WAC-031	98	20	20.408	331.6	P	15	2	13.333	P	P
WAC-017A	226	22	9.735	233.091	F	43	5	11.628	P	P
WAC-018	216	17	7.87	248.588	F	38	4	10.526	P	P
WAC-008	84	3	3.571	911.667	F	13	0	0	F	F
WAC-009	79	4	5.063	248.5	F	13	1	7.692	F	F
WAC-009A	93	15	16.129	314.933	P	15	1	6.667	F	P
WAC-014	84	3	3.571	219	F	12	0	0	F	F
WAC-020	245	73	29.796	524.411	N	47	24	51.064	N	N
WAC-021	226	36	15.929	435.833	P	43	9	20.93	P	P

Record: 1 of 54

Overall Supports

- Determines the supports from the assessment file
- Aquatic life use, recreational use, overall use, and each individual parameter

  – Has to merge the acute and chronic criterion

- Gives support by station for each parameter assessed

  – Full, Partial, Not

Supports Output

| STAT	CLASS	OVERALLUSE	RECUSE	ALUSE	AL_F_SUP	AL_P_SUP	AL_N_SU	BIO	DO	PH	TURB	TN	TP	CHLA	NH3	CD	CR	CU
B-005	FW	F	F	F	TURB,DO,PH				F	F	F							
B-005A	FW																	
B-008	FW	P	P	F	TURB,DO,PH				F	F	F							
B-014	FW	P	P	F	BIO,TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG			F	F	F	F				F	F	F	F
B-018A	FW	N	N	F	BIO,TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG			F	F	F	F				F	F	F	F
B-019	FW	N	N															
B-021	FW	P		P		BIO			P									
B-026	FW	N	N															
B-028	FW	N	N															
B-040	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-041	FW	P	P															
B-042	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-044	FW	F	F	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-046	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-047	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-048	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-051	FW	P	P															
B-053	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-054	FW	F	F	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-056	FW	N	N	F	TURB,DO,PH				F	F	F							
B-057	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-062	FW	P	P	F	BIO,TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG			F	F	F	F				F	F	F	F
B-067A	FW	N	N	F	TURB						F							
B-067B	FW	N	N															
B-072	FW	N	N	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-075	FW	N	N	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-080	FW	P	P															
B-081		P		P		BIO			P									
B-086	FW	N	N															
B-097	FW																	
B-099-7	FW	F		F	BIO			F										
B-100	FW	P	F	P	TURB,DO,PH	BIO			P	F	F							
B-102	FW	P	F	P	TURB,DO,PH	BIO			P	F	F							
B-123	FW	N	N															
B-126	FW	P	P	F	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG				F	F	F				F	F	F	F
B-136	FW	N	N	P	TURB,DO,PH,NH3,CD,CR,CU,NI,ZN,HG	BIO			P	F	F				F	F	F	F

KML

- Creates a KML file from the supports file
  - Each assessed station that has a latitude and longitude
 - The support assigned for the assessed parameters

Other Examples

- Beach – end of year report
- Maps of beach stations
- Plots of data
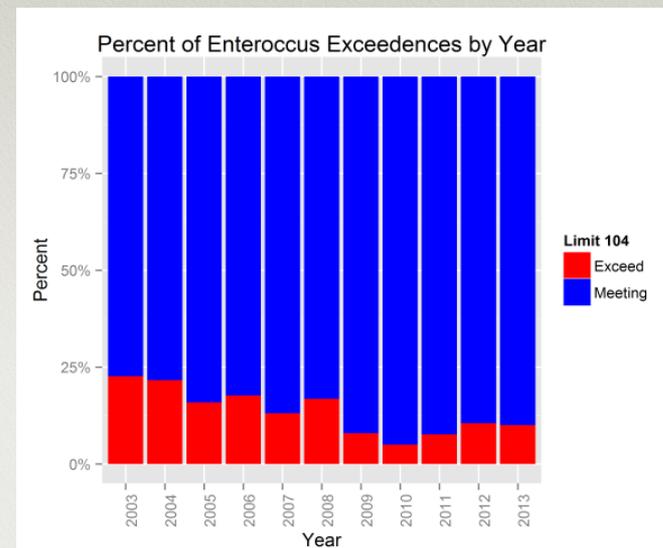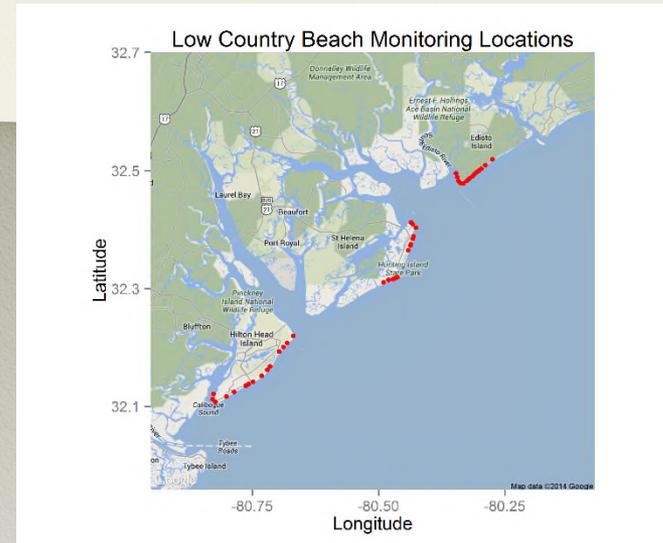
Other Examples

- Source tracking
- qPCR for four targets
- Library phyloseq
- Used output of Qiime

D H E C

PROMOTE PROTECT PROSPER
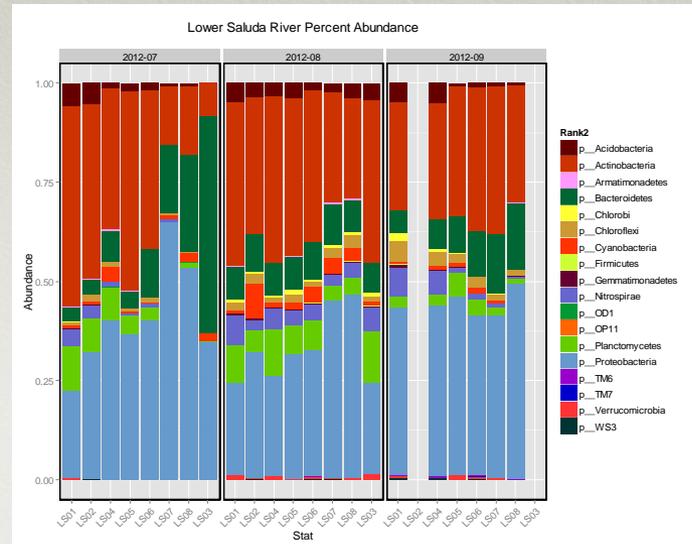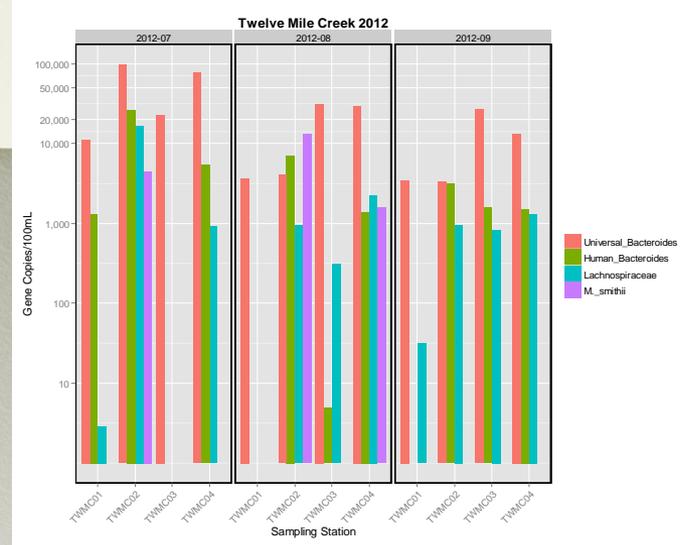
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