September 26, 2014

Dear MCWD Board of Managers,

HDR is pleased to present the report “Lake Data Statistical Analysis Report Part II“. The purpose of the report is to examine water quality trends in District lakes on a monthly time scale and to focus on water quality relationships in Stubbs, Jennings, and Halsteds Bays. Six major conclusions were found:

- Monthly averages were not closely aligned with annual averages for total phosphorus, chlorophyll *a*, or secchi disk transparency.
- Where statistically-significant trends in either bottom total phosphorus or soluble reactive phosphorus were noted on an annual scale, there were typically at least one month showing a similar trend.
- For Stubbs, Jennings, and Halsteds Bays, Secchi disk transparency is generally highly-correlated with chlorophyll *a* on both annual and monthly time scales.
- Chlorophyll *a* is generally not highly-correlated with total phosphorus on both annual and monthly time scales for Stubbs, Jennings, and Halsteds Bays.
- There is an apparent shift in the total phosphorus - chlorophyll *a* relationship around 2005 for Stubbs, Jennings, and Halsteds Bays.
- There is generally a poor statistical relationship between stream total phosphorus loading and bay surface total phosphorus concentration for Stubbs, Jennings, and Halsteds Bays.

Establishing a connection between watershed activities, stream phosphorus loading, in-lake phosphorus concentrations, and chlorophyll *a* using empirical data lends additional justification for the use of BMPs in the watershed. This report provides insights into these relationships, and also gives possible directions for future studies to further our understanding of relationships between water quality variables. We hope that the findings of this report are useful to the District in its endeavors to maintain and improve the quality of its lakes.

Sincerely,
HDR Minneapolis

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Lake Data Statistical Analysis Report Part II.

Prepared for

Minnehaha Creek Watershed District

Prepared by HDR, Minneapolis, MN

August 5, 2014

Table of Contents

List of Figures and Tables

Appendices

I. Introduction

Monitoring of lakes has occurred in the Minnehaha Creek Watershed District (MCWD) since 1968, with significant expansions in monitoring intensity occurring since 1997. Two of the goals of the MCWD Hydrodata Program (as noted in the MCWD 2013 5-Year Monitoring Plan) are to provide data to:

1. Identify long-term trends in water quality, and
2. Maximize efficiencies in monitoring frequencies, locations, and events.

These goals were addressed in part in a previous report (HDR 2013) which analyzed annual trends for Lake Minnetonka (Figure 1) and Upper Watershed lakes (Figure 2) with respect to selected water quality parameters.

Monitored lake surface parameters of concern include total phosphorus (TP), chlorophyll *a* (CHLA), and Secchi disk transparency (SECC). In addition, an overall trophic state index (TSI) value is calculated every year for each monitoring station. These parameters are typical for lake surface sampling, and go back to 1968 for several stations. Lake above-bottom TP and soluble reactive phosphorus (SRP) have been measured in many MCWD-monitored lakes since 2004. MCWD lake sampling frequency is typically every two weeks from late April to early October.

Previous Work

HDR performed statistical analysis on MCWD lake data in 2013 (Phase I). That work had two objectives:

1. Assess the number of monitoring stations on Lake Minnetonka and the required sampling frequency to determine the health of Lake Minnetonka and of the lakes in the upper watershed, and

2. Perform trend analysis to determine statistically-significant improvement or degradation of water quality at the sampling stations.

These analyses focused on the annual time scale (i.e. June-September averages) for 26 Lake Minnetonka stations and 11 upper watershed lake stations. Data review and screening took place during Phase I to address duplicate values, below detection values, etc.

Spatial Sampling Frequency

Phase I results indicated that several Lake Minnetonka bays do not show statistically-significant differences to adjacent bays, suggesting that select adjacent bays are interacting hydraulically to the point that their water quality is quite similar. Given these results, MCWD can consider reducing sampling frequency (e.g. once every three years because of the similarities observed) for the following bays: Smithtown Bay, Phelps Bay, Carman Bay, Harrisons Bay, Forest Lake, Lower Lake North, and North Arm. Continuing to sample these bays on a three-year schedule is important to assess any highly-localized changes that might occur.

Temporal Sampling Frequency

Phase I results suggest that there is no benefit to sampling twice monthly with respect to summer SECC, CHLA, and TP means, and that MCWD can consider reducing sampling frequency from twice monthly to once monthly for all lakes and bays. While there were several instances of statistically-significant differences between "first half of the month" versus "second half of the month" sampling, their occurrences were inconsistent in the data. Hence, no preference should be given to time of the month that a bay or lake is sampled, but it is recommended that MCWD commit to sampling a lake or bay at the same time of month (e.g. always sample Lake X during the first half of the month). This is recommended for consistency and will aid MCWD staff in scheduling summer fieldwork. Increasing sampling frequency (e.g. weekly) would not reduce the relatively large variance seen for all variables enough to result in statistically-significant differences. Although averages may appear far enough apart, the relatively large variations (i.e. standard deviations, not presented) compared to average values makes it unlikely that a statistically-significant difference in averages is occurring.

Trend Analysis

Phase I results show a mixture of increasing, decreasing, and stable water quality trends through time and on a mean annual basis. For the upper watershed lakes, several lakes have remained relatively stable with respect to long-term water quality. These lakes include Christmas Lake, Lake Minnewashta, Parley Lake, Schutz Lake, and Wasserman Lake. Lakes showing trends of improving water quality include Dutch Lake, Gleason Lake, Langdon Lake, Long Lake, and Piersons Lake. The lake showing the most evident trend of decreasing water quality is Lake Virginia.

In Lake Minnetonka, there were few instances of statistically-significant changes in SECC, with decreases noted for Halsted Bay and increases for Peavey Lake and Wayzata Bay. Statistically-significant increases in CHLA were noted in several bays, notably the Southwestern area bays (Halsted Bay, Cooks Bay, West Upper Lake), the South Central area bays (Carman Bay, Spring Park Bay), the Northwestern area bays (Jennings Bay, Harrisons Bay, West Arm, Forest Lake), and the North Central area bays (Stubbs Bay, Maxwell Bay, North Arm). Several of the bays showing statistically-significant CHLA increases have relatively low CHLA (< 10 ppb); these bays include Carman Bay, Lafayette Bay, Lower Lake North, Lower Lake South, Spring Park Bay, St. Albans Bay, and West Upper Lake. Improving water quality with respect to TP was demonstrated with statistically-significant decreases for Black Lake, Carsons Bay, Grays Bay, Halsted Bay, Harrisons Bay, Phelps Bay, and Stubbs Bay. A statistically-significant increase in TP was noted for Peavey Lake. Any statistically-significant changes in TSI were associated with comparable changes in either CHLA or TP.

A comparison of early 1980s water quality to recent water quality for five Lake Minnetonka stations shows marked increases in water quality, in both high quality bays (e.g. Wayzata Bay) and more eutrophic bays (e.g. Jennings Bay). These results are encouraging, and may be due to both natural long-term lake cycles and human actions.

Phase II

The results from Phase I analyses provide an initial look into the complexity of Lake Minnetonka and Upper Watershed Lakes dynamics. Phase I work suggests that additional understanding of how these lakes and bays are changing (or not changing) could be found by performing trend analysis on a monthly basis (e.g. Lower Lake South, June averages through the years). Phase I results also note that there is some potentially unusual behavior taking place in the Lake Minnetonka systems associated with poor water quality (Halsted Bay, Jennings Bay, and Stubbs Bay). While the trend analyses and graphical analyses suggest that TP is decreasing in these bays, CHLA is increasing in these bays and the bays in close proximity. This is counter-intuitive because in P-limited lakes there is typically a strong relationship between TP and CHLA; additional statistical investigation was recommended.

Phase II goals include addressing the suggestions noted from Phase I, examining lake bottom TP trends, SRP trends, and analyzing the relationship between phosphorus concentrations and stream loadings for three Lake Minnetonka bays. The specific objectives of Phase II are:

1. To perform SECC, CHLA, and TP trend analysis on a monthly time scale for surface monitoring stations on Lake Minnetonka (n = 26) and lakes in the upper watershed (n = 11),

2. To perform TP and SRP trend analysis on monthly and annual time scales for lake bottom monitoring stations on Lake Minnetonka (n = 26) and lakes in the upper watershed (n = 11), and

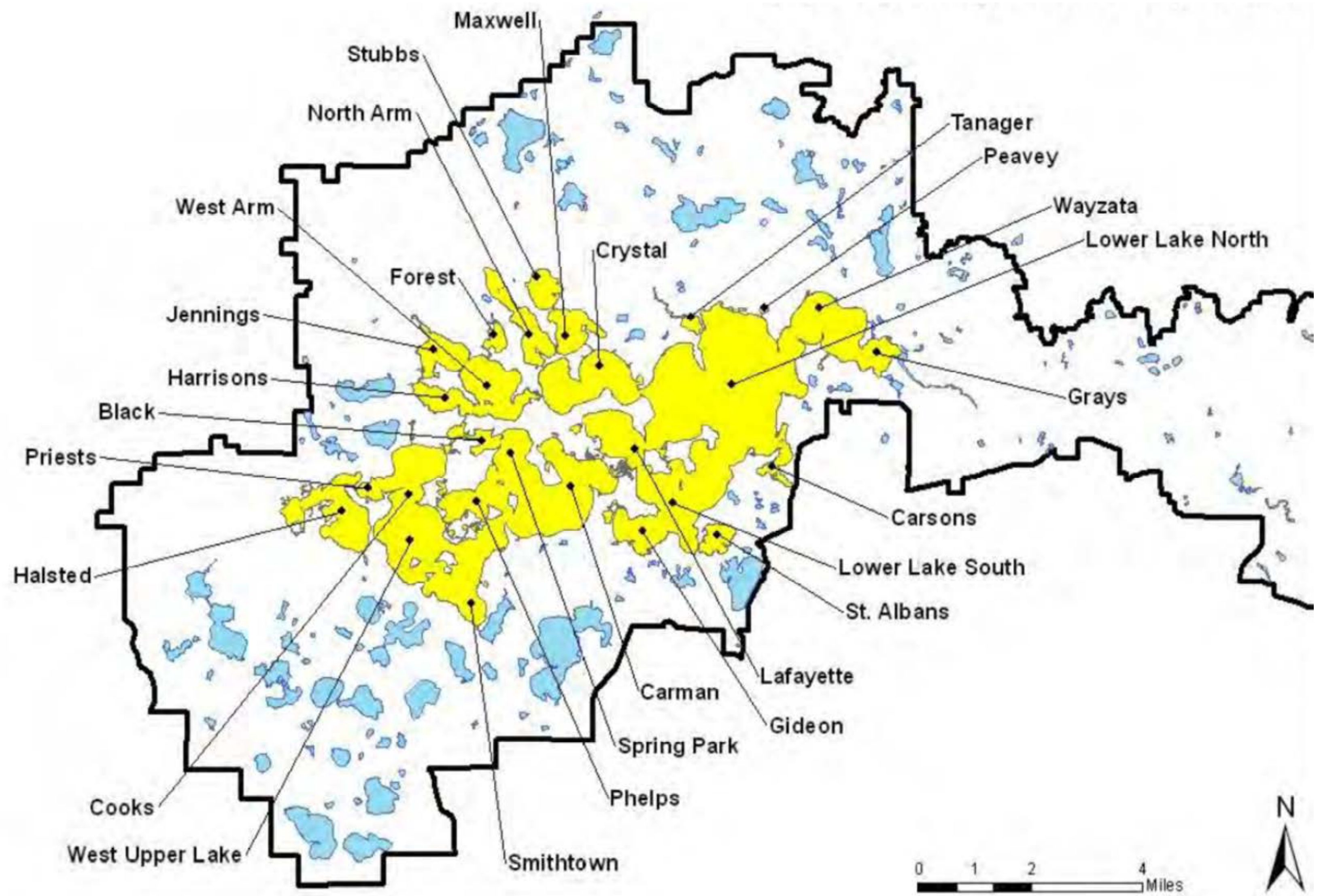
3. To perform water quality analysis on Halsted, Jennings, and Stubbs Bay on Lake Minnetonka to determine why increasing trends in CHLA are accompanied by decreasing trends in TP.

4. To identify any relationship between lake surface phosphorus concentrations and influent stream loadings for Halsted, Jennings, and Stubbs Bays.

Phase II analyzes water quality data from the same 26 Lake Minnetonka stations and 11 Upper Watershed lake stations. SPSS statistical software[1] was used for the analyses because of its ability to provide probability values (i.e. p-values) and the quality and acceptability of its analytical methods as compared to MS Excel programs. Data screening procedures for Phase II are identical to those described in Phase I.

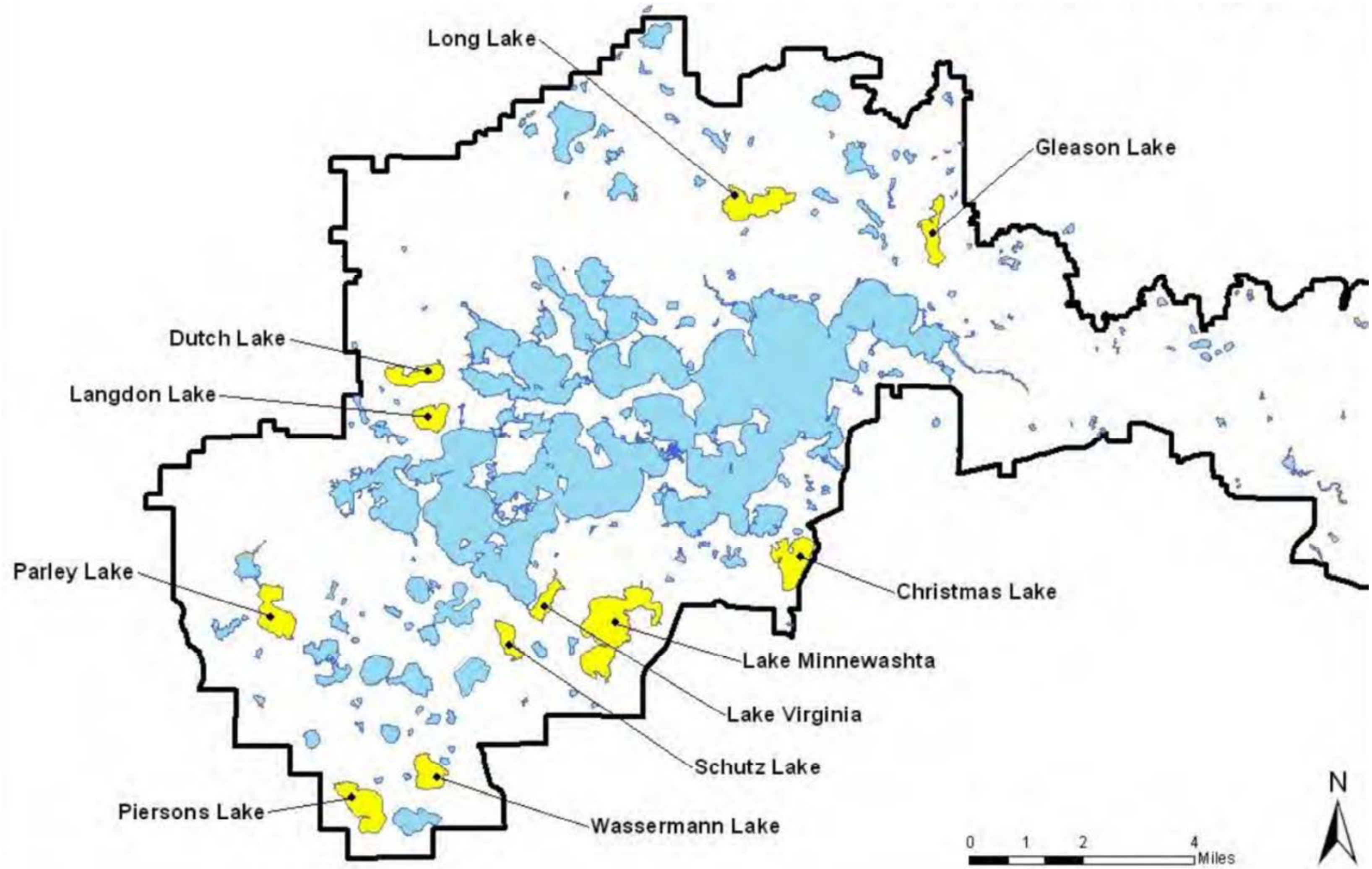
[1] http://www-01.ibm.com/software/analytics/spss/products/statistics/

Figure 1. Lake Minnetonka Water Quality Monitoring Stations*



*from MCWD 2011 Hydrologic Data Monitoring Report

Figure 2. Upper Watershed Lakes Water Quality Monitoring Stations*



*from MCWD 2011 Hydrologic Data Monitoring Report

II. Surface Samples: Monthly Trend Analysis

This analysis focused on trends displayed on a mean monthly basis (June-September) to determine if water quality (i.e. SECC, CHLA, and TP) is improving, decreasing, or showing no trend over the period of record. Three approaches were utilized for each station: raw water quality data, water quality data adjusted for monthly precipitation, and water quality data adjusted for monthly average air temperature (during sampling season). Data available from the 1997 to 2012 period were used for each monitoring station (26 Lake Minnetonka bays, 11 Upper Watershed lakes). Values for precipitation and air temperature are presented in Table 1. Precipitation and air temperature were used as weighting variables in addition to analyzing the raw data.

Table 1. Average Monthly Precipitation and Air Temperatures (MSP Airport)

	Precipitation (in)				Air Temperature (degr F)			
Year	JUN	JUL	AUG	SEP	JUN	JUL	AUG	SEP
1997	3.70	12.60	6.01	3.19	70.0	71.0	68.8	62.4
1998	6.52	2.63	5.99	1.32	64.9	72.6	71.6	66.6
1999	3.68	4.55	2.64	2.73	67.3	76.2	70.1	61.1
2000	4.56	6.10	3.19	2.15	66.1	72.4	72.2	61.6
2001	6.35	2.12	2.31	3.50	69.1	75.9	74.2	60.9
2002	8.30	5.19	8.30	3.89	71.1	77.0	70.9	65.5
2003	4.66	2.06	1.12	2.20	68.2	73.7	75.3	62.5
2004	3.06	3.36	1.19	4.21	65.4	72.2	66.3	67.4
2005	4.24	2.94	5.22	4.44	73.4	76.8	71.7	66.3
2006	2.81	1.29	6.90	2.44	70.9	79.6	72.1	59.6
2007	2.05	3.29	9.32	6.04	72.7	76.0	71.1	64.8
2008	2.70	2.13	3.35	1.78	68.7	75.6	72.5	63.6
2009	2.86	2.17	6.43	0.46	67.7	70.0	69.4	66.5
2010	6.25	3.03	4.91	5.52	69.2	76.3	77.0	60.2
2011	5.28	5.23	3.03	0.36	69.5	78.8	73.6	62.9
2012	3.59	4.90	1.38	0.30	72.3	80.2	72.0	63.9

For the purposes of this report, statistically-significant trends showing improvement or decline in water quality (positive or negative, p-values less than or equal to 0.1 using one-way ANOVAs) are reported for a given sampling station, water quality parameter, and month. The trends are noted if any of the approaches (raw data, precipitation weighted data, or air temperature weighted data) resulted in a statistically-significant result.

Temporal plots of the surface water quality data are located in Appendix A.

Upper Watershed Lakes

Results suggest that statistically-significant trends in water quality on a mean annual basis (June-September) do not necessarily imply such a trend on a monthly basis. For example, Dutch Lake showed a declining trend in SECC on an annual basis, but no such trend on a monthly basis (Table 2).

For lakes in which declining SECC was noted, changes typically occurred in August and September (e.g. Long Lake, Lake Minnewashta). For lakes in which increasing SECC was noted, changes typically occurred in most months (e.g. Langdon Lake, Piersons Lake). For lakes in which declining CHLA was noted, declines in TP were also noted (e.g. Christmas Lake, Langdon Lake, Piersons Lake).

Table 2. Trend Analysis for Raw and Weighted Data, Upper Watershed Lakes (By Parameter and Time Period)

	SECC					CHLA					TP				
Lake	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**
Christmas							Increasing		Increasing	Increasing					Increasing
Dutch					Declining		Increasing		Declining				Increasing		
Gleason													Increasing	Increasing	Increasing
Langdon		Increasing	Increasing	Increasing		Declining			Increasing	Increasing		Increasing			
Long			Declining	Declining	Declining				Declining					Declining	
Minnewashta			Declining	Declining	Declining										
Parley				Declining									Increasing		
Piersons	Increasing	Increasing	Increasing	Increasing	Increasing		Increasing	Increasing	Increasing	Increasing	Increasing		Increasing	Increasing	Increasing
Schutz							Declining			Declining			Declining		
Virginia						Declining				Declining					
Wasserman				Declining											

	JUN			JUL			AUG			SEP			ANN		
Lake	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**
Christmas					Increasing						Increasing			Increasing	Increasing
Dutch					Increasing				Increasing		Declining		Declining		
Gleason									Increasing			Increasing			Increasing
Langdon		Declining		Increasing		Increasing	Increasing			Increasing	Increasing			Increasing	
Long							Declining			Declining	Declining	Declining	Declining		
Minnewashta							Declining			Declining			Declining		
Parley									Increasing	Declining					
Piersons	Increasing		Increasing	Increasing	Increasing		Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Schutz					Declining				Declining					Declining	
Virginia		Declining												Declining	
Wasserman										Declining					

Increasing water quality (blue)
Declining water quality (gold)

*note that cells are left blank when a statistically-significant trend was not observed.

Lake Minnetonka Bays

The following spatial clusters of monitoring stations in Lake Minnetonka were selected for analysis:

- Southwestern: Halsted Bay – Priests Bay – Cooks Bay – West Upper Lake – Smithtown Bay – Phelps Bay – Black Lake – Spring Park Bay – Carman Bay
- Northwestern: Jennings Bay – West Arm – Harrisons Bay – Forest Lake
- North Central: Stubbs Bay – North Arm – Maxwell Bay – Crystal Bay
- Northeastern: Lower Lake North – Wayzata Bay – Grays Bay – Peavey Lake – Tanager Lake
- Southeastern: Lafayette Bay – St. Albans Bay – Lower Lake South – Carsons Bay

Declines in SECC were noted primarily in the Southwestern and Northwestern bays (Tables 3 and 4), while increases in CHLA were noted across Lake Minnetonka. Declines in TP were noted across Lake Minnetonka as well, which suggests that there might not be a strong statistical relationship between TP and CHLA in the lake because declining TP is often thought to be associated with declining CHLA.

Table 3. Trend Analysis for Raw and Weighted Data, Lake Minnetonka Bays (By Parameter)

	SECC					CHLA					TP				
Bay	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**
Halsted	Declining	Declining	Declining	Declining	Declining			Declining	Declining	Declining		Increasing	Increasing	Increasing	
Priests			Declining						Declining						Increasing
Cooks		Declining	Increasing	Increasing			Declining	Declining	Declining	Declining	Increasing	Increasing	Increasing	Increasing	
West Upper		Declining					Declining	Declining	Declining	Declining	Increasing	Increasing	Increasing	Increasing	
Smithtown									Declining				Increasing		
Phelps											Increasing			Increasing	Increasing
Black												Increasing	Increasing	Increasing	Increasing
Spring Park								Declining	Declining	Declining	Increasing	Increasing			
Carman										Declining		Increasing			
Jennings			Declining				Declining	Declining	Declining	Declining					
West Arm			Declining				Declining	Declining	Declining	Declining	Increasing	Increasing	Increasing	Increasing	
Harrisons			Declining				Declining	Declining	Declining	Declining	Increasing	Increasing			Increasing
Forest			Declining	Declining				Declining		Declining	Increasing				
Stubbs								Declining	Declining	Declining	Increasing	Increasing			Increasing
North Arm		Declining	Declining				Declining	Declining	Declining	Declining				Increasing	
Maxwell	Increasing						Declining	Declining	Declining	Declining	Increasing				
Crystal															
LLNorth										Declining					
Wayzata	Increasing	Increasing		Increasing	Increasing			Declining	Increasing		Increasing	Increasing	Increasing	Increasing	
Grays	Increasing			Declining									Increasing		Increasing
Peavey					Increasing							Declining	Declining	Declining	Declining
Tanager			Declining					Declining				Increasing	Declining		
Lafayette									Declining	Declining					
St Albans										Declining	Increasing	Increasing	Increasing	Increasing	
LLSouth	Increasing								Declining	Declining	Increasing	Increasing	Increasing	Increasing	
Carsons	Increasing										Increasing				Increasing

Increasing water quality

Declining water quality

*note that cells are left blank when a statistically-significant trend was not observed.

HDR

Table 4. Trend Analysis for Raw and Weighted Data, Lake Minnetonka Bays (By Time Period)

	JUN			JUL			AUG			SEP			ANN		
Bay	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**	**SECC**	**CHLA**	**TP**
Halsted	Declining			Declining		Increasing	Declining	Declining	Increasing	Declining	Declining	Increasing	Declining	Declining	
Priests							Declining				Declining				Increasing
Cooks			Increasing	Declining	Declining	Increasing	Increasing	Declining	Increasing	Increasing	Declining	Increasing		Declining	
West Upper			Increasing	Declining	Declining	Increasing		Declining	Increasing		Declining	Increasing		Declining	
Smithtown									Increasing		Declining				
Phelps			Increasing									Increasing			Increasing
Black						Increasing			Increasing			Increasing			Increasing
Spring Park			Increasing			Increasing		Declining			Declining			Declining	
Carman						Increasing								Declining	
Jennings					Declining		Declining	Declining			Declining			Declining	
West Arm			Increasing		Declining	Increasing	Declining	Declining	Increasing		Declining	Increasing		Declining	
Harrisons			Increasing		Declining	Increasing	Declining	Declining			Declining			Declining	Increasing
Forest			Increasing				Declining	Declining		Declining				Declining	
Stubbs			Increasing			Increasing		Declining			Declining			Declining	Increasing
North Arm				Declining	Declining		Declining	Declining			Declining	Increasing		Declining	
Maxwell	Increasing		Increasing		Declining			Declining			Declining			Declining	
Crystal															
LLNorth														Declining	
Wayzata	Increasing		Increasing	Increasing		Increasing		Declining	Increasing	Increasing	Increasing	Increasing	Increasing		
Grays	Increasing								Increasing	Declining					Increasing
Peavey						Declining			Declining			Declining			Declining
Tanager						Increasing	Declining	Declining	Declining						
Lafayette											Declining			Declining	
St Albans			Increasing			Increasing			Increasing			Increasing		Declining	
LLSouth	Increasing		Increasing			Increasing			Increasing		Declining	Increasing		Declining	
Carsons	Increasing		Increasing												Increasing

Increasing water quality
Declining water quality

*note that cells are left blank when a statistically-significant trend was not observed.

III. Bottom TP and SRP: Annual and Monthly Trend Analysis

This analysis focused on trends displayed on a mean monthly and mean annual (June-September) basis to determine if water quality is increasing, declining, or remaining the same over the period of record. Only the raw water quality data was analyzed (i.e. no weighting). Data available from the 1997 to 2012 period were used for each monitoring station (26 Lake Minnetonka bays, 11 Upper Watershed lakes) to assess trends over the period of record. For the purposes of this report, significant trends in either increasing or declining water quality (positive or negative, p-values less than or equal to 0.1 using one-way ANOVAs) are reported for a given sampling station, water quality parameter, and month. Temporal plots of the bottom water quality data are located in Appendix B.

Upper Watershed Lakes

Trends in bottom TP were not always associated with trends in bottom SRP in the upper watershed lakes (Table 5). For example, Christmas Lake showed a statistically-significant increasing trend in bottom TP in July, but not for bottom SRP. Christmas Lake and Long Lake showed statistically-significant increasing trends for both bottom TP and SRP. Gleason Lake showed statistically-significant declining trends for both TP and SRP. Schutz Lake showed a statistically-significant declining trend in TP but not SRP. Dutch, Parley, Piersons, and Wasserman showed statistically-significant declining trends for bottom SRP.

Lake Minnetonka Bays

Trends in bottom TP were not always associated with trends in bottom SRP in Lake Minnetonka bays (Tables 6 and 7). For example, Black Lake showed a statistically-significant decline in bottom TP for August, but not for SRP. Cooks, West Arm, Wayzata, Peavey, Tanager, St. Albans, and Lower Lake South showed statistically-significant increasing trends for either TP or SRP. Halsted, Priests, Smithtown, Black, Spring Park, West Arm, Harrisons, Forest, Crystal, Grays, Lafayette, and Carsons showed statistically-significant declining trends for either TP or SRP.

Table 5. Trend Analysis for Lake Bottom Data, Upper Watershed Lakes (By Parameter and Time Period)

	BOTTOM TP					BOTTOM SRP				
LAKE	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**
Christmas										
Dutch										
Gleason										
Langdon										
Long										
Minnewashta										
Parley										
Piersons										
Schutz										
Virginia										
Wasserman										

	JUN		JUL		AUG		SEP		ANN	
Lake	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**
Christmas										
Dutch										
Gleason										
Langdon										
Long										
Minnewashta										
Parley										
Piersons										
Schutz										
Virginia										
Wasserman										

Improving water quality

Decreasing water quality

*note that cells are left blank when a statistically-significant trend was not observed.

Table 6. Trend Analysis for Lake Bottom Data, Lake Minnetonka Bays (By Parameter)

	BOTTOM TP					BOTTOM SRP				
BAY	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**
Halsted Bay	[Improving]	[Improving]			[Improving]	[Improving]	[Improving]			
Priests Bay	[Improving]		[Improving]	[Improving]		[Improving]		[Improving]	[Improving]	
Cooks Bay		[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]
West Upper										
Smithtown Bay		[Improving]	[Improving]	[Improving]	[Improving]		[Improving]	[Improving]		[Improving]
Phelps Bay										
Black Lake			[Improving]							
Spring Park Bay	[Improving]	[Improving]		[Improving]		[Improving]	[Improving]	[Improving]		[Improving]
Carman Bay										
Jennings Bay										
West Arm	[Improving]								[Decreasing]	
Harrisons Bay	[Improving]									
Forest Lake	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]
Stubbs Bay										
North Arm										
Maxwell Bay										
Crystal Bay			[Improving]	[Improving]	[Improving]					
Lower Lake North										
Wayzata Bay									[Decreasing]	[Decreasing]
Grays Bay					[Improving]					
Peavey Lake	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]
Tanager Lake			[Decreasing]							
Lafayette Bay	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	[Improving]	
St. Albans Bay			[Decreasing]	[Decreasing]	[Decreasing]				[Decreasing]	
Lower Lake South		[Decreasing]	[Decreasing]				[Decreasing]	[Decreasing]	[Decreasing]	[Decreasing]
Carsons Bay		[Improving]	[Improving]	[Improving]		[Improving]		[Improving]	[Improving]	

Improving water quality (blue)
Decreasing water quality (orange)

*note that cells are left blank when a statistically-significant trend was not observed.

Table 7. Trend Analysis for Lake Bottom Data, Lake Minnetonka Bays (By Time Period)

	JUN		JUL		AUG		SEP		ANN	
Bay	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**	**TP**	**SRP**
Halsted Bay	Improving	Improving	Improving	Improving					Improving	
Priests Bay	Improving	Improving			Improving	Improving	Improving	Improving		
Cooks Bay		Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
West Upper										
Smithtown Bay			Improving	Improving	Improving	Improving	Improving		Improving	Improving
Phelps Bay										
Black Lake					Improving					
Spring Park Bay	Improving	Improving	Improving	Improving		Improving	Improving			Improving
Carman Bay										
Jennings Bay										
West Arm	Improving							Decreasing		
Harrisons Bay	Improving									
Forest Lake	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving
Stubbs Bay										
North Arm										
Maxwell Bay										
Crystal Bay					Improving		Improving		Improving	
Lower Lake North										
Wayzata Bay								Decreasing		Decreasing
Grays Bay									Improving	
Peavey Lake	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Tanager Lake					Decreasing					
Lafayette Bay	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
St. Albans Bay					Decreasing		Decreasing	Decreasing	Decreasing	
Lower Lake South			Decreasing	Decreasing	Decreasing	Decreasing		Decreasing		Decreasing
Carsons Bay		Improving	Improving		Improving	Improving	Improving	Improving		

Improving water quality (blue)

Decreasing water quality (orange)

*note that cells are left blank when a statistically-significant trend was not observed.

IV. Halsted, Jennings, and Stubbs Bay Analysis

This analysis was performed because Phase I results show unusual patterns in these systems. While the trend analyses and graphical analyses suggest that TP is declining in these bays, CHLA is increasing in these bays and the bays in close proximity. This section will provide additional statistical investigation into these observations. These analyses focus on trends displayed in the mean monthly and mean annual water quality data (June-September) to determine the relationships between variables.

Halsted Bay

Halsted Bay typically had the highest monthly SECC values and lowest monthly CHLA values in June (Figure 3). TP values did not display similar behavior. High CHLA and TP values often remain late in the season (August and September). As shown in Table 3, Halsted Bay showed statistically-significant declines in SECC during all months and on an annual basis, statistically-significant increases in CHLA during August and September and on an annual basis, and statistically-significant declines in TP during July, August, and September.

Bottom TP and SRP values were relatively low in June, relatively high in July and August, but then declined greatly in September (Figure 4). This behavior might suggest that fall turnover may occur in late August/early September in some years, because September surface TP at times is elevated relative to other months (Figure 3); MCWD has lake temperature profile data that could assess this idea.

As shown in Phase I, Halsted Bay had statistically-significant declines in SECC and statistically-significant declines in CHLA on an annual basis, but not so for TP (Figure 5). Comparisons between TP and CHLA showed no statistically-significant relationships, while comparisons between CHLA and SECC showed statistically-significant relationships on both monthly and annual time scales (Figure 5, Table 8).

Jennings Bay

Jennings Bay typically had the highest monthly SECC values and lowest monthly CHLA values in June (Figure 6). TP values did not display similar behavior. Low SECC, high CHLA, and high TP values often remain late in the season (August and September). As shown in Table 3, Jennings Bay showed statistically-significant declines in SECC in August, statistically-significant increases in CHLA during July, August, September, and on an annual basis, but no statistically-significant trends in TP.

Bottom TP and SRP values were relatively low in June, relatively high in July and August, but then declined greatly in September (Figure 7). This behavior might suggest that fall turnover may occur in late August/early September in some years, because September surface TP at times is elevated relative to other months (Figure 6); MCWD has lake temperature profile data that could assess this idea.

Jennings Bay had statistically-significant increases in CHLA, but not so for either SECC or TP (Figure 8). Comparisons between TP and CHLA showed a statistically-significant relationship in

August (positive slope), while comparisons between CHLA and SECC showed statistically-significant relationships on both monthly and annual time scales (Figure 8, Table 8).

Stubbs Bay

Stubbs Bay typically had the highest monthly SECC values and lowest monthly CHLA values in June (Figure 9). TP values did not display similar behavior. High CHLA and TP values often remain late in the season (August and September). As shown in Table 3, Stubbs Bay showed statistically-significant increases in CHLA during August, September, and annually, and statistically-significant declines in TP during June, July, and annually.

Bottom TP and SRP values were relatively low in June, relatively high in July and August, and often higher in September (Figure 10). This behavior might suggest that fall turnover may occur after September in some years because surface TP does not increase greatly in September (Figure 9); MCWD has lake temperature profile data that could assess this idea.

Stubbs Bay had statistically-significant increases in CHLA and statistically-significant declines in TP on an annual basis, but not so for SECC (Figure 11). Comparisons between TP and CHLA showed a statistically-significant relationship in June (positive slope), while comparisons between CHLA and SECC showed statistically-significant relationships on both monthly and annual time scales (Figure 11, Table 8).

Annual Surface Water Quality Relationships for All Waterbodies

A brief exercise to determine if poor TP-CHLA relationships and/or strong CHLA-SECC relationships existed in other Lake Minnetonka bays existed on an annual basis revealed that 7 of the 26 bays had statistically-significant relationships between TP and CHLA, and 16 of the 26 bays had statistically-significant relationships between CHLA and SECC (Table 9). A similar exercise using Upper Watershed lakes indicated that 6 of the 11 lakes had statistically-significant relationships between TP and CHLA, and 8 of the 11 lakes had statistically-significant relationships between CHLA and SECC (Table 10).

Comparison of annual TP versus CHLA relationships by time period is depicted in Figure 12. In all three bays there appears to be a shift in the relationship around 2005 or 2006. Comparing the 1997-2005 period to the 2006-2012 period, in general TP values shift lower but CHLA values shift higher. Splitting out the two time periods, the relationship between TP and CHLA is statistically-significant for all comparisons except for Halsted 1999-2005 and Stubbs 1997-2005.

Figure 3. Halsted Bay SECC, CHLA, and TP Concentration Surface Time Series

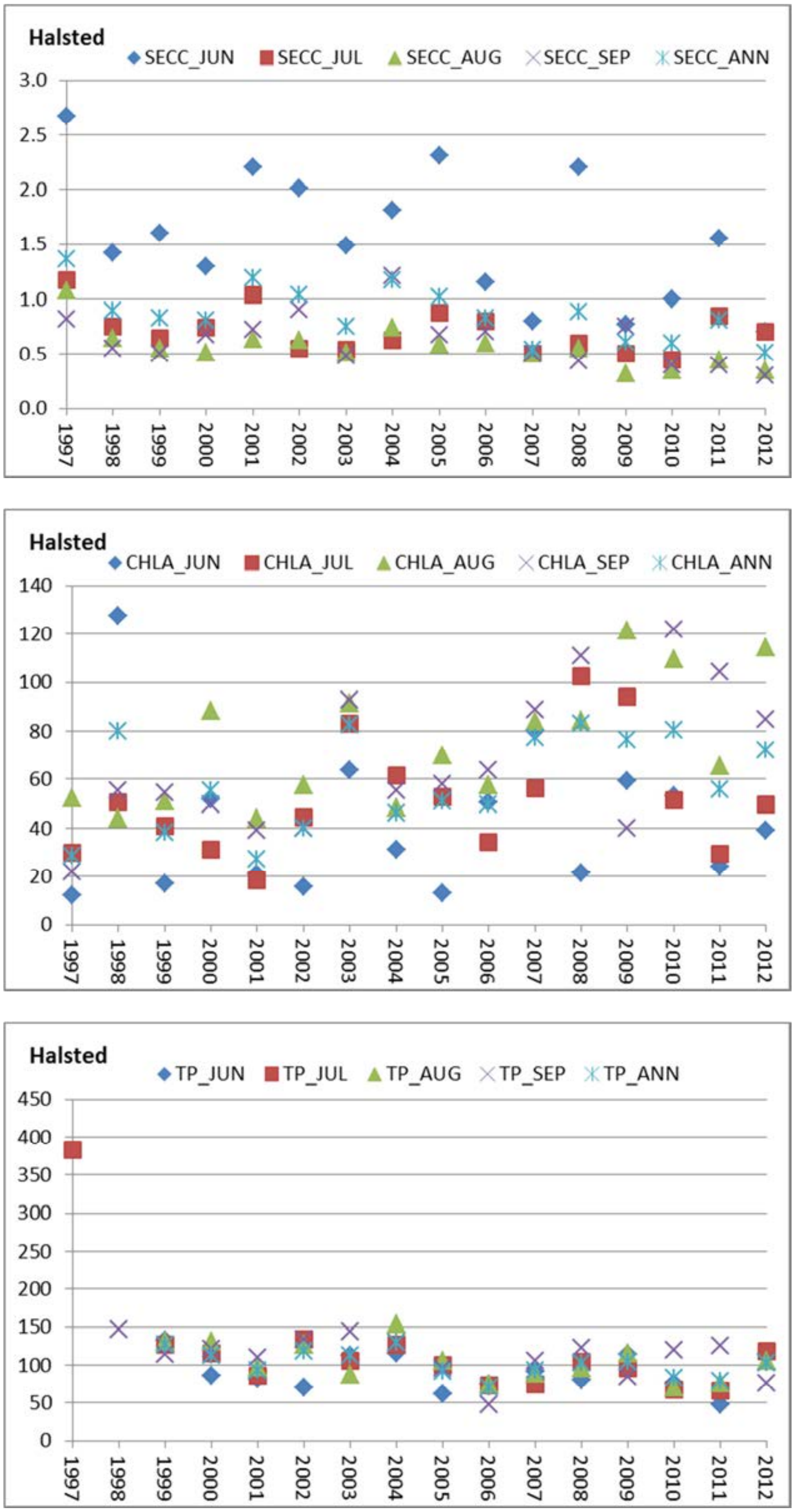
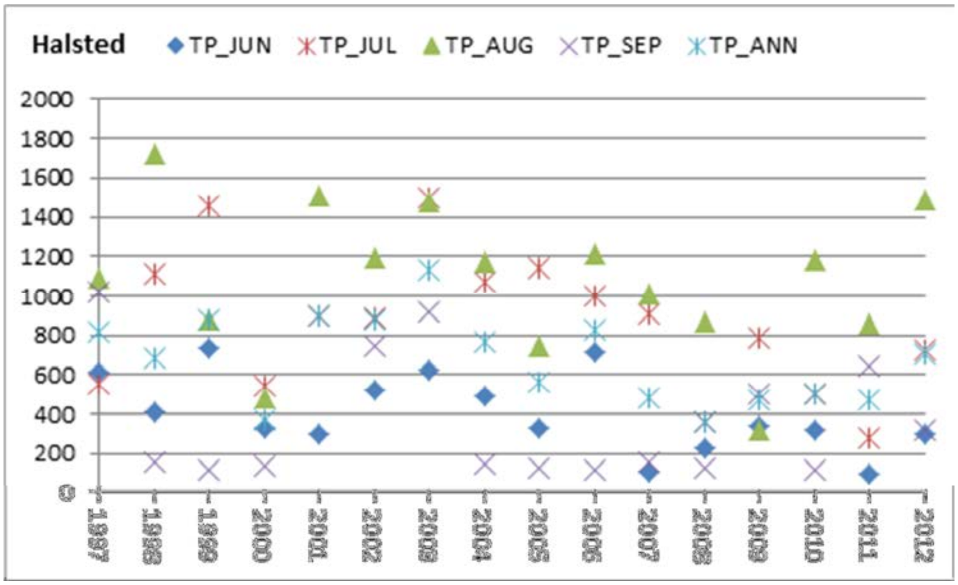


Figure 4. Halsted Bay Bottom TP and SRP Concentration Time Series



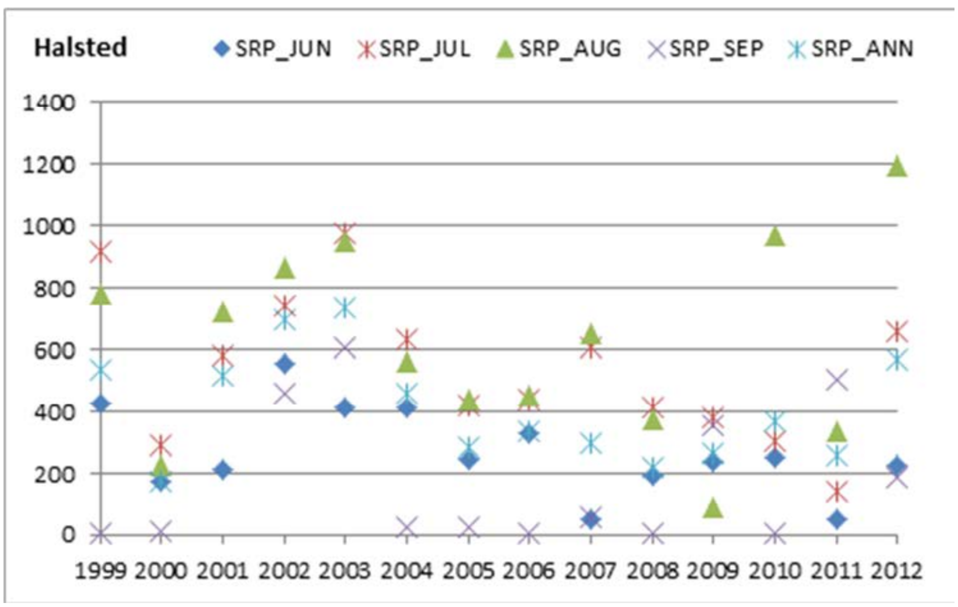
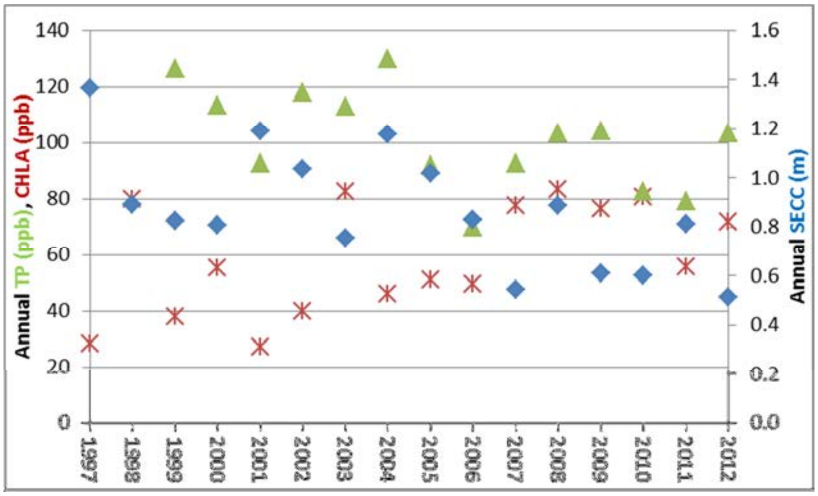
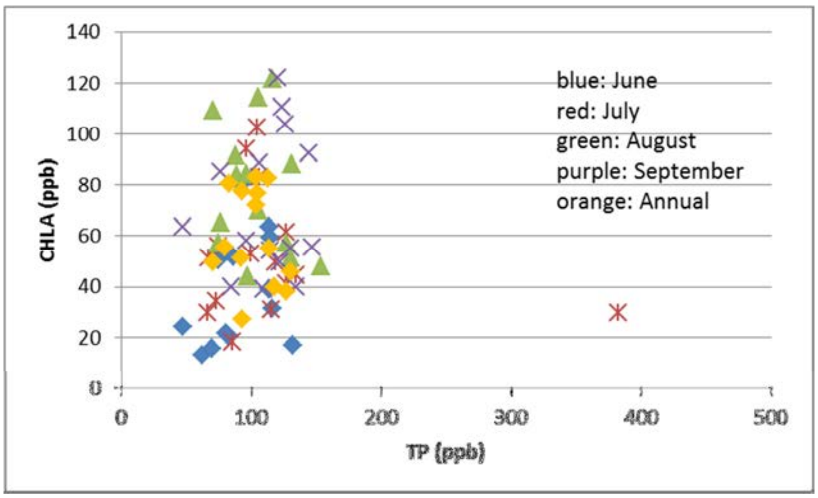


Figure 5. Halsted Bay TP, CHLA, and SECC Annual Time Series, TP-CHLA Relationships, and CHLA-SECC Relationships





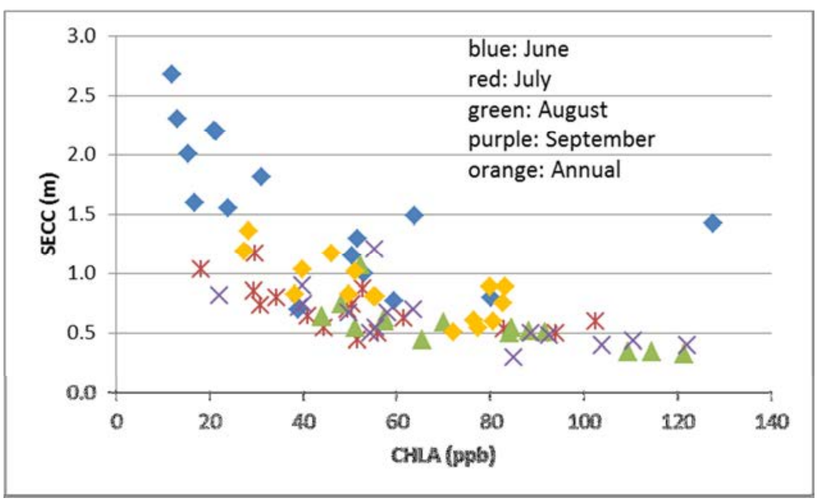


Figure 6. Jennings Bay SECC, CHLA, and TP Surface Concentration Time Series

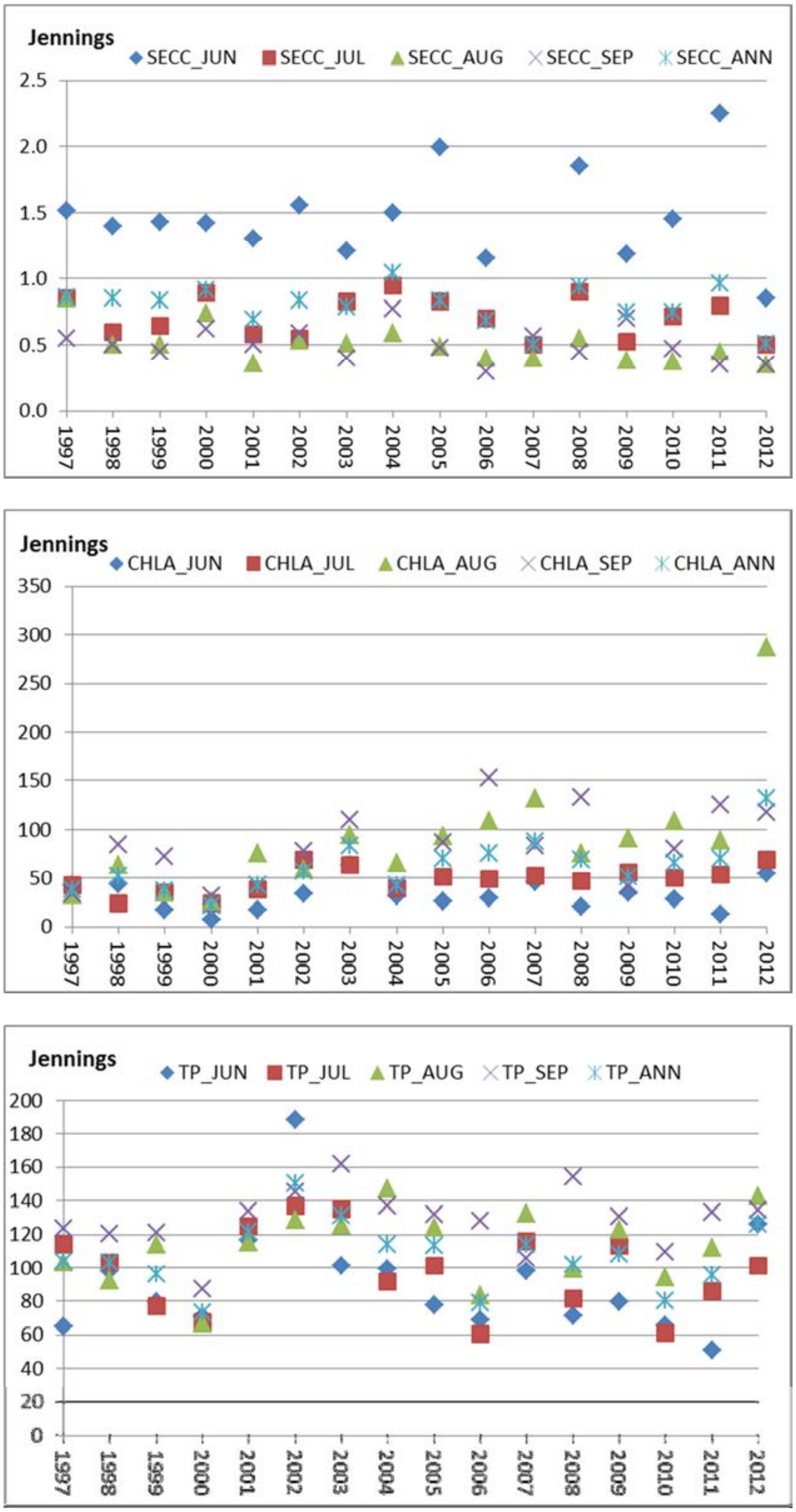
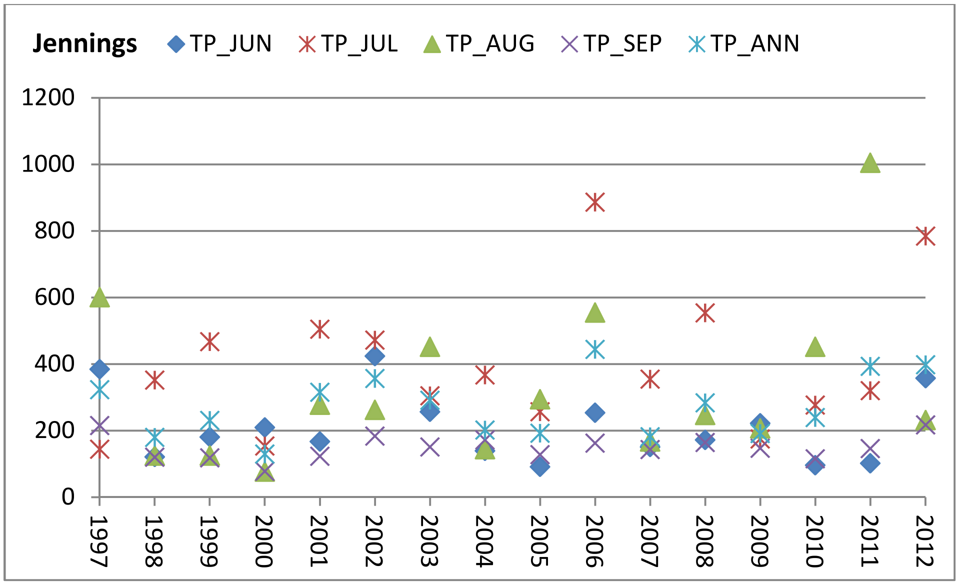


Figure 7. Jennings Bay Bottom TP and SRP Concentration Time Series



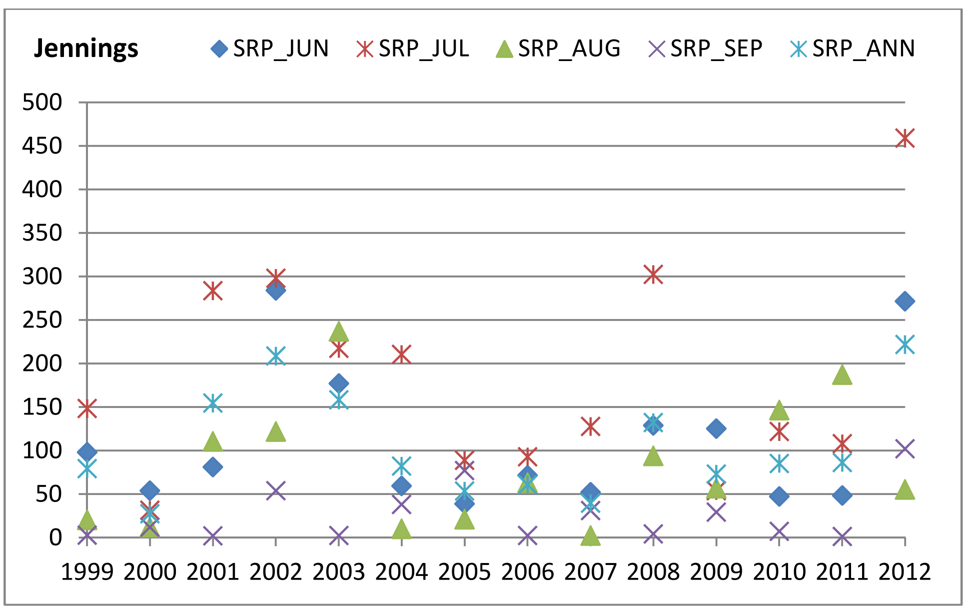
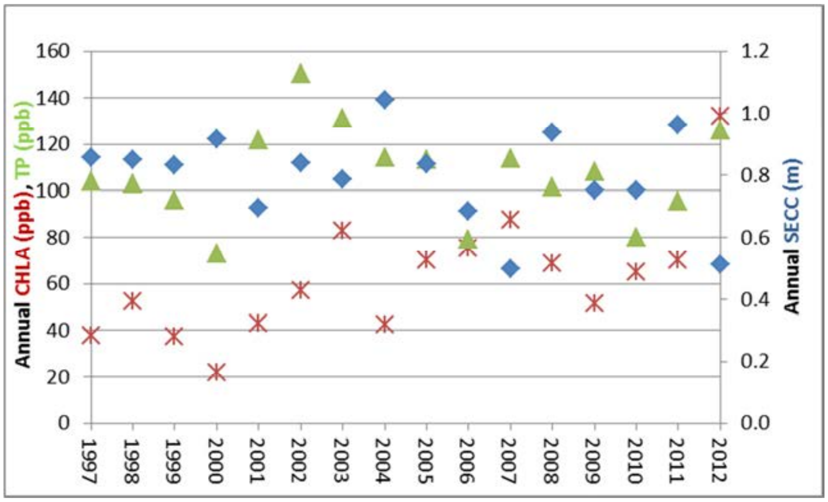
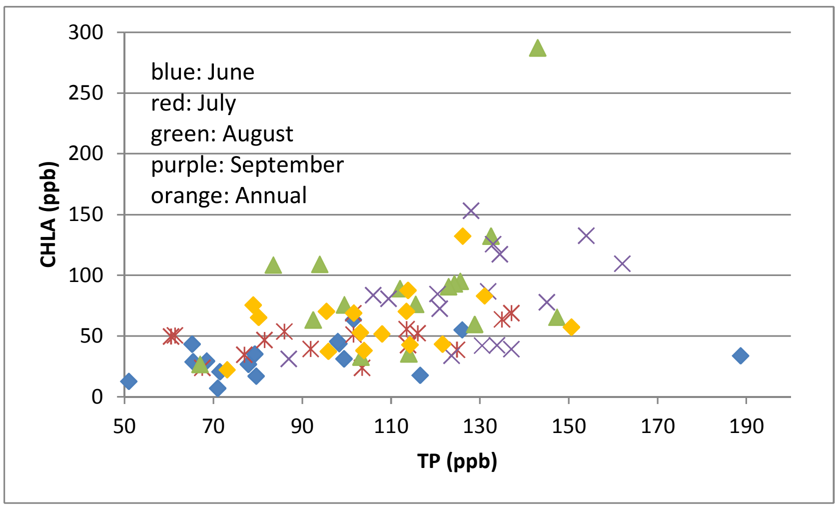


Figure 8. Jennings Bay TP, CHLA, and SECC Annual Time Series, TP-CHLA Relationships, and CHLA-SECC Relationships





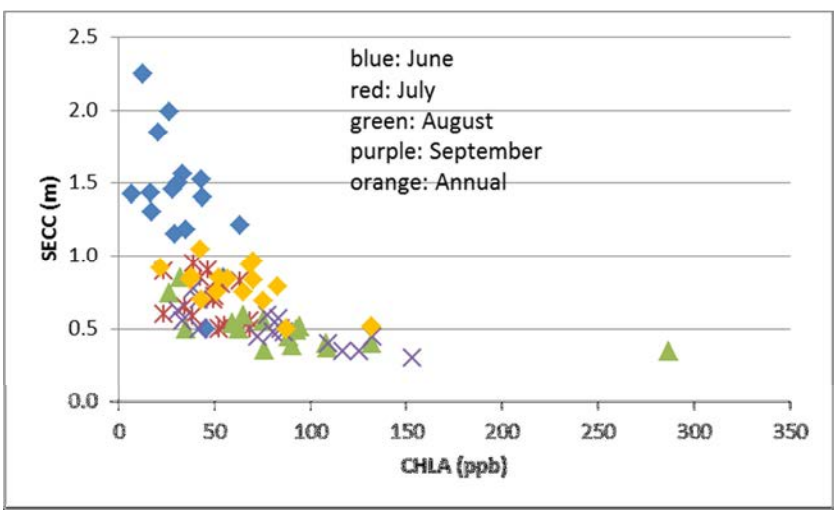


Figure 9. Stubbs Bay SECC, CHLA, and TP Surface Concentration Time Series

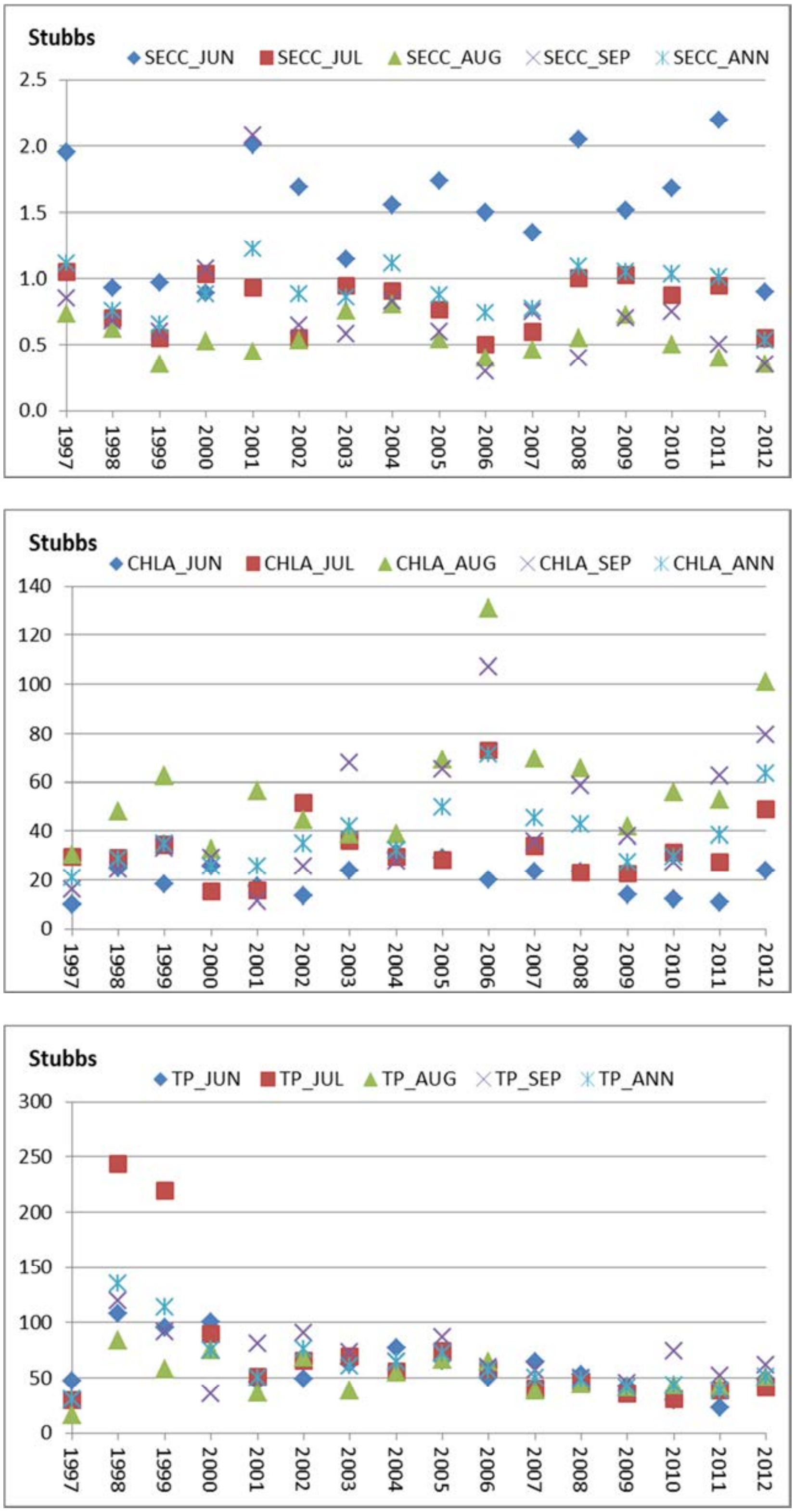
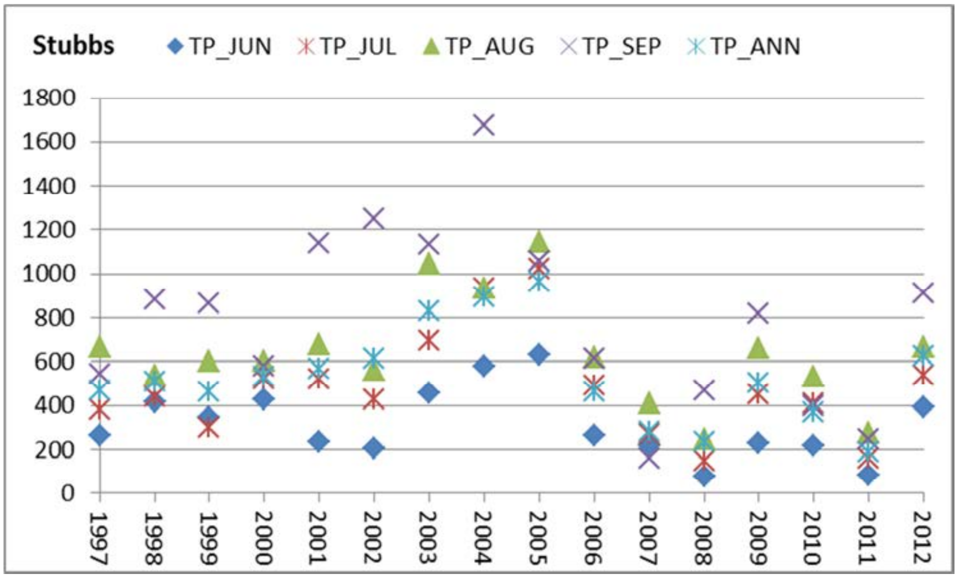


Figure 10. Stubbs Bay Bottom TP and SRP Concentration Time Series



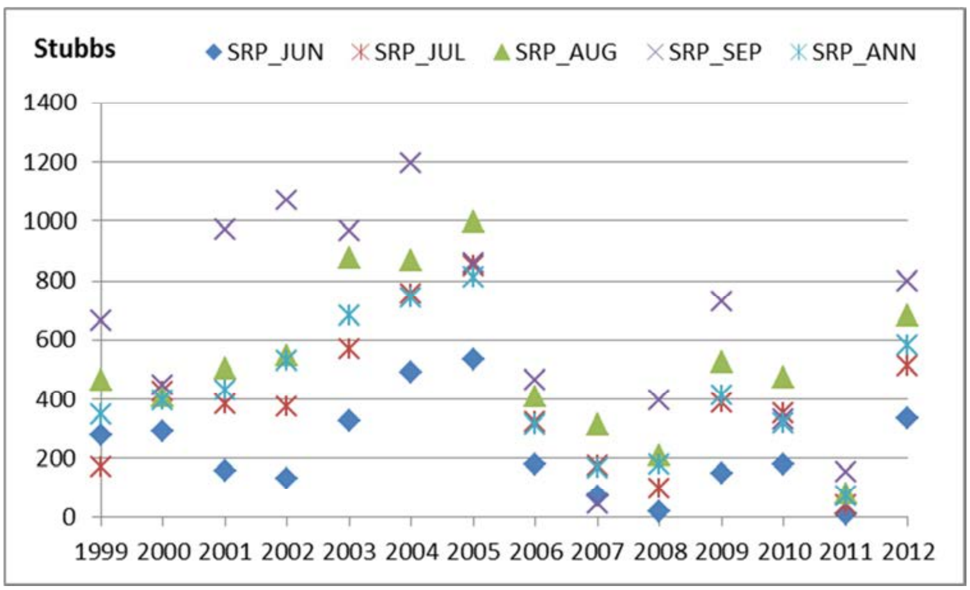
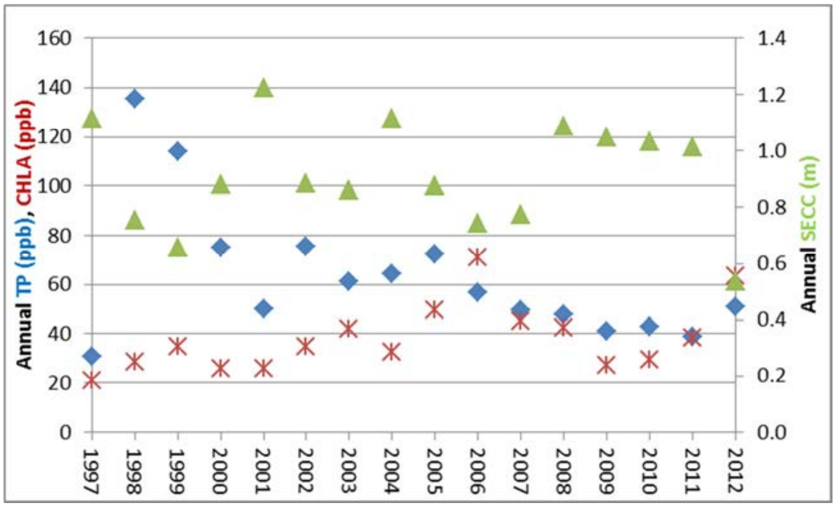
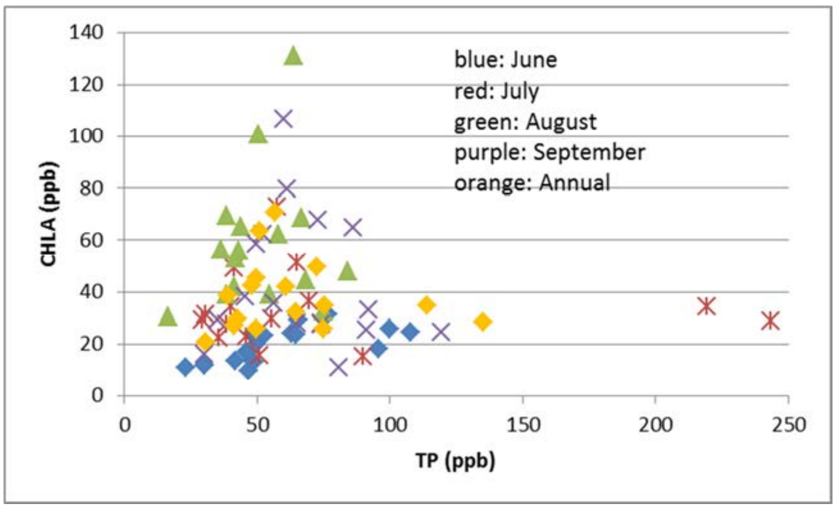


Figure 11. Stubbs Bay TP, CHLA, and SECC Annual Time Series, TP-CHLA Relationships, and CHLA-SECC Relationships





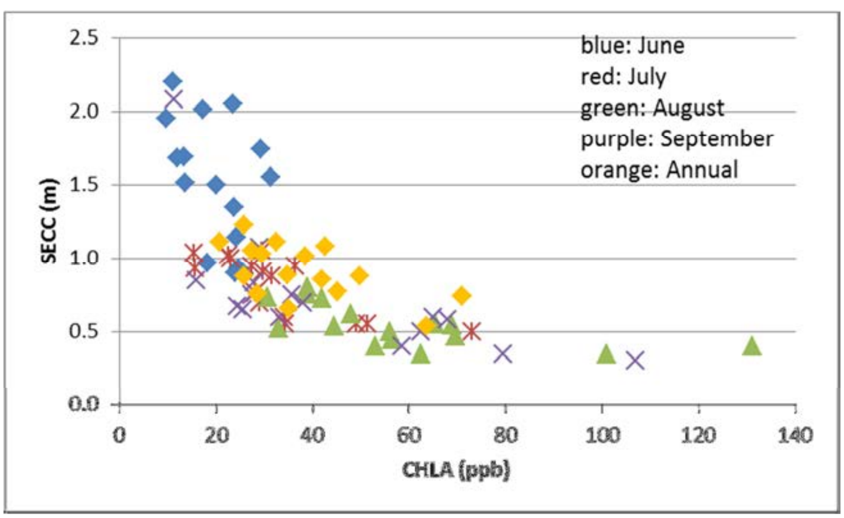


Table 8. Probability Values (p-values) for Monthly and Annual Mean Concentration Comparisons in Halsted, Jennings, and Stubbs Bays

	TP vs CHLA					CHLA vs SECC				
Bay	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**	**JUN**	**JUL**	**AUG**	**SEP**	**ANN**
Halsted	0.377	0.494	0.373	0.658	0.545	0.015	0.006	0.002	0.002	0.002
Jennings	0.188	0.111	0.084	0.116	0.216	0.031	0.181	0.032	< 0.001	0.007
Stubbs	0.009	0.855	0.551	0.644	0.757	0.073	0.002	0.012	0.004	0.004

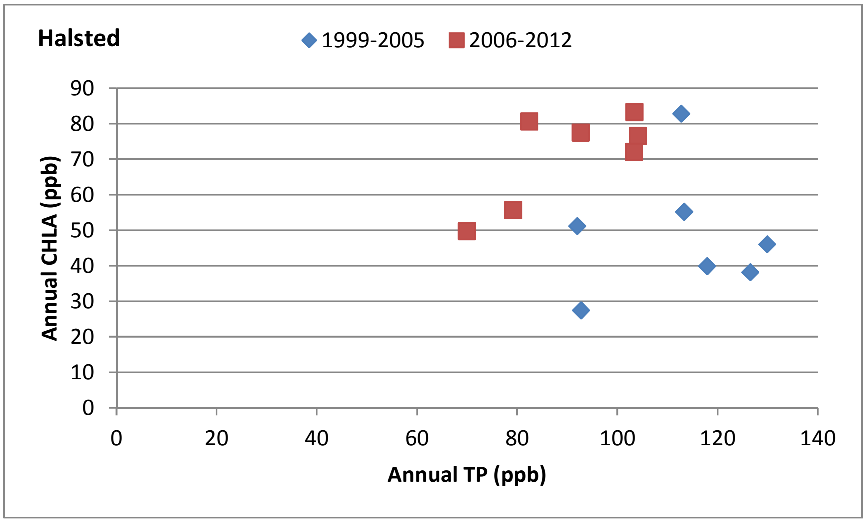
Table 9. Probability Values (p-values) for Annual Mean Concentration Comparisons in Lake Minnetonka

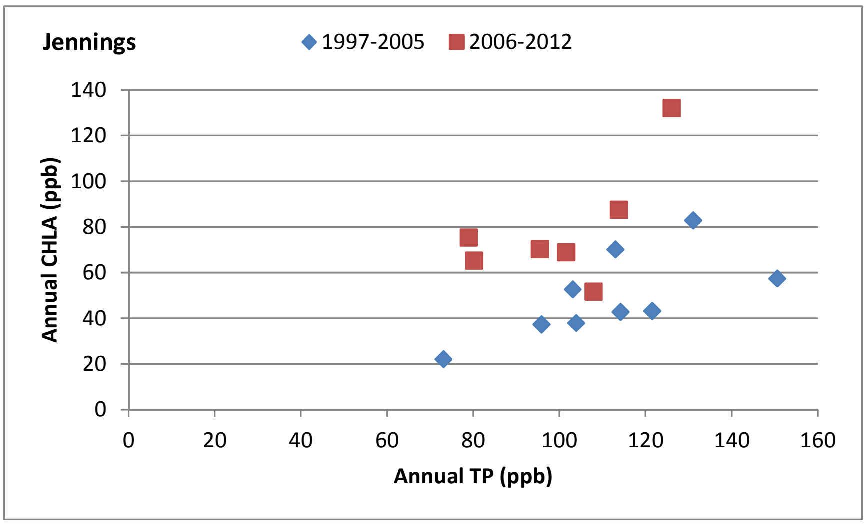
Bay	TP vs. CHLA	CHLA vs. SECC	Years
Halsted	0.545	0.002	1997-2012
Priests	0.007	0.014	2004-2012
Cooks	0.071	0.021	1997-2012
West Upper	0.043	0.124	1997-2012
Smithtown	0.790	0.438	2004-2012
Phelps	0.053	0.040	2006-2012
Black	0.308	0.254	2004-2012
Spring Park	0.402	0.022	1997-2012
Carman	0.392	0.142	2004-2012
Jennings	0.216	0.007	1997-2012
West Arm	0.139	0.021	1997-2012
Harrisons	0.282	0.010	1997-2012
Forest	0.162	0.004	1997-2012
Stubbs	0.757	0.004	1997-2012
North Arm	0.913	0.026	1997-2012
Maxwell	0.751	0.062	1997-2012
Crystal	0.007	< 0.001	1997-2012
LL North	0.307	0.099	1997-2012
Wayzata	0.392	0.105	1997-2012
Grays	0.827	0.454	2004-2012
Peavey	0.148	0.353	1999-2012
Tanager	0.256	0.285	2000-2012
Lafayette	0.010	0.067	97-99, 2005-2012
St. Albans	0.566	0.476	1997-2012
LL South	0.324	0.038	1997-2012
Carsons	0.621	0.142	2004-2012

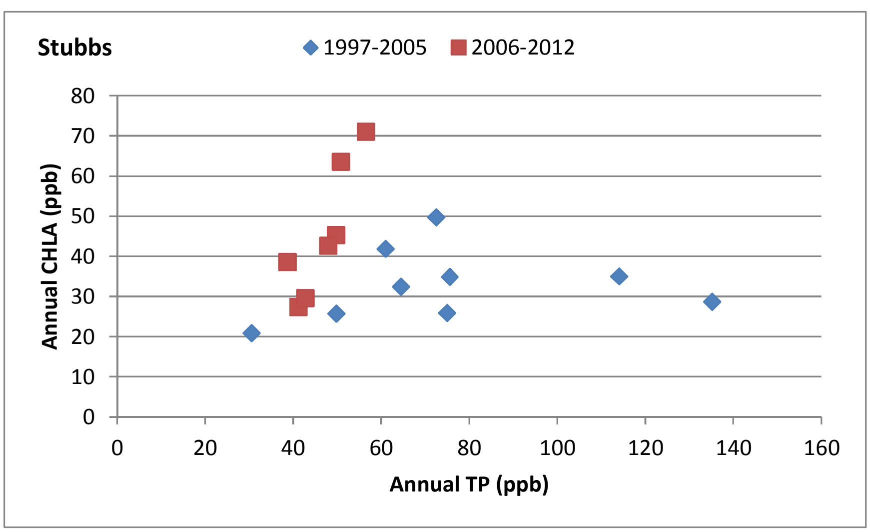
Table 10. Probability Values (p-values) for Annual Mean Concentration Comparisons in Upper Watershed Lakes

Lake	TP vs. CHLA	CHLA vs. SECC	Years
Christmas	0.192	0.625	1997-2012
Dutch	0.002	0.022	1997-2012
Gleason	0.030	0.001	1997-2012
Langdon	0.013	0.017	1997-2012
Long	0.006	0.001	1997-2012
Minnewashta	0.637	0.003	1997-2012
Parley	0.480	0.057	1999-2012
Piersons	0.067	0.004	1997-2012
Schutz	0.232	0.253	2002-2012
Virginia	0.015	0.293	2002-2012
Wasserman	0.179	0.004	1997-2012

Figure 12. TP-CHLA Relationships by Time Period





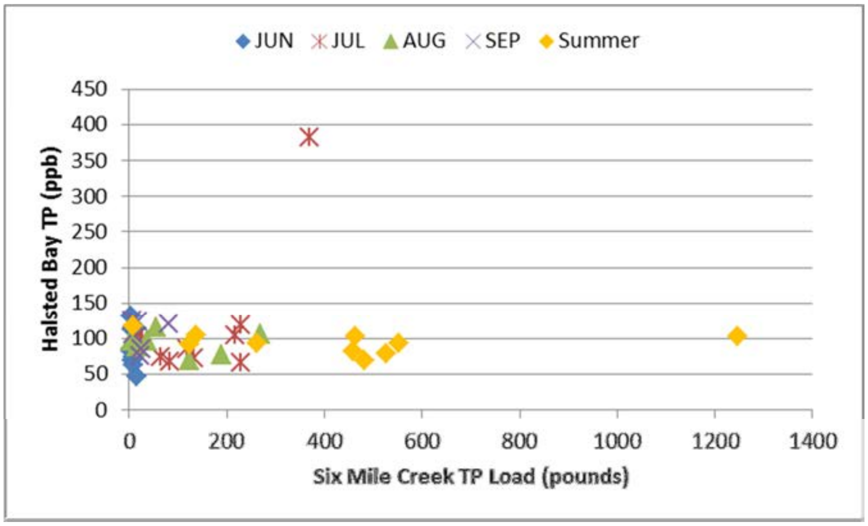


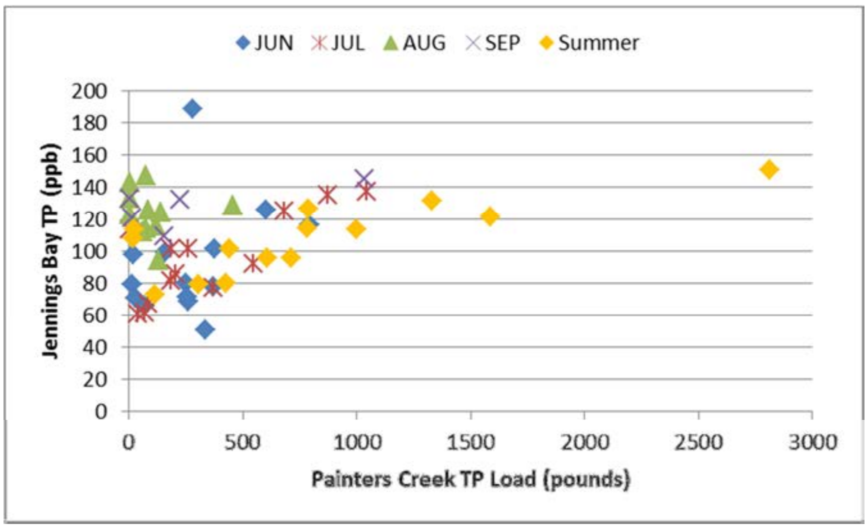
V. Stream Phosphorus Loading

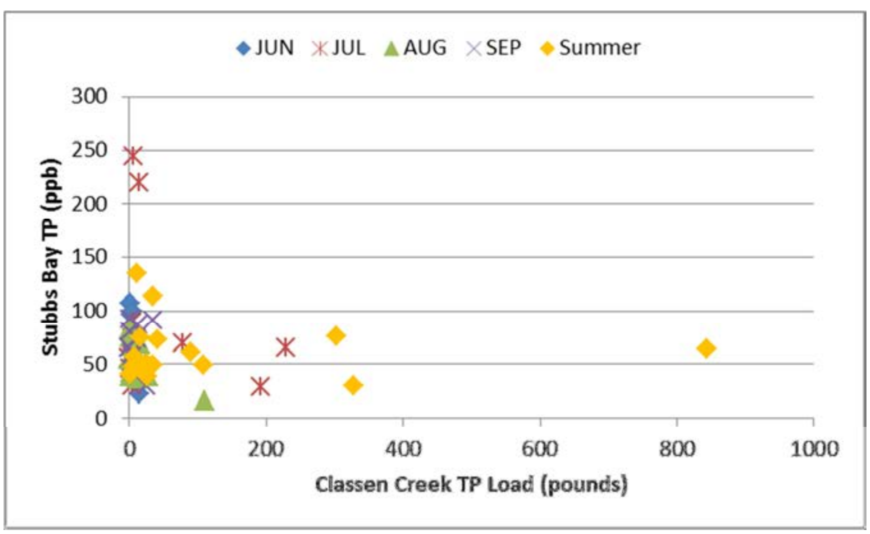
Data were analyzed to identify relationships between lake surface phosphorus concentrations and influent stream phosphorus loadings for Halsted, Jennings, and Stubbs Bays. Annual stream phosphorus loads are reported by MCWD in their Hydrodata Report, but the values are calculated using all available data which could be collected from as early as March to as late as November. For the present analysis, only the loading data from June through September were used where available for the years 1997 through 2012. Note that Six Mile Creek flows into Halsted Bay, Painter Creek flows into Jennings Bay, and Classen Creek flows into Stubbs Bay (Figure 1).

For the Six Mile Creek – Halsted Bay system (Figure 13), the only statistically-significant relationship between stream TP load and bay TP concentration occurred for July ($p = 0.021$, positive slope). For the Painter Creek – Jennings Bay system, statistically-significant relationships occurred for July ($p = 0.002$, positive slope) and the annual June-September mean ($p = 0.002$, positive slope). For the Classen Creek – Stubbs Bay system, the only statistically-significant relationship occurred for August ($p = 0.039$, negative slope).

Figure 13. Creek TP Loads vs. Bay TP Concentrations







VI. Discussion and Conclusions

There four primary objectives of the Phase II study. These objectives are presented below, along with the conclusions found for each. The objectives of Phase II were to:

1. Perform SECC, CHLA, and TP trend analysis on a monthly time scale for surface monitoring stations on Lake Minnetonka and lakes in the upper watershed, and compare these trends with those identified in Phase 1. One intent was to determine if certain months in the summer were contributing more than others to trends seen on the annual (summer season) time scale. The analysis indicates that:

   Monthly averages were not closely aligned with annual averages for TP, CHLA, or SECC. Tables 2 through 4 display the results of the annual averages from Phase I work as well as the monthly averages from the present Phase II work. There are some instances of monthly and annual trends being similar (e.g. increasing trends on both time scales for a given water quality parameter), but in general this wasn't consistent within sampling stations.

   It may be the case that natural variation in the lakes and bays on monthly and annual time scales is relatively large so that statistically-significant trends cannot be detected. Increasing sampling intensity (e.g. more sampling dates each month) will not likely improve this situation. It is recommended, however, that this analysis be repeated in 3 to 5 years because some of the bays only had data back to 2006; perhaps trends will become more apparent with additional years of data for these waterbodies.

2. To perform TP and SRP trend analysis on monthly and annual time scales for lake bottom monitoring stations on Lake Minnetonka and lakes in the upper watershed. The analysis indicates that:

   Where statistically-significant trends in either bottom TP or SRP were noted on an annual scale, there were typically at least one month showing a similar trend. Tables 5 through 7 depict these results. It is encouraging to see that several waterbodies show declining P trends, especially during stratified periods (e.g. August, September). There may be less statistical variability in the bottom P samples because the hypolimnion is somewhat isolated from phenomena at the lake surface (e.g. wind, phytoplankton growth). It recommended that these analyses be repeated in 3 to 5 years so that bays with limited data (e.g. only back to 2006) may have more data generated.

3. To perform water quality analysis on Halsted, Jennings, and Stubbs Bay on Lake Minnetonka to determine why increasing trends in surface CHLA are accompanied by declining trends in surface TP. The analysis indicates that:
   SECC is generally highly-correlated with CHLA on both annual and monthly time scales for these bays. This suggests that clarity in these bays is strongly associated with algal biomass and not with inorganic particulates like soil runoff from streams and/or re-suspended material from the bay bottom (Figures 5, 8, and 11; Table 8). In addition, this relationship is typical of other bays and lakes in the upper watershed (Tables 9 and 10).

CHLA is generally not highly-correlated with TP on both annual and monthly time scales for these bays. This suggests that algal biomass in these bays is influenced strongly by factors other than P (Figures 5, 8, and 11; Table 8). Examples might include light, zooplankton grazing, temperature, to name a few. However, there were statistically-significant relationships between TP and CHLA for several bays in the upper part o Lake Minnetonka (Table 9) and several upper watershed lakes (Table 10).

There is an apparent shift in the TP-CHLA relationship around 2005. As noted in Phase I work, declining TP and increasing CHLA in these bays is counter-intuitive. The present work suggests that there has been a subtle shift in this relationship in these three bays around 2005 (Figure 12). The nature of this apparent shift is unknown at this time. This relationship hasn't been evaluated at the monthly time scale or for other bays/lakes. The influence of other drivers (e.g. light, temperature, zooplankton grazing, possible phytoplankton community shifts) has not been evaluated at this time either.

4. To identify any relationship between lake surface phosphorus concentrations and influent stream loadings for Halsted, Jennings, and Stubbs Bays. The analysis indicates that:

There is generally a poor statistical relationship between stream TP loading and bay surface TP concentration. This may be due to factors such as the ability of the load calculation method to accurately estimate true loads and/or the possibility that spring loads (e.g. April, May) are greater influences on summer TP concentrations in the bays. It may be the case that stream loading impacts bottom P concentrations such that relatively cooler stream runoff temperatures deliver P to the deeper, cooler strata of the bays. These potential explanations have not been evaluated at this time.

Future Directions

Changes in lake monitoring parameters and frequency of collection are not recommended at this time because it is unlikely that expanded efforts would effectively reduce the inherent natural variability evidenced in the monitored variables. To more accurately determine loads at the mouths of Classen, Painter, and Six Mile Creek for the purposes of potentially establishing a significant statistical relationship between loads and lake concentrations, it is suggested that continuous stream level monitoring and possibly installation of storm water samplers (i.e. ISCOs) take place.

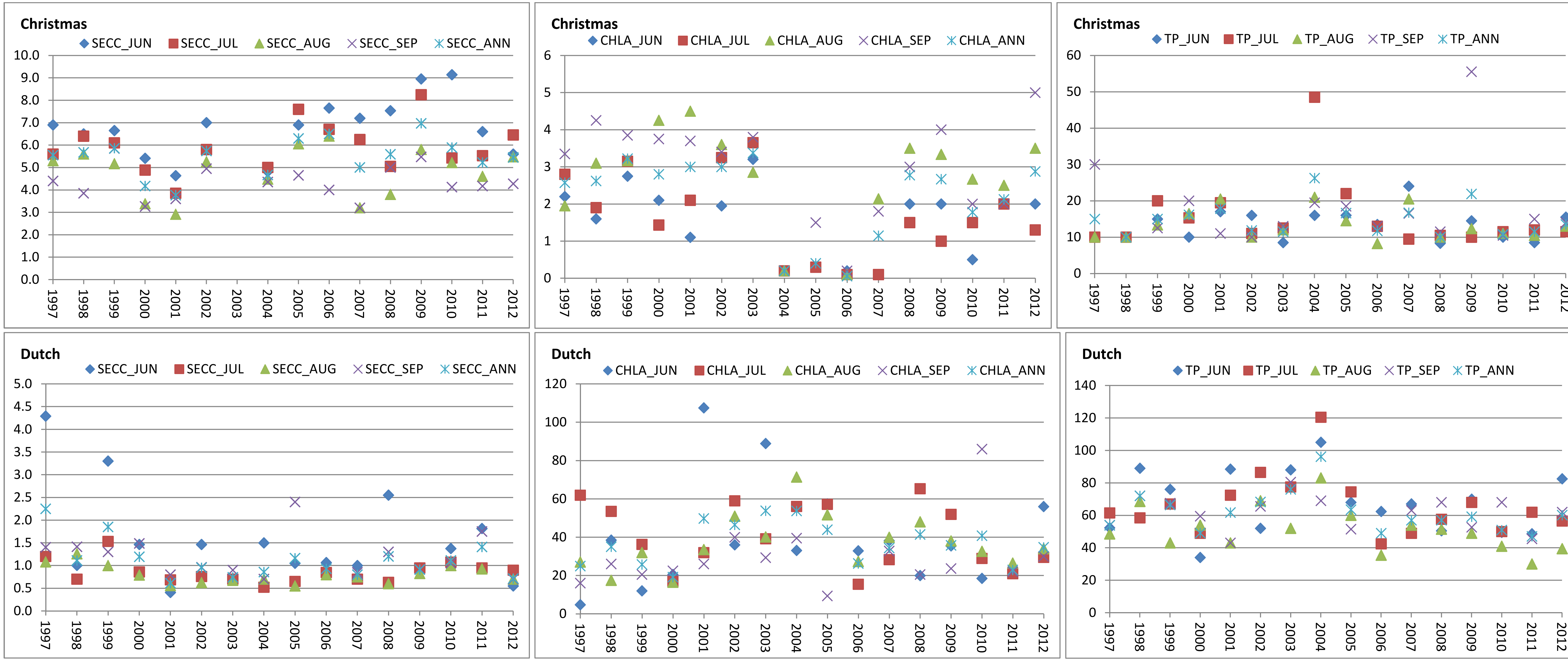
Based on conversations with MCWD water quality staff, monitoring of Lake Minnetonka bays for phytoplankton and zooplankton has occurred since 2006 in Halsted Bay, but continuous monitoring has not occurred for any of the other bays. Such data is available for Jennings and Stubbs Bays for the 2006-2008 period. Given the poor relationships seen between lake TP and CHLA in theses bays, perhaps understanding the relationship between plankton and either TP or CHLA might shed some light on this counter-intuitive situation. Maintaining a continuous phytoplankton and zooplankton monitoring program in Halsted Bay would therefore be recommended, along with re-establishing a continuous phytoplankton and zooplankton monitoring program for Jennings and Stubbs Bays.

Establishing a connection between watershed activities, stream P loading, in-lake P concentrations, and CHLA using empirical data lends additional justification for the use of BMPs in the watershed. Phase II has provided insights into these relationships, and also given possible directions for future studies to further our understanding of relationships between water quality variables. If establishing statistically-significant relationships between these variables is in the interest of the MCWD, then it is recommended that additional statistical analyses be performed to:

1. Provide a stronger connection between stream P loading and bay P. Activities include:
    a. Examination of possible time lags between stream P load and bay P concentration.
    b. Examination of possible connections between stream P load, water temperature (both stream and bay), and bay P (both surface and bottom).
2. Determine, if possible, the primary driver(s) of CHLA in Halsted, Jennings, and Stubbs Bays.
    a. Assessment of available phytoplankton and zooplankton data (trend analysis, relationships with other water quality variables). The objective is to determine if any changes plankton community composition are related to the apparent changes seen in Figure 12.
    b. Use advanced statistical techniques (e.g. multiple regression) to better estimate CHLA. Suggested independent parameters include P (surface and bottom), nitrogen, water temperature, phytoplankton measures, and zooplankton measures. The objective is to further explore the apparent changes seen in Figure 12.

Appendix A

Graphs of Surface Lake Water Quality SECC, CHLA, and TP Monthly and Annual Means


Christmas
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Christmas
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
6 5 4 3 2 1 0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Christmas
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
60 50 40 30 20 10 0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Dutch
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Dutch
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
120 100 80 60 40 20 0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Dutch
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
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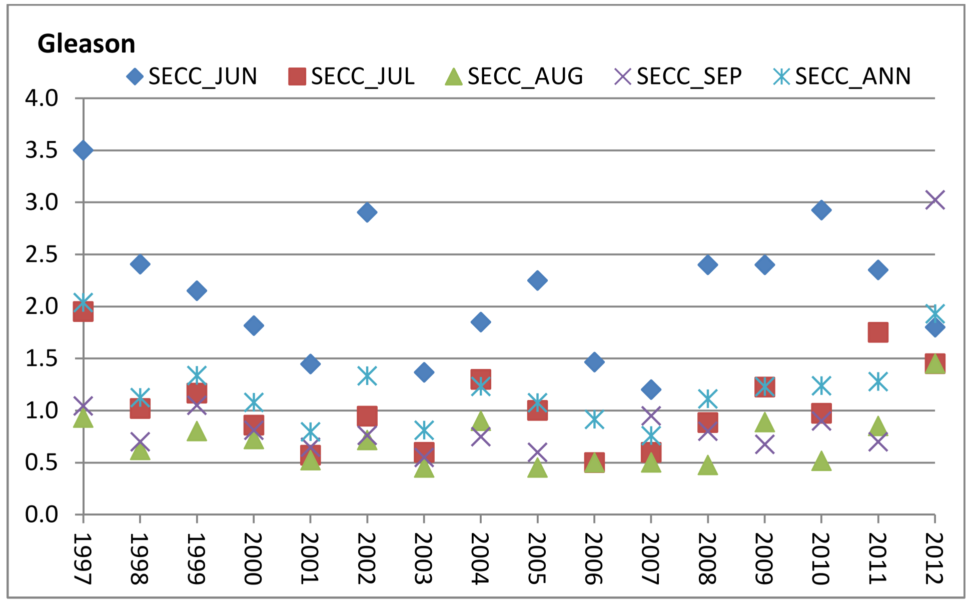
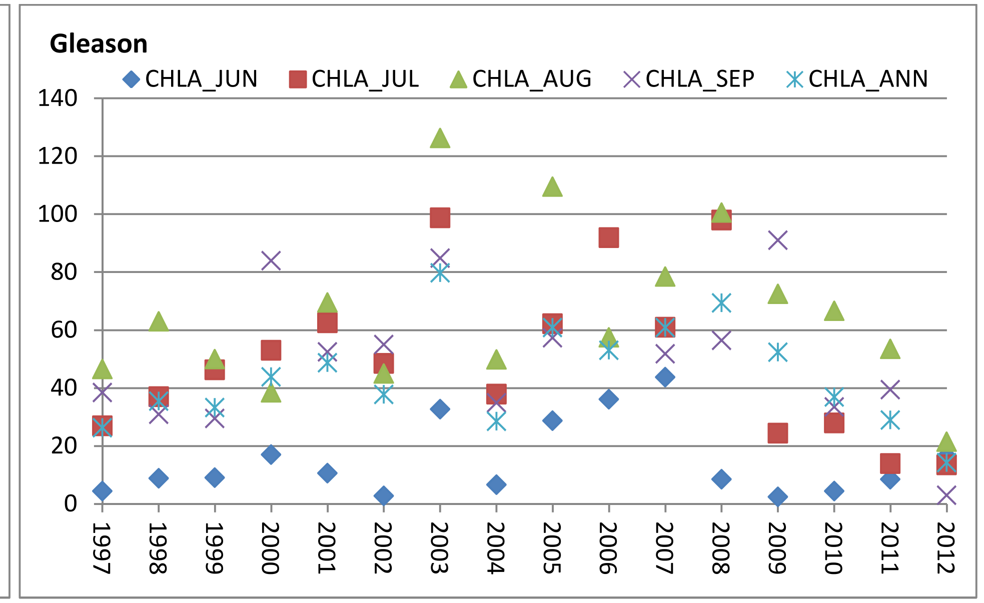
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012


Gleason
SECC_JUN
SECC_JUL
SECC_AUG
SECC_SEP
SECC_ANN


Gleason
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CHLA_JUL
CHLA_AUG
CHLA_SEP
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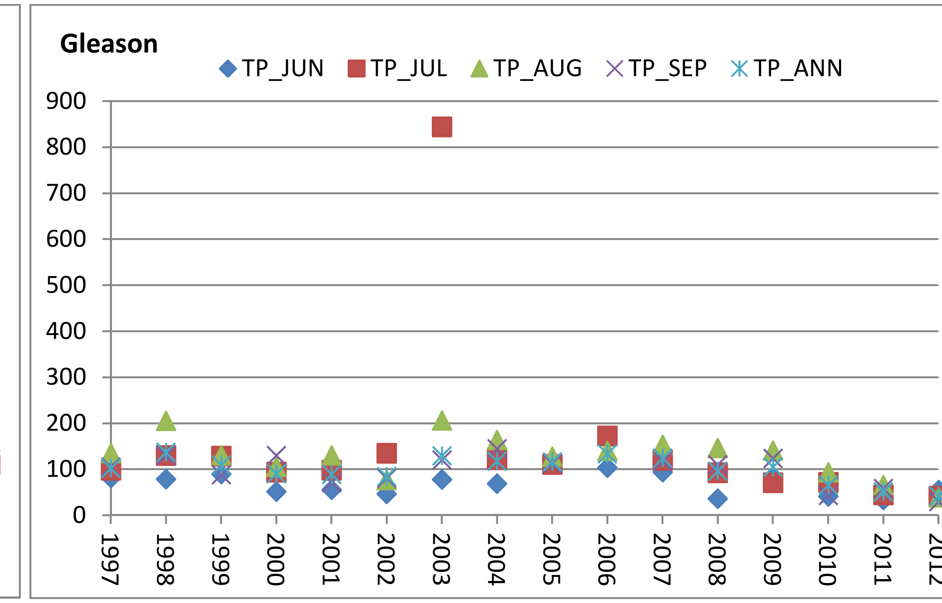
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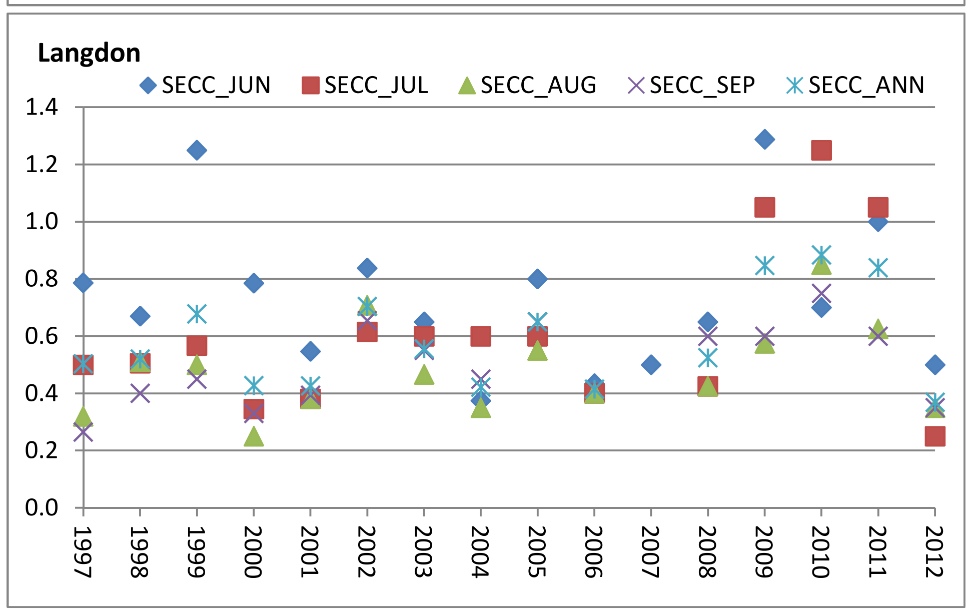
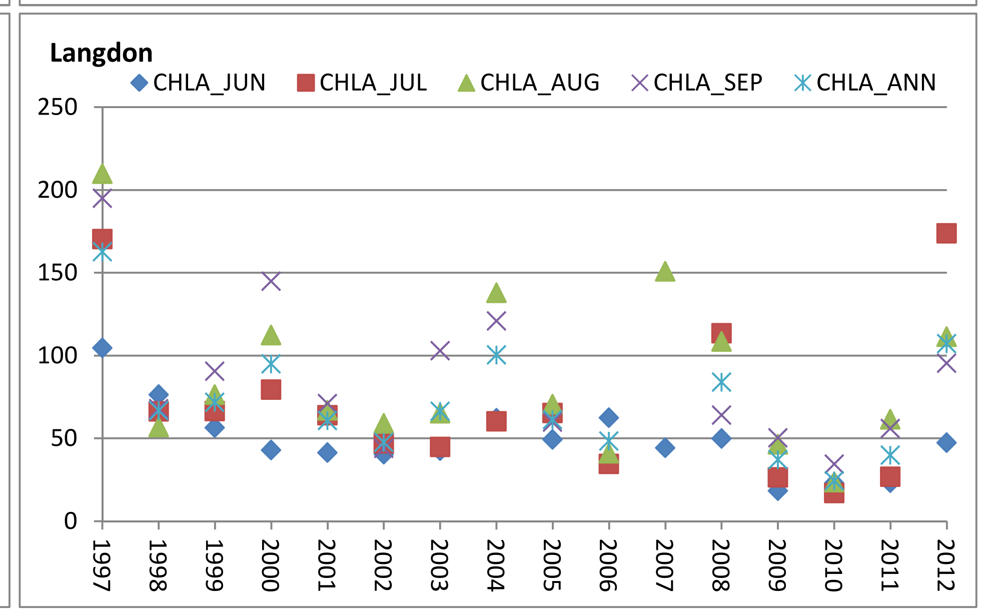
TP_JUL
TP_AUG
TP_SEP
TP_ANN


Langdon
SECC_JUN
SECC_JUL
SECC_AUG
SECC_SEP
SECC_ANN


Langdon
CHLA_JUN
CHLA_JUL
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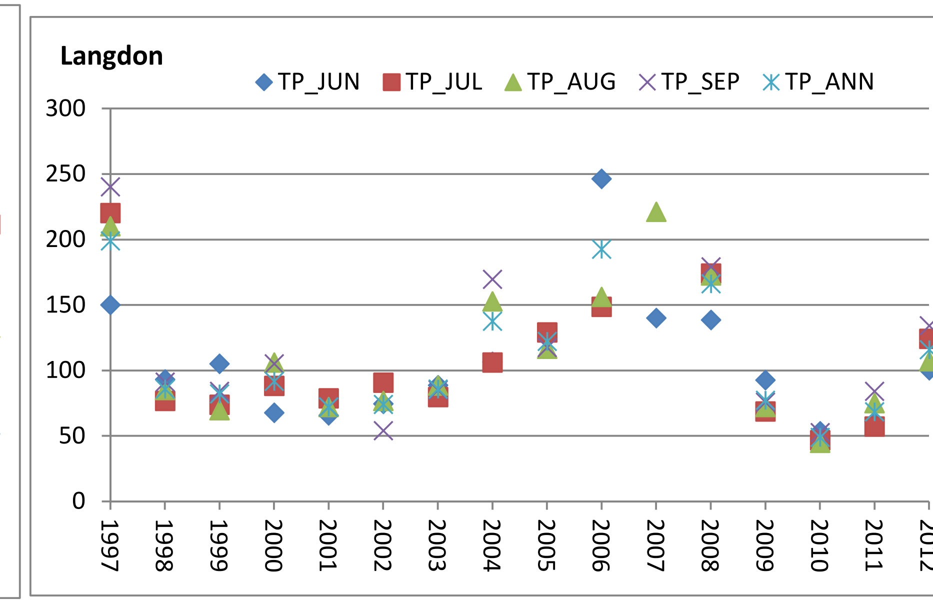
CHLA_ANN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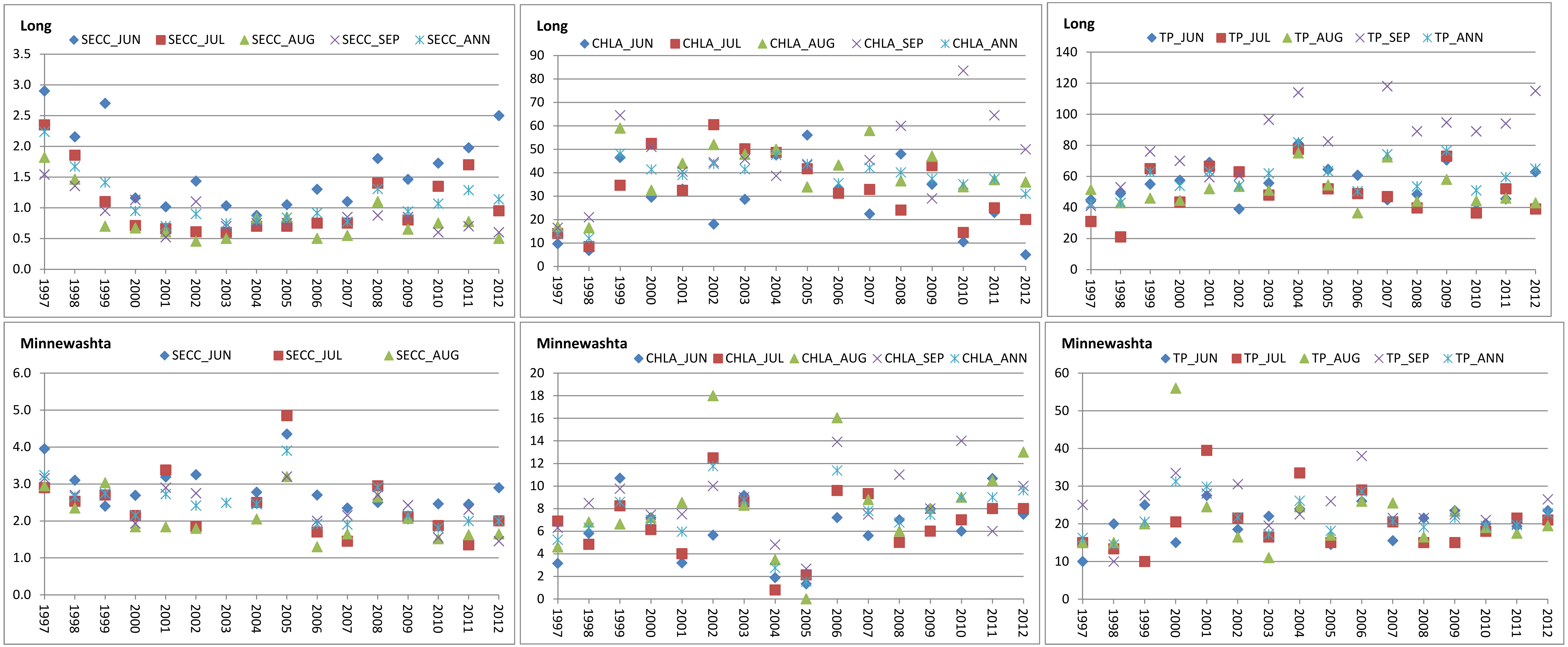
TP_SEP
TP_ANN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Long
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Minnewashta
SECC_JUN SECC_JUL SECC_AUG
Minnewashta
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
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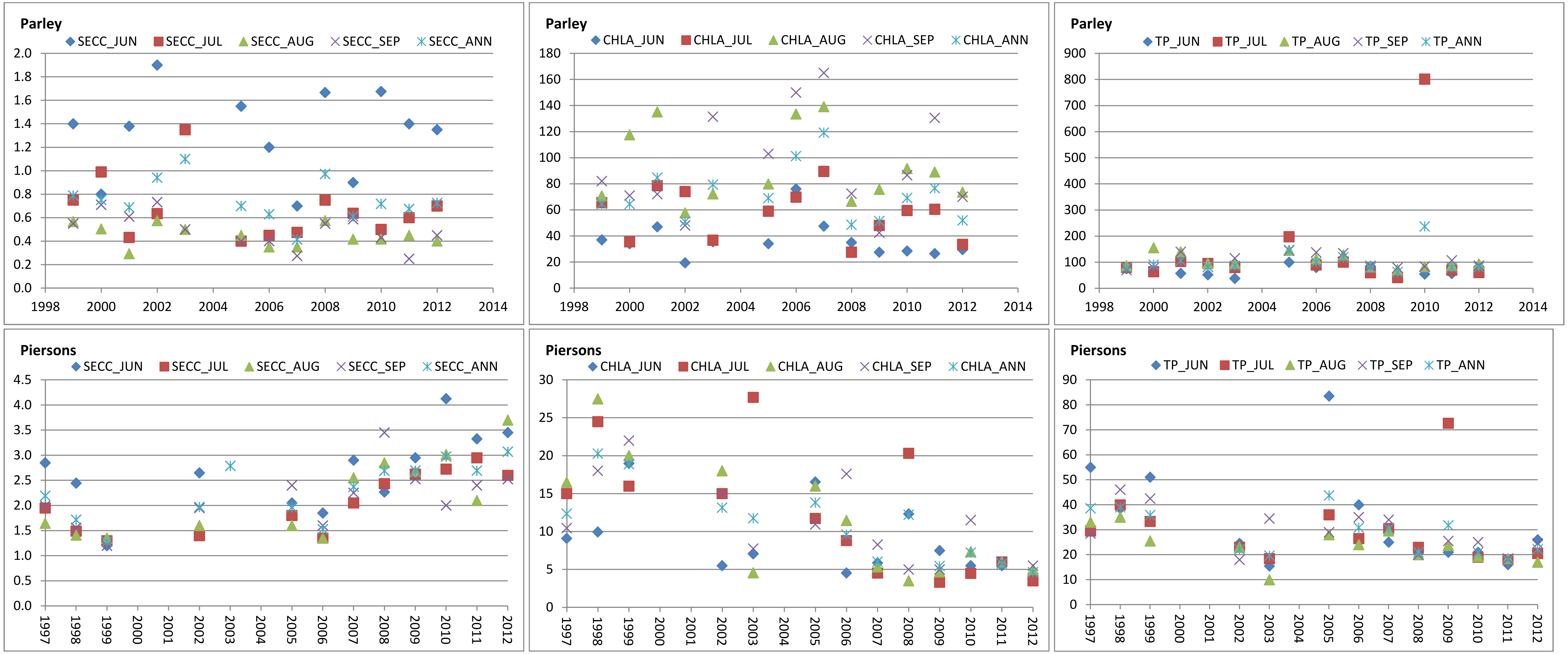
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CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
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1998 2000 2002 2004 2006 2008 2010 2012 2014
Parley
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 100 200 300 400 500 600 700 800 900
1998 2000 2002 2004 2006 2008 2010 2012 2014
Piersons
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1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Piersons
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 5 10 15 20 25 30
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
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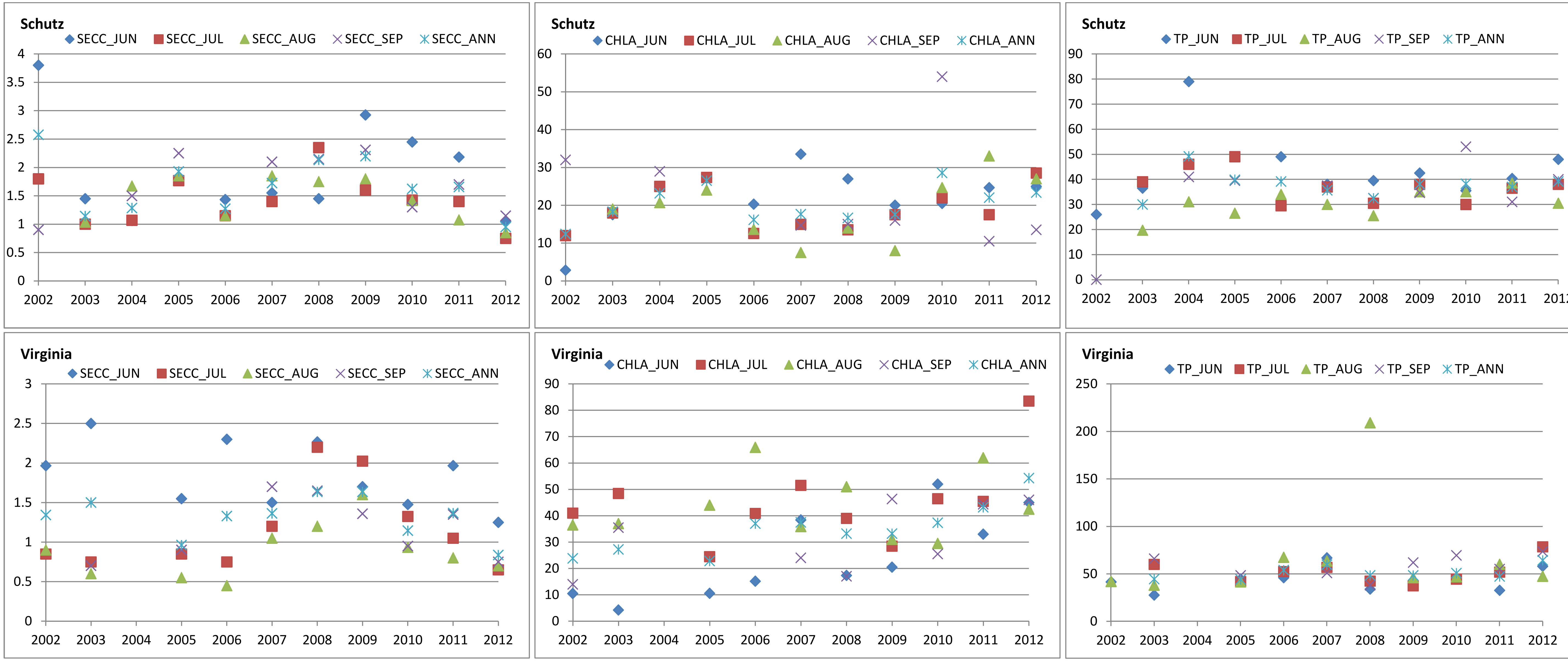
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Schutz
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Virginia
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
Virginia
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
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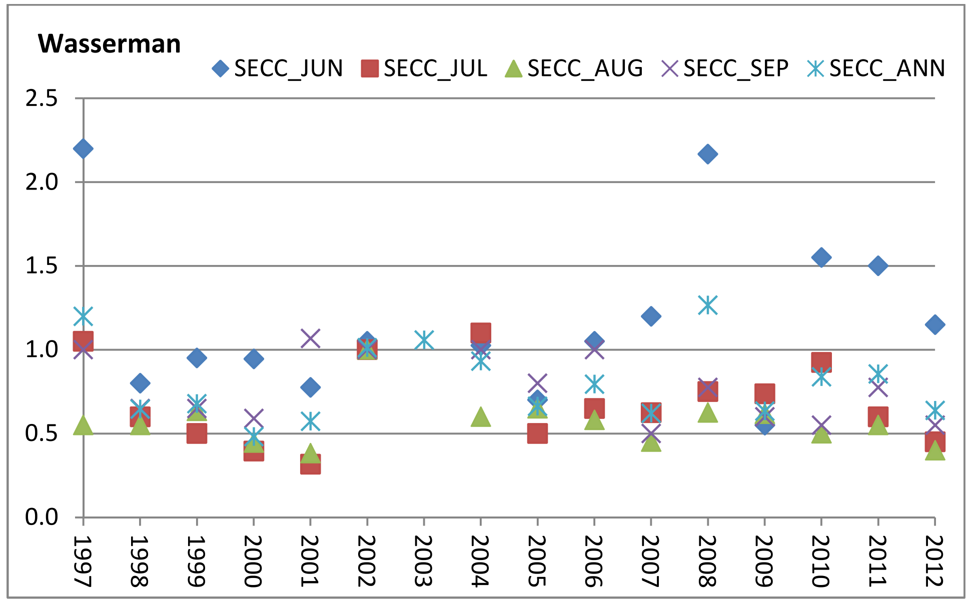
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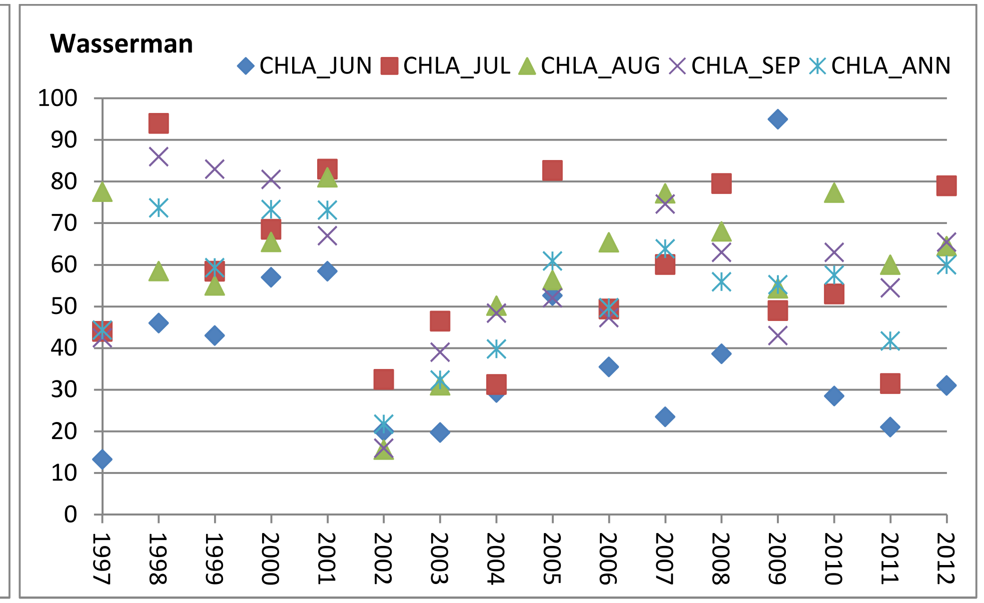
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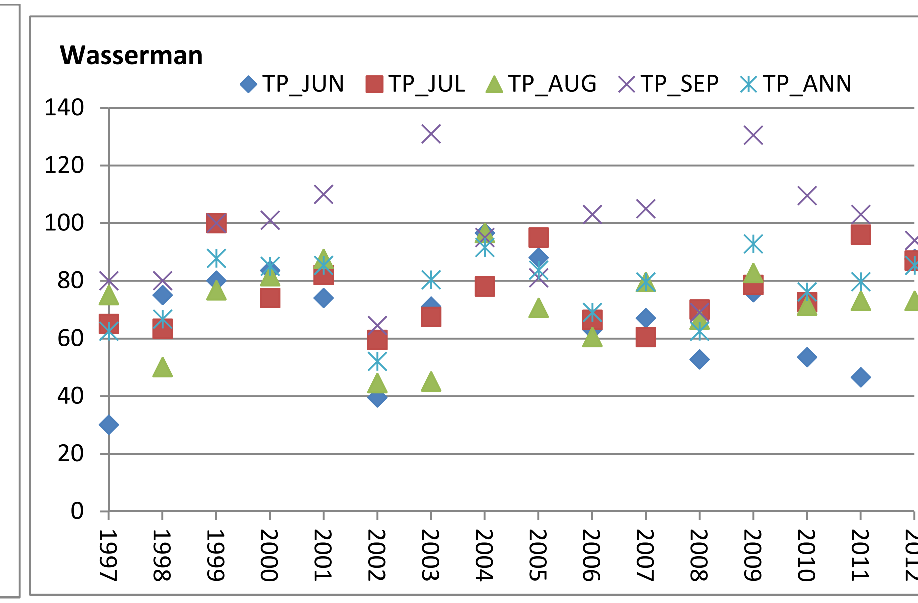
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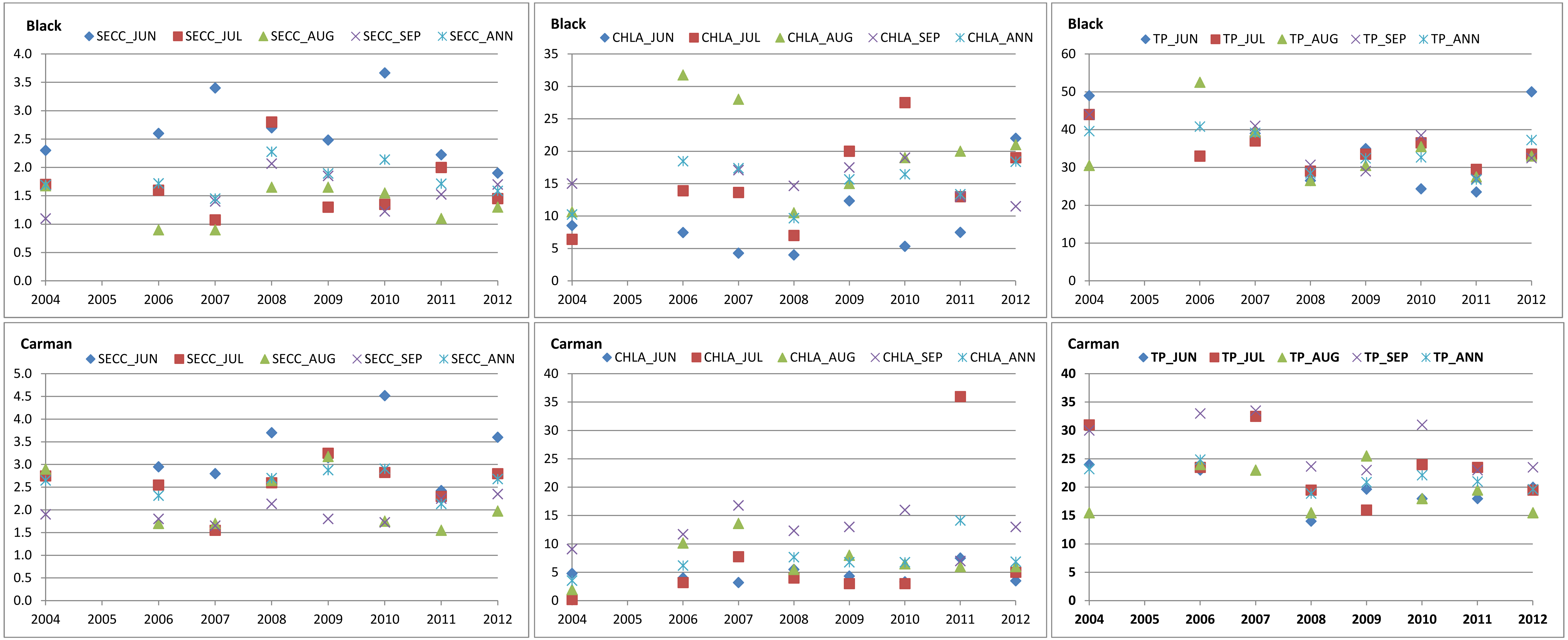

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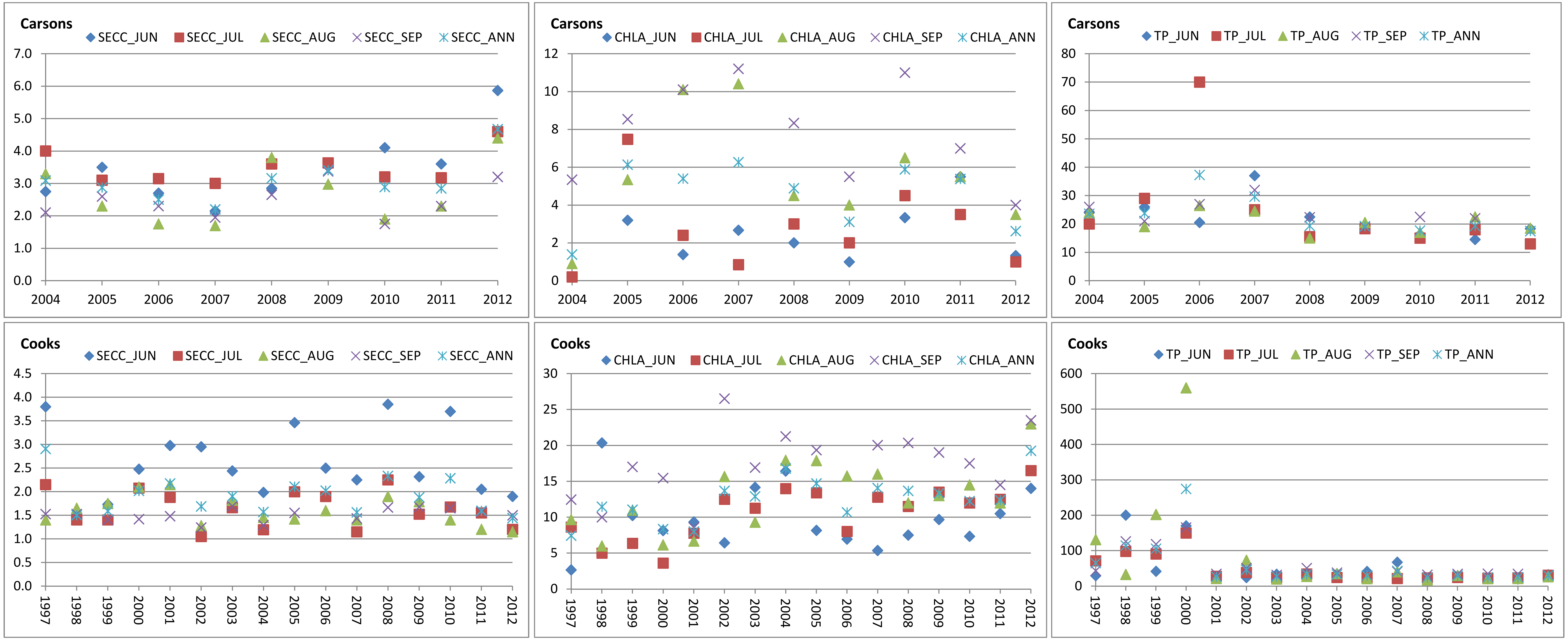
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
Black
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Carman
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
Carman
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
Carman
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
2004 2005 2006 2007 2008 2009 2010 2011 2012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SECC_JUL
SECC_AUG
SECC_SEP
SECC_ANN
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3.0
2.0
1.0
0.0
2004
2005
2006
2007
2008
2009
2010
2011
2012
Carsons
CHLA_JUN
CHLA_JUL
CHLA_AUG
CHLA_SEP
CHLA_ANN
12
10
8
6
4
2
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
Carsons
TP_JUN
TP_JUL
TP_AUG
TP_SEP
TP_ANN
80
70
60
50
40
30
20
10
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
Cooks
SECC_JUN
SECC_JUL
SECC_AUG
SECC_SEP
SECC_ANN
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Cooks
CHLA_JUN
CHLA_JUL
CHLA_AUG
CHLA_SEP
CHLA_ANN
30
25
20
15
10
5
0
1997
1998
1999
2000
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2002
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2004
2005
2006
2007
2008
2009
2010
2011
2012
Cooks
TP_JUN
TP_JUL
TP_AUG
TP_SEP
TP_ANN
600
500
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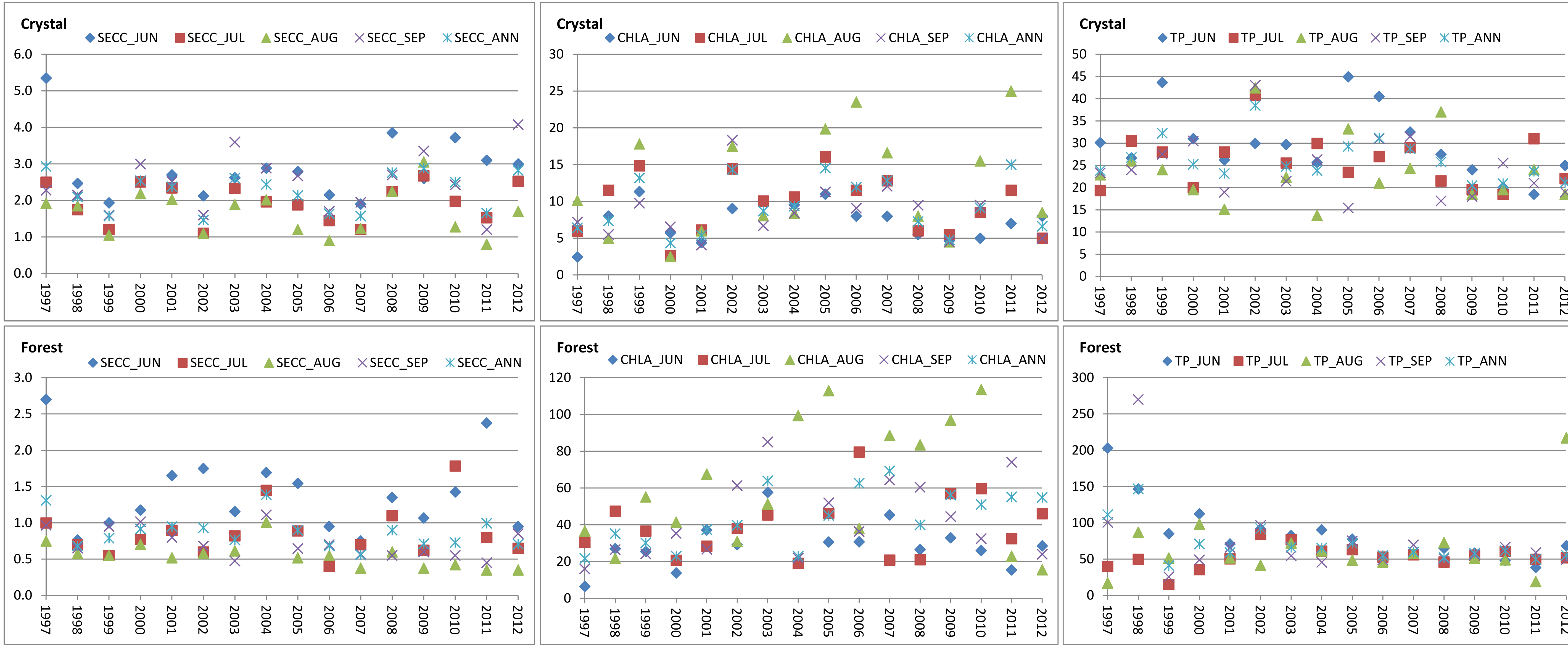
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CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
Crystal
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Forest
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
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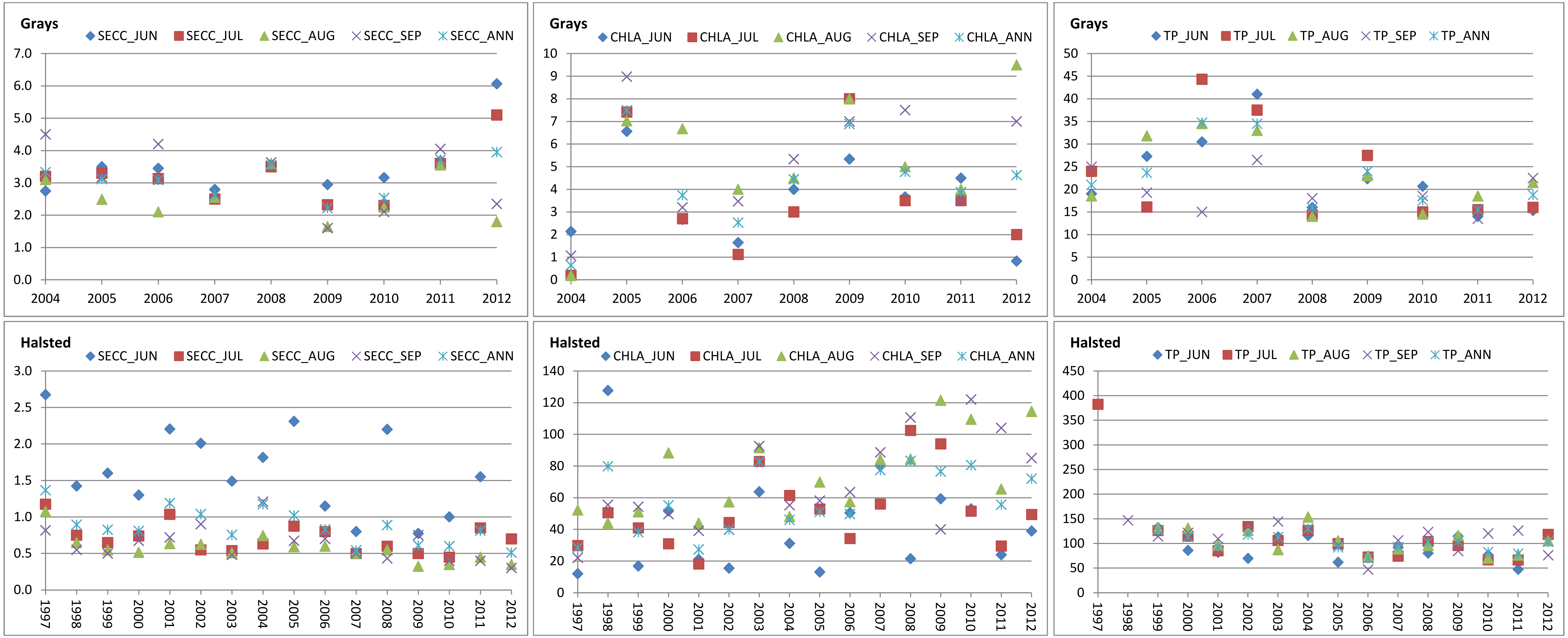
Forest
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN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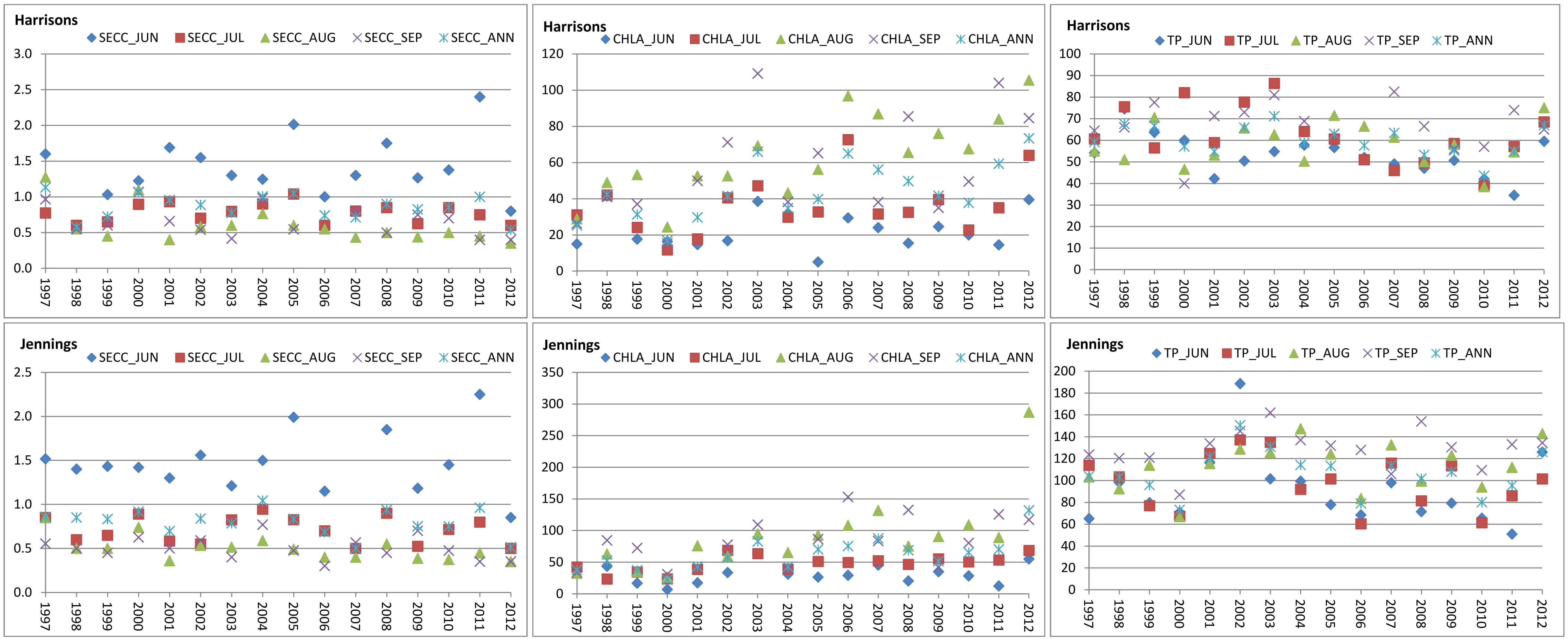
2004 2005 2006 2007 2008 2009 2010 2011 2012
Grays
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 1 2 3 4 5 6 7 8 9 10
2004 2005 2006 2007 2008 2009 2010 2011 2012
Grays
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 5 10 15 20 25 30 35 40 45 50
2004 2005 2006 2007 2008 2009 2010 2011 2012
Halsted
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
0.0 0.5 1.0 1.5 2.0 2.5 3.0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Halsted
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 20 40 60 80 100 120 140
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Halsted
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 50 100 150 200 250 300 350 400 450
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012


Harrisons
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Harrisons
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 20 40 60 80 100 120
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Harrisons
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 10 20 30 40 50 60 70 80 90 100
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Jennings
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
0.0 0.5 1.0 1.5 2.0 2.5
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Jennings
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 50 100 150 200 250 300 350
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
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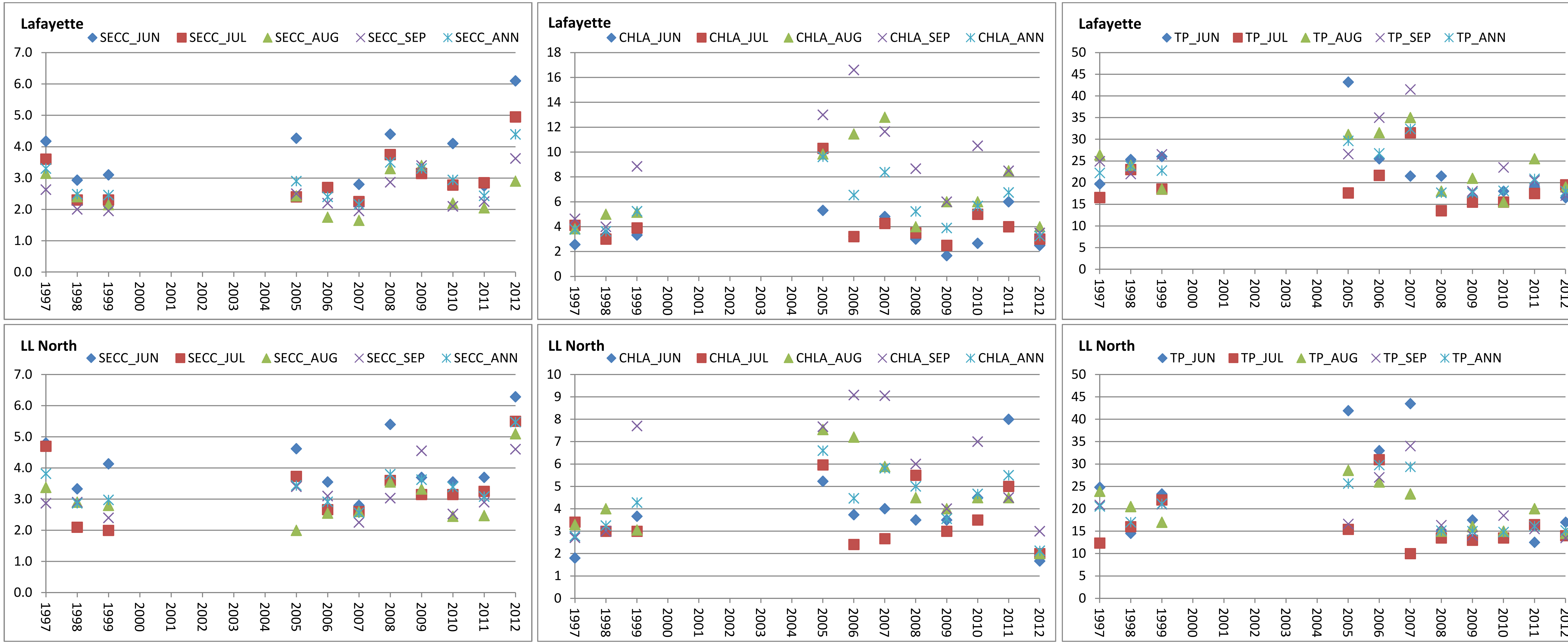

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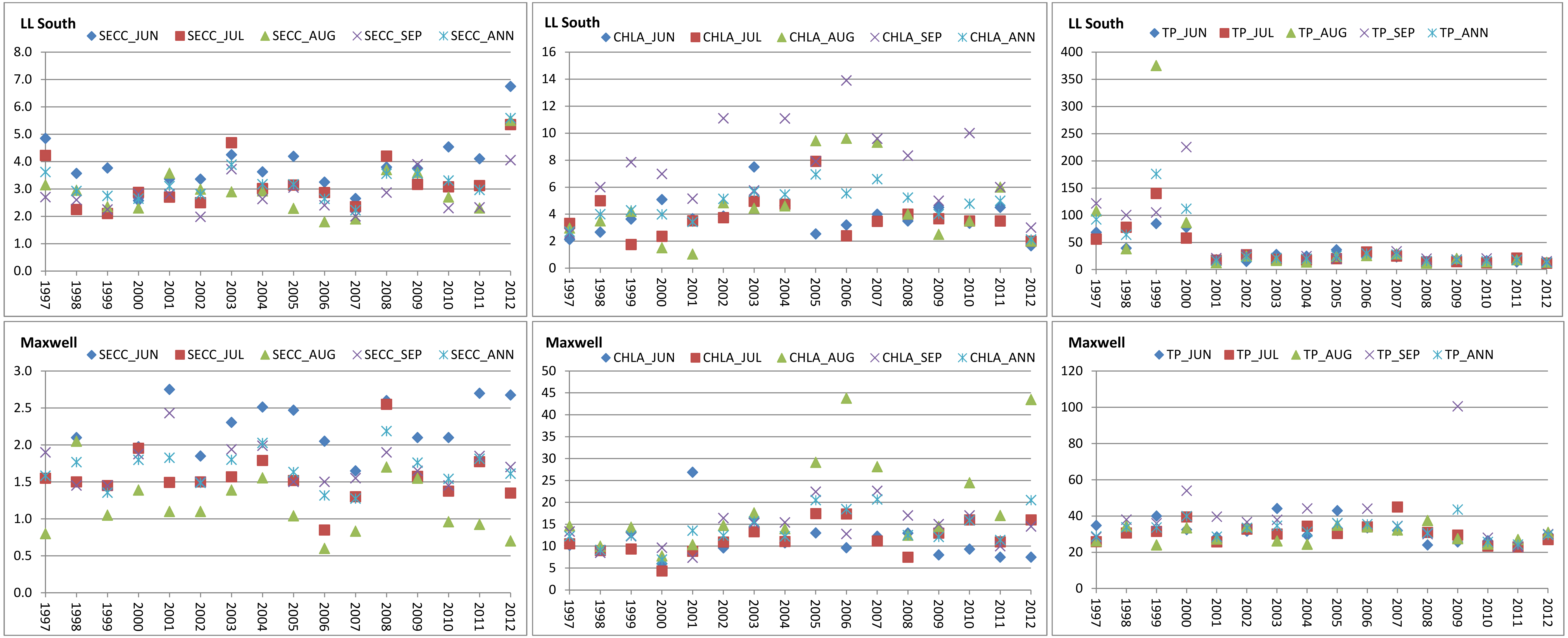
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 2 4 6 8 10 12 14 16 18
Lafayette
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 5 10 15 20 25 30 35 40 45 50
LL North
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0
LL North
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 1 2 3 4 5 6 7 8 9 10
LL North
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 5 10 15 20 25 30 35 40 45 50
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012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LL South
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 2 4 6 8 10 12 14 16
LL South
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 50 100 150 200 250 300 350 400
Maxwell
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
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Maxwell
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 5 10 15 20 25 30 35 40 45 50
Maxwell
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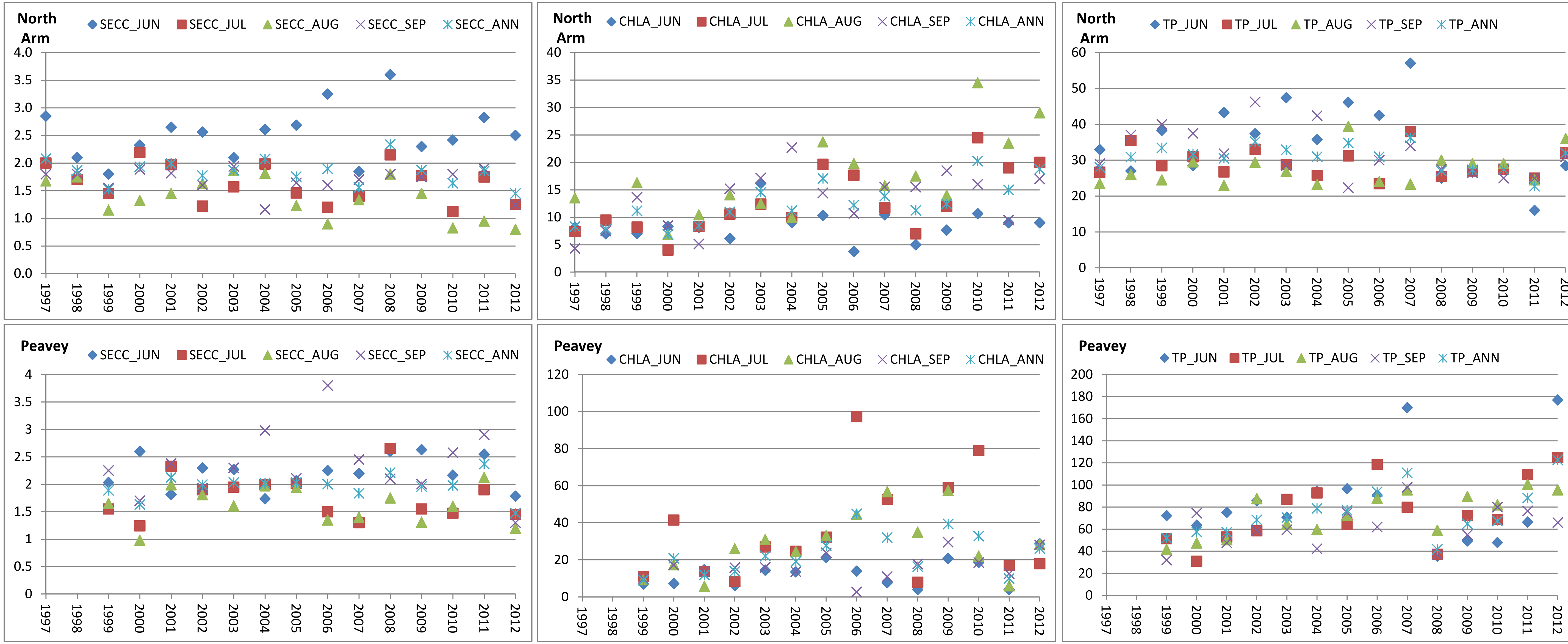
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SECC_SEP
SECC_ANN
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3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
North Arm
CHLA_JUN
CHLA_JUL
CHLA_AUG
CHLA_SEP
CHLA_ANN
40
35
30
25
20
15
10
5
0
North Arm
TP_JUN
TP_JUL
TP_AUG
TP_SEP
TP_ANN
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30
20
10
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SECC_JUL
SECC_AUG
SECC_SEP
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3
2.5
2
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1
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CHLA_JUN
CHLA_JUL
CHLA_AUG
CHLA_SEP
CHLA_ANN
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60
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20
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Peavey
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TP_JUL
TP_AUG
TP_SEP
TP_ANN
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180
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140
120
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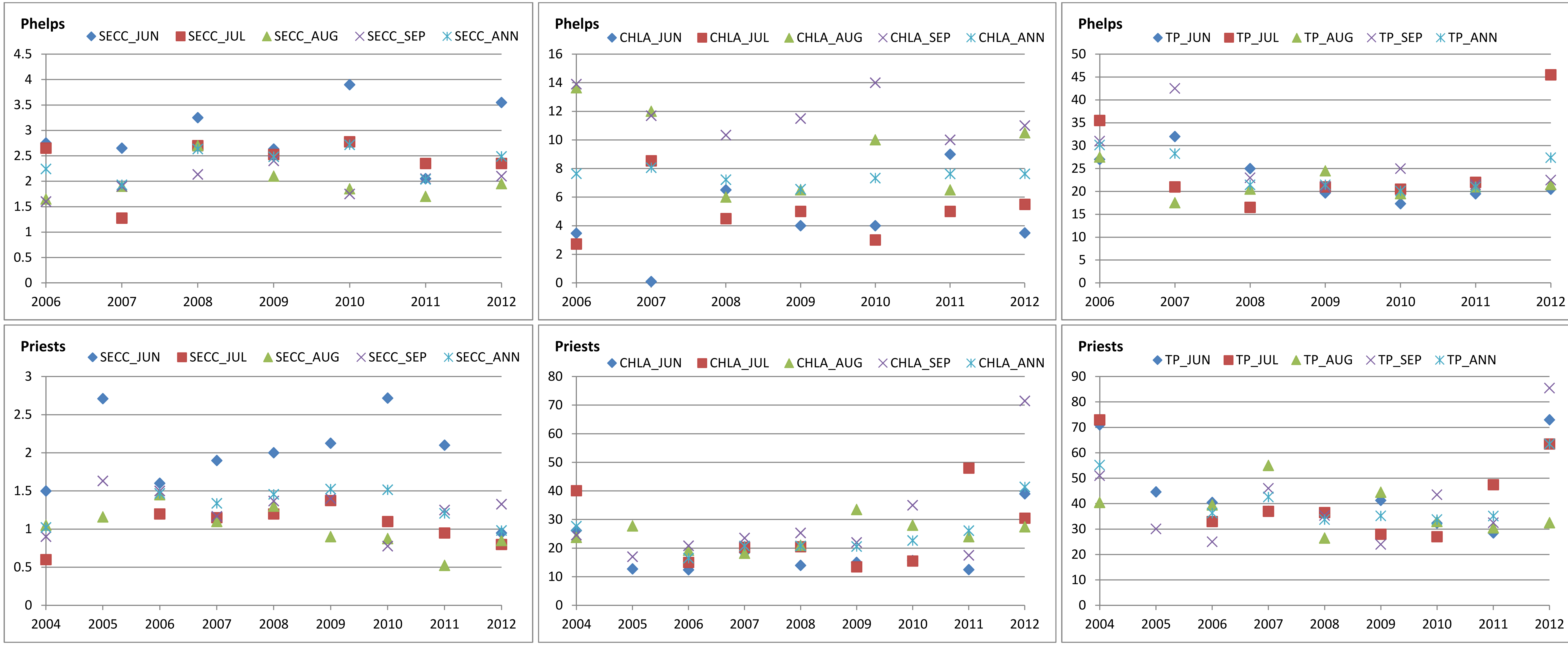

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Phelps
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 2 4 6 8 10 12 14 16
2006 2007 2008 2009 2010 2011 2012
Phelps
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
0 5 10 15 20 25 30 35 40 45 50
2006 2007 2008 2009 2010 2011 2012
Priests
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
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2004 2005 2006 2007 2008 2009 2010 2011 2012
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CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
0 10 20 30 40 50 60 70 80
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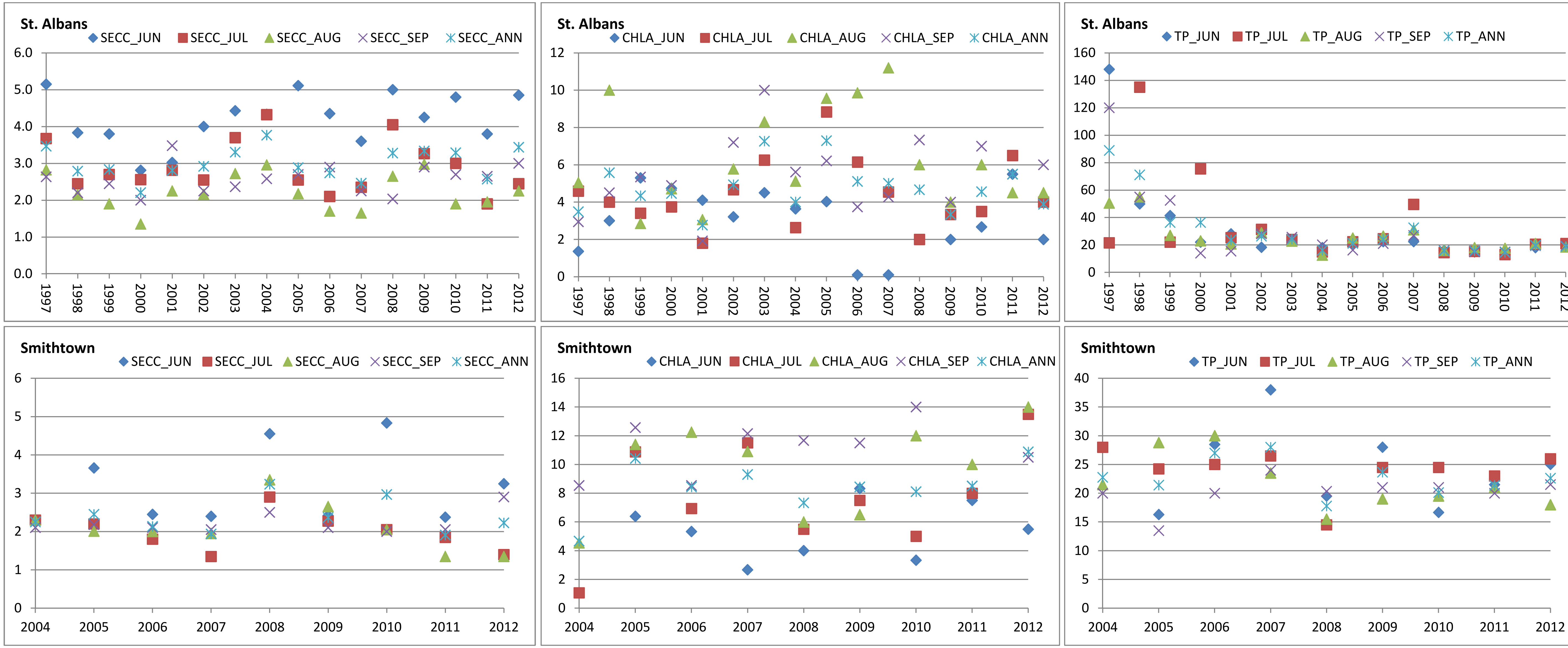
2004 2005 2006 2007 2008 2009 2010 2011 2012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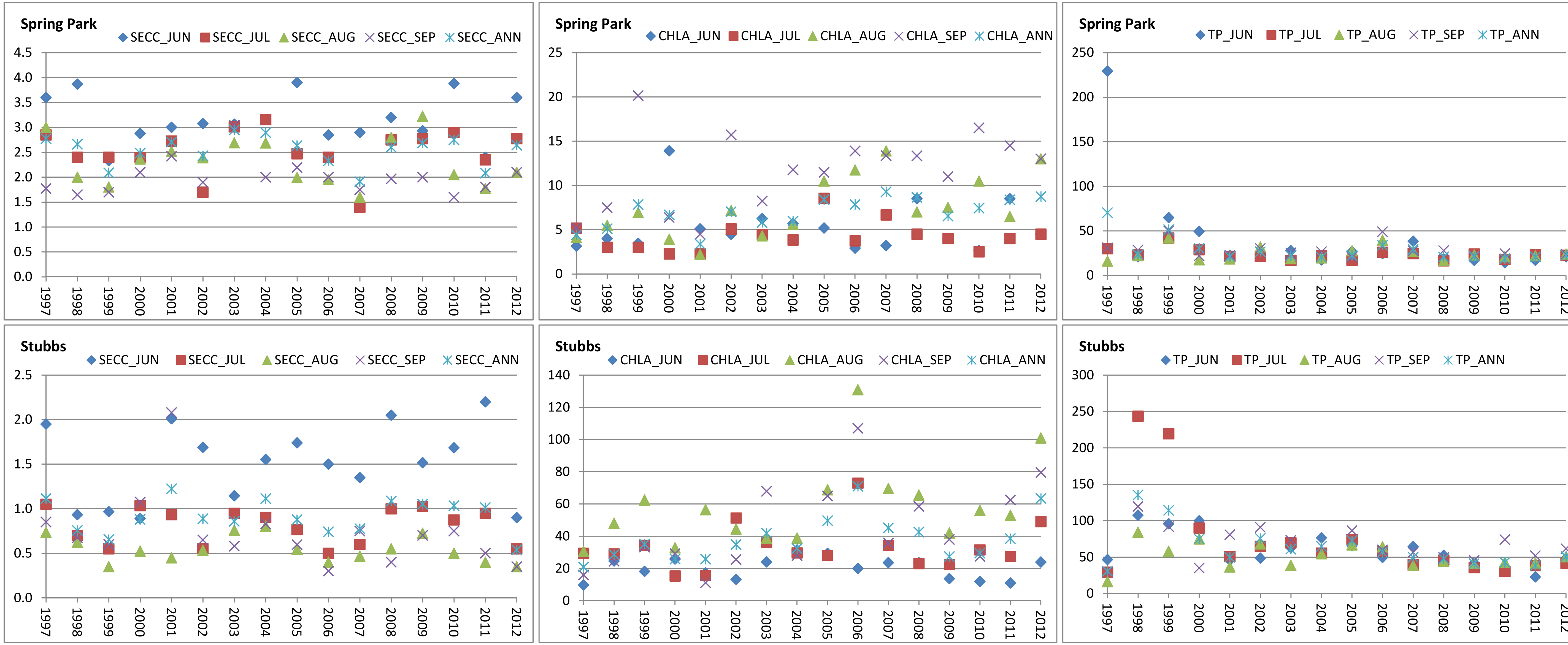
St. Albans
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
St. Albans
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Smithtown
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
Smithtown
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
Smithtown
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN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Spring Park
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Stubbs
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
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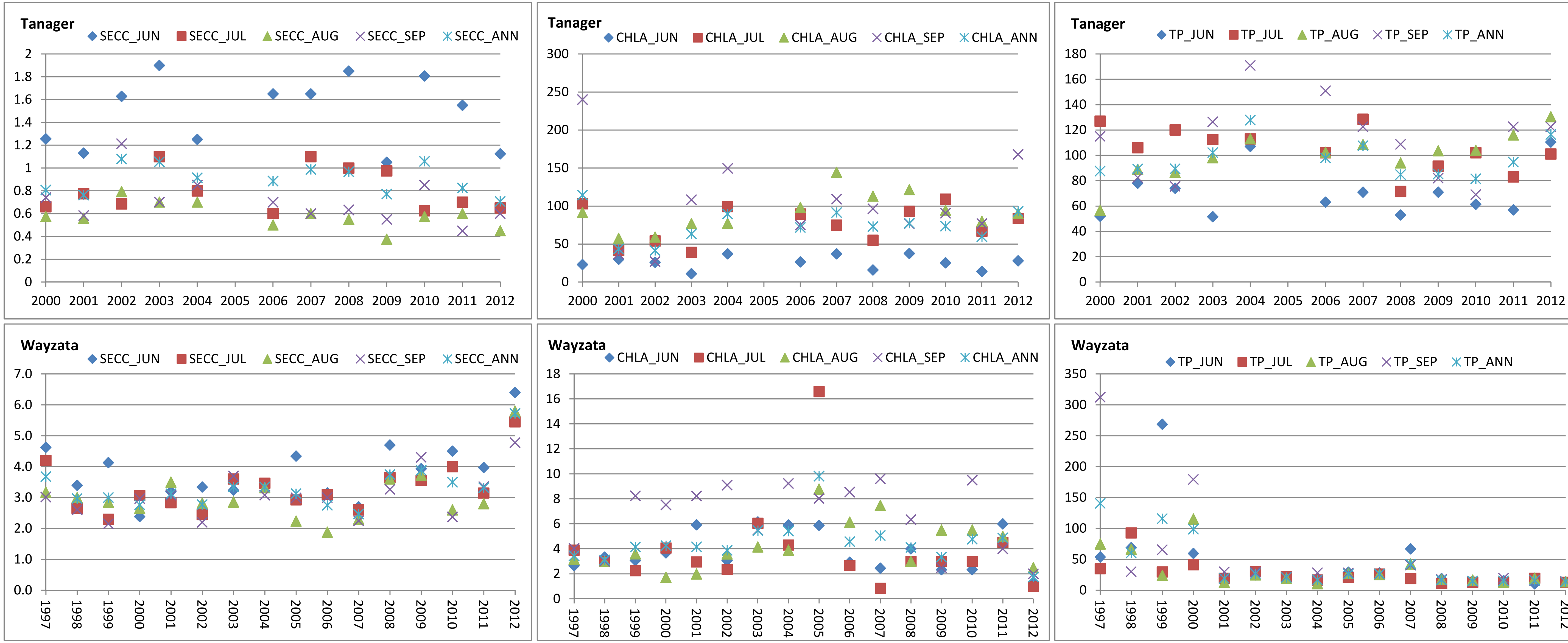
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN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Tanager
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
Wayzata
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
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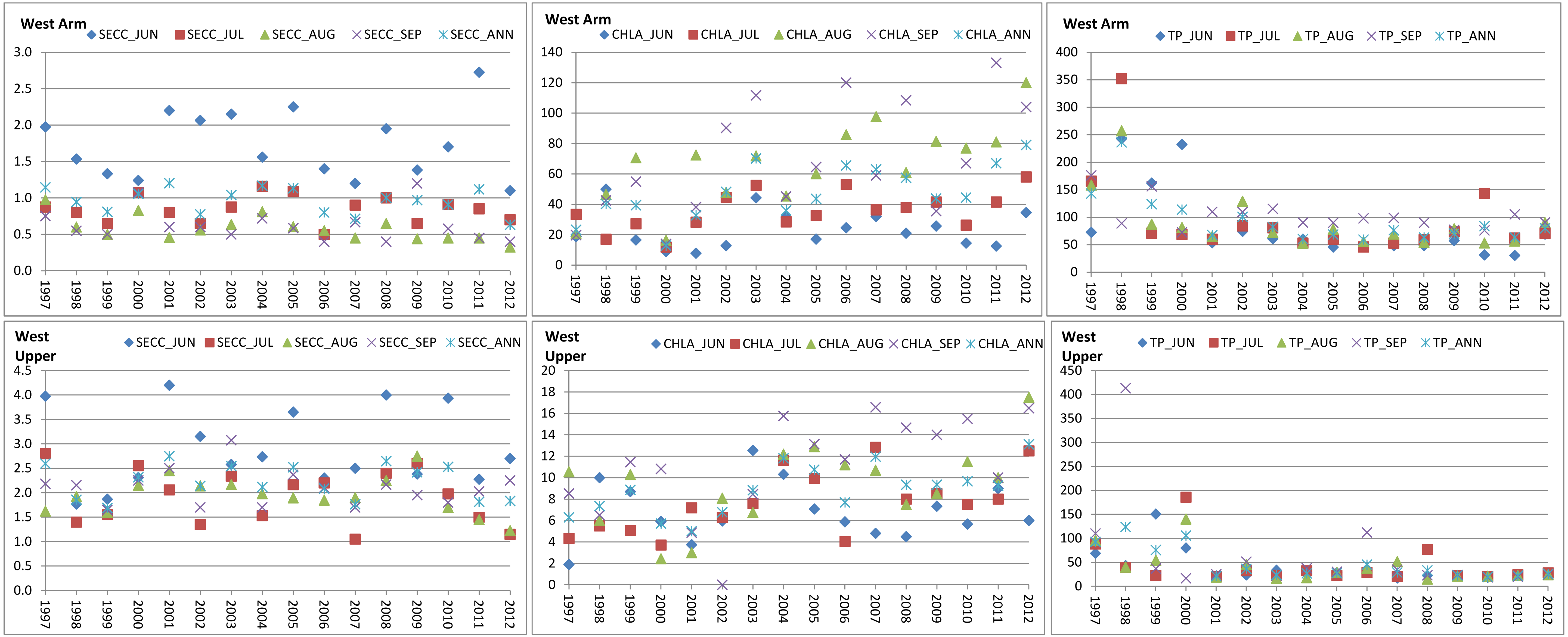
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN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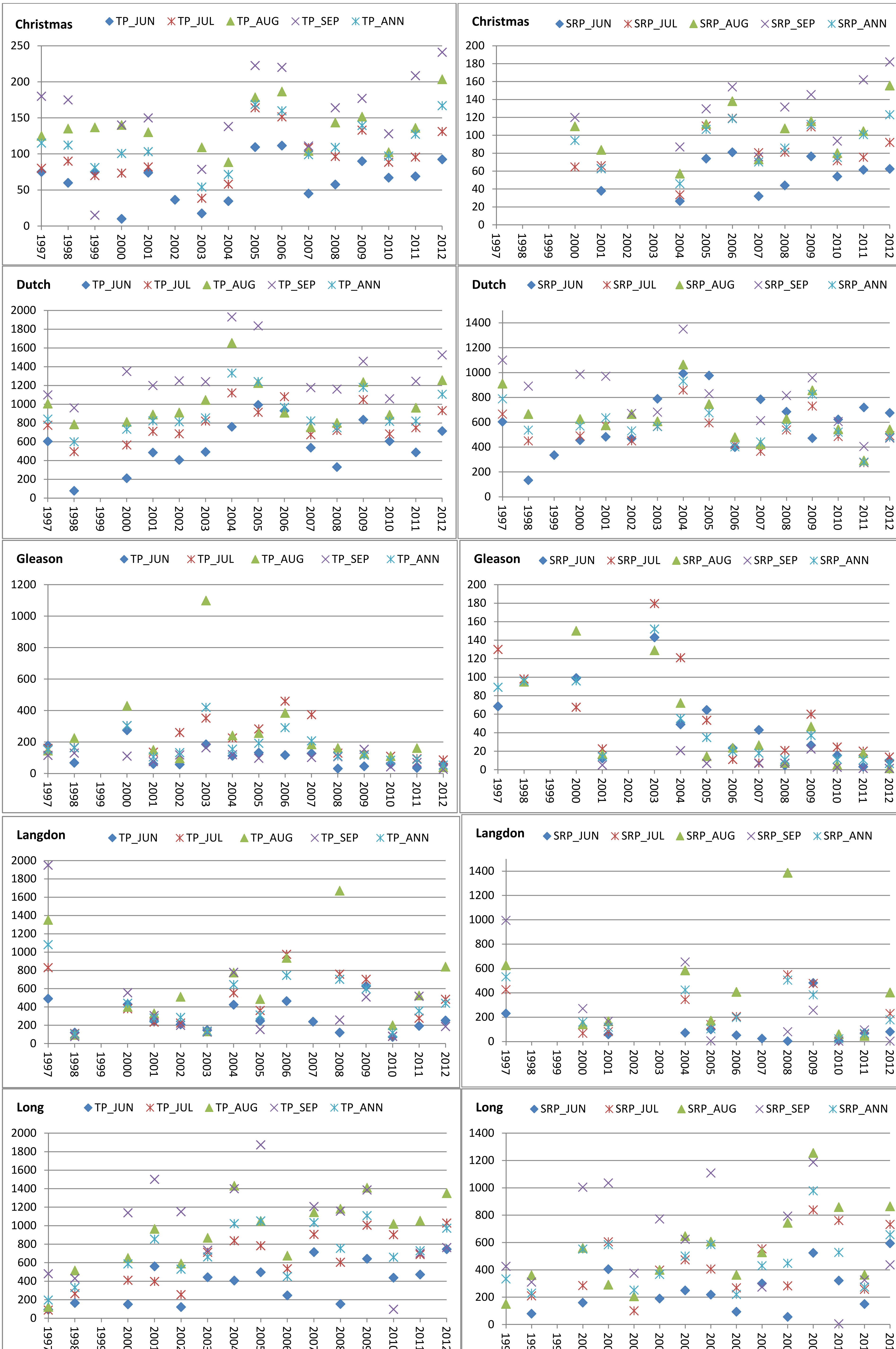
West Arm
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
West Arm
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN
West Upper
SECC_JUN SECC_JUL SECC_AUG SECC_SEP SECC_ANN
West Upper
CHLA_JUN CHLA_JUL CHLA_AUG CHLA_SEP CHLA_ANN
West Upper
TP_JUN TP_JUL TP_AUG TP_SEP TP_ANN

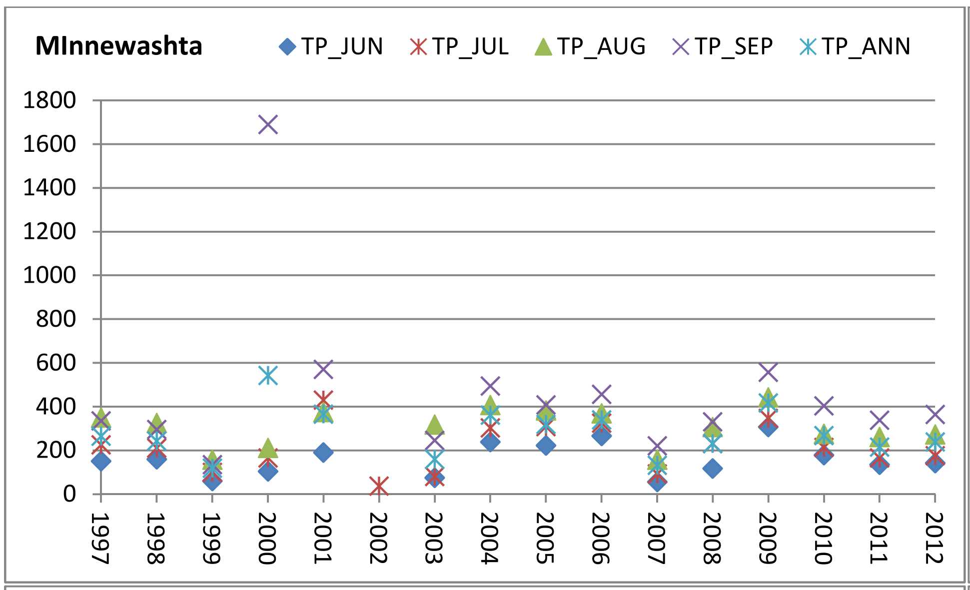
Appendix B

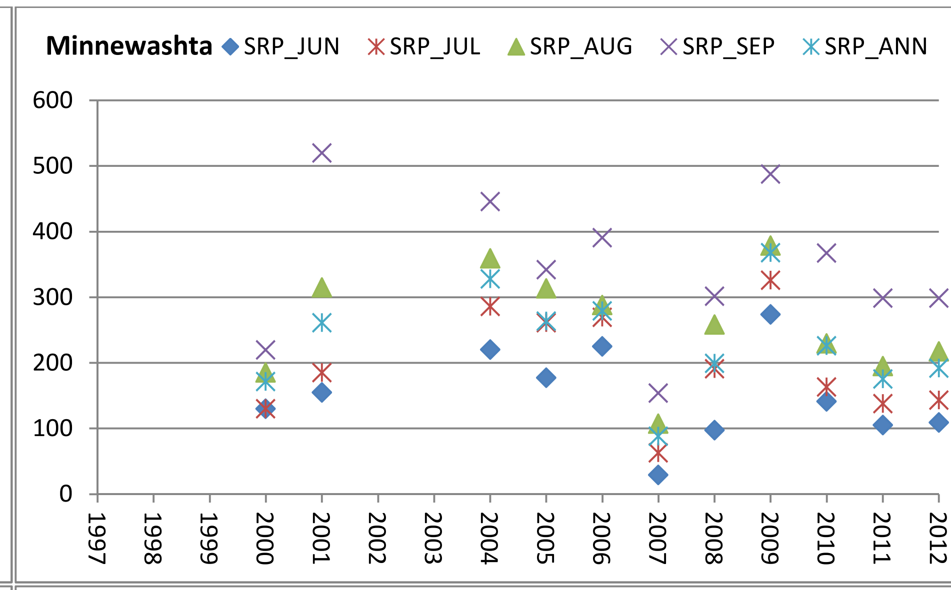
Graphs of Bottom Lake Water Quality TP and SRP Monthly and Annual Means

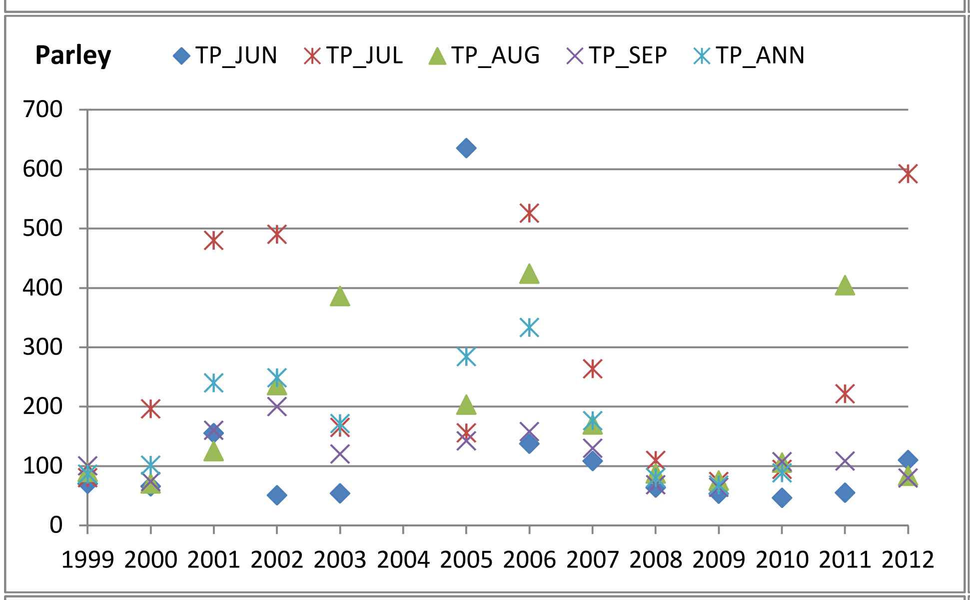
Bottom TP and SRP

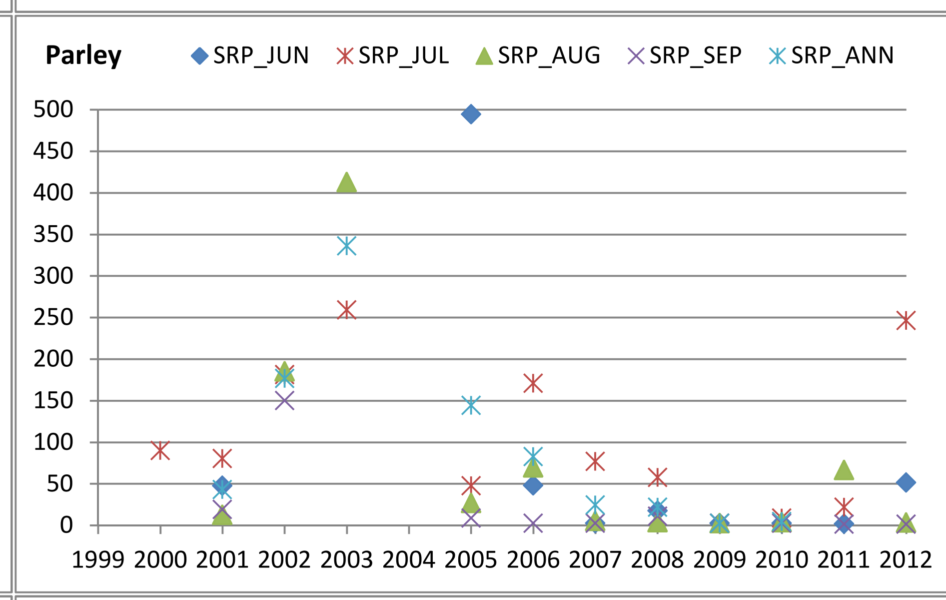


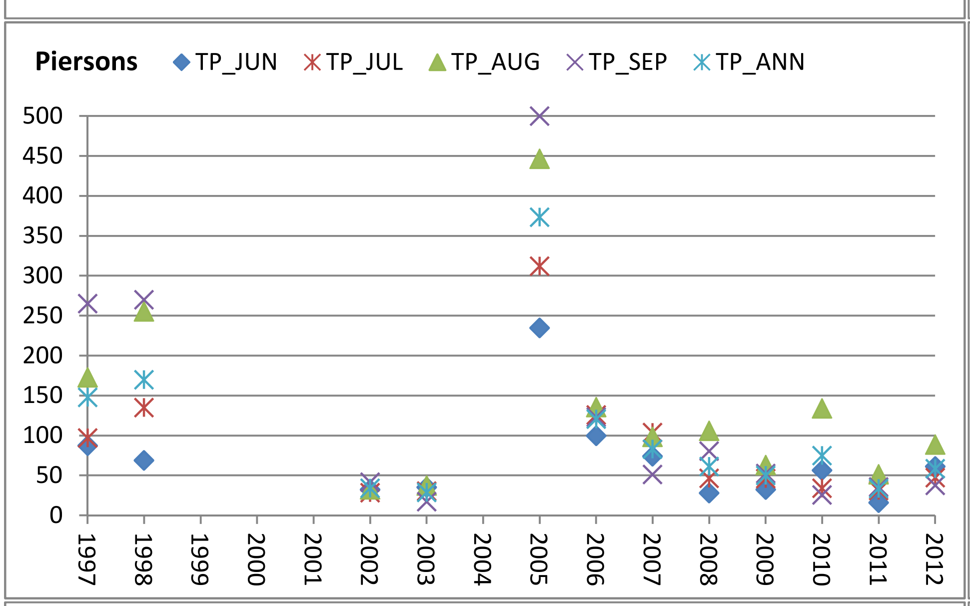
Bottom TP and SRP

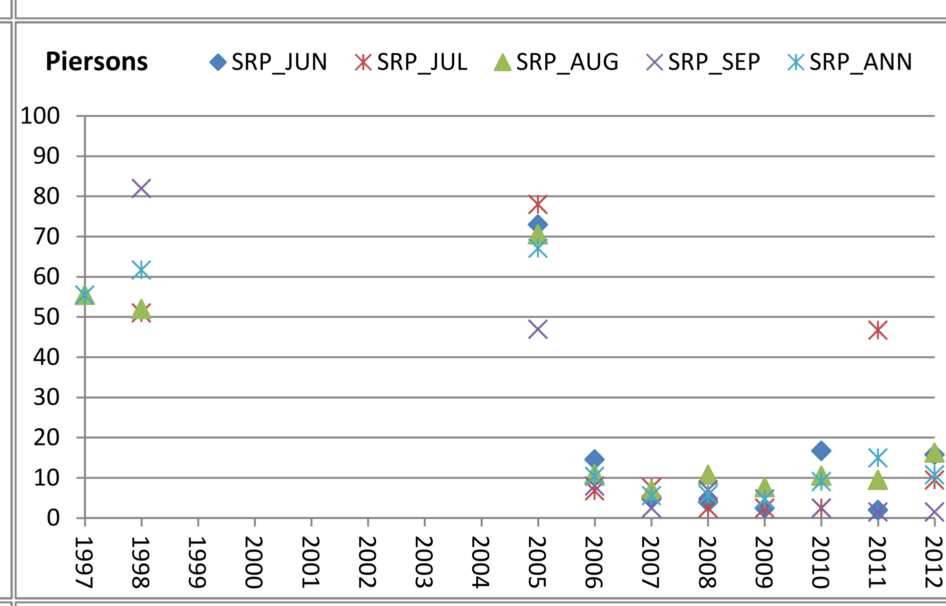


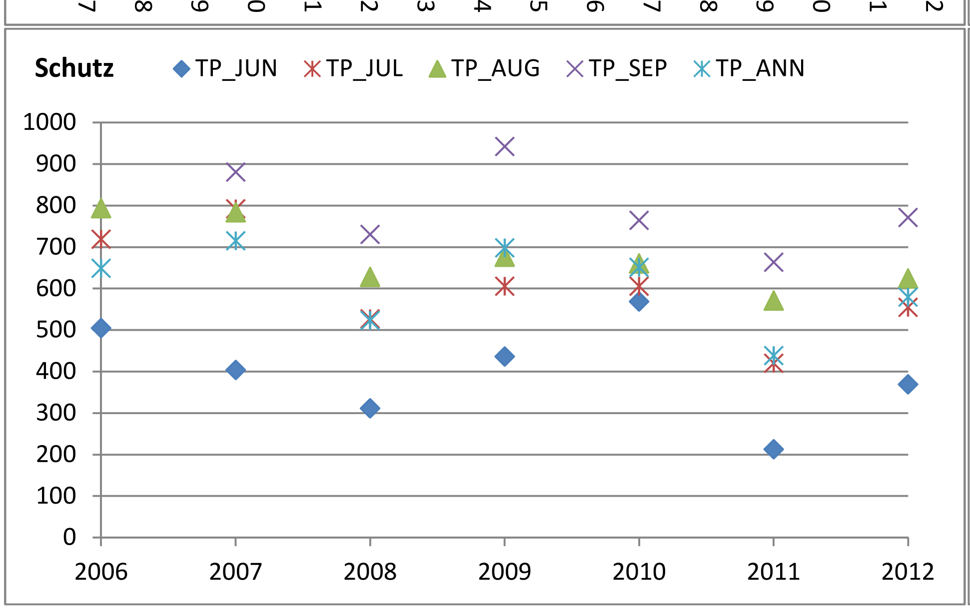


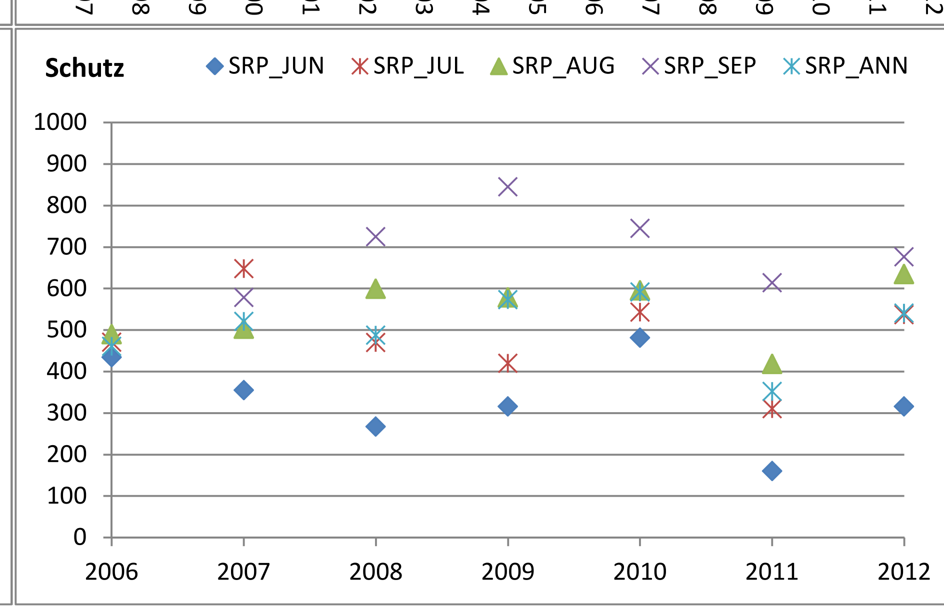




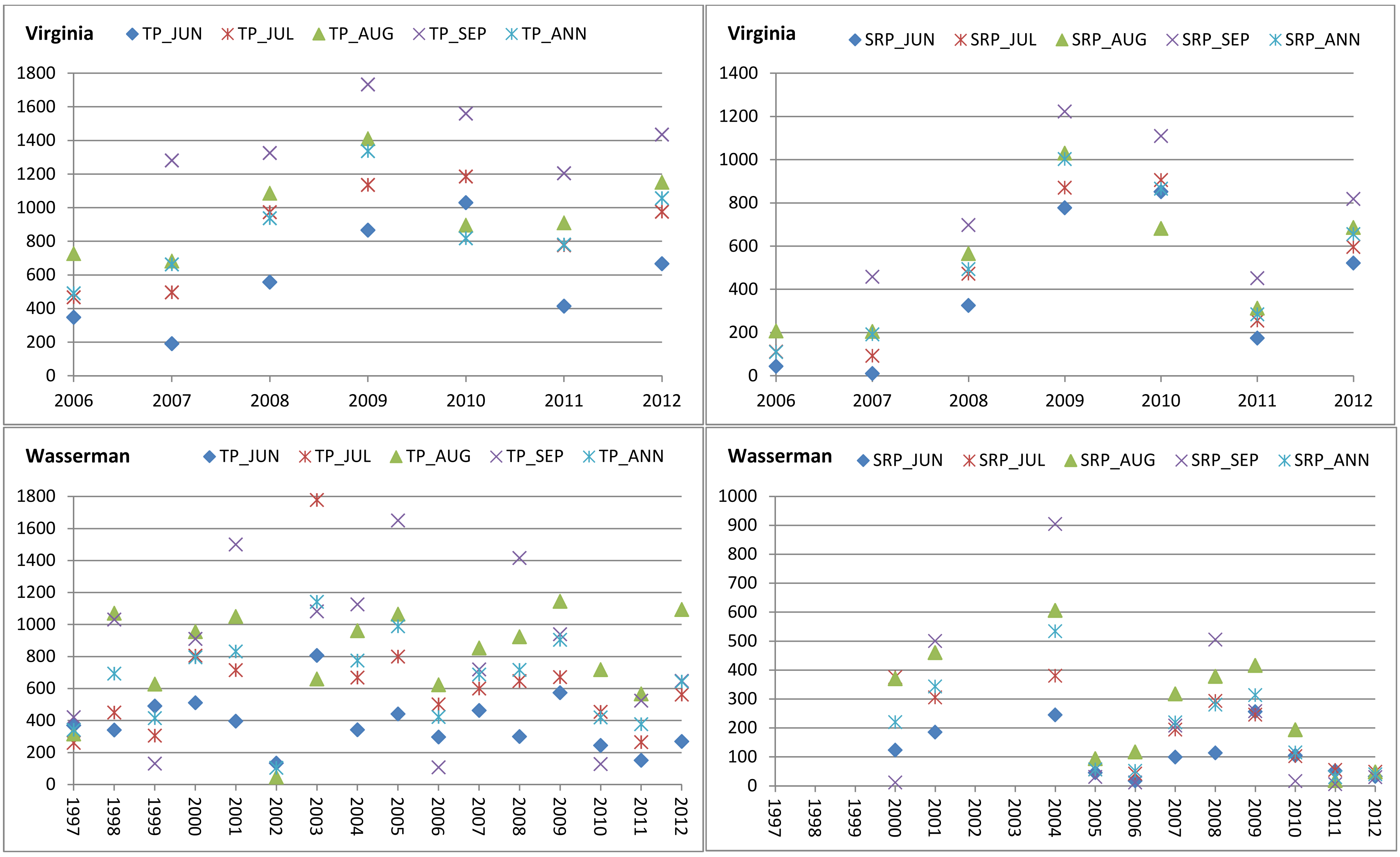




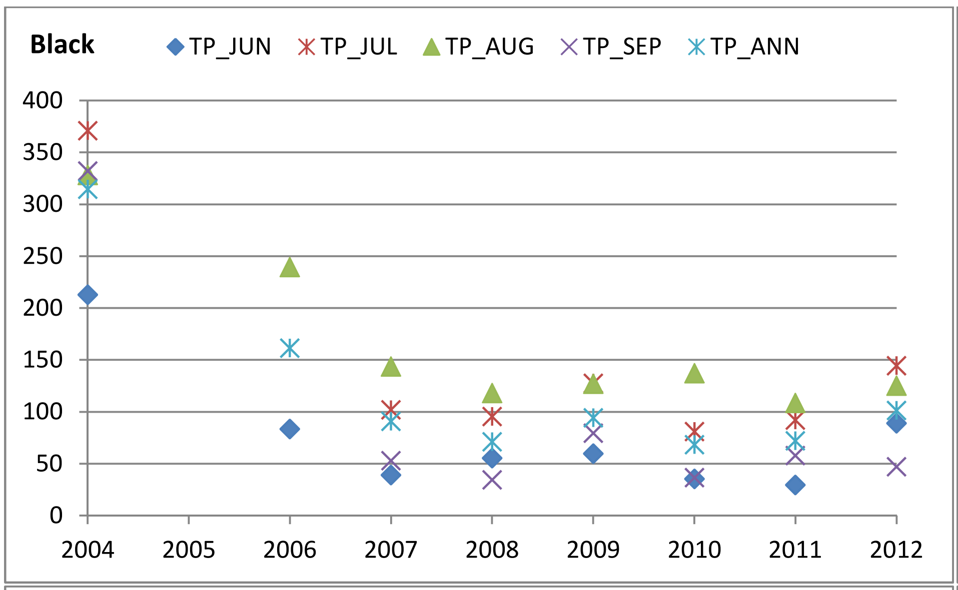


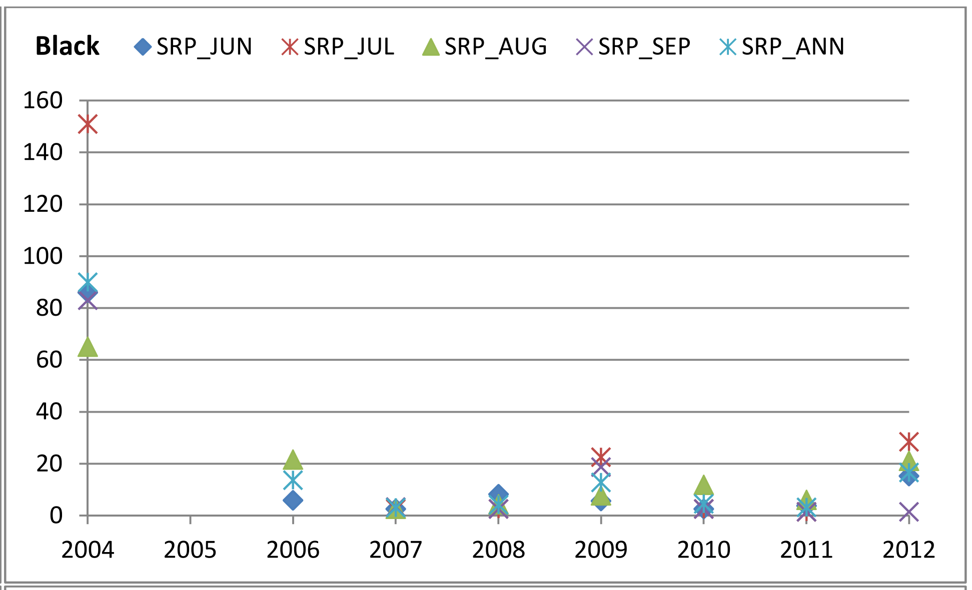


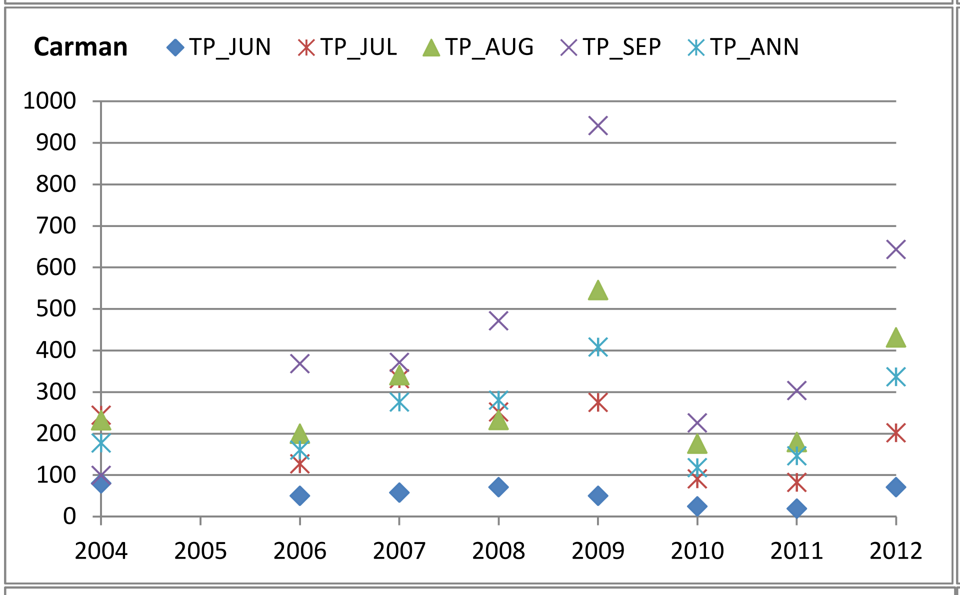
Bottom TP and SRP

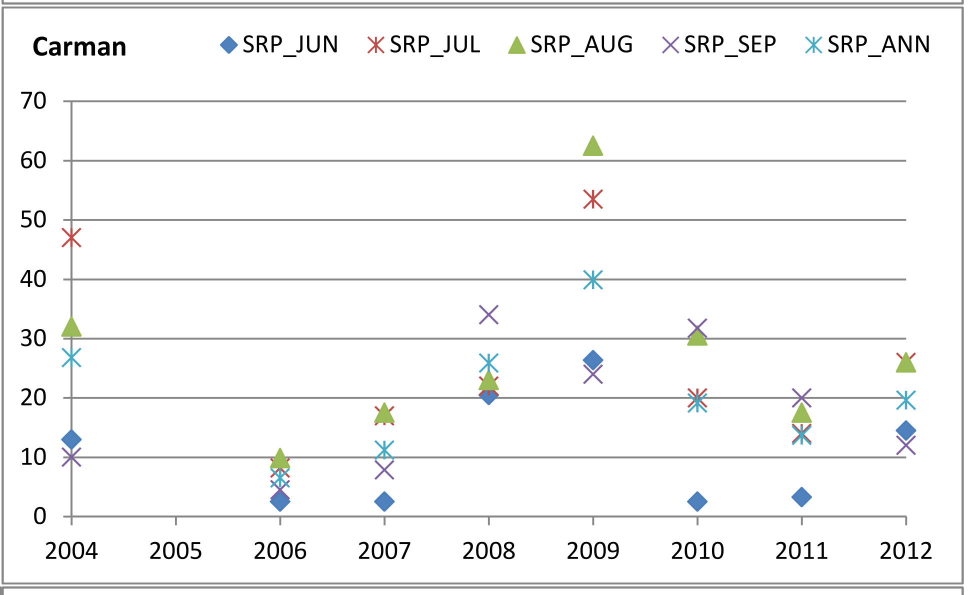


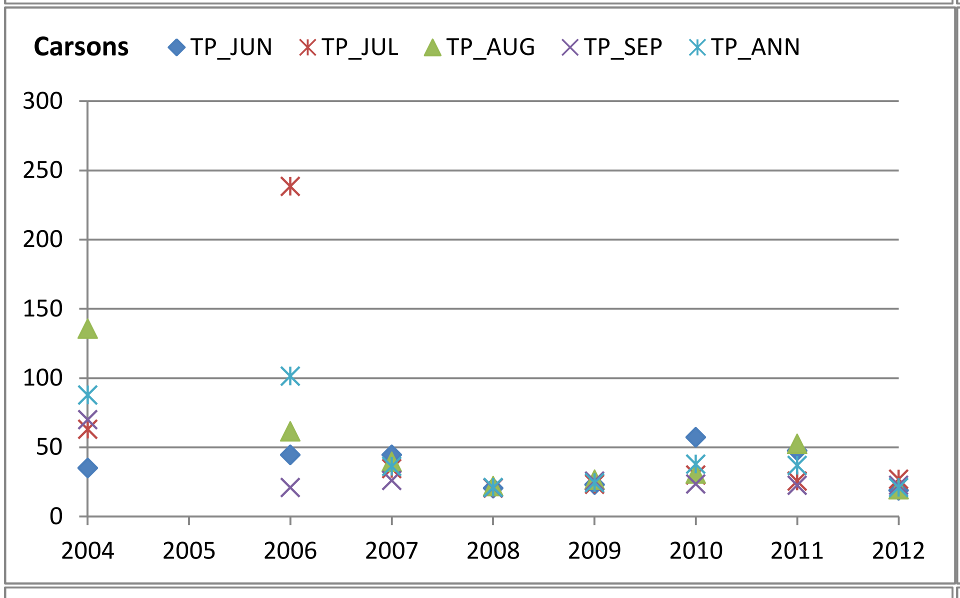
Bottom TP and SRP

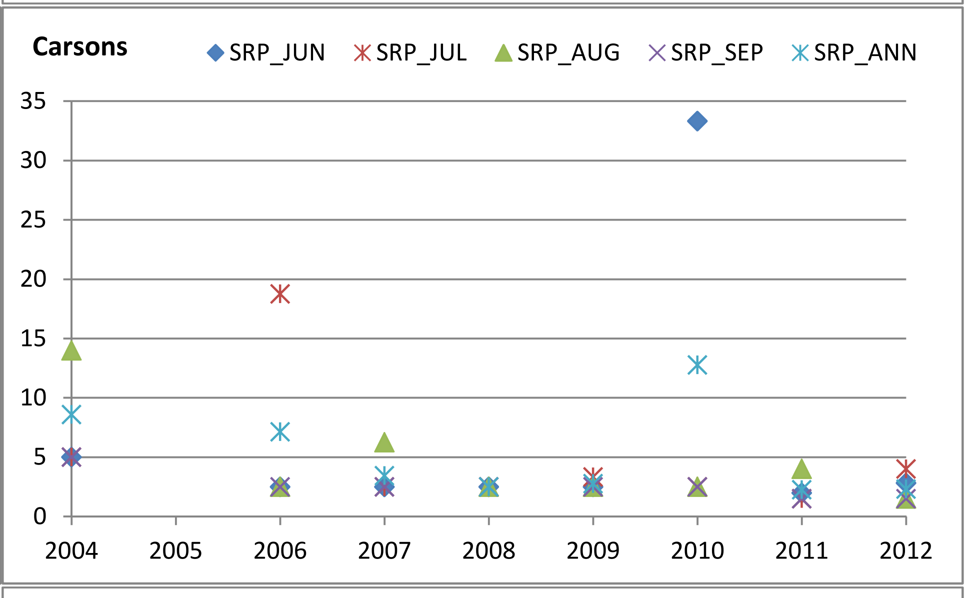


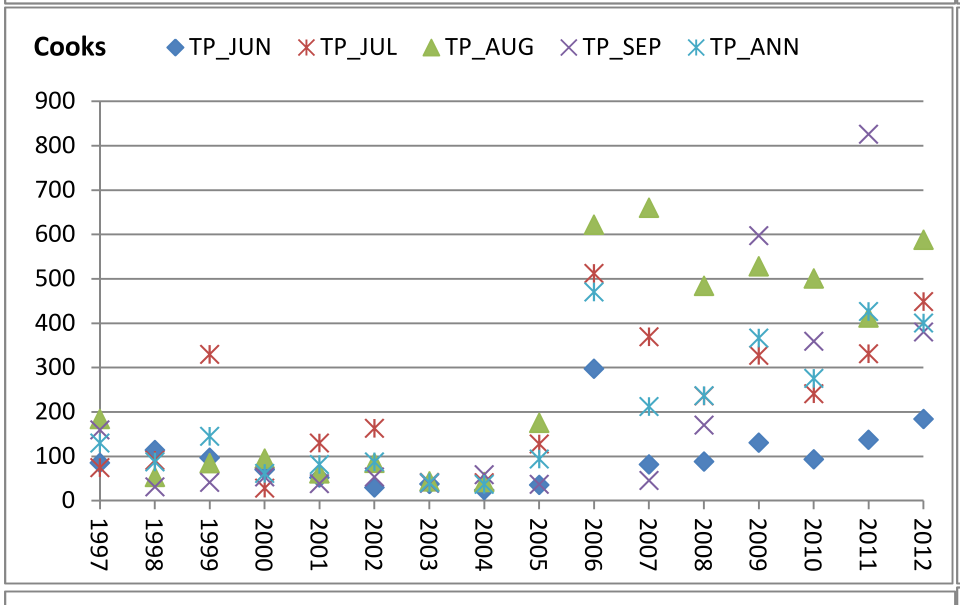


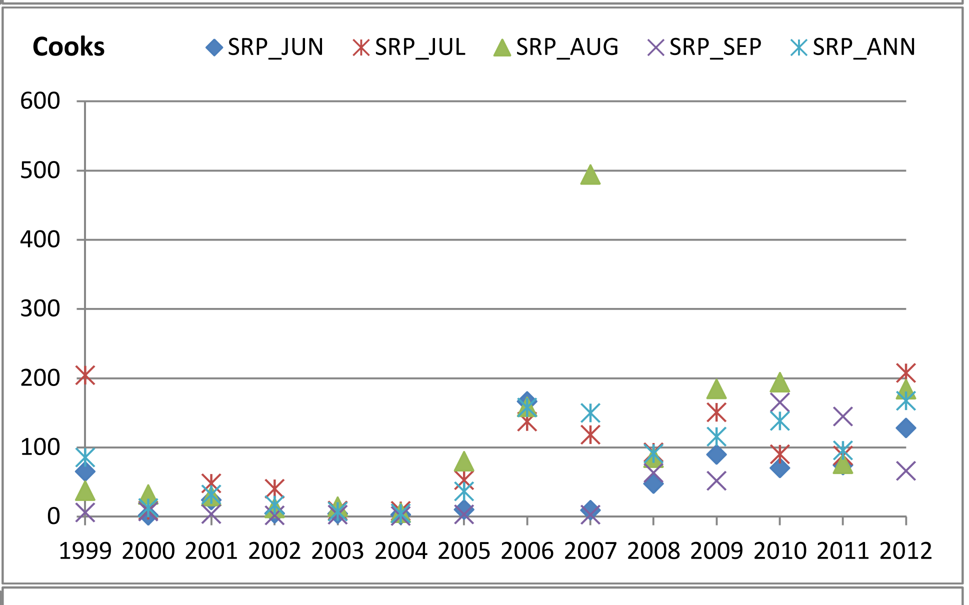


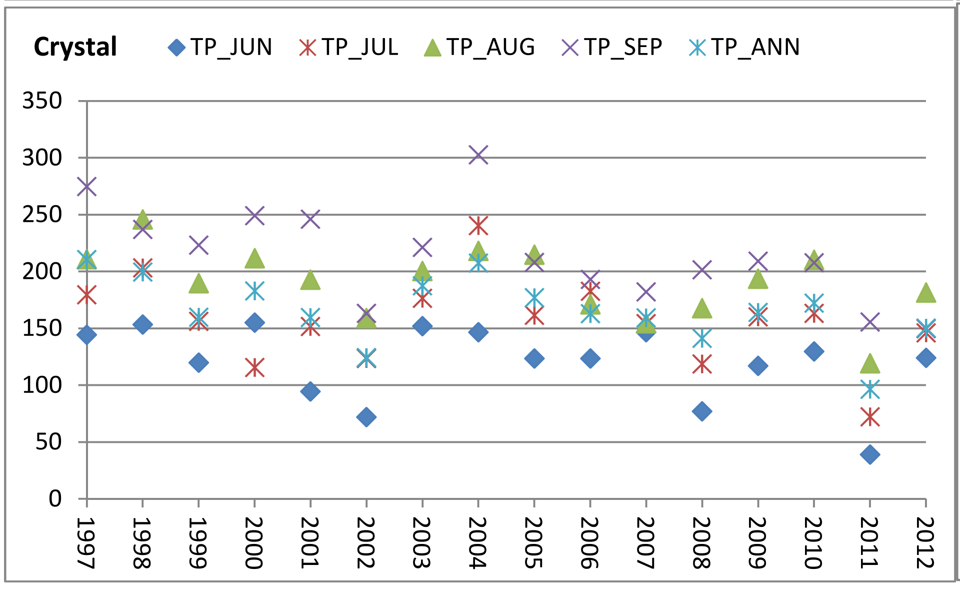


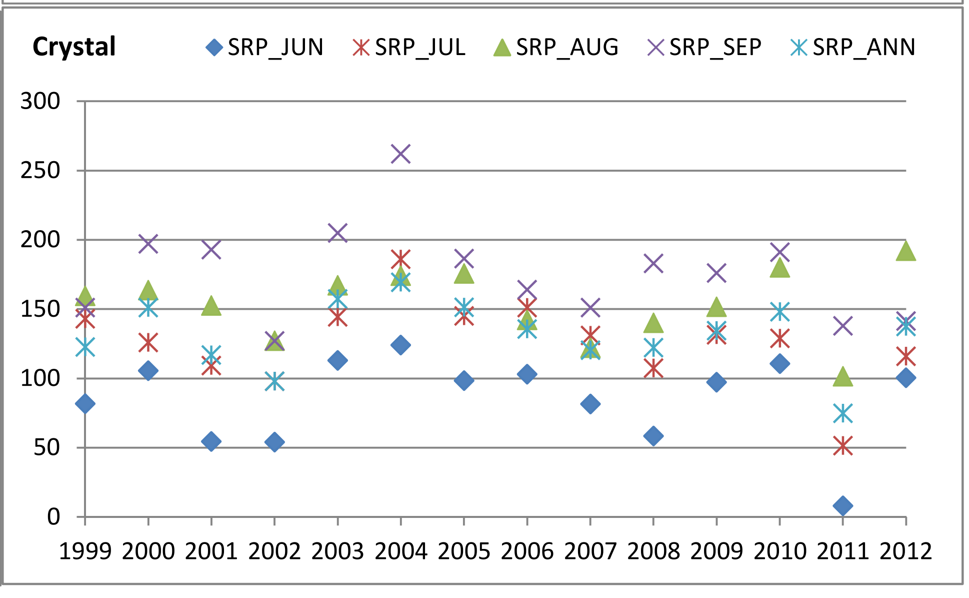












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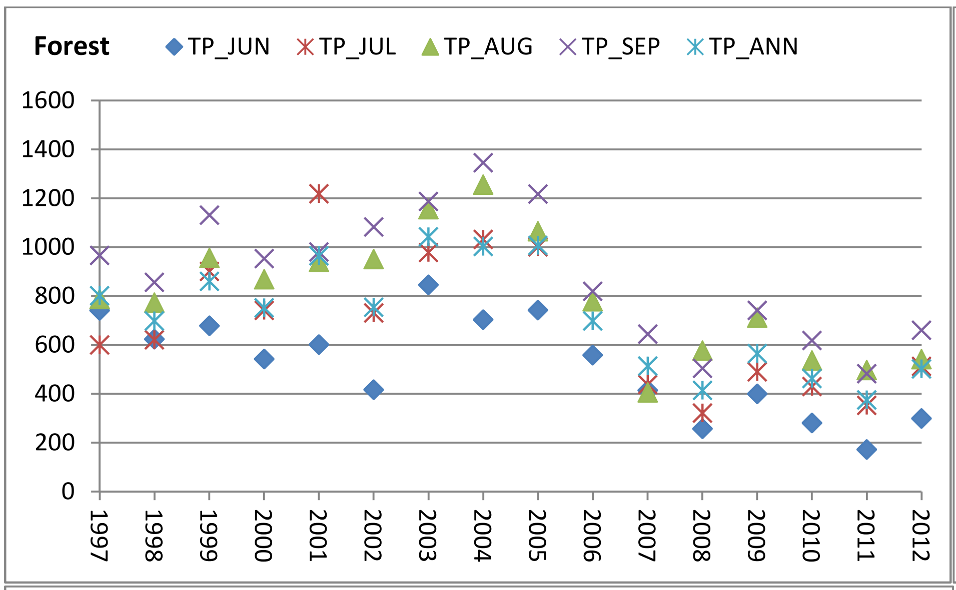

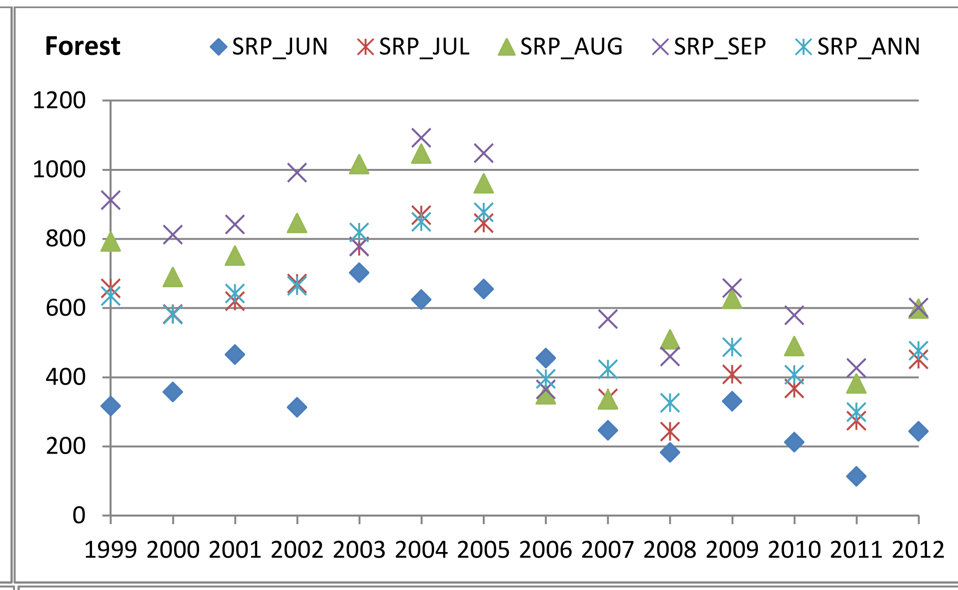

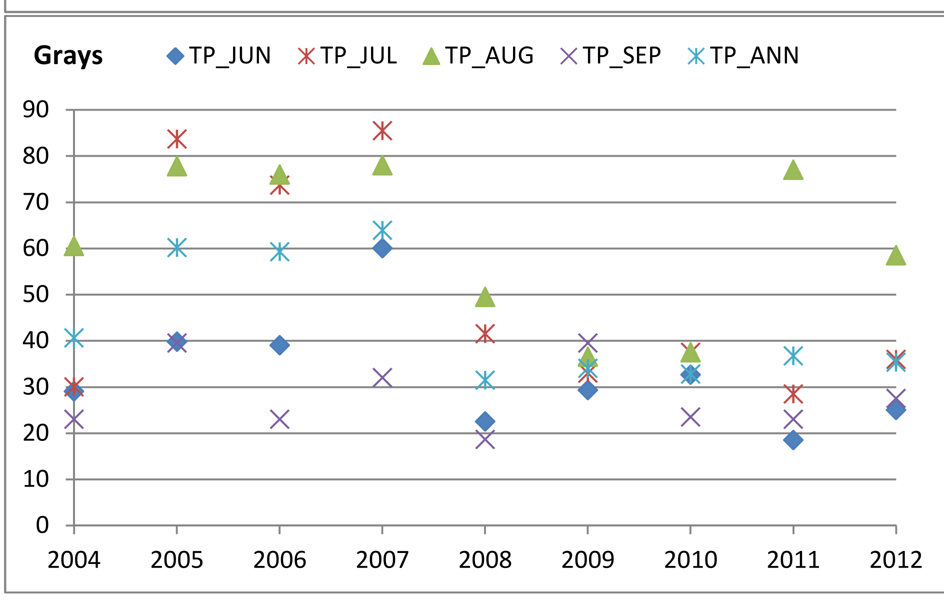

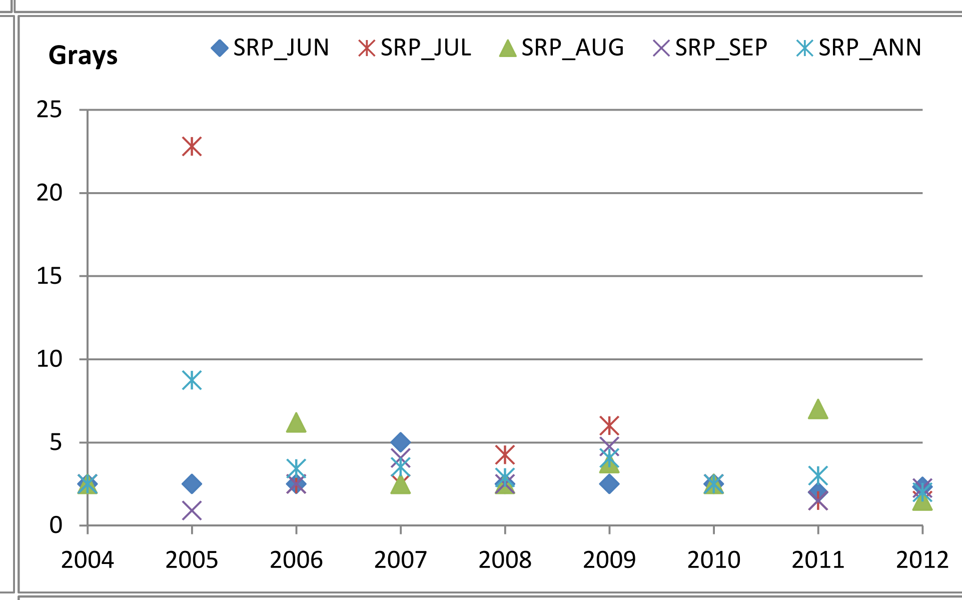

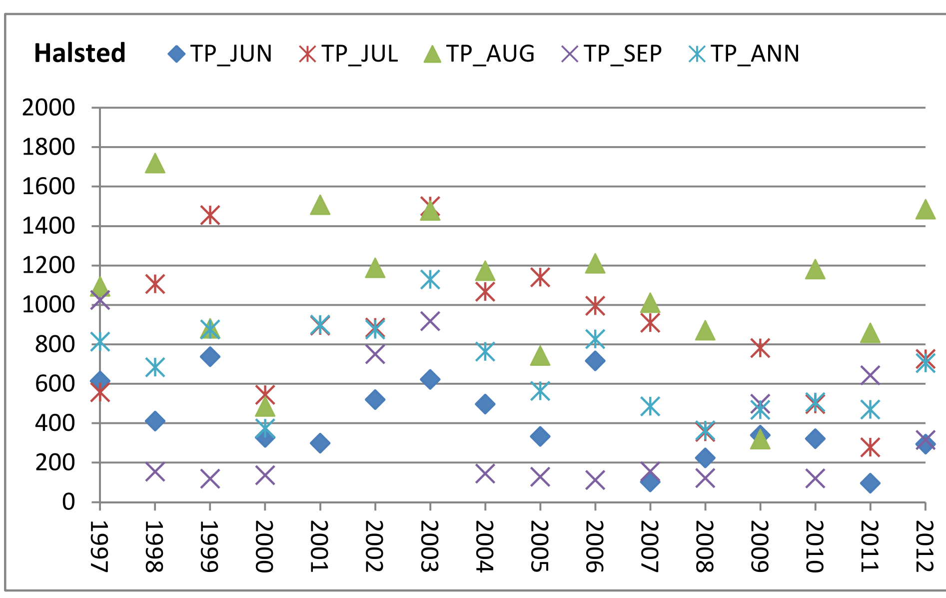

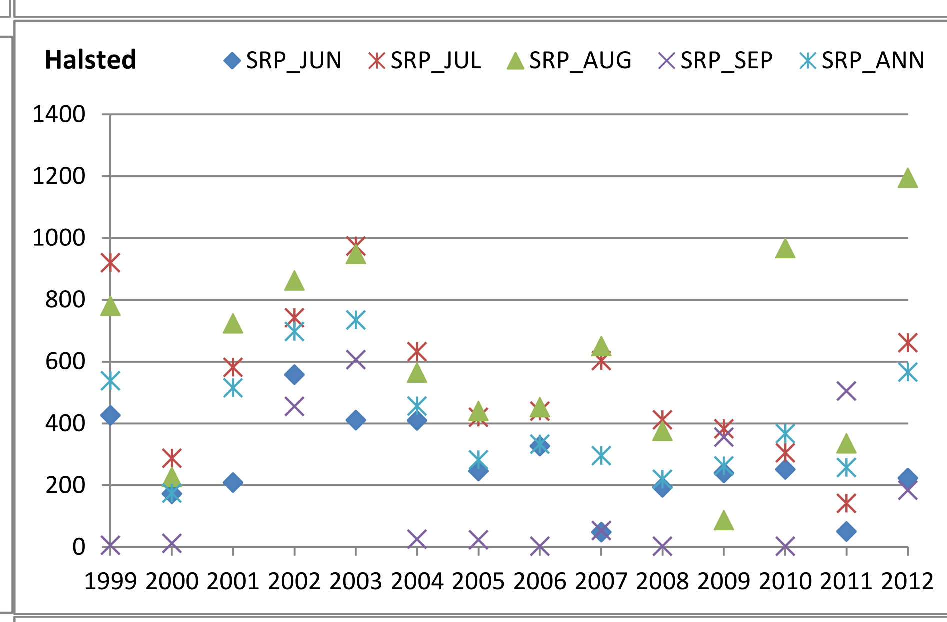

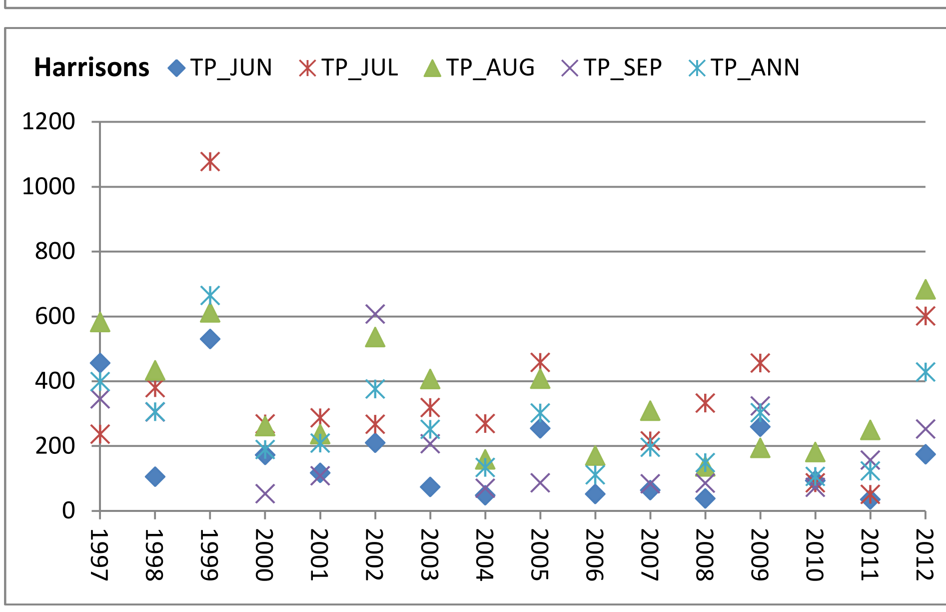

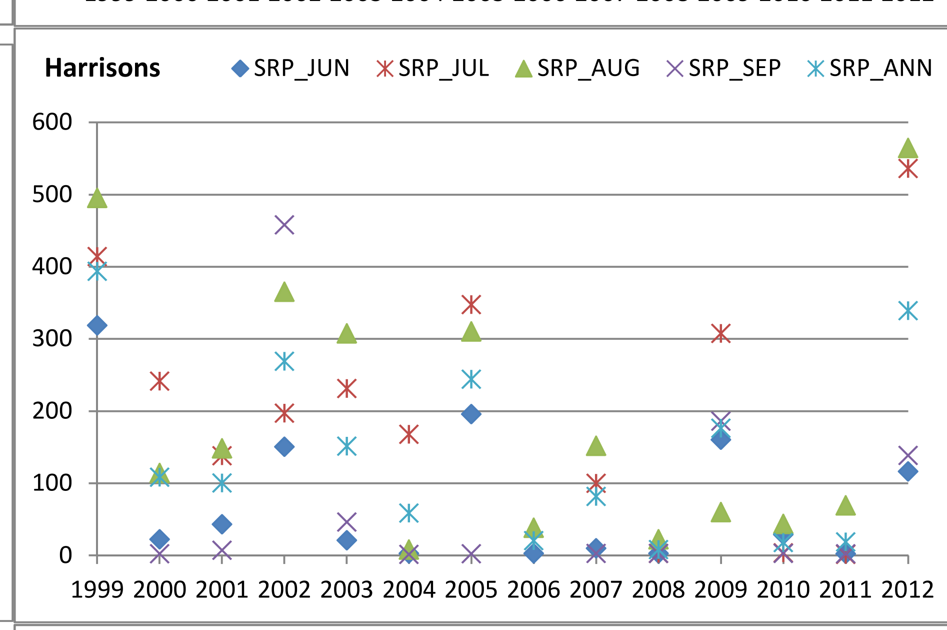

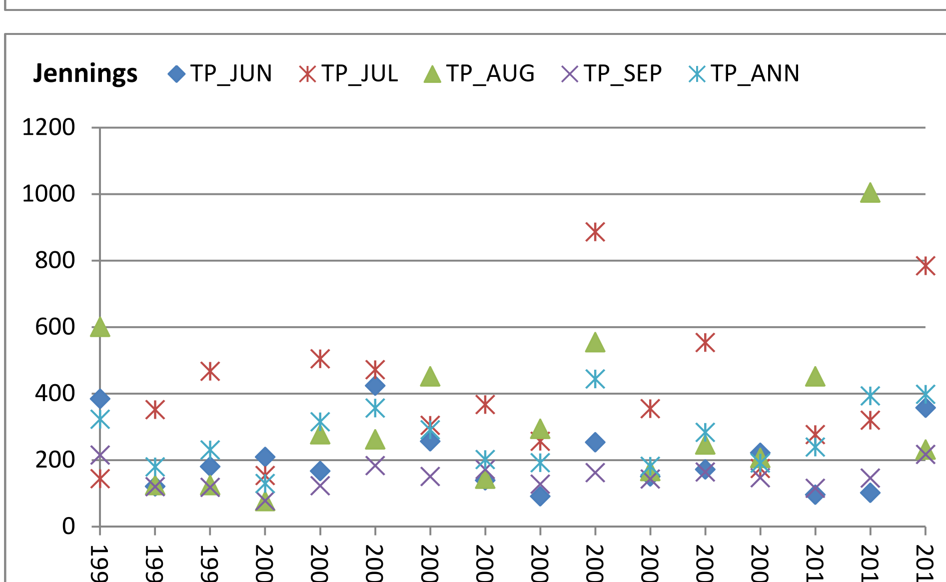

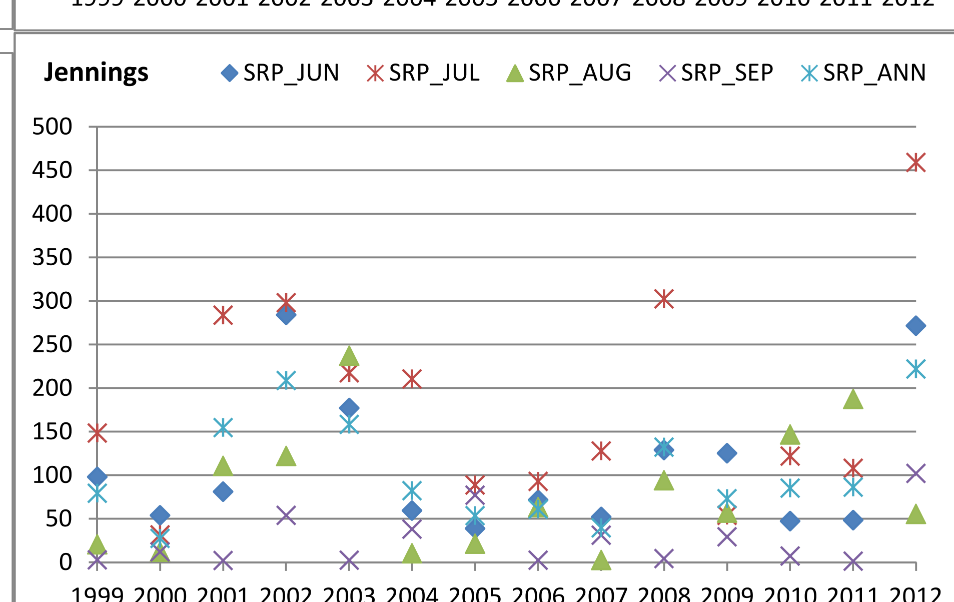

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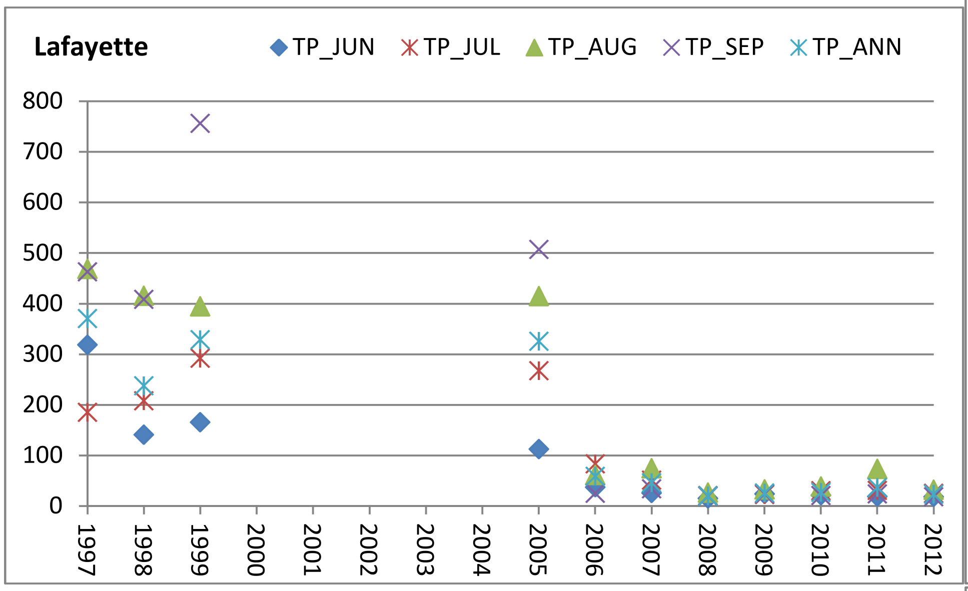

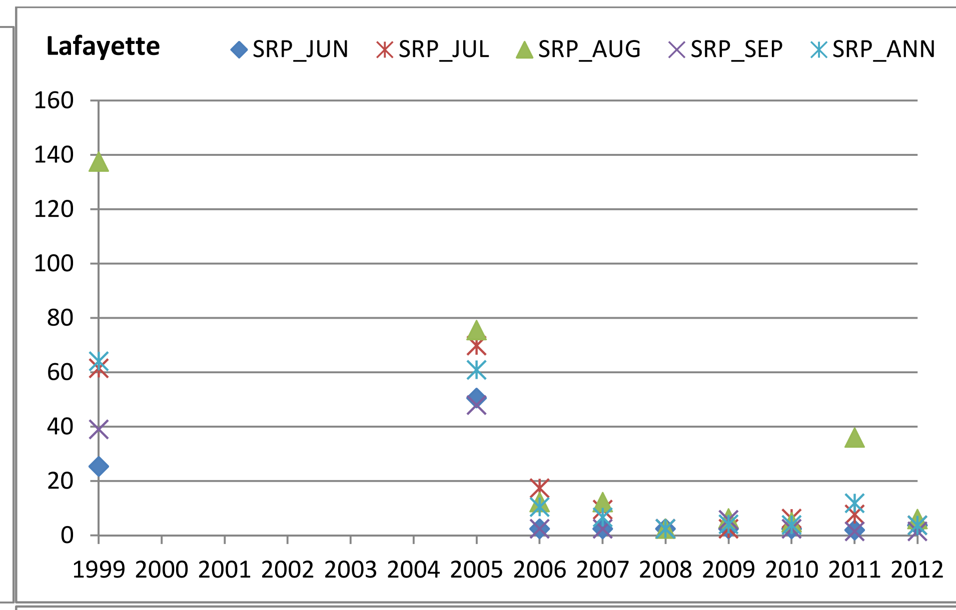

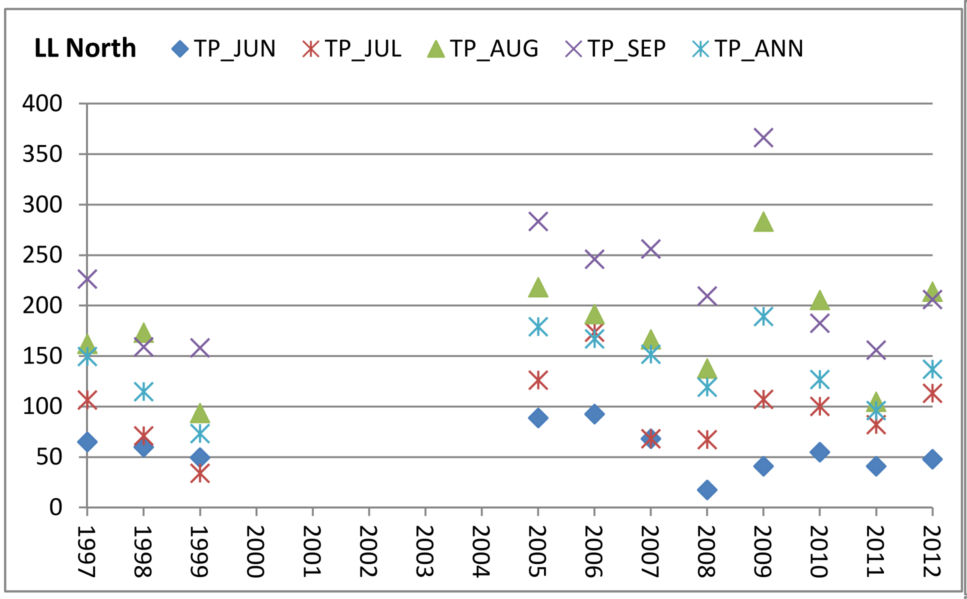

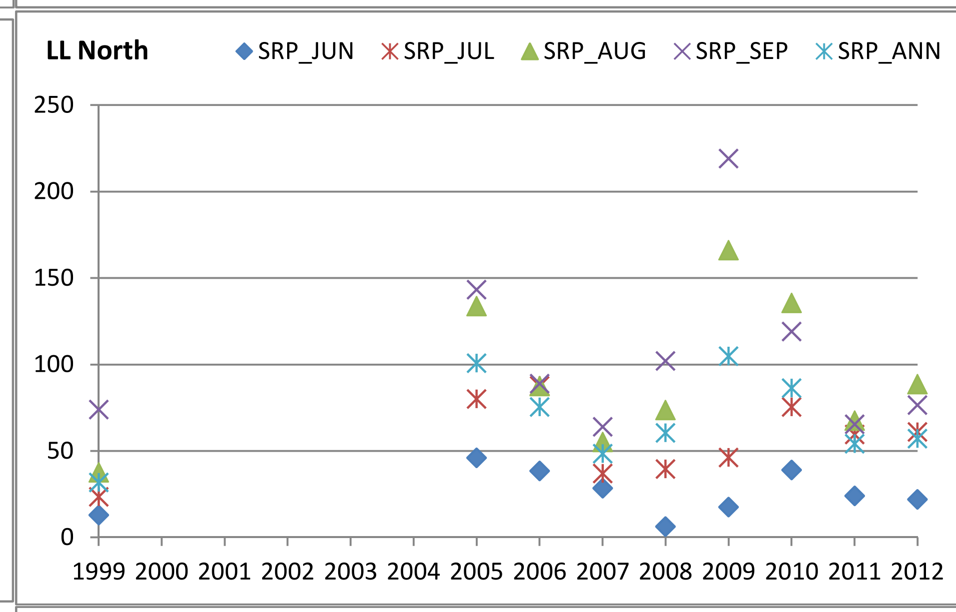

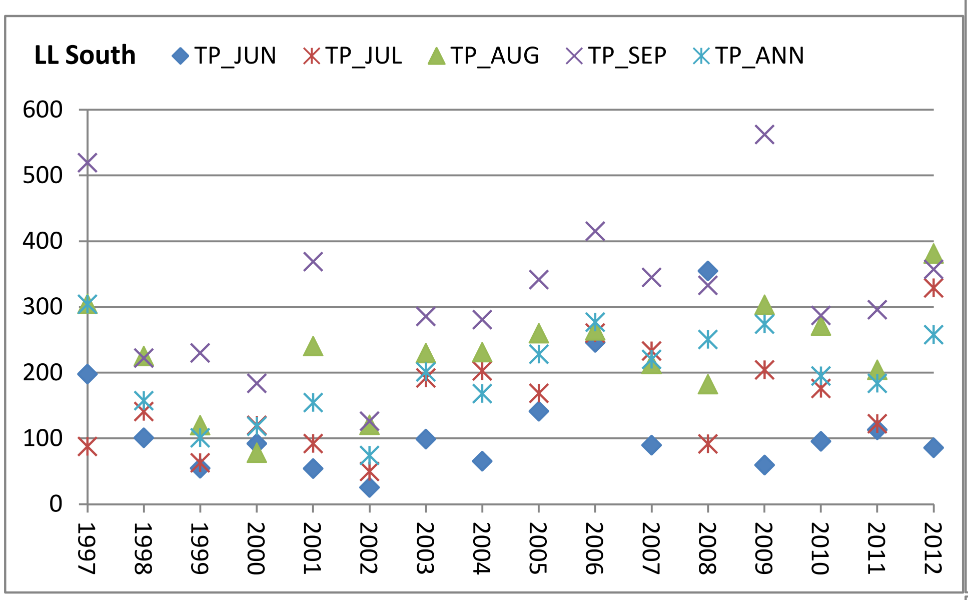

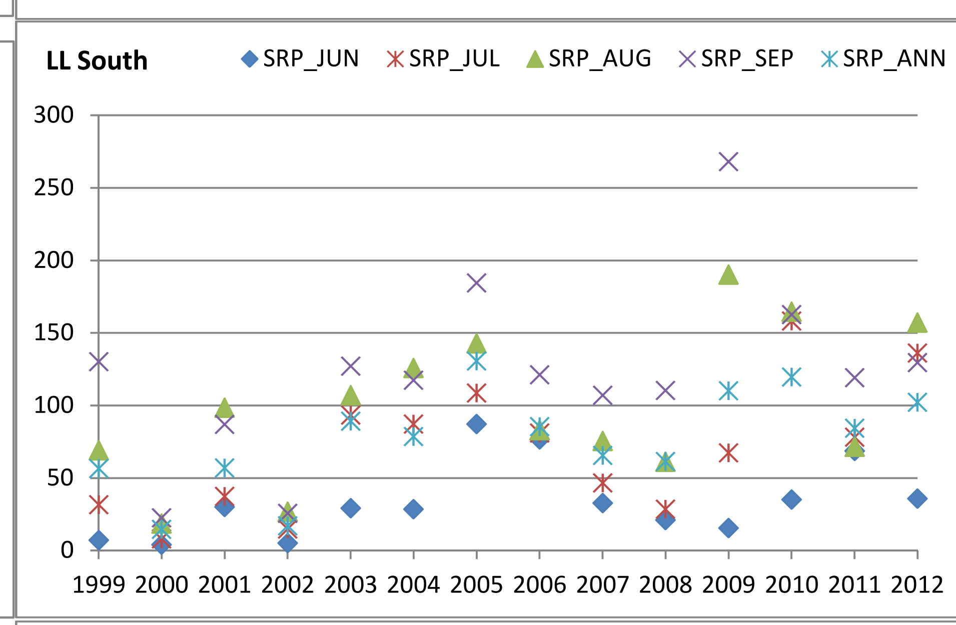

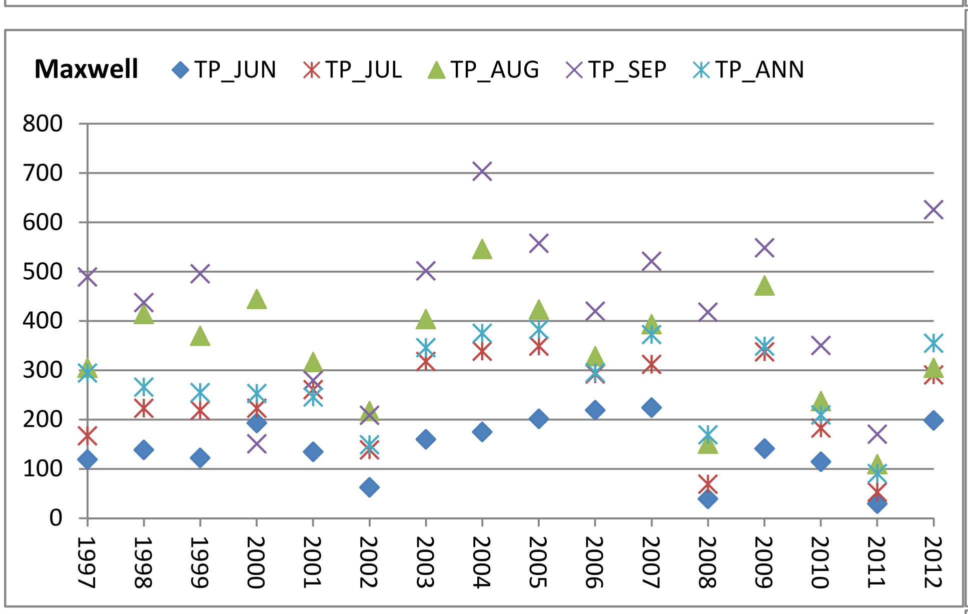

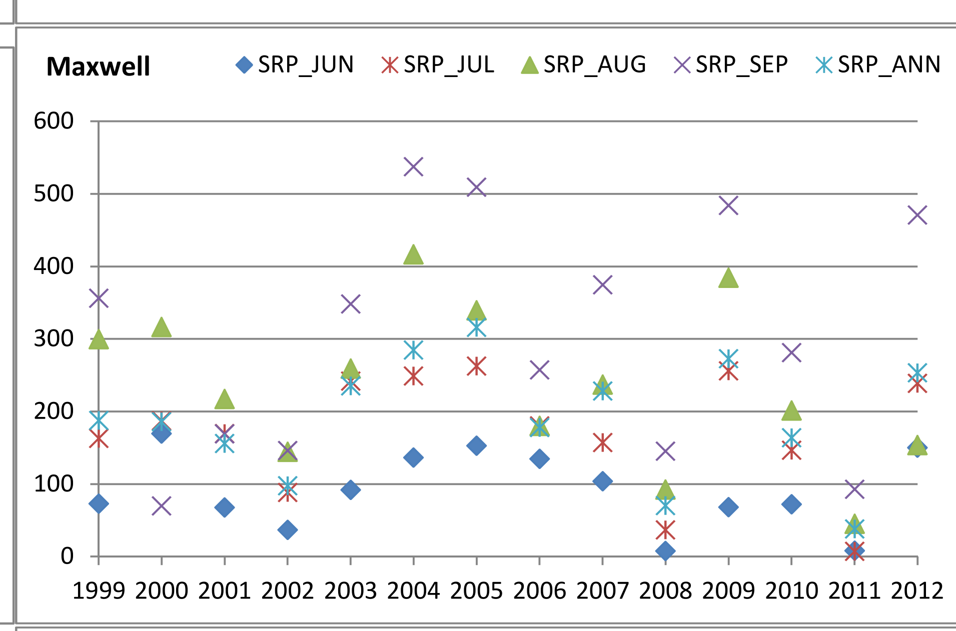

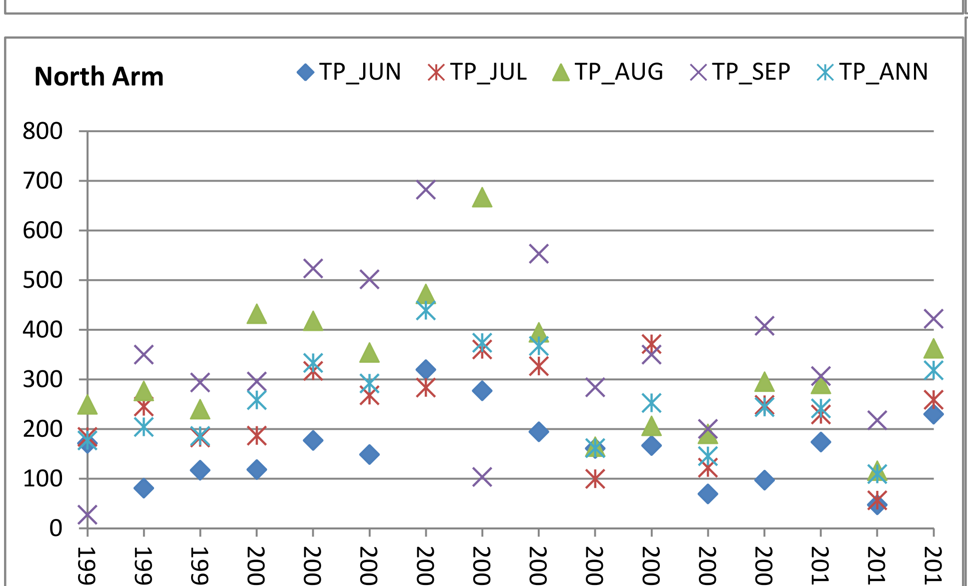

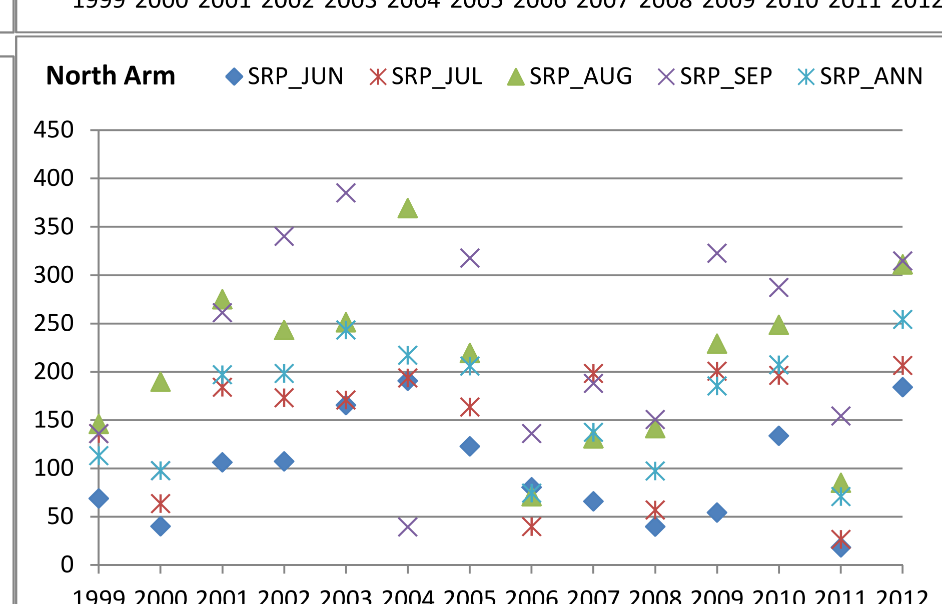

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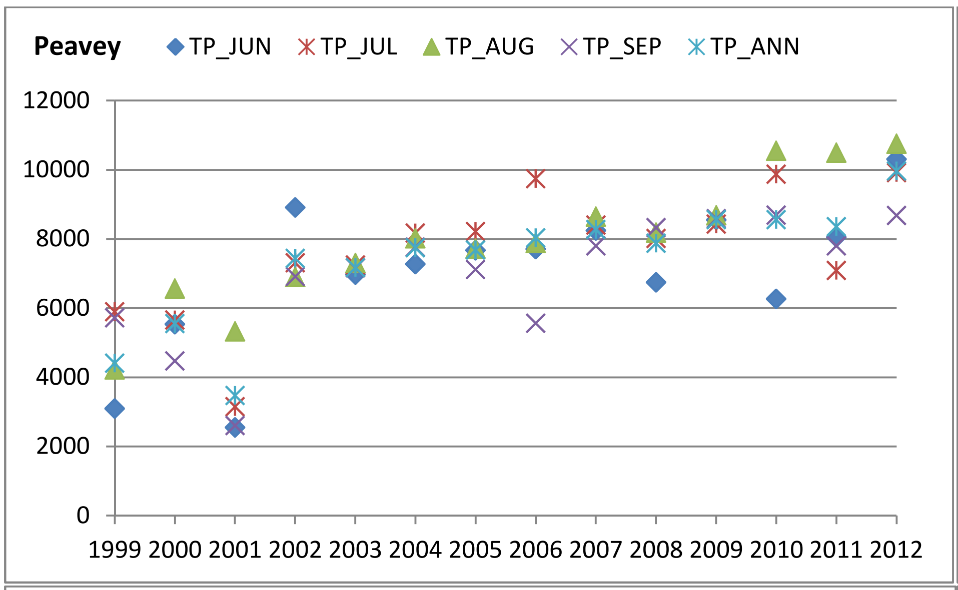

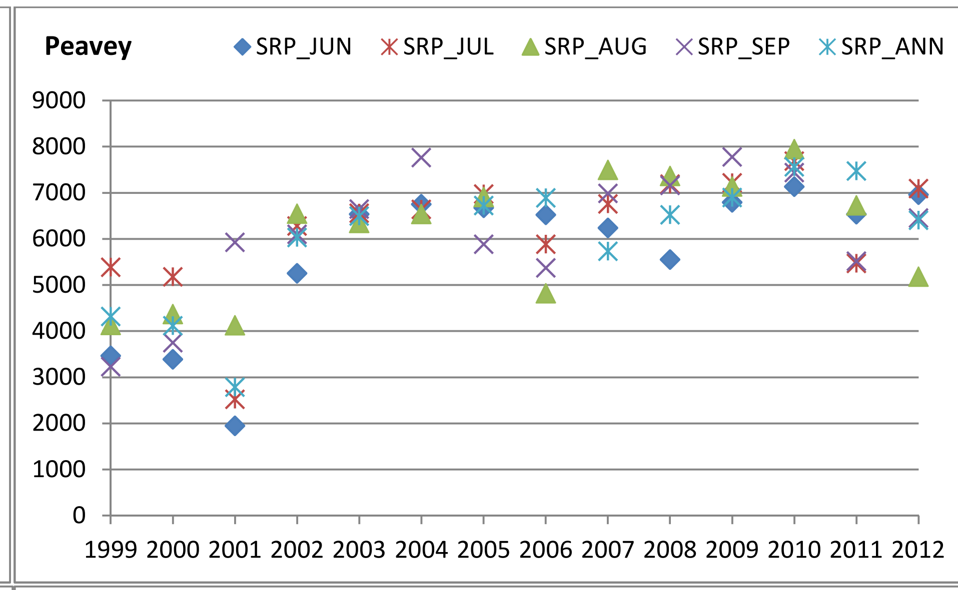

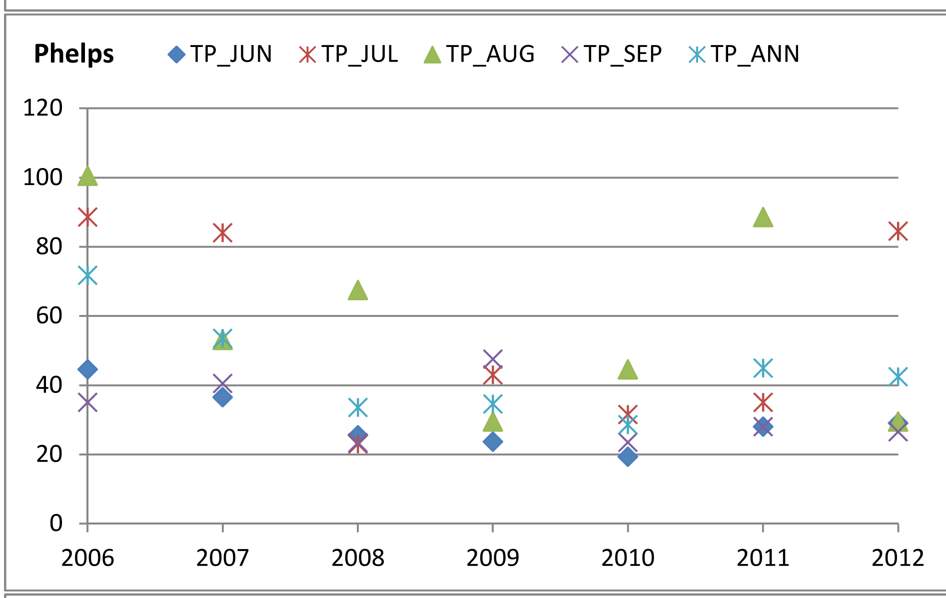

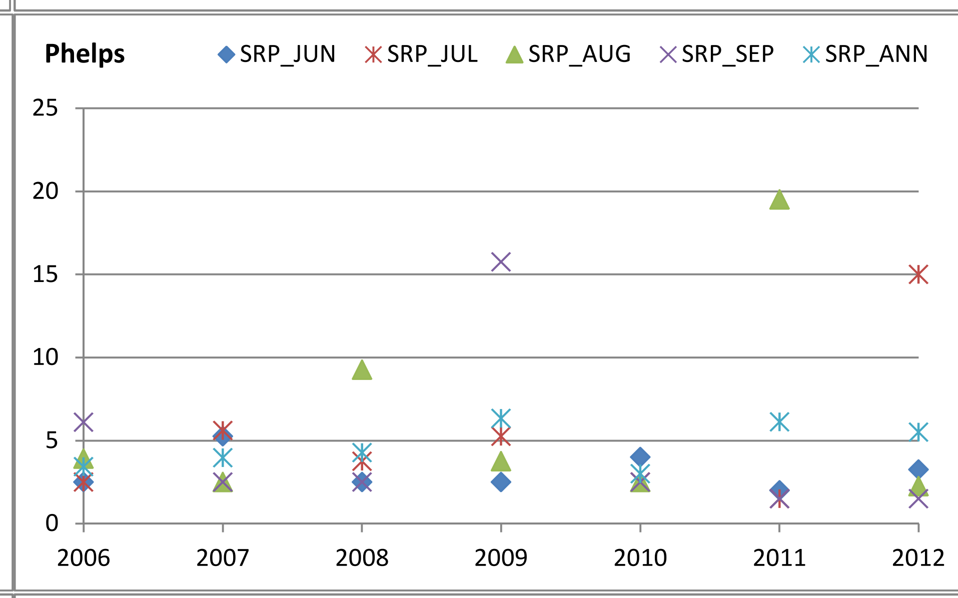

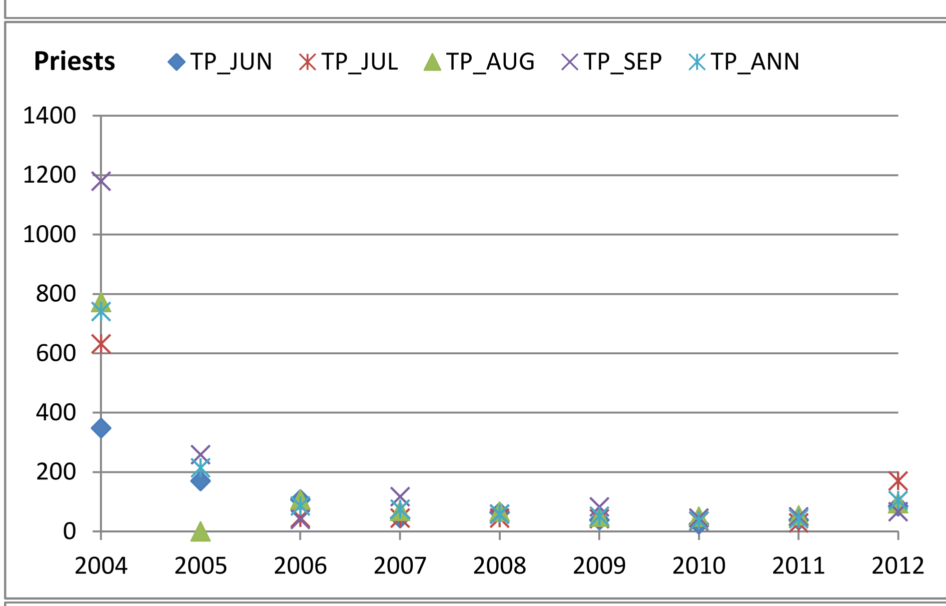

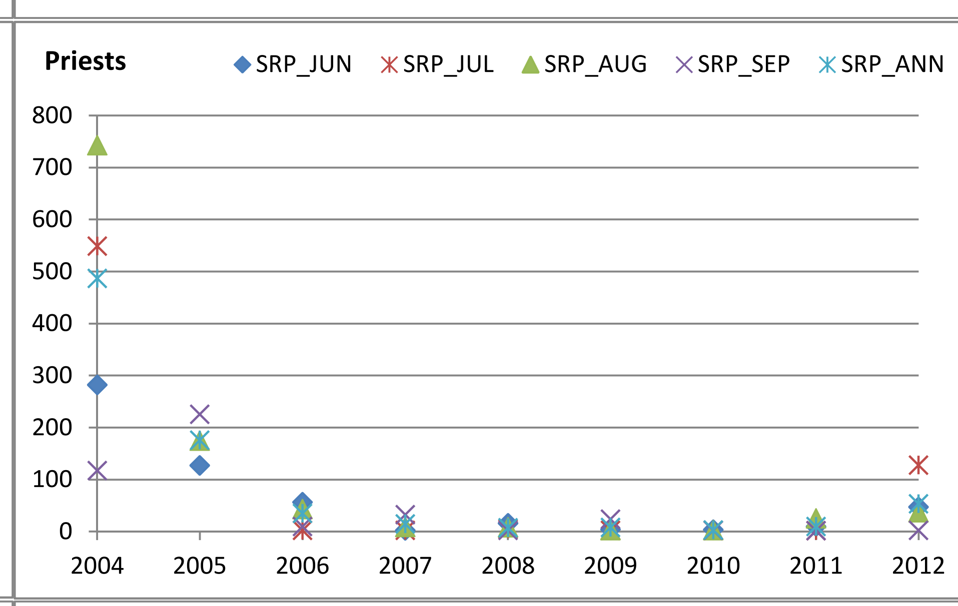

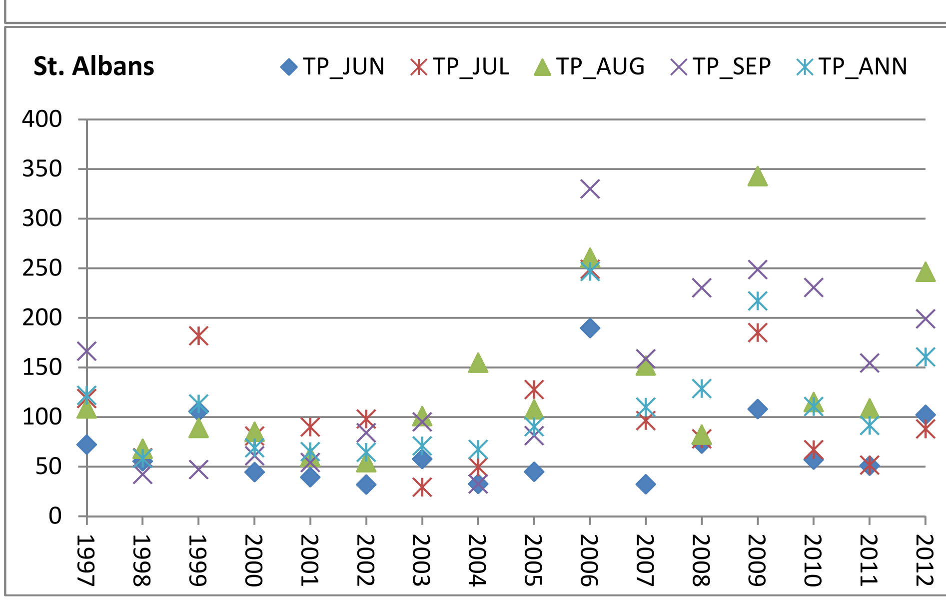

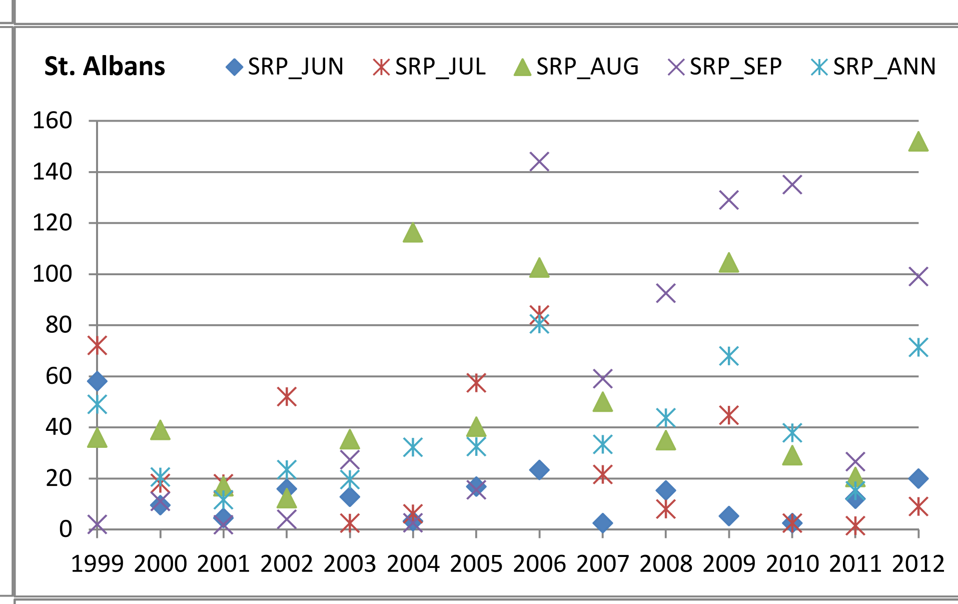

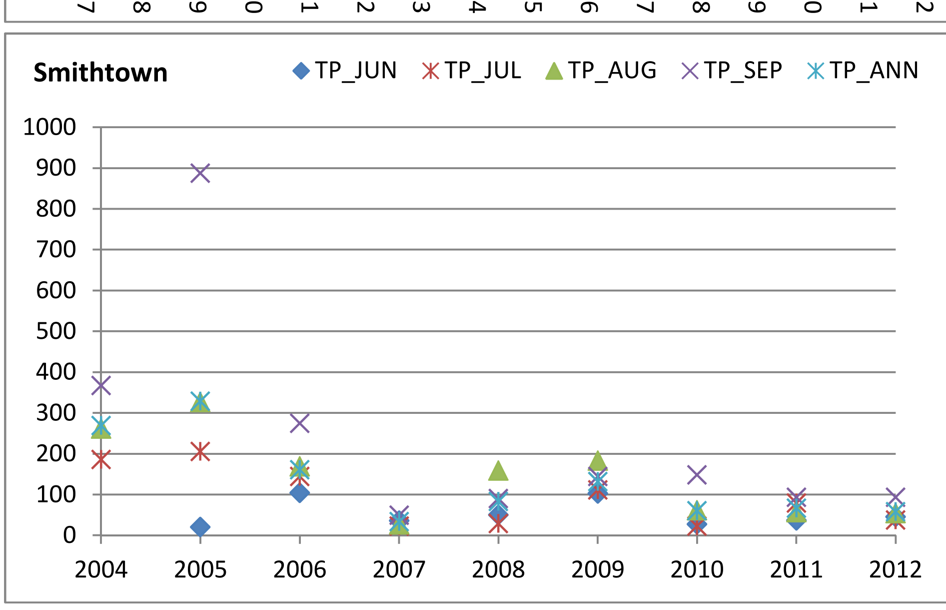

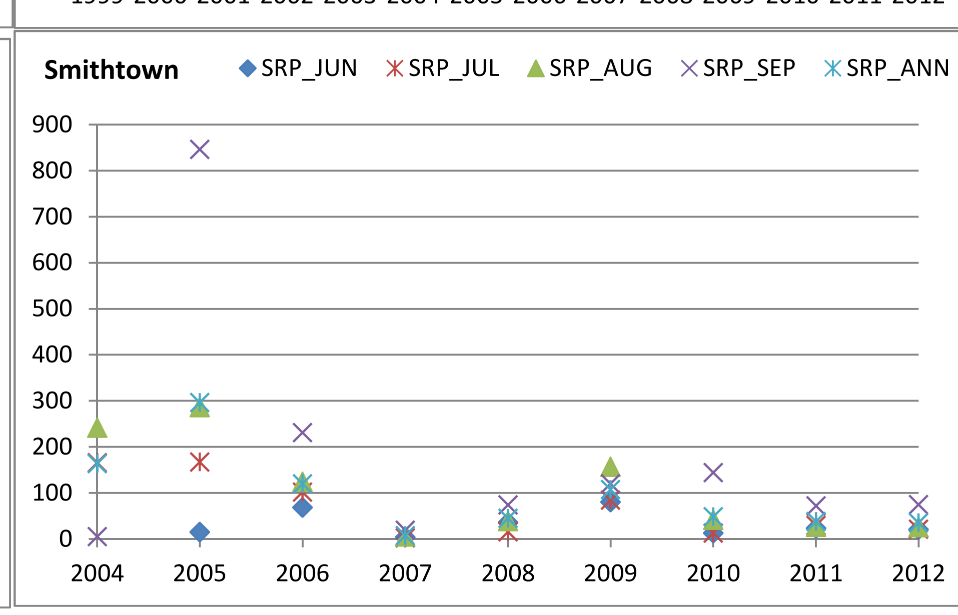

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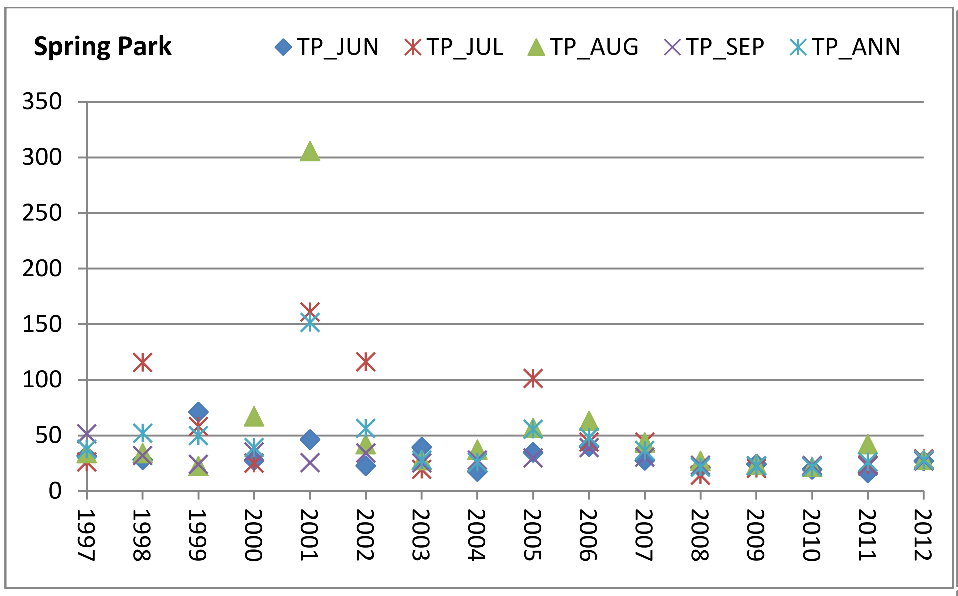

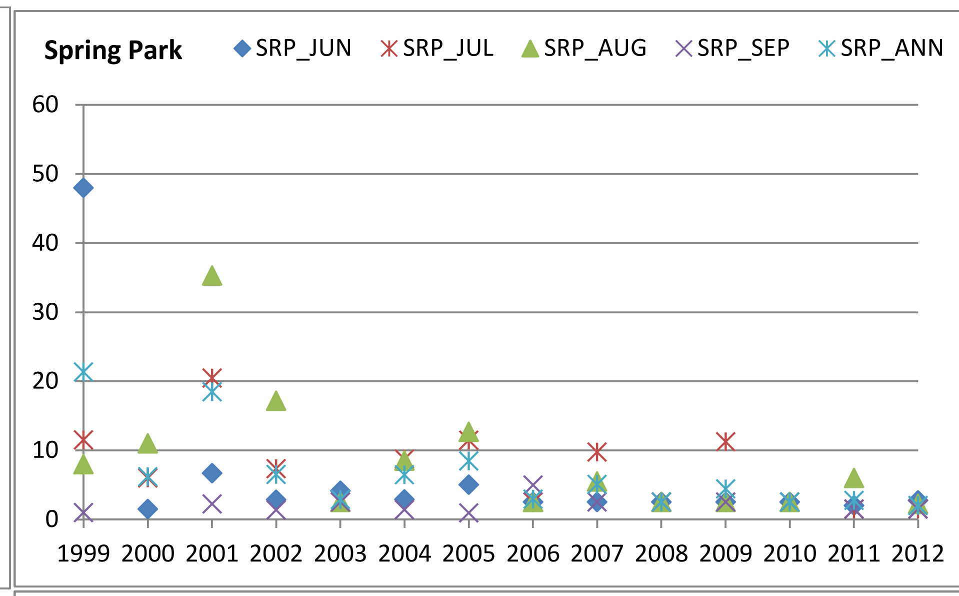

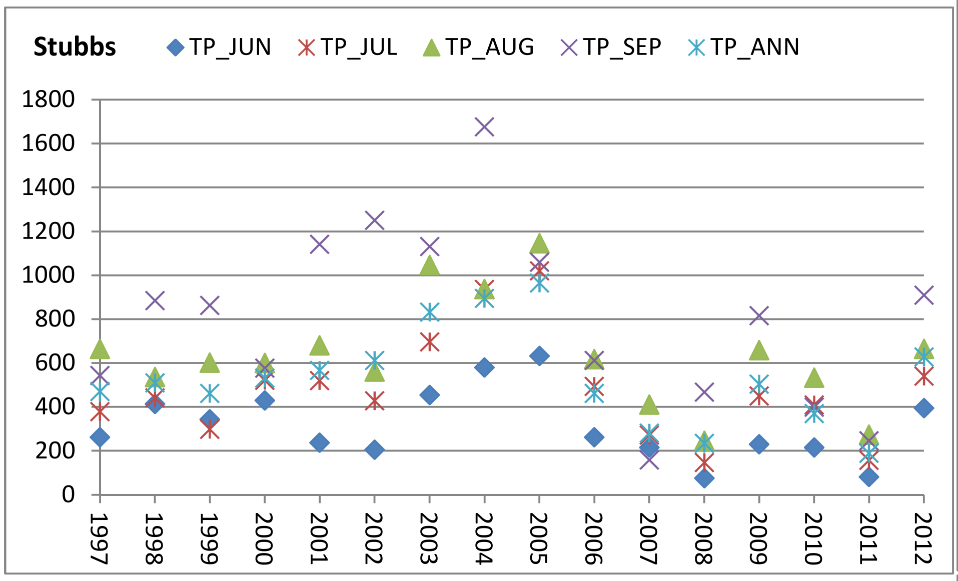

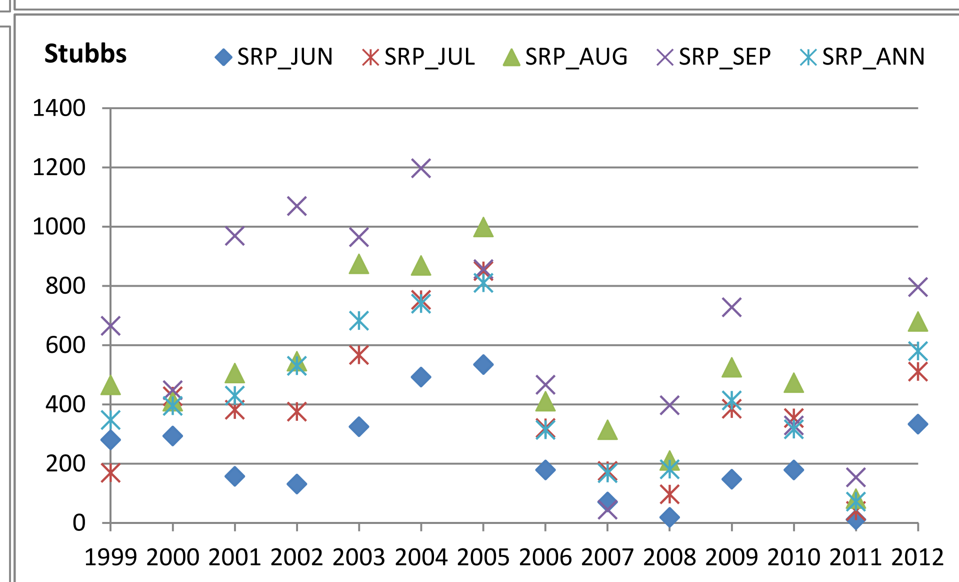

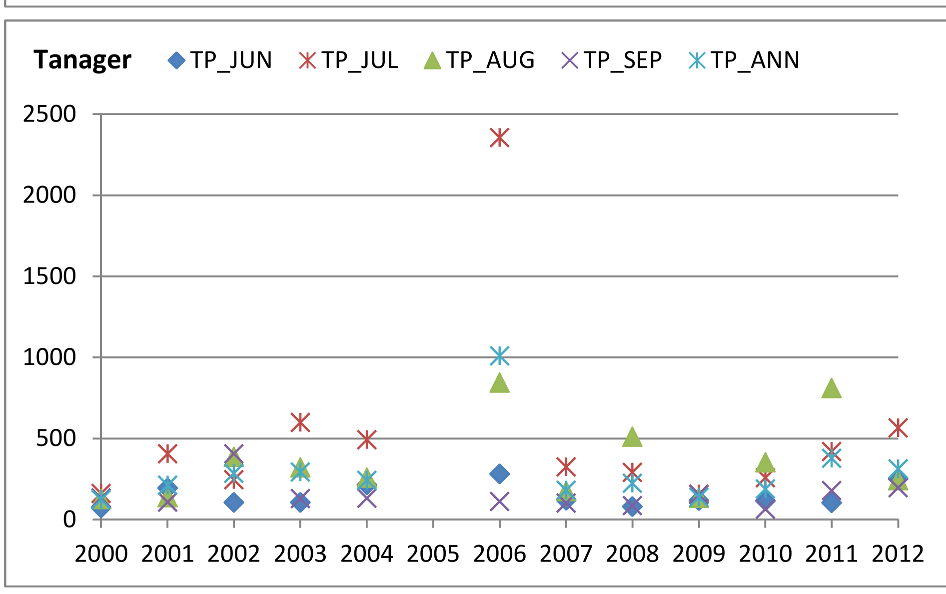

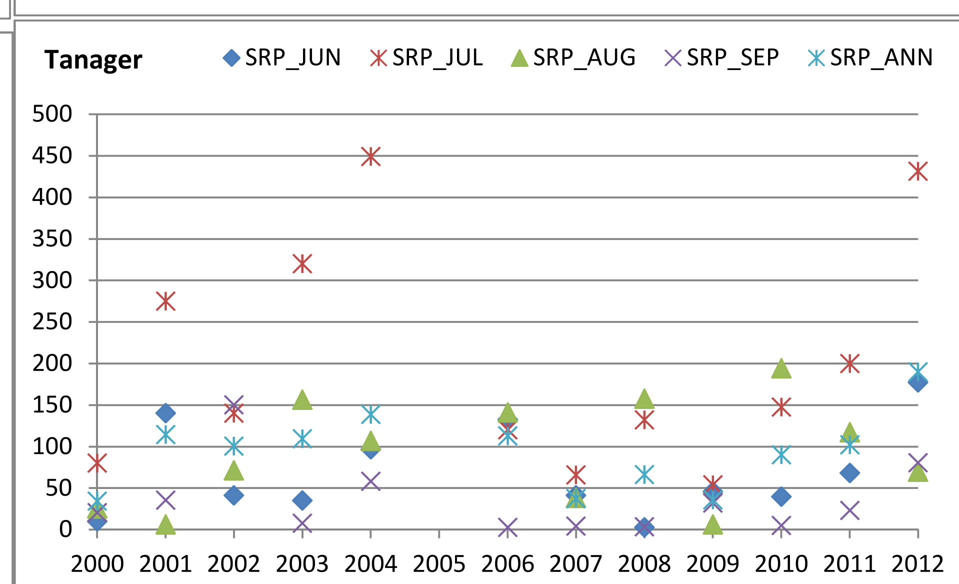

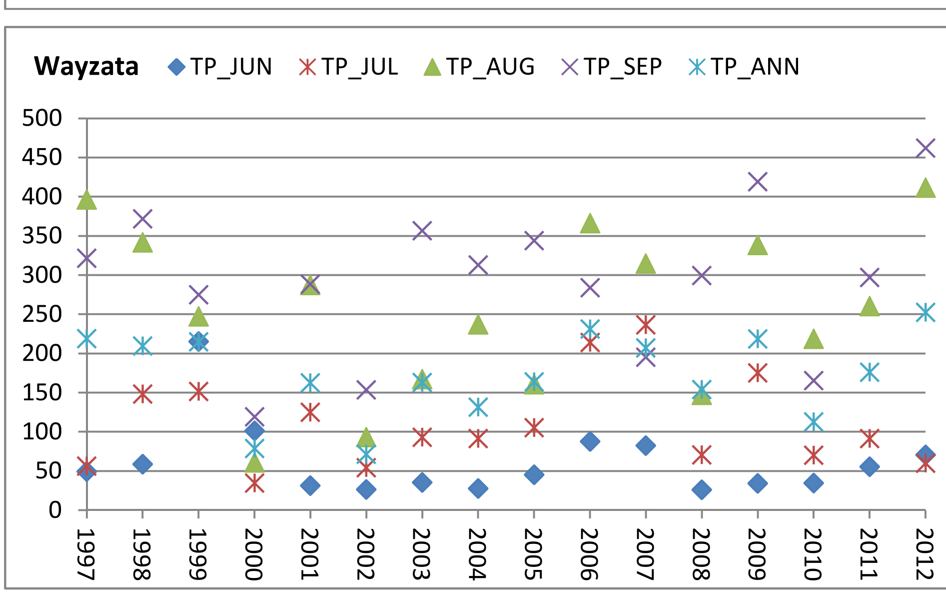

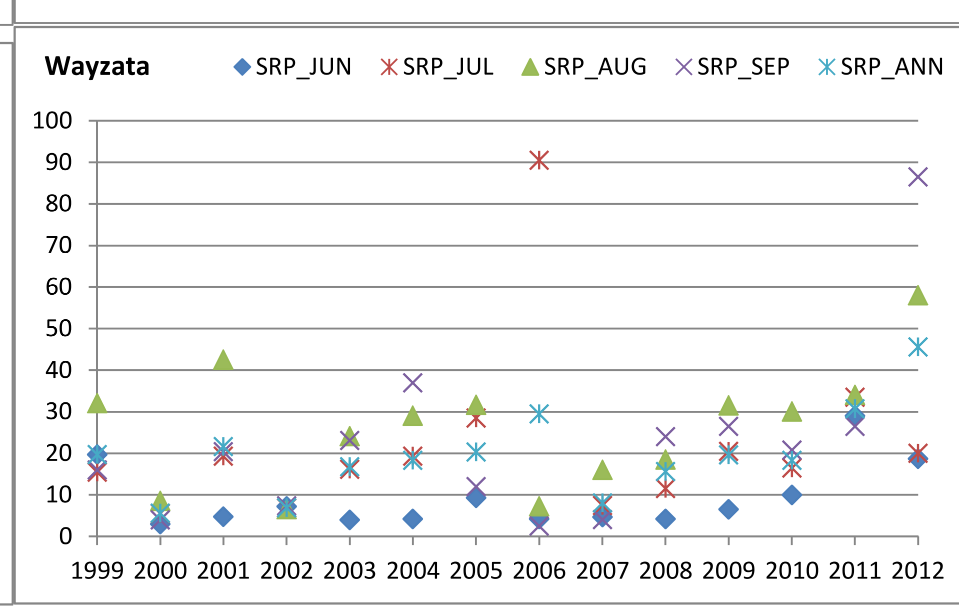

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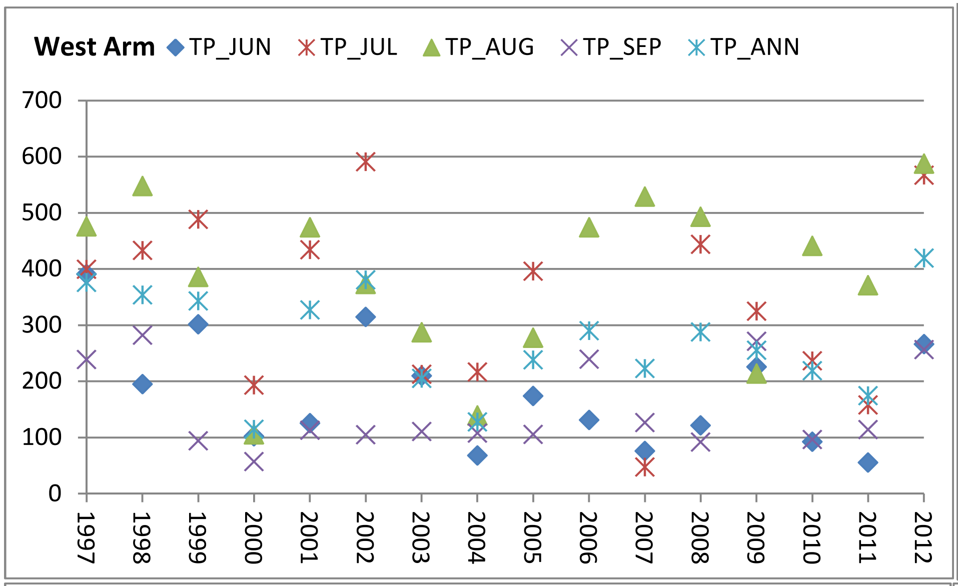

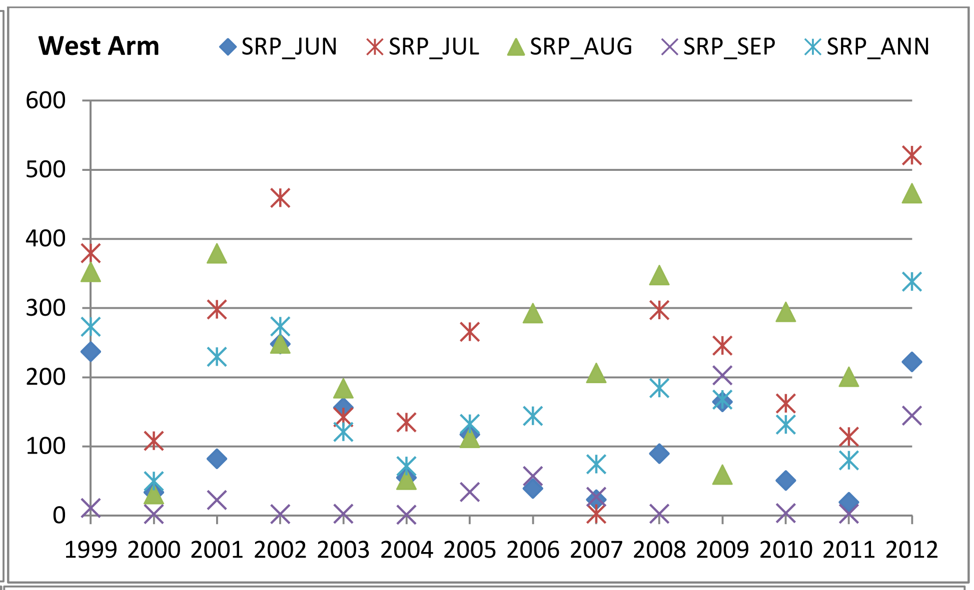

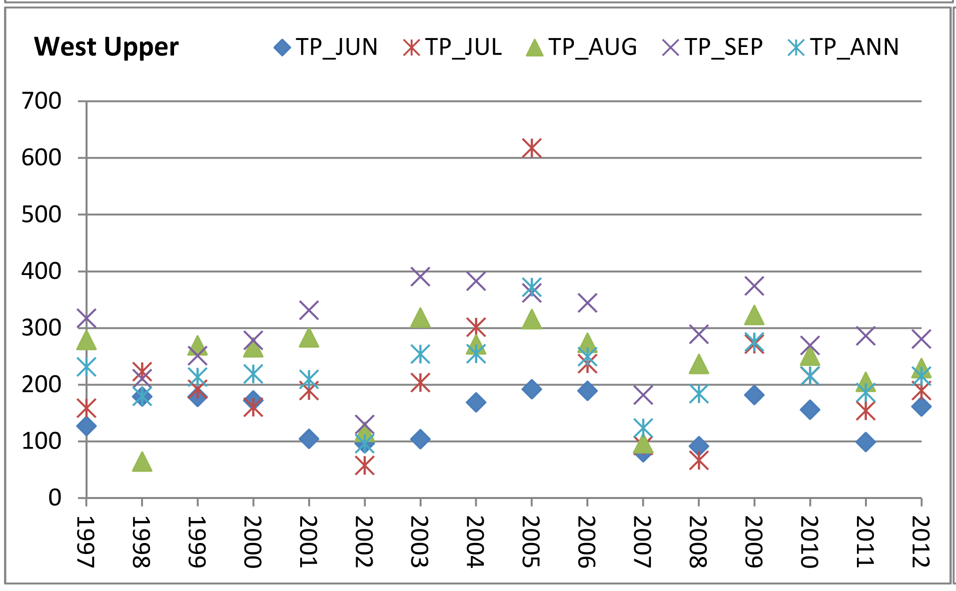

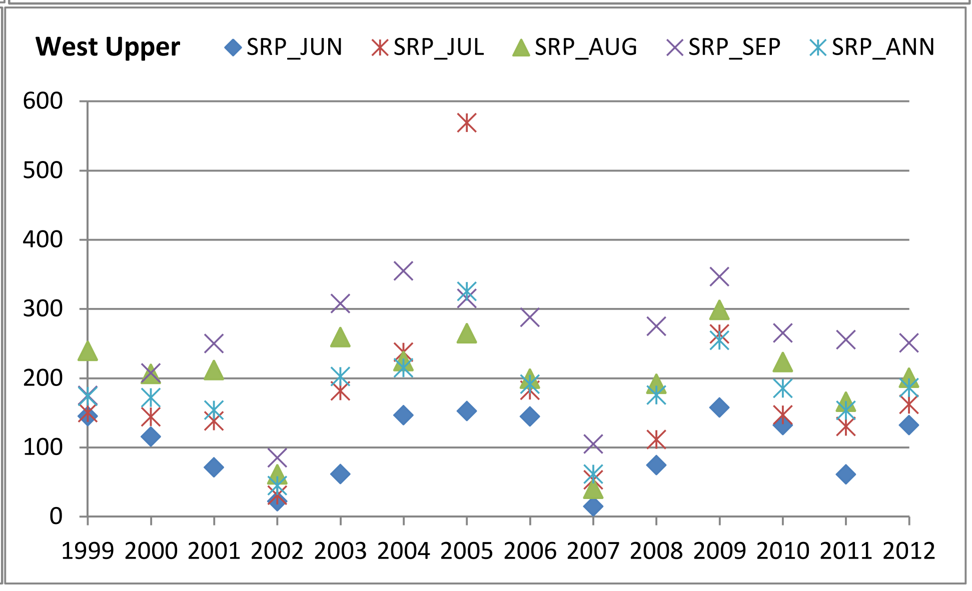

Appendix C

Descriptive Statistics of Lake Water Quality Data

Surface Water Summary Statistics: Upper Watershed Lakes

Christmas	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	5.6	1.0	8	0.7	2.6	0.9	8	0.6	15	11	8	7
1998	5.7	1.2	9	0.8	2.6	1.3	9	0.8	10	0	9	0
1999	5.9	1.0	9	0.7	3.2	0.7	9	0.5	15	8	9	5
2000	4.2	0.9	8	0.7	2.8	1.5	8	1.0	16	6	8	4
2001	3.8	0.9	7	0.7	3.0	1.5	6	1.2	18	6	7	5
2002	5.7	1.3	7	1.0	3.0	0.9	7	0.7	12	4	7	3
2003	4.4	0.9	8	0.6	3.4	0.6	8	0.4	12	3	8	2
2004	4.7	0.5	8	0.3	0.2	0.0	8	0.0	26	25	8	17
2005	6.3	1.3	8	0.9	0.4	0.9	8	0.6	17	4	8	3
2006	6.5	1.4	7	1.0	0.1	0.1	7	0.1	12	3	7	3
2007	5.0	2.0	8	1.4	1.1	1.5	7	1.1	17	7	7	5
2008	5.6	1.6	9	1.1	2.8	1.3	9	0.9	10	2	9	1
2009	7.0	1.7	9	1.1	2.7	1.3	9	0.9	22	30	9	19
2010	5.9	2.1	9	1.3	1.8	1.2	9	0.8	11	2	9	1
2011	5.2	1.0	8	0.7	2.1	0.4	8	0.2	12	4	8	2
2012	5.5	0.9	8	0.6	2.9	1.8	8	1.3	14	2	8	1

Dutch	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.2	1.7	9	1.1	24.9	23.9	9	15.6	54	12	9	8
1998	1.1	0.4	9	0.3	35.0	18.9	7	14.0	72	14	7	10
1999	1.9	1.1	8	0.7	25.8	12.8	8	8.8	66	11	8	7
2000	1.2	0.5	7	0.4	19.1	3.0	8	2.1	49	13	8	9
2001	0.6	0.2	8	0.2	49.8	43.6	8	30.2	62	31	8	22
2002	1.0	0.4	8	0.3	46.5	15.1	8	10.5	68	18	8	13
2003	0.7	0.2	9	0.1	53.8	38.5	9	25.2	76	24	9	16
2004	0.9	0.4	8	0.3	53.7	22.6	7	16.8	96	30	8	21
2005	1.2	0.9	8	0.7	43.9	24.4	8	16.9	64	12	8	8
2006	0.9	0.3	7	0.3	26.3	12.9	7	9.6	49	19	7	14
2007	0.8	0.2	7	0.1	34.3	7.4	7	5.5	57	15	7	11
2008	1.2	0.9	9	0.6	41.4	25.0	9	16.4	57	12	9	8
2009	0.9	0.2	9	0.1	35.8	15.0	9	9.8	59	15	9	10
2010	1.1	0.2	9	0.1	40.8	34.6	9	22.6	51	12	9	8
2011	1.4	0.7	9	0.5	22.9	10.8	9	7.0	47	16	9	11
2012	0.7	0.2	8	0.2	34.7	14.5	7	10.7	60	21	8	15

Gleason	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.0	1.4	9	0.9	26.4	21.6	9	14.1	102	32	9	21
1998	1.1	0.8	9	0.5	35.5	23.1	7	17.1	137	54	7	40
1999	1.3	0.8	8	0.6	33.3	20.7	8	14.3	109	36	8	25
2000	1.1	0.5	8	0.4	43.9	22.5	8	15.6	91	30	8	21
2001	0.8	0.5	8	0.3	48.8	27.1	8	18.8	89	36	8	25
2002	1.3	1.0	8	0.7	37.8	22.5	8	15.6	84	34	8	24
2003	0.8	0.6	9	0.4	79.8	47.8	9	31.2	129	61	8	43
2004	1.2	0.5	6	0.4	28.5	17.9	6	14.3	118	46	6	37
2005	1.1	0.9	8	0.6	60.9	43.0	8	29.8	116	22	8	15
2006	0.9	0.6	7	0.5	53.0	37.5	7	27.8	133	36	7	27
2007	0.8	0.3	7	0.2	60.9	25.9	7	19.2	125	25	7	19
2008	1.1	0.9	9	0.6	69.4	57.9	9	37.8	96	45	9	29
2009	1.2	0.9	9	0.6	52.3	38.8	9	25.3	105	37	9	24
2010	1.2	1.0	9	0.6	36.9	25.4	9	16.6	65	28	9	18
2011	1.3	0.7	7	0.5	29.0	24.5	8	17.0	50	16	8	11
2012	1.9	0.8	8	0.6	14.3	9.0	8	6.3	41	12	8	8

Langdon	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	0.5	0.3	9	0.2	162.8	57.1	9	37.3	199	44	9	29
1998	0.5	0.2	9	0.1	66.9	10.1	7	7.5	86	13	7	10
1999	0.7	0.5	9	0.3	71.9	13.5	9	8.8	82	16	9	11
2000	0.4	0.3	8	0.2	95.0	49.1	8	34.0	92	21	8	14
2001	0.4	0.1	8	0.1	60.9	14.4	8	10.0	72	7	8	5
2002	0.7	0.2	8	0.1	47.6	19.1	8	13.2	74	15	8	10
2003	0.6	0.1	9	0.1	66.5	28.5	8	19.7	86	11	9	7
2004	0.4	0.1	7	0.1	100.4	38.2	7	28.3	138	38	7	28
2005	0.7	0.1	8	0.1	61.4	27.3	8	18.9	122	20	8	14
2006	0.4	0.0	7	0.0	48.4	17.2	7	12.8	193	120	7	89
2007	na	na	na	na	na	na	na	na	na	na	na	na
2008	0.5	0.1	8	0.1	84.0	34.9	8	24.2	166	26	8	18
2009	0.8	0.4	9	0.2	37.1	19.8	9	12.9	77	18	9	12
2010	0.9	0.3	9	0.2	24.4	9.6	9	6.3	49	6	9	4
2011	0.8	0.3	9	0.2	39.9	20.5	9	13.4	68	14	9	9
2012	0.4	0.1	8	0.1	107.1	50.2	8	34.8	116	19	8	13

Long	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.2	1.2	9	0.8	13.7	5.7	8	3.9	42	12	9	8
1998	1.7	0.4	9	0.3	12.1	6.1	7	4.5	43	16	6	13
1999	1.4	1.0	8	0.7	48.1	29.4	8	20.4	63	14	8	10
2000	0.9	0.4	7	0.3	41.4	18.0	8	12.5	54	15	8	10
2001	0.7	0.2	8	0.2	39.0	6.4	8	4.4	63	17	8	12
2002	0.9	0.4	8	0.3	43.8	17.6	8	12.2	54	12	8	8
2003	0.7	0.3	9	0.2	41.5	13.2	9	8.6	62	31	9	20
2004	0.8	0.1	8	0.1	47.6	13.9	8	9.6	82	22	8	15
2005	0.8	0.3	8	0.2	43.7	16.0	8	11.1	63	14	8	9
2006	0.9	0.6	7	0.5	35.5	7.8	7	5.8	50	16	7	12
2007	0.8	0.3	7	0.2	42.1	16.1	7	11.9	74	35	7	26
2008	1.3	0.5	9	0.3	40.1	20.3	9	13.2	54	22	9	14
2009	0.9	0.5	8	0.3	37.4	11.2	9	7.3	76	30	9	20
2010	1.1	0.5	9	0.3	35.1	29.7	9	19.4	51	24	9	15
2011	1.3	0.7	8	0.5	37.4	20.9	8	14.5	60	29	8	20
2012	1.1	1.0	8	0.7	31.0	19.4	7	14.4	65	38	8	26

Minnewashta	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	3.2	0.6	8	0.4	5.2	2.0	8	1.4	16	7	8	5
1998	2.7	0.4	9	0.2	6.3	1.9	9	1.2	14	5	9	3
1999	2.7	0.4	9	0.3	8.6	2.2	9	1.4	21	13	9	9
2000	2.2	0.6	8	0.4	7.0	2.1	8	1.4	31	29	8	20
2001	2.7	0.7	6	0.6	6.0	2.6	6	2.1	30	10	7	7
2002	2.4	0.7	8	0.5	11.8	5.8	7	4.3	22	11	8	8
2003	2.5	0.6	8	0.4	8.8	1.0	8	0.7	17	6	8	4
2004	2.5	0.4	8	0.3	2.7	1.8	8	1.2	26	11	8	7
2005	3.9	1.0	8	0.7	1.5	2.1	8	1.5	18	5	8	4
2006	1.9	0.7	7	0.5	11.4	4.8	7	3.6	29	5	7	4
2007	1.9	0.5	8	0.3	7.8	1.7	8	1.2	21	7	8	5
2008	2.9	0.7	9	0.4	6.8	2.9	9	1.9	19	5	9	3
2009	2.2	0.3	9	0.2	7.4	2.5	9	1.6	22	5	9	3
2010	1.8	0.4	9	0.3	9.0	3.5	9	2.3	19	2	9	1
2011	2.0	0.5	9	0.3	9.0	2.6	9	1.7	20	2	9	2
2012	2.0	0.6	8	0.4	9.6	3.2	8	2.2	23	3	8	2

Parley	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1999	0.8	0.4	9	0.3	64.6	22.0	9	14.4	79	14	9	9
2000	0.8	0.3	8	0.2	64.5	56.1	8	38.9	90	46	8	32
2001	0.7	0.6	7	0.4	84.7	43.1	7	31.9	106	38	7	28
2002	0.9	0.7	8	0.5	51.0	25.6	8	17.8	83	25	8	17
2003	1.1	1.0	8	0.7	79.4	51.5	8	35.7	86	38	8	27
2004	na	na	na	na	na	na	na	na	na	na	na	na
2005	0.7	0.5	8	0.4	68.9	44.7	8	31.0	147	41	8	28
2006	0.6	0.6	7	0.4	101.3	51.0	7	37.8	100	24	7	18
2007	0.4	0.2	7	0.1	119.2	46.1	7	34.1	119	22	7	16
2008	1.0	0.9	9	0.6	48.6	30.4	9	19.9	79	27	9	18
2009	0.6	0.2	9	0.1	51.4	22.1	9	14.4	63	18	9	12
2010	0.7	0.7	9	0.4	69.1	30.0	9	19.6	237	489	9	320
2011	0.7	0.5	8	0.3	76.6	42.9	8	29.7	80	22	8	15
2012	0.7	0.4	8	0.3	51.9	21.9	8	15.2	81	15	8	11

Piersons	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.2	0.6	9	0.4	12.4	4.6	9	3.0	39	19	9	12
1998	1.7	0.5	8	0.3	20.3	10.3	7	7.6	39	8	7	6
1999	1.3	0.2	8	0.2	18.9	4.9	8	3.4	36	11	8	8
2000	na	na	na	na	na	na	na	na	na	na	na	na
2001	na	na	na	na	na	na	na	na	na	na	na	na
2002	2.0	0.5	7	0.4	13.1	5.8	7	4.3	22	5	8	3
2003	2.8	0.9	8	0.6	11.8	14.3	8	9.9	20	12	8	8
2004	na	na	na	na	na	na	na	na	na	na	na	na
2005	2.0	0.5	8	0.4	13.8	4.7	8	3.3	44	38	8	27
2006	1.5	0.3	7	0.2	9.6	4.7	7	3.5	31	8	7	6
2007	2.4	0.5	7	0.4	6.0	1.7	7	1.2	30	8	7	6
2008	2.7	0.5	9	0.4	12.2	15.2	9	9.9	21	3	9	2
2009	2.7	0.7	33	0.2	5.4	3.0	34	1.0	32	25	34	8
2010	3.0	1.0	9	0.7	7.2	3.2	9	2.1	21	3	9	2
2011	2.7	0.7	8	0.5	5.8	1.7	8	1.2	18	2	8	1
2012	3.1	0.7	8	0.5	4.6	1.5	8	1.0	22	5	8	3

Schutz	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2002	2.6	1.5	4	1.4	12.4	13.8	na	na	na	na	0	na
2003	1.1	0.3	7	0.2	18.3	5.4	7	4.0	30	11	7	8
2004	1.3	0.3	6	0.2	23.2	6.8	6	5.4	49	30	6	24
2005	1.9	0.4	7	0.3	26.5	17.7	4	17.3	40	16	7	12
2006	1.3	0.4	7	0.3	16.2	7.3	7	5.4	39	12	7	9
2007	1.7	0.4	8	0.3	17.7	12.4	8	8.6	36	13	8	9
2008	2.1	0.8	9	0.5	16.7	8.4	9	5.5	32	8	9	6
2009	2.2	0.7	9	0.4	17.6	5.6	9	3.7	38	6	9	4
2010	1.6	0.6	9	0.4	28.6	19.3	9	12.6	38	13	9	8
2011	1.7	0.8	9	0.5	22.0	14.8	9	9.7	37	10	9	7
2012	1.0	0.2	8	0.1	23.4	7.4	8	5.1	39	7	8	5

Virginia	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2002	1.3	0.8	7	0.6	23.8	16.5	9	10.8	na	na	na	na
2003	1.5	1.0	9	0.6	27.2	20.6	8	14.3	45	22	9	15
2004	na	na	na	na	na	na	na	na	na	na	na	na
2005	1.0	0.4	8	0.3	22.8	14.4	5	12.6	44	7	8	5
2006	1.3	1.3	7	0.9	37.0	25.3	7	18.7	54	13	7	9
2007	1.4	0.4	8	0.2	37.5	26.7	8	18.5	60	13	8	9
2008	1.6	0.4	9	0.3	33.2	19.7	9	12.9	48	20	9	13
2009	1.6	0.4	9	0.3	33.2	19.7	9	12.9	48	20	9	13
2010	1.1	0.4	9	0.3	37.3	29.3	9	19.2	51	14	9	9
2011	1.4	0.5	9	0.4	43.2	24.9	9	16.3	47	19	9	12
2012	0.8	0.3	8	0.2	54.3	18.7	8	13.0	64	17	8	12

Wasserman	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.2	0.7	8	0.5	44.3	27.6	8	19.1	63	22	8	15
1998	0.6	0.2	9	0.1	73.7	32.6	9	21.3	67	18	9	12
1999	0.7	0.2	9	0.1	59.3	21.9	9	14.3	88	27	9	18
2000	0.5	0.1	7	0.1	73.3	13.6	7	10.1	85	13	7	10
2001	0.6	0.4	7	0.3	73.1	25.2	7	18.7	85	14	7	10
2002	1.0	0.2	8	0.2	21.7	9.5	7	7.1	52	16	8	11
2003	1.1	0.6	7	0.5	32.4	13.9	7	10.3	80	63	7	47
2004	0.9	0.3	8	0.2	39.8	16.4	8	11.4	92	17	8	12
2005	0.7	0.1	8	0.1	60.9	14.9	8	10.4	84	12	8	9
2006	0.8	0.2	7	0.2	49.7	13.3	7	9.9	69	16	7	12
2007	0.6	0.3	7	0.2	63.9	26.5	7	19.7	80	23	7	17
2008	1.3	1.1	10	0.7	55.9	31.7	10	19.6	62	12	10	7
2009	0.6	0.1	8	0.1	55.3	20.6	8	14.3	93	39	8	27
2010	0.8	0.5	9	0.3	57.6	25.8	9	16.8	76	22	9	15
2011	0.9	0.4	8	0.3	41.8	21.1	8	14.6	80	34	8	23
2012	0.6	0.3	8	0.2	60.0	20.7	8	14.3	85	13	8	9

Surface Water Summary Statistics: Lake Minnetonka

Black	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	1.7	0.4	5	0.4	10.3	3.2	5	2.8	40	10	5	9
2005	na	na	na	na	na	na	na	na	na	na	na	na
2006	1.7	1.1	5	0.9	18.5	12.8	5	11.2	41	13	5	11
2007	1.5	0.9	7	0.7	17.4	9.1	7	6.7	39	4	7	3
2008	2.3	0.7	9	0.4	9.7	5.2	9	3.4	28	3	9	2
2009	1.9	0.6	9	0.4	15.7	6.1	9	4.0	32	5	9	3
2010	2.1	1.3	9	0.8	16.4	12.0	9	7.8	33	8	9	5
2011	1.7	0.5	8	0.3	13.4	6.1	8	4.3	27	5	8	4
2012	1.6	0.4	8	0.3	18.4	7.2	8	5.0	37	10	8	7

Carman	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	2.7	0.4	5	0.4	3.5	3.8	5	3.3	23	8	5	7
2005	na	na	na	na	na	na	na	na	na	na	na	na
2006	2.3	0.6	7	0.4	6.2	4.9	7	3.7	25	5	7	4
2007	na	na	na	na	na	na	na	na	na	na	na	na
2008	2.7	0.7	9	0.5	7.7	4.2	9	2.7	19	5	9	3
2009	2.9	0.8	9	0.5	6.8	4.5	9	3.0	21	4	9	3
2010	2.9	1.3	9	0.9	6.8	5.6	9	3.7	22	6	9	4
2011	2.1	0.5	8	0.3	14.1	21.4	8	14.8	21	4	8	3
2012	2.7	0.9	8	0.6	6.9	4.2	8	2.9	20	3	8	2

Carsons	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	3.1	0.7	5	0.6	1.4	2.3	5	2.0	24	7	5	6
2005	2.9	0.5	4	0.5	6.1	2.4	4	2.3	24	4	4	4
2006	2.5	0.8	7	0.6	5.4	4.5	7	3.3	37	32	7	23
2007	2.2	0.6	8	0.4	6.3	5.1	8	3.5	30	16	8	11
2008	3.2	0.6	9	0.4	4.9	2.8	9	1.9	19	4	9	3
2009	3.4	0.5	9	0.3	3.1	2.3	9	1.5	19	4	9	3
2010	2.9	1.3	9	0.8	5.9	3.5	9	2.3	18	4	9	3
2011	2.8	0.8	8	0.5	5.4	1.8	8	1.3	19	4	8	3
2012	4.7	1.2	8	0.8	2.6	1.6	8	1.1	18	4	8	2

Cooks	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.9	2.7	9	1.8	7.4	5.2	9	3.4	65	72	9	47
1998	1.5	0.2	8	0.1	11.4	8.2	9	5.4	114	117	8	81
1999	1.6	0.3	9	0.2	11.0	4.1	9	2.7	105	114	9	75
2000	2.0	0.6	8	0.4	8.3	5.8	8	4.0	274	326	7	242
2001	2.2	0.6	8	0.4	8.0	2.1	8	1.5	26	7	8	5
2002	1.7	1.0	7	0.8	13.7	6.9	7	5.1	46	26	7	19
2003	1.9	0.4	8	0.3	12.9	3.9	8	2.7	27	8	8	6
2004	1.6	0.4	8	0.3	16.8	3.6	8	2.5	33	9	8	6
2005	2.1	0.9	8	0.6	14.7	5.3	8	3.6	33	6	8	4
2006	2.0	0.6	5	0.5	10.7	4.8	5	4.2	30	11	5	10
2007	1.6	0.5	8	0.3	14.1	6.6	8	4.5	43	25	8	17
2008	2.3	1.0	9	0.6	13.7	5.5	9	3.6	24	7	9	5
2009	1.9	0.4	9	0.3	13.3	4.3	9	2.8	29	6	9	4
2010	2.3	1.4	9	0.9	12.2	4.8	9	3.1	24	6	9	4
2011	1.6	0.4	8	0.3	12.4	2.9	8	2.0	25	7	8	5
2012	1.4	0.4	8	0.3	19.3	7.1	8	5.0	30	3	8	2

Crystal	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.9	1.7	9	1.1	6.4	3.6	8	2.5	24	7	9	5
1998	2.1	0.5	9	0.4	7.4	2.7	7	2.0	27	7	9	5
1999	1.6	0.4	8	0.3	13.2	3.9	9	2.6	32	10	9	6
2000	2.5	0.4	8	0.3	4.4	2.2	8	1.5	25	8	8	6
2001	2.4	0.4	8	0.3	5.4	2.7	8	1.9	23	7	8	5
2002	1.5	0.5	7	0.4	14.3	6.0	7	4.5	38	7	7	5
2003	2.6	1.1	8	0.7	8.7	2.0	8	1.4	25	7	8	5
2004	2.4	0.7	8	0.5	9.4	2.3	8	1.6	24	8	8	6
2005	2.1	1.0	8	0.7	14.5	6.0	8	4.1	29	13	8	9
2006	1.6	0.6	6	0.5	11.9	6.4	6	5.1	31	9	6	7
2007	1.6	0.4	8	0.3	12.8	4.1	8	2.9	29	9	8	6
2008	2.8	0.7	8	0.5	7.3	2.5	8	1.8	26	9	8	6
2009	2.9	0.4	9	0.3	4.8	1.4	9	0.9	20	4	9	3
2010	2.5	1.3	9	0.8	9.1	4.3	9	2.8	21	4	9	3
2011	1.7	1.1	8	0.8	15.0	8.8	8	6.1	24	8	8	5
2012	2.8	1.1	8	0.7	6.6	2.1	8	1.4	21	4	8	3

Forest	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.3	0.8	9	0.6	21.7	14.3	9	9.4	111	131	9	86
1998	0.7	0.3	9	0.2	35.1	12.0	8	8.3	147	128	9	84
1999	0.8	0.3	9	0.2	30.2	7.4	9	4.8	41	67	9	43
2000	0.9	0.3	8	0.2	22.9	10.6	8	7.4	71	51	8	35
2001	0.9	0.5	8	0.3	37.4	17.5	8	12.1	59	12	8	8
2002	0.9	0.6	7	0.4	39.8	11.9	7	8.8	92	14	7	10
2003	0.8	0.3	8	0.2	63.9	18.1	8	12.6	66	15	8	11
2004	1.4	0.3	8	0.2	23.0	6.6	8	4.6	65	25	8	17
2005	0.9	0.6	8	0.4	45.0	13.3	8	9.2	72	7	8	5
2006	0.7	0.2	6	0.2	62.7	34.4	6	27.5	55	9	6	7
2007	0.6	0.1	7	0.1	69.3	34.2	7	25.3	60	15	7	11
2008	0.9	0.4	8	0.3	40.0	19.4	8	13.5	52	10	8	7
2009	0.7	0.3	9	0.2	56.1	31.5	9	20.6	58	4	9	3
2010	0.7	0.4	9	0.3	51.0	27.1	9	17.7	61	12	9	8
2011	1.0	1.1	8	0.7	55.1	38.0	8	26.3	50	11	8	8
2012	0.7	0.3	7	0.2	54.9	41.8	7	31.0	55	10	7	7

Grays	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	3.3	0.8	5	0.7	0.6	1.0	5	0.8	21	5	5	4
2005	3.1	0.4	4	0.4	7.5	1.0	4	1.0	24	7	4	7
2006	3.1	0.8	8	0.5	3.7	2.3	8	1.6	35	24	8	17
2007	2.6	0.2	8	0.1	2.5	1.7	8	1.2	35	11	8	8
2008	3.5	0.5	9	0.3	4.4	0.9	9	0.6	16	2	9	1
2009	2.2	0.7	9	0.4	6.9	1.7	9	1.1	24	3	9	2
2010	2.5	0.7	9	0.4	4.8	2.2	9	1.4	18	5	9	3
2011	3.7	0.5	8	0.4	3.9	1.6	8	1.1	16	3	8	2
2012	4.0	2.1	8	1.4	4.6	4.1	8	2.8	19	4	8	3

Halsted	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.4	1.0	9	0.7	28.4	19.1	9	12.5	na	na	na	na
1998	0.9	0.5	7	0.4	79.9	60.5	8	41.9	na	na	na	na
1999	0.8	0.5	8	0.3	38.2	19.9	9	13.0	127	21	9	14
2000	0.8	0.3	8	0.2	55.2	28.4	8	19.7	113	21	8	15
2001	1.2	0.7	8	0.5	27.3	17.7	8	12.3	93	16	9	10
2002	1.0	0.7	7	0.5	39.8	16.1	9	10.5	118	29	10	18
2003	0.8	0.5	8	0.3	82.7	18.4	8	12.8	113	23	8	16
2004	1.2	0.6	8	0.4	46.0	20.3	8	14.0	130	30	8	21
2005	1.0	0.8	10	0.5	51.1	23.5	10	14.6	92	19	9	13
2006	0.8	0.3	7	0.2	49.7	18.3	7	13.5	70	16	7	12
2007	0.5	0.1	7	0.1	77.4	17.4	7	12.9	93	17	7	13
2008	0.9	0.8	9	0.5	83.2	41.1	9	26.9	103	19	9	12
2009	0.6	0.2	9	0.1	76.6	33.7	9	22.0	104	19	9	13
2010	0.6	0.4	9	0.3	80.6	39.3	9	25.7	82	27	9	17
2011	0.8	0.6	8	0.4	55.6	40.1	8	27.8	79	32	8	22
2012	0.5	0.2	8	0.2	72.0	47.3	8	32.8	103	33	8	23

Harrisons	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.1	0.5	9	0.3	25.3	9.2	8	6.4	59	10	9	6
1998	0.6	0.1	8	0.0	42.4	11.2	8	7.8	68	15	9	10
1999	0.7	0.3	9	0.2	31.3	15.1	9	9.8	67	10	9	7
2000	1.1	0.3	8	0.2	16.9	7.2	8	5.0	57	25	8	17
2001	1.0	0.6	8	0.4	29.7	26.6	8	18.4	55	17	8	12
2002	0.9	0.6	7	0.4	41.6	22.2	7	16.4	66	14	7	10
2003	0.8	0.4	8	0.3	66.0	32.0	8	22.2	71	21	8	15
2004	1.0	0.2	8	0.2	34.8	7.5	8	5.2	59	9	8	6
2005	1.1	0.7	8	0.5	39.8	26.4	8	18.3	63	8	8	6
2006	0.7	0.2	5	0.2	65.0	34.8	5	30.5	58	11	5	9
2007	0.7	0.3	7	0.2	56.0	32.3	7	23.9	63	17	7	12
2008	0.9	0.6	8	0.4	49.8	31.0	8	21.5	53	11	8	7
2009	0.8	0.4	9	0.3	41.7	22.3	9	14.6	55	6	9	4
2010	0.9	0.4	9	0.2	37.8	24.1	9	15.8	44	9	9	6
2011	1.0	1.0	8	0.7	59.4	40.2	8	27.9	55	16	8	11
2012	0.5	0.2	8	0.2	73.4	31.0	8	21.5	67	9	8	6

Jennings	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1979	0.5	0.1	4	0.1	66.5	43.3	4	42.4	165	30	4	29
1980	0.4	0.2	3	0.2	145.6	39.8	3	45.0	150	57	2	78
1981	0.7	0.6	4	0.6	85.6	104.2	4	102.1	350	257	4	252
1982	0.6	0.2	4	0.2	75.0	40.2	4	39.4	133	30	4	29
1983	0.7	0.1	4	0.1	9.5	6.0	4	5.9	145	17	4	17
1984	0.8	0.5	4	0.5	7.5	11.0	4	10.8	195	51	4	50
1985	0.8	0.1	4	0.1	5.0	2.6	3	3.0	195	6	4	6
1986	0.8	0.1	4	0.1	34.0	2.8	2	3.9	103	50	4	49
1997	0.9	0.4	9	0.3	37.9	18.2	8	12.6	104	35	9	23
1998	0.9	0.6	8	0.4	52.6	29.9	9	19.6	103	26	9	17
1999	0.8	0.5	9	0.3	37.2	26.1	9	17.0	96	24	9	16
2000	0.9	0.4	8	0.2	22.0	10.3	8	7.1	73	11	8	7
2001	0.7	0.6	8	0.4	43.1	25.5	8	17.7	122	34	8	24
2002	0.8	0.5	7	0.4	57.3	18.9	7	14.0	151	73	7	54
2003	0.8	0.3	7	0.2	82.8	24.4	8	16.9	131	28	8	19
2004	1.0	0.4	8	0.3	42.7	18.6	8	12.9	114	34	8	24
2005	0.8	0.7	10	0.5	70.2	31.9	10	19.8	113	26	10	16
2006	0.7	0.4	7	0.3	75.3	50.3	7	37.3	79	26	7	20
2007	0.5	0.1	7	0.1	87.5	36.6	7	27.1	114	16	7	12
2008	0.9	0.6	8	0.4	68.8	46.4	8	32.1	102	34	8	24
2009	0.8	0.4	9	0.3	51.6	29.6	9	19.4	108	28	9	18
2010	0.8	0.5	9	0.3	65.2	38.2	9	25.0	80	28	9	18
2011	1.0	0.9	8	0.7	70.1	46.8	8	32.4	96	33	8	23
2012	0.5	0.3	8	0.2	132.0	132.1	8	91.5	126	21	8	15

Lafayette	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	3.3	0.7	9	0.5	3.8	0.9	8	0.6	22	6	9	4
1998	2.5	0.7	8	0.5	3.6	1.2	8	0.8	24	4	9	3
1999	2.5	0.6	9	0.4	5.2	2.6	8	1.8	23	8	9	5
2005	2.9	0.9	4	0.9	9.6	3.2	4	3.1	30	11	4	10
2006	2.4	0.5	8	0.3	6.5	5.9	8	4.1	27	6	8	4
2007	2.2	0.5	8	0.3	8.4	4.2	8	2.9	32	10	8	7
2008	3.5	0.8	9	0.5	5.2	2.7	9	1.8	18	4	9	2
2009	3.3	0.3	9	0.2	3.9	2.5	9	1.6	18	3	9	2
2010	2.9	0.9	9	0.6	5.7	3.8	9	2.5	18	4	9	3
2011	2.4	0.4	7	0.3	6.8	2.1	8	1.5	21	4	8	3
2012	4.4	1.4	8	1.0	3.3	1.2	8	0.8	18	2	8	1

LLNorth	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	3.8	1.1	9	0.7	2.8	1.4	9	0.9	21	8	9	5
1998	2.9	0.8	9	0.5	3.3	0.9	8	0.6	17	4	8	3
1999	3.0	1.2	9	0.8	4.3	2.2	9	1.5	21	7	9	5
2005	3.4	1.1	4	1.1	6.6	1.2	4	1.2	26	12	4	12
2006	2.9	0.8	8	0.5	4.5	3.2	8	2.2	30	10	8	7
2007	2.6	0.4	8	0.3	5.8	2.8	8	1.9	29	19	8	13
2008	3.8	1.0	9	0.6	5.0	1.2	9	0.8	15	2	9	1
2009	3.6	0.6	9	0.4	3.6	1.1	9	0.7	15	3	9	2
2010	3.4	1.5	9	1.0	4.7	1.7	9	1.1	15	3	9	2
2011	3.1	0.6	8	0.4	5.5	2.7	8	1.9	16	4	8	2
2012	5.5	1.0	8	0.7	2.1	0.8	8	0.6	15	5	8	3

LLSouth	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1979	1.3	0.1	4	0.1	14.8	5.4	4	5.3	33	5	4	5
1980	1.4	0.2	3	0.2	8.9	6.6	3	7.5	37	6	3	7
1981	2.0	0.4	3	0.5	5.6	5.9	4	5.8	88	122	4	119
1982	2.4	0.6	4	0.6	10.3	6.7	4	6.5	33	13	4	12
1983	2.1	0.2	4	0.2	2.0	1.7	3	2.0	45	21	4	20
1984	2.0	0.6	4	0.6	na	na	na	na	40	12	4	11
1985	2.2	0.1	4	0.1	2.0	1.0	3	1.1	110	167	4	164
1986	2.2	0.5	4	0.5	8.0	7.2	3	8.2	30	0	4	0
1997	3.6	1.0	9	0.6	2.7	1.2	9	0.8	92	82	9	54
1998	2.9	0.7	9	0.5	4.0	1.8	8	1.2	64	58	8	40
1999	2.7	1.0	9	0.6	4.3	2.8	9	1.8	176	178	8	124
2000	2.6	0.4	8	0.3	4.0	2.4	8	1.7	112	112	8	78
2001	3.1	0.6	8	0.4	3.4	1.6	7	1.2	17	4	8	2
2002	2.8	0.5	7	0.4	5.1	2.7	7	2.0	23	8	7	6
2003	3.9	1.0	8	0.7	5.7	1.6	8	1.1	21	6	8	4
2004	3.2	0.4	8	0.3	5.5	2.7	8	1.9	20	7	8	5
2005	3.2	0.8	8	0.6	6.9	2.9	8	2.0	25	8	8	6
2006	2.6	0.6	8	0.4	5.5	4.9	8	3.4	30	7	8	5
2007	2.2	0.3	8	0.2	6.6	3.1	8	2.2	28	8	8	6
2008	3.6	0.6	9	0.4	5.2	2.9	9	1.9	16	4	9	3
2009	3.6	0.4	9	0.3	4.0	1.6	9	1.0	18	4	9	3
2010	3.3	1.1	9	0.7	4.8	2.9	9	1.9	16	4	9	3
2011	3.0	0.9	8	0.6	5.0	1.6	8	1.1	18	3	8	2
2012	5.6	1.3	8	0.9	2.1	0.8	8	0.6	13	2	8	1

Maxwell	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.6	0.4	9	0.3	12.3	7.0	9	4.6	29	6	9	4
1998	1.8	0.5	9	0.4	9.1	3.0	8	2.1	34	5	9	3
1999	1.4	0.2	9	0.2	12.4	5.0	9	3.2	34	8	9	5
2000	1.8	0.3	8	0.2	6.9	2.7	8	1.9	40	10	8	7
2001	1.8	0.7	8	0.5	13.6	13.3	8	9.2	29	6	8	4
2002	1.5	0.4	7	0.3	12.4	3.7	7	2.8	33	3	7	3
2003	1.8	0.6	8	0.4	15.6	3.7	8	2.6	35	10	8	7
2004	2.0	0.6	8	0.4	12.2	2.6	8	1.8	31	8	8	5
2005	1.6	0.6	8	0.4	20.5	7.2	8	5.0	36	6	8	4
2006	1.3	0.7	6	0.6	18.4	13.3	6	10.7	36	7	6	5
2007	1.3	0.4	8	0.3	20.7	8.7	8	6.0	34	7	8	5
2008	2.2	0.5	8	0.3	12.5	4.6	8	3.2	31	8	8	5
2009	1.8	0.3	9	0.2	12.1	4.1	9	2.7	44	48	9	32
2010	1.5	0.5	9	0.3	15.9	7.3	9	4.8	26	2	9	1
2011	1.8	0.9	8	0.6	11.4	5.2	8	3.6	24	4	8	3
2012	1.6	0.8	8	0.6	20.5	15.1	8	10.5	30	4	8	3

North Arm	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.1	0.5	8	0.4	8.3	5.8	8	4.0	28	8	8	5
1998	1.9	0.3	9	0.2	7.9	2.1	7	1.6	31	8	9	5
1999	1.5	0.3	9	0.2	11.2	4.5	8	3.1	33	9	9	6
2000	1.9	0.5	8	0.3	6.9	2.2	8	1.5	32	9	8	6
2001	2.0	0.5	8	0.4	8.4	4.1	8	2.8	31	11	8	8
2002	1.8	0.7	7	0.5	11.0	4.7	7	3.5	35	8	7	6
2003	1.9	0.3	8	0.2	14.6	3.9	8	2.7	33	10	8	7
2004	2.1	0.6	8	0.4	11.2	5.0	8	3.5	31	9	8	6
2005	1.8	0.7	8	0.5	17.0	6.4	8	4.4	35	11	8	8
2006	1.9	1.1	6	0.9	12.2	7.3	6	5.8	31	10	6	8
2007	1.6	0.3	8	0.2	13.9	3.2	8	2.2	36	15	8	10
2008	2.3	0.9	8	0.6	11.3	6.8	8	4.7	27	3	8	2
2009	1.9	0.4	9	0.2	12.4	4.7	9	3.0	27	3	9	2
2010	1.6	0.8	9	0.5	20.2	10.5	9	6.8	27	3	9	2
2011	1.9	0.9	8	0.6	15.0	8.9	8	6.2	23	6	8	4
2012	1.5	0.7	8	0.5	18.8	8.6	8	6.0	32	7	8	5

Peavey	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1979	1.6	0.4	3	0.5	17.8	9.3	4	9.1	133	58	3	65
1980	1.5	0.2	3	0.2	24.0	13.9	3	15.8	120	42	2	59
1981	2.1	0.4	3	0.5	5.9	4.7	4	4.6	473	799	4	783
1982	2.6	0.7	3	0.8	16.3	11.9	4	11.7	90	42	4	42
1983	1.6	0.4	4	0.4	4.0	2.8	2	3.9	123	39	4	38
1984	1.5	0.2	3	0.2	2.0	1.4	2	2.0	113	6	3	7
1985	1.8	0.5	4	0.5	3.3	1.5	3	1.7	245	371	4	363
1986	1.3	0.1	4	0.1	11.7	4.0	3	4.6	70	18	4	18
1999	1.9	0.3	9	0.2	9.0	3.0	9	2.0	52	24	9	16
2000	1.6	0.8	8	0.6	20.8	22.0	8	15.3	57	24	7	18
2001	2.1	0.4	8	0.2	11.9	6.1	8	4.3	57	14	8	10
2002	2.0	0.5	7	0.4	13.8	10.4	7	7.7	68	30	10	19
2003	2.0	0.4	8	0.3	22.1	10.8	8	7.5	70	14	8	10
2004	2.0	0.5	8	0.3	19.1	10.3	8	7.1	79	30	8	21
2005	2.0	0.4	8	0.3	27.6	13.4	8	9.3	77	20	8	14
2006	2.0	0.9	7	0.7	44.9	49.5	7	36.7	94	32	7	23
2007	1.8	0.6	8	0.4	32.0	28.2	8	19.5	111	69	8	48
2008	2.2	0.4	8	0.3	16.3	14.6	9	9.5	42	12	9	8
2009	2.0	0.7	9	0.5	39.3	25.1	9	16.4	65	22	9	14
2010	2.0	0.6	9	0.4	32.8	30.4	9	19.9	67	19	9	13
2011	2.4	0.5	8	0.4	9.9	8.1	8	5.6	88	26	8	18
2012	1.5	0.3	9	0.2	26.1	12.8	9	8.4	123	49	9	32

Phelps	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2006	2.2	0.7	7	0.5	7.6	6.5	7	4.8	30	7	7	5
2007	1.9	0.6	8	0.4	8.1	5.2	8	3.6	28	15	8	10
2008	2.6	0.7	9	0.5	7.2	3.1	9	2.0	21	4	9	2
2009	2.5	0.4	8	0.2	6.6	3.7	9	2.4	21	2	9	1
2010	2.7	1.1	9	0.7	7.3	4.8	9	3.1	20	4	9	3
2011	2.0	0.3	8	0.2	7.6	2.4	8	1.7	21	2	8	1
2012	2.5	0.8	8	0.6	7.6	3.7	8	2.6	27	12	8	8

Priests	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	1.0	0.3	5	0.3	27.7	7.0	5	6.2	55	16	5	14
2005	na	na	na	na	na	na	na	na	na	na	na	na
2006	1.5	0.4	6	0.3	16.5	4.6	6	3.7	36	10	6	8
2007	1.3	0.4	8	0.3	20.8	4.2	8	2.9	43	7	8	5
2008	1.5	0.4	9	0.3	20.8	7.6	9	5.0	34	6	9	4
2009	1.5	0.5	9	0.3	20.6	9.3	9	6.1	35	13	9	9
2010	1.5	1.1	9	0.7	22.7	10.2	9	6.7	34	9	9	6
2011	1.2	0.7	8	0.5	26.1	15.0	8	10.4	35	9	8	6
2012	1.0	0.3	8	0.2	41.4	32.2	8	22.3	64	39	8	27

St. Albans	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	3.5	1.1	9	0.7	3.5	1.7	8	1.2	89	106	9	69
1998	2.8	0.9	9	0.6	5.6	3.3	7	2.5	71	47	9	31
1999	2.8	1.0	9	0.6	4.3	1.8	9	1.2	36	17	9	11
2000	2.2	0.8	7	0.6	4.5	2.5	7	1.9	36	39	7	29
2001	2.8	0.5	8	0.4	2.8	1.5	7	1.1	24	5	8	4
2002	2.9	0.9	6	0.7	4.9	1.7	7	1.3	26	7	7	5
2003	3.3	1.0	8	0.7	7.3	2.6	8	1.8	24	6	8	4
2004	3.8	0.9	8	0.6	4.0	1.4	8	1.0	16	4	8	3
2005	2.9	0.9	10	0.6	7.3	3.0	10	1.9	21	6	10	4
2006	2.7	1.2	7	0.9	5.1	4.2	7	3.1	24	4	7	3
2007	2.5	0.9	8	0.6	5.0	4.3	8	3.0	33	17	8	12
2008	3.3	1.4	9	0.9	4.7	2.8	9	1.8	16	2	9	2
2009	3.3	0.6	9	0.4	3.3	1.0	9	0.7	16	2	9	1
2010	3.3	1.3	9	0.8	4.6	2.3	9	1.5	15	3	9	2
2011	2.6	0.9	8	0.6	5.5	1.2	8	0.8	20	3	8	2
2012	3.4	1.3	8	0.9	3.9	1.8	9	1.2	19	3	9	2

Smithtown	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2004	2.3	0.2	4	0.2	4.7	3.4	4	3.3	23	7	4	7
2005	2.5	0.7	5	0.6	10.4	2.4	5	2.1	21	6	5	6
2006	2.1	0.4	6	0.3	8.4	3.2	6	2.6	27	6	6	5
2007	1.9	0.4	8	0.3	9.3	4.3	8	3.0	28	7	8	5
2008	3.2	1.0	9	0.7	7.3	3.4	9	2.2	18	5	9	3
2009	2.4	0.5	9	0.3	8.4	3.6	9	2.4	24	6	9	4
2010	3.0	1.7	9	1.1	8.1	4.7	9	3.1	20	4	9	2
2011	1.9	0.4	8	0.3	8.5	2.1	8	1.5	21	2	8	1
2012	2.2	1.1	8	0.7	10.9	4.3	8	3.0	23	4	8	3

Spring Park	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	2.8	0.9	9	0.6	4.4	1.5	8	1.0	70	115	9	75
1998	2.7	1.8	8	1.2	5.1	2.4	8	1.6	24	4	8	3
1999	2.1	0.5	9	0.3	7.8	8.2	9	5.3	51	24	9	16
2000	2.5	0.4	7	0.3	6.7	8.5	7	6.3	31	21	7	16
2001	2.7	0.3	8	0.2	3.4	1.9	7	1.4	21	4	8	3
2002	2.4	0.6	5	0.6	7.0	4.2	7	3.1	27	6	7	4
2003	3.0	0.2	8	0.1	5.8	2.0	8	1.4	22	7	8	5
2004	2.9	0.5	8	0.3	6.0	2.8	8	1.9	20	5	8	3
2005	2.6	0.8	12	0.4	8.4	4.2	12	2.4	22	7	12	4
2006	2.3	0.4	6	0.4	7.8	5.7	6	4.5	34	12	6	9
2007	1.9	0.7	8	0.5	9.3	4.9	8	3.4	29	12	8	8
2008	2.6	0.7	9	0.5	8.7	3.9	9	2.5	21	6	9	4
2009	2.7	0.7	8	0.5	6.6	3.4	9	2.2	21	4	9	3
2010	2.8	1.0	9	0.7	7.4	6.2	9	4.0	19	4	9	3
2011	2.1	0.4	8	0.3	8.4	4.2	8	2.9	21	3	8	2
2012	2.6	0.9	8	0.6	8.8	4.8	8	3.3	23	2	8	2

Stubbs	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.1	0.7	9	0.5	20.8	12.4	9	8.1	31	17	9	11
1998	0.8	0.3	9	0.2	28.6	12.0	8	8.3	135	109	9	71
1999	0.7	0.3	9	0.2	35.0	18.8	9	12.3	114	108	9	71
2000	0.9	0.3	8	0.2	25.8	11.2	8	7.7	75	34	8	23
2001	1.2	0.8	8	0.5	25.7	20.3	8	14.1	50	15	8	10
2002	0.9	0.6	7	0.4	34.8	19.1	7	14.1	76	19	9	12
2003	0.9	0.2	8	0.2	41.8	18.3	8	12.7	61	15	8	11
2004	1.1	0.4	8	0.3	32.4	5.6	8	3.9	65	16	8	11
2005	0.9	0.5	12	0.3	49.7	23.7	11	14.0	73	13	11	8
2006	0.7	0.6	7	0.5	71.0	45.0	7	33.3	57	8	7	6
2007	0.8	0.4	8	0.3	45.2	21.6	8	14.9	50	13	8	9
2008	1.1	0.8	7	0.6	42.6	23.2	8	16.1	48	8	8	5
2009	1.1	0.4	9	0.3	27.3	13.1	9	8.6	41	5	9	3
2010	1.0	0.6	9	0.4	29.6	19.8	9	12.9	43	19	9	13
2011	1.0	0.9	8	0.6	38.5	24.2	8	16.7	39	13	8	9
2012	0.5	0.3	8	0.2	63.5	34.2	8	23.7	51	13	8	9

Tanager	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
2000	0.8	0.3	8	0.2	114.4	100.2	8	69.4	88	74	8	51
2001	0.8	0.3	8	0.2	43.6	20.5	8	14.2	89	20	8	14
2002	1.1	0.4	8	0.3	41.5	17.5	8	12.2	89	24	8	17
2003	1.1	0.5	9	0.3	63.5	41.7	8	28.9	102	35	9	23
2004	0.9	0.3	7	0.2	89.6	57.1	7	42.3	128	37	7	27
2005	na	na	na	na	na	na	na	na	na	na	na	na
2006	0.9	0.6	7	0.4	71.9	32.9	7	24.4	98	32	7	24
2007	1.0	0.6	8	0.4	91.4	47.8	8	33.1	108	33	8	23
2008	1.0	0.6	9	0.4	73.0	43.0	9	28.1	85	27	9	18
2009	0.8	0.5	9	0.3	77.3	39.4	9	25.7	85	16	9	10
2010	1.1	0.7	9	0.5	73.4	43.0	9	28.1	81	26	9	17
2011	0.8	0.5	8	0.4	59.5	33.8	8	23.5	95	29	8	20
2012	0.7	0.3	8	0.2	93.1	58.8	8	40.7	117	15	8	10

Wayzata	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1979	1.3	0.1	4	0.1	11.3	2.5	4	2.5	30	8	4	8
1980	1.3	0.2	3	0.2	9.9	7.5	3	8.4	67	64	3	72
1981	2.1	0.7	4	0.6	11.3	7.9	4	7.7	80	120	4	118
1982	2.4	1.1	4	1.1	8.0		1	0.0	35	13	4	13
1983	2.0	0.3	4	0.3	2.0	1.0	3	1.1	98	90	4	88
1984	1.7	0.0	2	0.1	1.0		1	0.0	54	6	2	8
1985	2.1	0.2	4	0.2	3.0	1.4	2	2.0	122	123	4	121
1986	2.0	0.4	4	0.4	5.7	2.5	3	2.8	121	128	4	125
1997	3.7	0.9	9	0.6	3.4	0.8	8	0.5	141	202	9	132
1998	3.0	0.7	9	0.4	3.1	1.2	9	0.8	61	28	7	21
1999	3.0	1.0	9	0.7	4.2	2.5	9	1.6	116	212	9	138
2000	2.8	0.4	8	0.3	4.2	2.9	8	2.0	99	82	8	57
2001	3.1	0.5	8	0.4	4.2	2.7	6	2.2	19	6	8	4
2002	2.8	0.6	7	0.4	3.9	2.4	7	1.8	27	4	7	3
2003	3.3	0.5	8	0.3	5.5	1.1	8	0.8	21	3	8	2
2004	3.3	0.5	8	0.3	5.4	2.1	8	1.5	17	6	8	4
2005	3.1	0.9	8	0.6	9.8	7.7	8	5.3	26	6	8	4
2006	2.8	1.1	7	0.8	4.6	2.4	7	1.8	27	7	7	5
2007	2.5	0.2	8	0.2	5.1	4.5	8	3.1	42	27	8	19
2008	3.7	0.6	9	0.4	4.1	2.3	9	1.5	16	4	9	3
2009	3.9	0.4	9	0.2	3.3	1.6	9	1.0	15	4	9	3
2010	3.5	1.1	9	0.7	4.8	3.3	9	2.2	15	3	9	2
2011	3.3	0.5	8	0.3	4.9	1.6	8	1.1	16	5	8	3
2012	5.7	1.0	8	0.7	1.8	0.9	8	0.6	14	1	8	1

West Arm	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1997	1.1	0.6	8	0.4	23.2	14.1	8	9.8	143	99	8	69
1998	0.9	0.6	9	0.4	40.2	21.0	9	13.7	236	210	9	137
1999	0.8	0.4	9	0.3	39.5	24.5	9	16.0	124	95	9	62
2000	1.1	0.2	8	0.1	12.8	3.9	8	2.7	114	79	8	55
2001	1.2	0.9	9	0.6	32.8	26.8	9	17.5	67	20	9	13
2002	0.8	0.4	6	0.3	48.2	24.9	6	19.9	101	28	6	22
2003	1.0	0.8	8	0.6	70.1	31.9	8	22.1	82	24	8	17
2004	1.2	0.4	8	0.3	36.0	12.1	8	8.4	60	14	8	10
2005	1.1	0.8	8	0.6	43.6	25.3	8	17.5	68	22	8	15
2006	0.8	0.5	6	0.4	65.6	39.6	6	31.7	59	21	6	17
2007	0.7	0.3	7	0.2	63.0	27.8	7	20.6	76	24	7	18
2008	1.0	0.7	8	0.5	57.4	36.8	8	25.5	63	18	8	13
2009	1.0	0.6	9	0.4	43.8	23.0	9	15.0	70	14	9	9
2010	0.9	0.6	9	0.4	44.3	32.1	9	20.9	84	105	9	69
2011	1.1	1.3	8	0.9	67.0	49.9	8	34.6	64	30	8	21
2012	0.6	0.3	8	0.2	79.0	38.5	8	26.7	80	14	8	10

West Upper	SECC				CHLA				TP			
Year	mean	sdev	n	95% CI	mean	sdev	n	95% CI	mean	sdev	n	95% CI
1979	1.1	0.1	4	0.1	22.8	11.9	4.0	12	114	18	4	18
1980	1.2	0.1	3	0.1	8.7	4.1	3.0	5	112	93	3	105
1981	1.9	0.2	4	0.2	9.0	8.4	4.0	8	163	141	4	139
1982	1.9	0.8	4	0.8	16.3	7.1	4.0	7	112	24	4	24
1983	1.7	0.3	4	0.3	1.0	0.0	2.0	0	104	16	4	16
1984	1.9	0.4	4	0.4	na	na	na	na	149	120	4	118
1985	1.7	0.4	4	0.3	3.3	1.2	3.0	1	115	83	4	81
1986	2.0	0.4	4	0.4	7.3	7.5	3.0	8	116	16	4	16
1997	2.6	1.1	9	0.7	6.3	4.1	8.0	3	93	38	9	25
1998	1.9	0.5	8	0.3	7.3	3.3	9.0	2	124	239	9	156
1999	1.7	0.3	9	0.2	8.9	3.6	9.0	2	75	90	9	59
2000	2.3	0.5	8	0.3	5.7	3.8	8.0	3	106	115	8	80
2001	2.7	1.0	8	0.7	5.0	2.2	8.0	1	21	4	8	3
2002	2.1	0.8	7	0.6	6.8	1.6	6.0	1	36	16	7	12
2003	2.5	0.5	8	0.3	8.8	2.9	8.0	2	24	7	8	5
2004	2.1	0.6	8	0.4	11.8	2.7	8.0	2	27	7	8	5
2005	2.5	0.8	8	0.6	10.8	2.9	8.0	2	27	6	8	4
2006	2.1	0.3	6	0.3	7.7	4.2	7.0	3	45	31	7	23
2007	1.8	0.6	8	0.4	12.0	6.0	8.0	4	29	12	8	9
2008	2.6	0.9	9	0.6	9.3	4.4	9.0	3	33	37	9	24
2009	2.4	0.4	9	0.3	9.3	3.4	9.0	2	22	2	9	1
2010	2.5	1.4	9	0.9	9.7	4.1	9.0	3	20	2	9	1
2011	1.8	0.4	8	0.3	9.3	2.4	8.0	2	22	3	8	2
2012	1.8	0.9	8	0.6	13.1	5.8	8.0	4	26	4	8	3

Bottom Water Summary Statistics: Upper Watershed Lakes

Christmas	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	115	55	8	38	na	na	na	na
1998	112	57	9	37	na	na	na	na
1999	81	66	9	43	na	na	na	na
2000	101	48	8	33	94	29	7	22
2001	103	34	7	25	63	19	7	14
2002	na	na	na	na	na	na	na	na
2003	54	37	7	27	na	na	na	na
2004	71	39	7	29	46	24	7	18
2005	169	45	8	31	107	23	8	16
2006	160	42	7	31	119	29	7	21
2007	99	25	7	18	70	17	7	13
2008	109	50	9	33	86	39	9	26
2009	139	39	9	25	112	31	9	20
2010	97	29	9	19	75	22	9	14
2011	127	57	8	39	101	42	8	29
2012	167	76	8	53	123	56	8	39

Dutch	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	841	315	9	206	788	324	9	212
1998	599	319	6	255	536	272	6	218
1999	na	na	na	na	na	na	na	na
2000	734	451	8	313	569	313	8	217
2001	821	286	8	198	636	227	8	157
2002	813	340	8	235	530	203	8	141
2003	853	373	9	244	564	230	8	159
2004	1331	468	8	324	931	274	8	190
2005	1242	429	8	298	675	146	8	101
2006	968	226	7	167	402	69	7	51
2007	821	292	7	217	441	134	7	100
2008	749	311	9	203	560	211	9	138
2009	1179	262	9	171	824	130	9	85
2010	817	213	9	139	520	72	9	47
2011	819	348	9	227	279	98	8	68
2012	1106	360	8	250	478	59	8	41

Gleason	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	152	70	9	46	89	38	3	43
1998	163	62	6	50	96	15	3	17
1999	na	na	na	na	na	na	na	na
2000	304	230	7	170	96	41	4	40
2001	105	52	8	36	14	12	8	8
2002	133	94	8	65	na	na	na	na
2003	420	472	9	308	152	67	5	59
2004	155	64	6	51	55	38	6	31
2005	192	128	8	89	35	33	8	23
2006	291	240	7	178	20	12	7	9
2007	207	147	7	109	18	15	7	11
2008	110	64	9	42	11	10	9	6
2009	116	58	9	38	37	21	9	14
2010	84	40	9	26	11	10	9	6
2011	90	78	8	54	11	13	8	9
2012	53	29	8	20	7	9	8	6

Langdon	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	1081	644	9	421	531	332	9	217
1998	104	18	7	13	na	na	na	na
1999	na	na	na	na	na	na	na	na
2000	441	115	8	80	159	103	3	116
2001	279	55	8	38	117	58	8	41
2002	286	193	8	134	na	na	na	na
2003	135	17	9	11	na	na	na	na
2004	644	432	7	320	422	454	7	336
2005	312	138	8	95	103	73	8	50
2006	745	301	7	223	196	167	7	123
2007	na	na	na	na	na	na	na	na
2008	702	666	8	462	504	606	8	420
2009	598	302	7	224	383	223	7	165
2010	118	63	9	41	22	28	9	18
2011	358	270	9	176	67	50	9	33
2012	441	283	8	196	178	165	8	114

Long	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	195	182	8	126	333	159	3	180
1998	331	158	7	117	230	130	7	96
1999	na	na	na	na	na	na	na	na
2000	587	403	8	279	551	371	7	275
2001	856	526	8	364	584	311	8	215
2002	529	440	8	305	252	139	5	122
2003	662	363	9	237	367	197	8	136
2004	1022	549	8	380	501	218	8	151
2005	1052	569	8	394	585	361	8	250
2006	451	215	7	159	220	131	7	97
2007	1033	621	7	460	430	230	7	170
2008	756	569	9	372	448	395	9	258
2009	1108	671	8	465	977	585	9	383
2010	659	402	9	263	528	372	9	243
2011	729	404	8	280	274	190	8	131
2012	972	433	8	300	657	286	8	198

Minnewashta	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	265	98	8	68	na	na	na	na
1998	243	76	9	50	na	na	na	na
1999	118	64	9	42	na	na	na	na
2000	542	1035	8	718	171	44	7	33
2001	366	158	7	117	261	140	7	104
2002	na	na	na	na	na	na	na	na
2003	160	117	7	87	na	na	na	na
2004	361	107	8	74	328	93	8	64
2005	319	78	7	58	264	69	7	51
2006	339	68	7	50	279	57	7	42
2007	131	80	8	55	88	64	8	45
2008	231	100	9	65	199	94	9	61
2009	416	101	9	66	368	102	9	67
2010	268	88	9	57	226	91	9	59
2011	214	88	9	57	175	81	9	53
2012	238	98	8	68	192	80	8	55

Parley	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	na	na	na	na	na	na	na	na
1998	na	na	na	na	na	na	na	na
1999	86	17	8	12	na	na	na	na
2000	102	82	8	57	na	na	na	na
2001	240	216	7	160	43	53	7	39
2002	249	233	8	162	177	72	5	63
2003	171	190	10	118	336	109	2	151
2004	na	na	na	na	na	na	na	na
2005	284	259	8	180	144	239	8	166
2006	333	261	7	193	83	87	7	65
2007	176	89	7	66	24	56	7	41
2008	80	28	9	18	22	24	9	16
2009	68	11	9	7	3	0	9	0
2010	88	31	8	21	5	4	8	3
2011	197	223	8	154	23	45	8	31
2012	216	236	8	163	76	117	8	81

Piersons	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	148	99	9	65	56	1	2	1
1998	170	91	7	68	62	18	3	20
1999	na	na	na	na	na	na	na	na
2000	na	na	na	na	na	na	na	na
2001	na	na	na	na	na	na	na	na
2002	34	9	8	6	na	na	na	na
2003	29	11	7	8	na	na	na	na
2004	na	na	na	na	na	na	na	na
2005	373	117	8	81	67	16	8	11
2006	121	39	7	29	10	7	7	5
2007	83	27	7	20	6	3	7	2
2008	61	39	9	25	6	5	9	4
2009	50	18	9	12	5	5	9	3
2010	75	53	8	37	9	10	8	7
2011	33	19	8	13	15	31	8	22
2012	59	28	8	20	11	13	8	9

Schutz	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2006	648	140	7	103	461	143	7	106
2007	715	205	8	142	521	248	8	172
2008	523	185	9	121	488	197	9	129
2009	698	226	8	157	573	247	8	171
2010	651	76	9	50	592	101	9	66
2011	438	197	9	128	352	186	9	122
2012	580	172	8	119	541	164	8	114

Virginia	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2006	490	184	7	136	110	77	7	57
2007	662	463	8	321	191	190	8	131
2008	937	334	9	218	494	158	9	103
2009	1336	356	9	233	1003	191	9	125
2010	818	585	8	406	866	219	8	152
2011	780	348	9	227	285	114	9	74
2012	1057	317	8	220	656	123	8	86

Wasserman	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	341	91	8	63	na	na	na	na
1998	692	361	9	236	na	na	na	na
1999	414	277	9	181	na	na	na	na
2000	795	468	8	324	220	180	8	125
2001	831	421	7	312	343	138	7	103
2002	104	51	3	58	na	na	na	na
2003	1142	644	7	477	na	na	na	na
2004	774	344	8	239	534	280	8	194
2005	988	500	8	346	56	32	8	22
2006	421	198	7	147	52	48	7	35
2007	687	399	7	296	219	137	7	102
2008	717	465	10	288	281	170	10	106
2009	903	492	8	341	314	157	8	109
2010	418	305	8	211	115	78	8	54
2011	376	276	8	191	30	23	7	17
2012	643	417	8	289	40	14	8	10

Bottom Water Summary Statistics: Lake Minnetonka

Black	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	314	161	5	141	90	49	5	43
2005	na	na	na	na	na	na	na	na
2006	162	105	4	103	14	11	4	11
2007	91	59	7	44	3	1	7	1
2008	71	43	9	28	4	4	9	3
2009	94	44	9	28	13	14	9	9
2010	68	49	9	32	5	6	9	4
2011	72	39	8	27	3	2	8	2
2012	101	62	8	43	17	17	8	12

Carman	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	177	109	5	96	27	17	5	15
2005	na	na	na	na	na	na	na	na
2006	160	113	7	84	7	3	7	3
2007	275	228	8	158	11	9	8	6
2008	280	292	9	191	26	13	9	9
2009	408	362	9	237	40	20	9	13
2010	118	131	9	86	19	20	9	13
2011	146	140	8	97	14	9	8	6
2012	337	241	8	167	20	10	8	7

Carsons	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	88	82	5	72	9	8	5	7
2005	na	na	na	na	na	na	na	na
2006	101	122	7	90	7	12	7	9
2007	36	20	8	14	3	14	8	10
2008	21	3	9	2	3	0	9	0
2009	24	3	9	2	3	1	9	1
2010	38	38	9	25	13	31	9	20
2011	37	20	8	14	2	1	8	1
2012	21	6	8	4	2	1	8	1

Cooks	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	129	75	9	49	na	na	na	na
1998	87	82	7	61	na	na	na	na
1999	145	131	8	91	86	81	8	56
2000	61	46	8	32	13	16	8	11
2001	82	62	8	43	32	27	8	19
2002	87	57	7	43	17	17	7	12
2003	40	9	8	6	7	8	8	5
2004	37	13	8	9	4	5	7	4
2005	94	76	8	53	36	39	8	27
2006	470	233	5	204	157	17	5	15
2007	212	278	8	193	150	207	5	181
2008	236	193	9	126	91	48	7	35
2009	366	206	9	134	116	56	9	36
2010	275	236	9	154	138	94	8	65
2011	426	280	8	194	96	34	8	23
2012	400	246	8	171	167	47	7	35

Crystal	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	210	56	9	37	na	na	na	na
1998	199	44	8	30	na	na	na	na
1999	160	46	7	34	123	40	7	30
2000	183	60	8	42	151	41	7	31
2001	159	54	8	37	117	53	8	37
2002	124	41	7	30	98	33	7	25
2003	187	31	8	21	157	37	8	26
2004	207	68	8	47	169	52	8	36
2005	177	46	8	32	151	45	8	31
2006	163	33	6	26	136	27	6	21
2007	159	18	8	13	120	30	8	21
2008	141	54	8	38	122	53	8	37
2009	164	43	9	28	134	35	9	23
2010	172	39	9	25	148	38	9	25
2011	96	48	8	34	75	53	8	37
2012	150	27	8	19	138	39	8	27

Forest	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	802	226	8	157	na	na	na	na
1998	699	173	7	128	na	na	na	na
1999	860	189	8	131	635	262	7	194
2000	751	169	7	125	582	186	7	138
2001	965	496	8	344	642	141	8	98
2002	754	271	7	201	665	272	7	201
2003	1042	164	8	113	819	207	8	143
2004	1004	277	8	192	850	215	8	149
2005	1006	198	8	137	877	160	8	111
2006	698	131	5	114	395	67	5	59
2007	514	157	7	116	423	182	7	134
2008	415	153	8	106	326	161	7	119
2009	565	160	9	105	487	154	9	101
2010	463	127	9	83	407	142	9	93
2011	376	170	8	118	299	155	8	107
2012	502	159	7	118	477	176	7	130

Grays	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	41	21	5	19	3	0	5	0
2005	60	24	4	23	9	12	3	14
2006	59	22	8	16	3	3	8	2
2007	64	26	8	18	4	2	8	1
2008	31	16	9	10	3	1	9	1
2009	34	5	9	3	4	2	9	1
2010	33	7	9	4	3	0	9	0
2011	37	28	8	19	3	3	8	2
2012	35	22	8	15	2	1	8	1

Halsted	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	813	603	8	418	na	na	na	na
1998	685	576	8	399	na	na	na	na
1999	876	698	8	484	538	533	7	394
2000	373	257	8	178	175	160	8	111
2001	900	535	7	396	516	236	7	175
2002	876	400	10	248	698	318	9	208
2003	1129	574	8	398	735	410	8	284
2004	764	642	8	445	456	354	8	245
2005	564	455	7	337	282	196	8	136
2006	827	418	6	335	334	198	6	158
2007	486	526	7	390	296	383	7	284
2008	364	332	9	217	219	250	9	163
2009	469	244	9	159	263	153	9	100
2010	507	427	9	279	367	379	9	248
2011	469	426	8	295	258	329	8	228
2012	705	537	8	372	566	458	8	317

Harrisons	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	398	222	9	145	na	na	na	na
1998	306	218	7	162	na	na	na	na
1999	664	446	7	330	393	130	6	104
2000	189	125	8	87	108	131	7	97
2001	209	124	8	86	100	91	8	63
2002	376	198	7	147	269	153	7	113
2003	252	142	8	99	151	133	8	92
2004	133	112	8	77	58	97	6	78
2005	302	168	8	116	244	140	7	103
2006	111	80	4	78	20	36	4	35
2007	196	143	7	106	81	104	7	77
2008	148	199	8	138	8	15	7	11
2009	303	142	9	93	176	128	9	84
2010	106	46	9	30	18	21	9	14
2011	123	114	8	79	19	43	8	30
2012	428	261	8	181	339	257	8	178

Jennings	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	322	258	9	168	na	na	na	na
1998	180	108	8	75	na	na	na	na
1999	230	208	8	144	79	68	8	47
2000	130	81	8	56	27	28	8	19
2001	315	230	8	159	155	161	8	112
2002	357	140	7	103	209	154	7	114
2003	291	122	8	85	159	111	8	77
2004	201	119	8	82	82	89	8	61
2005	192	119	8	82	54	36	7	27
2006	444	369	6	295	61	51	6	41
2007	181	90	7	67	40	51	7	38
2008	284	181	8	125	132	120	8	83
2009	191	74	9	48	73	74	9	49
2010	239	158	9	103	85	62	9	41
2011	393	399	8	277	86	77	8	53
2012	397	295	8	205	222	187	8	129

Lafayette	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	370	245	9	160	na	na	na	na
1998	237	132	7	98	na	na	na	na
1999	328	201	8	139	64	53	8	37
2005	325	173	4	169	61	14	4	13
2006	59	33	8	23	11	10	8	7
2007	46	25	8	17	7	5	8	4
2008	20	5	9	3	3	0	9	0
2009	25	6	9	4	4	3	9	2
2010	27	10	9	6	4	3	9	2
2011	36	24	8	16	12	16	8	11
2012	23	9	8	6	4	3	8	2

LL North	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	149	72	9	47	na	na	na	na
1998	115	63	6	51	na	na	na	na
1999	73	48	7	35	32	22	7	17
2005	179	88	4	86	101	46	4	45
2006	167	64	8	45	76	25	8	18
2007	152	83	8	57	48	16	8	11
2008	119	82	9	54	61	40	9	26
2009	189	143	9	93	105	89	9	58
2010	127	67	9	44	86	43	9	28
2011	96	49	8	34	54	23	8	16
2012	137	85	8	59	57	31	8	22

LL South	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	304	185	9	121	na	na	na	na
1998	157	59	8	41	na	na	na	na
1999	101	65	7	48	56	47	6	38
2000	118	69	8	48	15	9	7	6
2001	154	120	8	83	57	40	8	28
2002	74	47	7	35	17	10	7	7
2003	201	82	8	57	89	41	8	28
2004	168	111	8	77	79	60	8	42
2005	228	89	67	21	131	47	66	11
2006	277	62	8	43	85	15	8	11
2007	220	105	8	73	65	31	8	22
2008	251	202	9	132	61	42	9	28
2009	274	196	9	128	110	97	8	67
2010	195	92	9	60	119	73	9	48
2011	184	82	8	57	84	29	8	20
2012	258	150	8	104	102	56	8	39

Maxwell	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	294	177	9	115	na	na	na	na
1998	266	152	8	106	na	na	na	na
1999	255	144	8	100	187	119	8	82
2000	253	132	8	92	186	102	8	71
2001	245	137	8	95	156	113	8	78
2002	149	72	7	54	98	52	7	38
2003	346	151	8	105	235	112	8	77
2004	375	204	8	141	284	155	8	108
2005	383	143	8	99	316	151	8	105
2006	295	75	6	60	178	45	6	36
2007	373	118	8	82	228	109	8	76
2008	169	170	8	118	70	82	8	57
2009	349	176	9	115	272	179	9	117
2010	209	102	9	67	164	93	9	60
2011	90	70	8	48	38	40	8	28
2012	355	194	8	134	253	165	8	114

North Arm	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	177	80	7	59	na	na	na	na
1998	205	126	8	87	na	na	na	na
1999	186	76	8	53	113	60	8	42
2000	258	166	8	115	98	82	8	57
2001	333	132	8	92	197	85	8	59
2002	292	126	7	93	198	84	7	62
2003	439	175	8	122	243	102	8	70
2004	374	225	8	156	217	117	8	81
2005	367	148	8	102	206	86	8	59
2006	162	75	6	60	75	40	6	32
2007	253	94	8	65	137	81	8	56
2008	146	68	8	47	97	63	8	44
2009	244	131	9	85	185	113	9	74
2010	242	64	9	42	207	70	9	46
2011	109	74	8	51	71	59	8	41
2012	318	99	8	68	254	76	8	53

Peavey	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1999	4406	1420	8	984	4317	1012	8	701
2000	5556	1142	8	792	4114	1348	8	934
2001	3476	1569	8	1088	2789	1056	8	732
2002	7440	2286	9	1493	6030	621	9	406
2003	7170	200	8	139	6495	273	7	202
2004	7742	447	8	310	na	na	na	na
2005	7678	456	8	316	6724	94	7	69
2006	8033	2214	7	1640	6890	478	8	331
2007	8273	712	8	494	5732	1085	9	709
2008	7872	1667	9	1089	6523	1217	9	795
2009	8560	751	9	491	6897	1224	9	800
2010	8556	2983	9	1949	7563	812	8	563
2011	8357	2315	8	1604	7475	404	8	280
2012	9961	1584	8	1097	6404	1590	8	1102

Phelps	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2006	72	33	7	24	3	2	7	1
2007	54	31	8	22	4	3	8	2
2008	34	29	9	19	4	4	9	3
2009	35	14	9	9	6	9	9	6
2010	29	12	9	8	3	2	9	1
2011	45	30	8	21	6	10	8	7
2012	42	35	8	24	6	8	8	6

Priests	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	741	310	5	271	487	287	5	252
2005	215	63	2	87	176	49	3	56
2006	86	60	6	48	35	42	6	33
2007	76	63	8	44	15	32	8	22
2008	59	18	9	12	7	8	9	5
2009	52	19	9	13	8	10	9	6
2010	37	13	9	9	3	1	9	1
2011	43	16	8	11	9	13	8	9
2012	104	50	8	35	53	54	8	37

St. Albans	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	122	67	9	44	na	na	na	na
1998	58	21	7	15	na	na	na	na
1999	113	48	7	36	49	24	7	18
2000	69	45	7	33	21	15	7	11
2001	65	24	8	16	12	11	7	8
2002	65	46	7	34	23	34	7	25
2003	71	44	8	31	19	18	8	12
2004	67	68	8	47	32	73	8	50
2005	90	54	8	38	32	34	8	23
2006	247	65	7	48	81	48	7	36
2007	110	60	8	42	33	25	8	18
2008	129	88	9	57	44	55	9	36
2009	217	109	9	71	68	57	9	37
2010	111	77	9	50	38	57	9	37
2011	91	49	8	34	15	14	8	10
2012	161	70	8	48	71	63	8	44

Smithtown	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2004	269	83	4	81	164	116	4	114
2005	329	331	5	290	296	322	5	282
2006	161	63	6	51	120	61	6	49
2007	34	14	8	10	8	8	8	6
2008	83	76	9	49	45	29	9	19
2009	132	52	9	34	107	52	9	34
2010	61	61	9	40	48	67	9	44
2011	66	27	8	19	38	25	8	18
2012	58	24	8	17	35	28	8	19

Spring Park	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	38	27	9	18	na	na	na	na
1998	52	42	8	29	na	na	na	na
1999	50	38	8	26	21	31	6	24
2000	39	24	7	18	6	6	6	5
2001	152	150	8	104	18	14	8	10
2002	56	64	7	47	6	6	6	5
2003	28	10	8	7	3	1	8	1
2004	26	10	8	7	6	4	6	3
2005	56	53	8	37	8	10	7	7
2006	48	14	6	11	3	1	6	1
2007	36	12	8	8	5	5	8	3
2008	22	5	9	3	3	0	9	0
2009	23	3	9	2	4	6	9	4
2010	21	2	9	2	3	0	9	0
2011	26	17	8	11	3	2	8	1
2012	28	4	8	3	2	1	8	1

Stubbs	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	470	263	9	172	na	na	na	na
1998	509	192	8	133	na	na	na	na
1999	461	215	8	149	347	177	8	123
2000	531	279	8	193	395	254	8	176
2001	566	306	8	212	430	274	8	190
2002	611	426	8	295	530	390	8	270
2003	831	316	8	219	683	284	8	197
2004	894	402	8	279	740	283	8	196
2005	964	287	8	199	810	200	8	138
2006	461	171	7	126	314	126	7	93
2007	281	119	8	82	169	135	8	93
2008	233	167	8	116	181	158	8	110
2009	504	248	9	162	413	242	9	158
2010	369	168	9	110	317	165	9	108
2011	189	115	8	79	72	106	8	73
2012	627	209	8	145	580	189	8	131

Tanager	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
2000	123	53	8	36	34	30	8	21
2001	211	146	8	101	114	123	8	85
2002	285	236	8	164	101	73	8	50
2003	292	200	9	131	109	113	8	78
2004	243	129	7	96	139	143	7	106
2005	na	na	na	na	na	na	na	na
2006	1010	1126	7	834	113	57	7	42
2007	180	174	8	121	37	46	8	32
2008	225	199	9	130	66	79	9	52
2009	138	46	9	30	36	41	9	27
2010	189	123	9	81	90	89	9	58
2011	378	315	8	218	102	73	8	50
2012	313	172	8	119	190	169	8	117

Wayzata	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	219	216	9	141	na	na	na	na
1998	210	143	7	106	na	na	na	na
1999	215	159	8	110	20	11	7	8
2000	79	67	8	46	6	3	7	2
2001	162	123	8	85	22	18	8	13
2002	72	47	7	35	7	3	7	2
2003	163	135	8	93	17	9	8	6
2004	131	118	8	82	18	14	8	9
2005	164	124	8	86	20	11	8	8
2006	231	121	7	90	30	62	7	46
2007	207	134	8	93	8	5	8	4
2008	154	123	9	80	16	9	9	6
2009	219	166	9	108	20	11	9	7
2010	112	108	9	71	18	15	9	10
2011	176	130	8	90	31	14	8	9
2012	252	202	8	140	46	31	8	21

West Arm	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	376	165	8	115	na	na	na	na
1998	353	163	8	113	na	na	na	na
1999	343	223	8	154	273	188	8	130
2000	114	67	8	46	50	47	7	35
2001	327	201	8	140	230	153	8	106
2002	380	238	7	176	273	207	7	154
2003	205	80	8	56	121	82	8	57
2004	128	90	8	63	72	83	6	67
2005	238	143	8	99	132	116	8	81
2006	290	195	5	171	144	146	5	128
2007	223	250	7	185	74	96	7	71
2008	288	196	8	136	184	154	8	107
2009	255	102	9	67	168	120	9	78
2010	219	150	9	98	132	120	9	79
2011	174	129	8	89	80	92	7	68
2012	419	219	8	152	338	215	8	149

West Upper	TP_BOTTOM				SRP_BOTTOM			
Year	mean	sd	n	95% CI	mean	sd	n	95% CI
1997	231	92	9	60	na	na	na	na
1998	179	61	6	49	na	na	na	na
1999	213	43	8	30	174	43	8	30
2000	219	61	8	42	172	46	7	34
2001	209	90	8	62	154	75	8	52
2002	96	42	7	31	45	27	7	20
2003	254	126	8	88	202	109	8	75
2004	254	84	8	59	215	74	8	52
2005	372	252	8	175	325	245	8	170
2006	249	62	7	46	191	50	7	37
2007	123	51	8	36	61	40	8	28
2008	184	107	9	70	176	88	9	57
2009	275	83	9	54	254	82	9	54
2010	215	53	9	34	185	64	9	42
2011	186	78	8	54	153	77	8	53
2012	215	88	8	61	186	77	8	53