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Utah Lake Research 2017-2018

Progress Report

Continued analysis of Utah Lake's unique foodweb with a focus on
the role of nutrients, phytoplankton, zooplankton,
and benthic invertebrates on cyanoHABs

Chapter 1: Phytoplankton Assemblages

Submitted to:
Wasatch Front Water Quality Council

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Forward

This progress report is a continued analysis of the critical role and interrelationships of nutrients, phytoplankton, zooplankton, and benthic macroinvertebrates in the foodweb of Utah Lake and how they affect and are affected by cyanobacteria blooms (cyanoHABs). There is a wealth of information in this report, however it is only a continuation of much more intensive and informative statistical and ecological analyses.

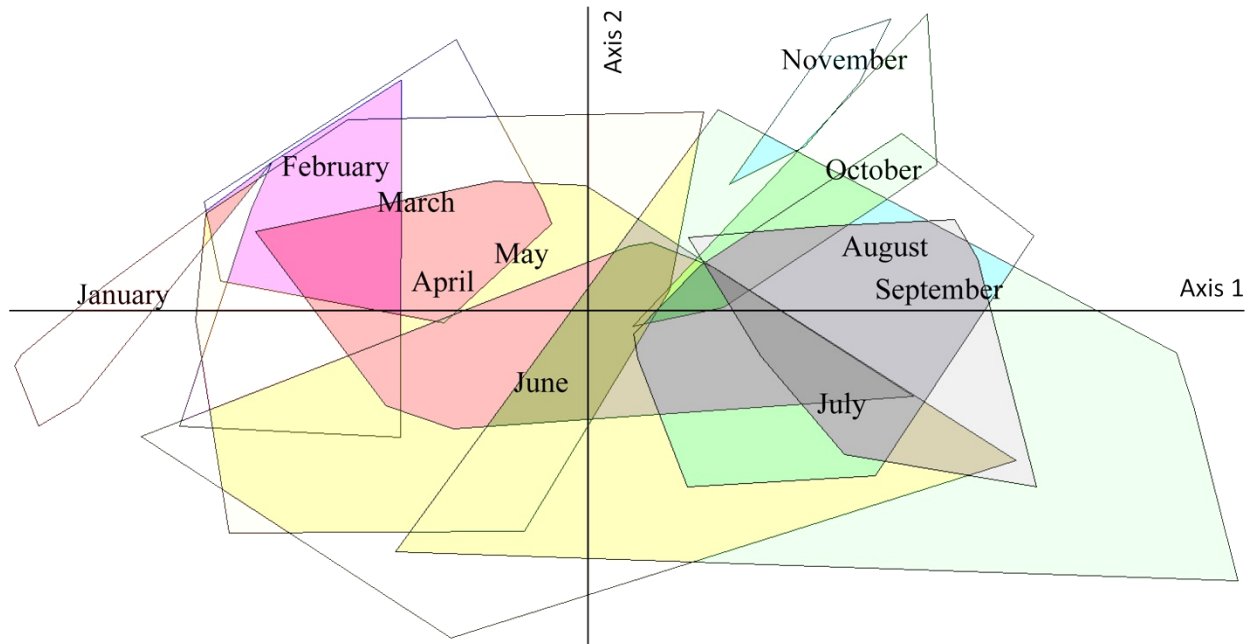
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We are grateful to the following that share(d) our vision of conducting the most intensive ecological analysis of Utah Lake to date: Dr. Sam Rushforth of Rushforth Phycology; Dr. Larry Gray at Utah Valley University; Brett Marshall at River Continuum Concepts; Mr. Dick Buhler most excellent air boat captain; the many technicians at Wasatch Front Water Quality Council; all of the POTWs associated with the Council and to the Wasatch Front Water Quality Council for funding this important work. Much of our research is in collaboration with Utah Division of Water Quality, Utah Lake Commission, and researchers at BYU, USU, and U of U and others.

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Utah Lake Phytoplankton Assemblages 2017-2018



Summary

We analyzed one hundred and eighty-one phytoplankton samples collected from various locations in Utah Lake from January to November 2017 and thirty-six samples from 2018 using multivariate community statistics, regression, and traditional frequentist statistics. Results from these analyses were very similar to our 2016 results showing that phytoplankton taxa, including cyanoHABs in Utah Lake were statistically seasonally and temporally dynamic, with many individual taxa useful seasonal and temporal indicators. Estimated total taxa richness was between 202 and 219 in 2017 based on several estimators, however α –diversity ranged from about 5 in winter to about 30 in August, and the effective number of taxa α –diversity was only between 2 and 5 suggesting a stressed system. In 2017, diversity peaked in June and August with a noticeable decline in July and was lowest in winter months. We are currently near completion of compiling all of our phytoplankton data from 2015 through 2018, as well as zooplankton, benthic, and nutrient and other environmental data and will conduct analyses on their spatially and temporal dynamics and interactions using the most appropriate multivariate statistical methods including multivariate time series, redundancy analysis, fuzzy set ordination, functional traits analysis, and also structural equation models and longitudinal mixed effects regression models where appropriate.

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Introduction

Very little is known about phytoplankton spatial and temporal patterns in Utah Lake despite the critically important relationships between phytoplankton and; benthic and water column nutrient cycling, cyanobacteria blooms (cyanoHABS)(Harmful Algal Blooms)¹, benthic invertebrates, zooplankton, and the physico-chemical conditions in the benthos and water column. Phytoplankton-zooplankton-water column nutrient cycling has been well documented throughout the world and has been extensively studied by limnologists and ecologists for several generations. Phytoplankton obviously are the major link between water column nutrients (trophic level bottom up effects) and zooplankton grazers and other top down trophic level effects. However, other interactions, including for example those between phytoplankton and the benthic component of the food web are less recognized and these interactions are likely important drivers of cyanobacteria blooms in Utah Lake. In this Chapter we report results from analyses of phytoplankton assemblage data that we collected in 2017 and 2018.

Methods

One hundred and eighty-one phytoplankton samples were collected from various locations in Utah Lake from January to November 2017 (Appendix 2) and thirty-five from 2018. Many of the phytoplankton samples were collected in the same locations and on the same dates as zooplankton samples (see pending Zooplankton chapter) and most were collected concomitantly with nutrient and water chemistry data (see pending Nutrient and Water Chemistry chapter). Every attempt was made to collect phytoplankton samples from the same locations where we collected in past years (e.g. Richards and Miller 2017).

Sample Collection

Phytoplankton samples were collected by inverting a small plastic bottle into the lake water down to elbow deep and then turning the bottle upright while bringing it to the surface. This insured that all the water column to elbow depth was collected equally. Samples were then placed in a cooler with ice and delivered within several hours of collection to Rushforth Phycology, Provo, Utah. If samples could not be delivered to their lab on the same day, then samples were preserved with several drops of Lugol's solution (usually 6-8 drops until water was 'tea colored') and delivered within two days. Samples were then processed by Rushforth Phycology using standard laboratory procedures. Taxa were counted as units mL⁻¹ and then calculated by Rushforth to cells mL⁻¹ using Utah Lake transformations specifically developed by Rushforth Phycology. We used cells mL⁻¹ in all of our statistical analyses presented in this progress report. The 2017 and 2018 data sets (including cell count conversions to biovolume) are

¹ Cyanobacteria are bacteria that can photosynthesize but they are not algae. Harmful Algal Blooms or cyanoHABS in Utah Lake are entirely comprised of cyanobacteria not algae.

available on the Utah Division of Water Quality website: <https://deq.utah.gov/division-water-quality> or by contacting UDWQ.

Statistics

Spatial and Temporal Patterns of Phytoplankton Assemblages: *Multivariate Models*

Non-metric multidimensional scaling (NMS) ordination was used to visually compare assemblage relationships between sites and months. Ordination techniques are often more informative than hypothesis-testing approaches for exploring relationships between multivariate ecological assemblages or communities (McCune and Grace 2002). In general, ordination is the ordering of objects along axes according to their (dis)similarities; the main objective of ordination is to reduce many-dimensional relationships into a small number of more easily interpretable dimensions (i.e., axes on a plot). The strongest correlation structure in the data is extracted and is then used to position objects in ordination space. Objects that are close in the ordination space are more similar than objects distant in ordination space (McCune and Mefford 2011).

NMS was used in these analyses because it has been shown to be robust and highly informative for understanding ecological relationships. NMS ordination is often more broadly applicable for ecological studies than other ordination techniques because it does not require relationships among variables to be linear (McCune and Mefford 2011; Peck 2010). NMS ordination permits the visualization of the multidimensional relationships of nutrients and other chemical variables into a more easily visualized, lower dimensional space. Dimensional reduction obviously creates some distortion in relationships between samples. The level of reduction in distortion is measured as ‘stress’; where lower stress values equal less distortion. NMS plots with stress values of 15% (0.15) or less are typically considered to be a good representation of the data and stress values lower than 10% (0.10) are considered excellent representations (McCune and Mefford 2011; Peck 2010).

NMS analyses of Utah Lake phytoplankton assemblage data was conducted using PC-ORD Version 7.07 (McCune and Mefford 2018). A Sorensen (Bray-Curtis) distance measure was used in the NMS analysis and run for 250 iterations using the real data and 250 iterations in randomized Monte Carlo simulations. The Sorensen distance measure is based on pairwise comparisons between all sample pairs, therefore NMS ordinations were rotated using varimax rotation to maximize variation along the axes and extracted as univariate scores. Therefore, the final ordinations can be rotated either vertically or horizontally without effecting the results. The best model was chosen based on scree plots and final stress values. Centroid labels of sites were added to the ordinations to aid in the interpret the relationships. Post hoc proportion of variance represented by each axis was calculated based on the R^2 value between distance in the ordination space and distance in the original space.

MRPP (multi-response permutation procedure), a non-parametric multivariate method was used to formally test the hypothesis of no differences in assemblages between months and sites. MRPP has the advantage of not requiring distributional assumptions such as multivariate normality and homogeneity of variance and thus is often preferred over MANOVA for analyzing multivariate ecological data (McCune and Grace 2002). A Sorensen (Bray-Curtis) distance measure was used in the MRPP analyses. The chance-corrected within-group test statistic, A (and associated p-value) was used to evaluate the hypothesis of no difference in the spatial and temporal groupings (McCune and Grace 2002). We also conducted indicator species analysis grouped by months using Dufrene's and Legendre's (1997) method (see McCune and Mefford 2018 for more details of indicator species analysis).

Individual Phytoplankton Taxa Temporal Patterns

Additional statistical analyses including taxon specific: time series graphs, boxplots, marginal predicted means and 95% CIs, ANOVAs, MANOVAs, Generalized Linear, truncated Poisson, truncated negative binomial, and fractional regressions were conducted based on the desired comparisons and effects and the distributions of the data using Stata 15.1 (StatCorp 2015). Fractional regression, truncated Poisson and truncated negative binomial regression methods were chosen because some diversity indices were proportions and individual plankton taxa density estimates were count data that were truncated at zero and contained mostly zero counts. Typically, these types of data cannot be reasonably transformed to approximate normal Gaussian (normal) distributions using any transformation method, therefore linear models were rarely appropriate.

Phytoplankton assemblages: Temporal Effects

Discerning phytoplankton assemblage patterns in Utah Lake 2016 was not straight forward because almost half of the taxa were rare and uncommon and many (98) occurred in < 10% of the samples, which resulted in a large proportion (0.91) of the dataset containing zero counts. We dropped taxa that occurred in < 10 samples (Appendix 4) and then used Beal's smoothing transformation method to account for the disproportionately large number of zero counts in the dataset. This transformation resulted in a loss of much of the quantitative information but not as severe of a loss of information as a presence/absence transformation would have caused. We used the Beal's smoothing formula:

$$b_y = \frac{1}{S_i} \sum_k \left(\frac{M_{jk}}{N_k} \right)$$

where S is the number of species in sample i , M_{jk} is the number of samples with both species j and k , and N_k is the number of samples with species k . (McCune and Mefford 1999)

This transformation helped relieve the "zero-truncation problem" (Beals 1984; McCune 1994), which is most severe in heterogeneous community data sets that have most of the samples

containing a fairly small proportion of the species (McCune and Mefford 1999). Beal's smoothing replaced presence/absence data with quantitative values that represented the "favorability" of each sample for each species, regardless of whether the species was present in the sample (McCune and Mefford 1999). The index evaluated the favorability of a given sample for species i , based on the whole data set, using the proportions of joint occurrences between the species that do occur in the sample and species i . (McCune and Mefford 1999). As with any numerical smoothing, Beal's smoothing tended to reduce the noise in the data by enhancing the strongest patterns in the data. In this case, the signal that is smoothed is the pattern of joint occurrences in the data. This is an extremely powerful transformation that is particularly effective on heterogeneous or noisy data. However, because, like any smoothing function; Beal's transformation can produce the appearance of reliable, consistent trends even from a series of random numbers (McCune and Mefford 1999).

Phytoplankton Assemblages 2017

NMS Results

Data editing and transformations resulted in the inclusion of 74 taxa in the multivariate analyses. The final NMS ordination resulted in a 2-dimensional solution with a final stress of 8.99 (final instability < 0.00001 at 76 iterations). Post-hoc analyses showed that Axis 1 accounted for 78% of the phytoplankton assemblage variability and Axis 2 accounted for 19% of the assemblage variability for a total of 97%. The NMS model therefore described the phytoplankton assemblage patterns extremely well given the low final stress and high R^2 values.

Figure 1 shows Utah Lake's phytoplankton assemblages in 2017 in relation to month. Although month is a relatively arbitrary concept to phytoplankton, it was a useful measure of season for interpretation of the assemblages. Most of the taxa were significantly positively correlated with Axis 1 and negatively correlated with Axis 2 illustrating the vast increase in abundances and diversity in summer and autumn (Appendix 8). A few taxa such as centric diatoms, *Monoraphidium convolutes*, unknown elongate chlorophytes, and unknown spherical chlorophytes were negatively correlated with Axis 1 (left side of graph) and were more abundant in late winter and spring (Appendix 8).

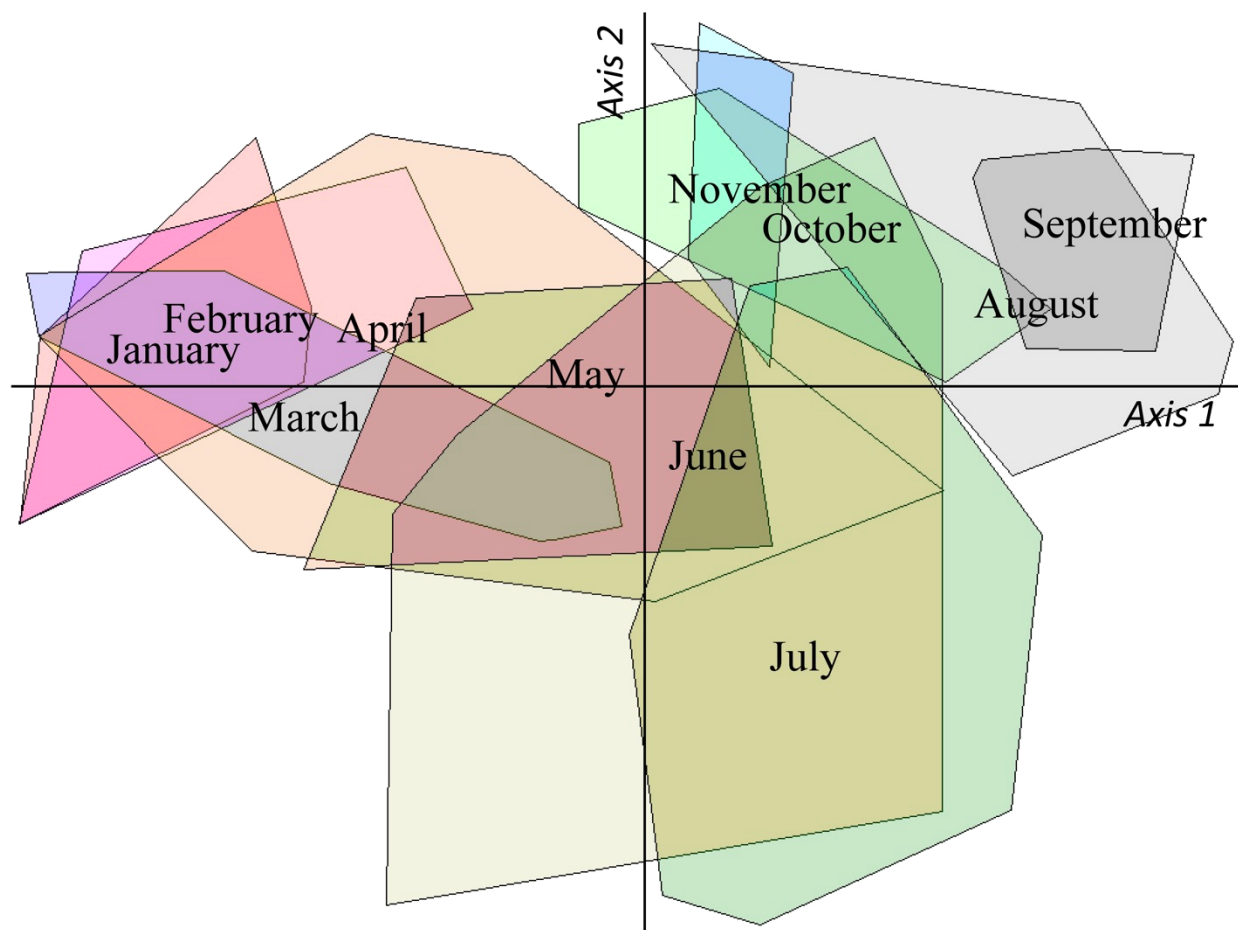


Figure 1. Phytoplankton assemblages in Utah Lake 2017. NMS Axis 1 and Axis 2 by months. Month centroids shown.

Results presented in Figure 1 were very similar to 2016 results shown in Figure 2 from Richards and Miller (2018). This highlights our understanding that phytoplankton assemblages in Utah Lake undergo a somewhat predictable season shift. Further analyses will allow us to determine if any taxa were lost, decreased, or increased in abundance seasonally over the years.

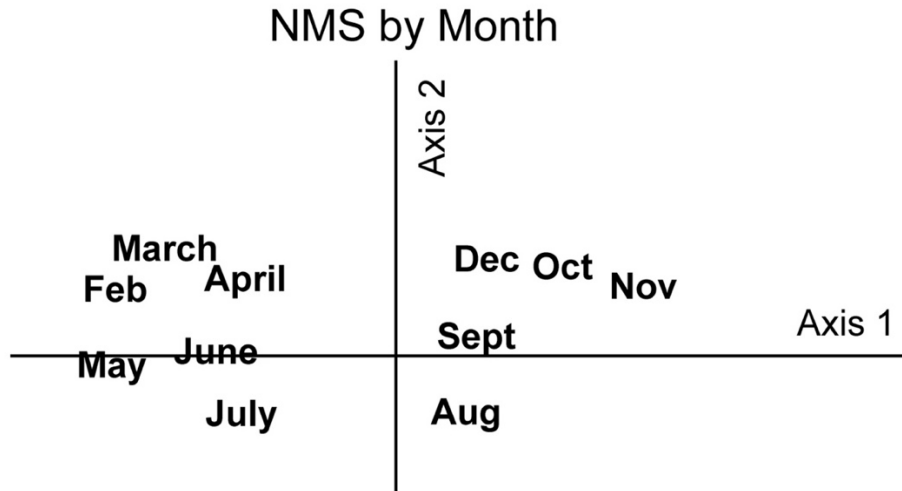


Figure 2. Phytoplankton assemblages in Utah Lake 2016. NMS Axis 1 and Axis 2 by months. Month centroids shown. Figure taken from Richards and Miller (2017).

MRPP

Multiple response permutation procedure showed that overall, phytoplankton assemblages significantly differed between months ($A = 0.37$; $p \ll 0.001$) and most did so between each month except for: February vs March; April vs May; August vs. September; and October vs. November assemblages (

Appendix 11).

NMS Phytoplankton by Algal Divisions

It is often easier to interpret phytoplankton assemblages by alga divisions: Bacillariophyta (diatoms), Chlorophyta (green algae), Euglenophyta (Euglena related species), and Cyanophyta (blue-green algae) etc. We developed the best fit NMS model based on algal divisions. This model had a final stress = 12.43; final instability $\ll 0.0001$; iterations = 81; Axis 1 $R^2 = 0.47$; Axis 2 $R^2 = 0.09$. It was not quite as good as the taxa-based model (Figure 3) but it was done so without any deletions or transformations. This algal division based model is shown in Figure 3.

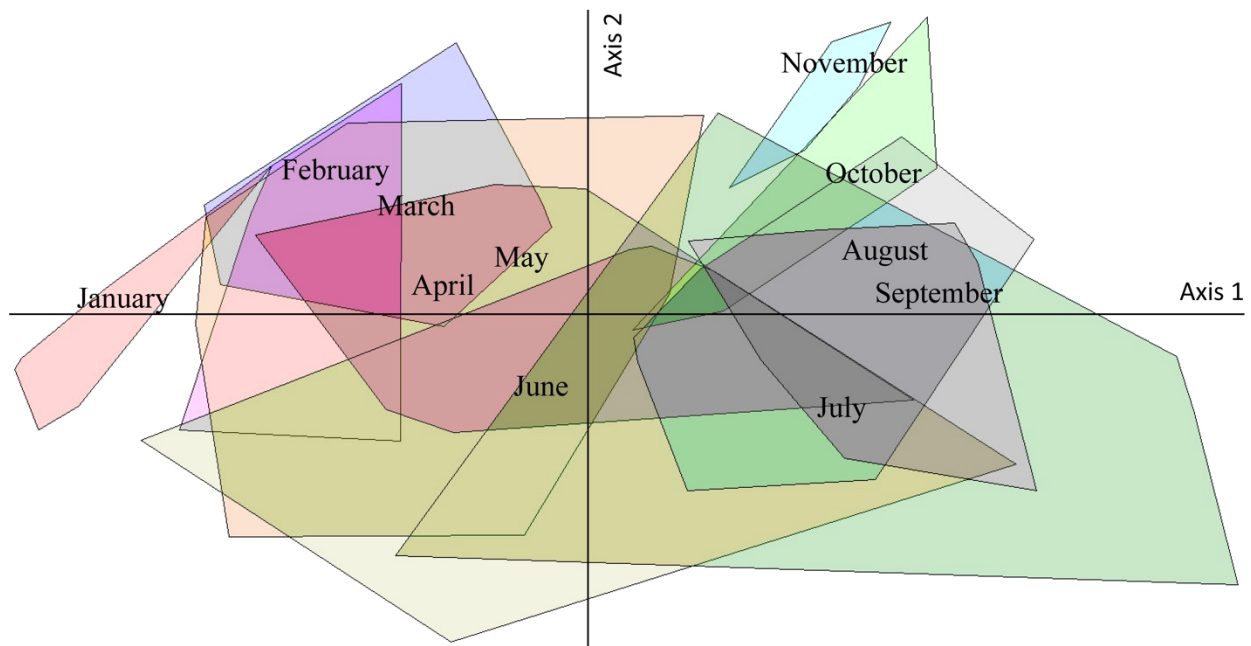


Figure 3. NMS ordination of *algal divisions* in Utah Lake 2017 with shaded convex hulls and centroids showing months.

MRPP: Algal Division

Multiple Response Permutation Procedure for algal division-based results ($A = 0.20$; $p \ll 0.001$) were almost exactly similar to those for taxa-based analyses with all significantly different by months except for February vs March; April vs May; August vs. September; and October vs. November assemblages.

Algal Divisions by Month

Figure 4 shows the changes in algal divisions by month. There was a sharp increase in cyanophytes and chlorophytes starting in July.

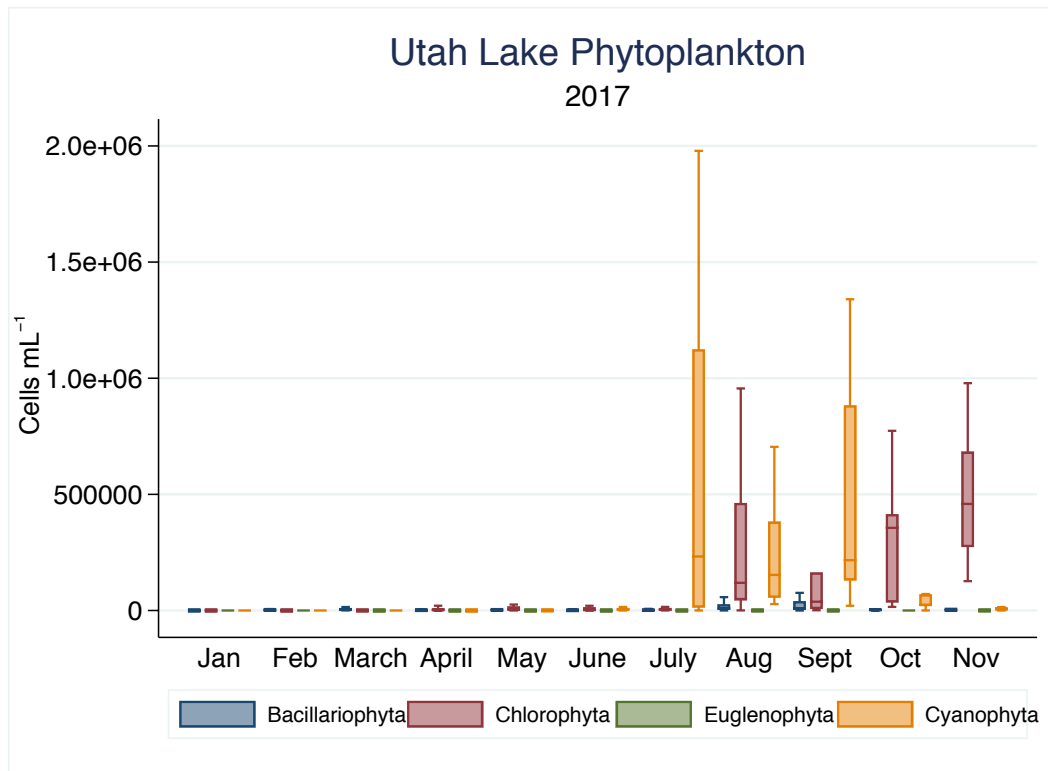
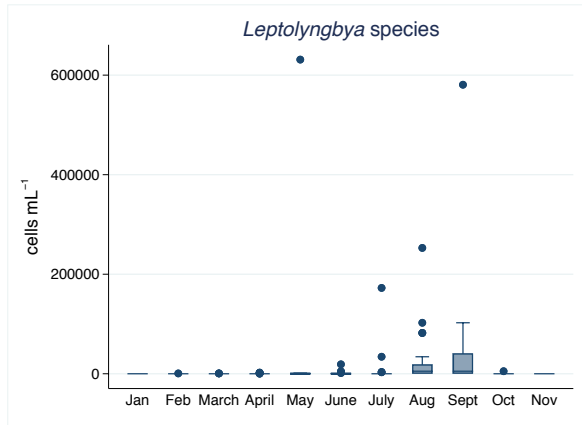
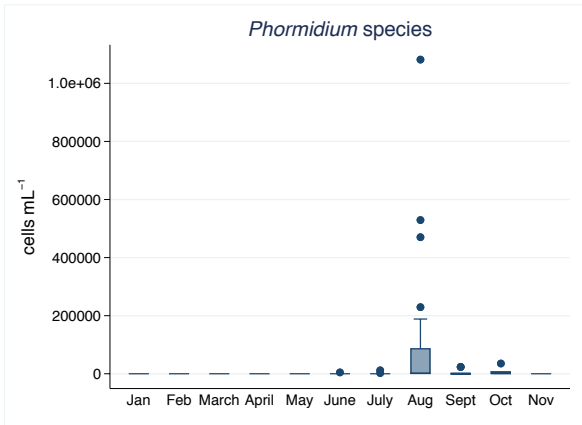
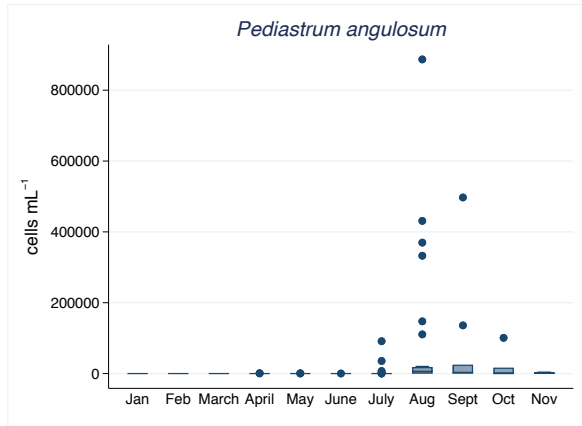
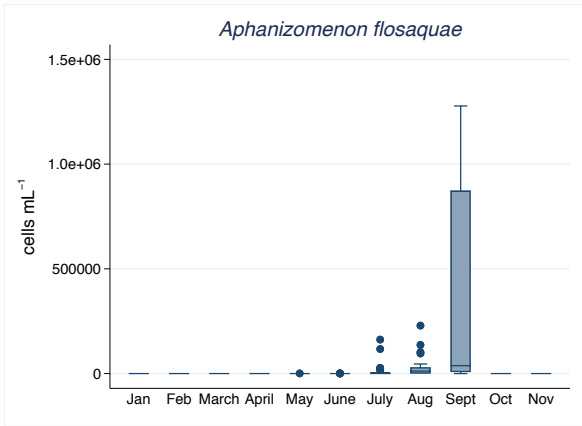
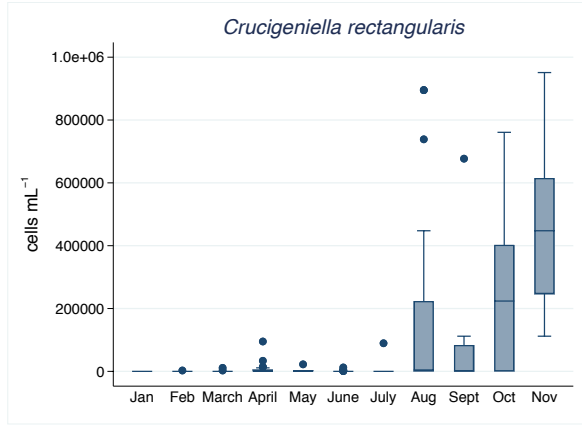
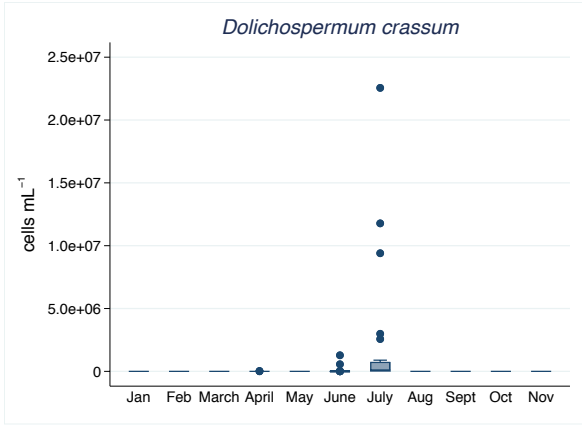


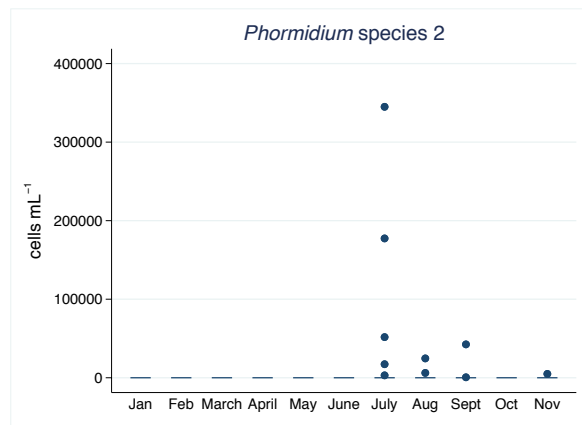
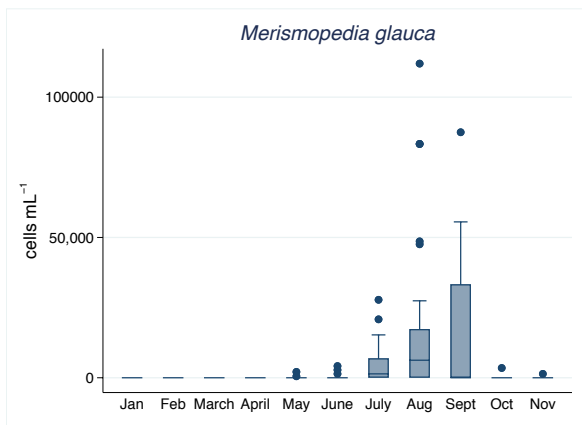
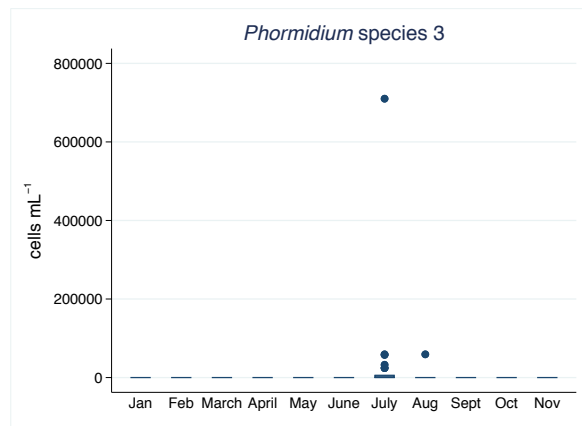
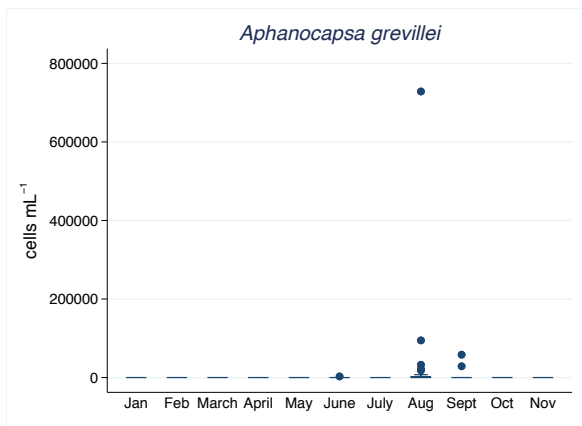
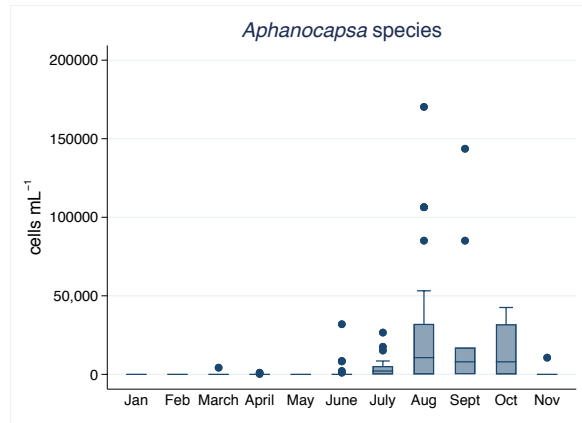
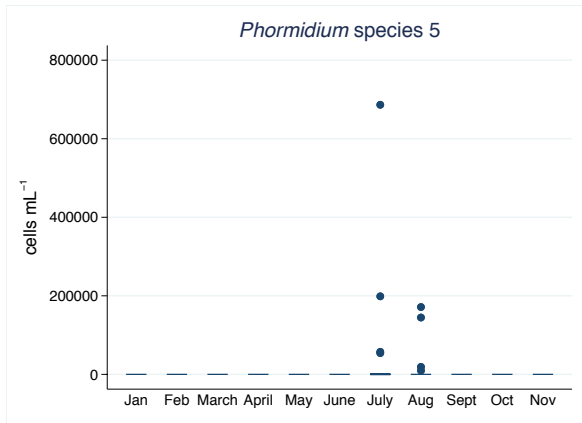
Figure 4. Box plots of algal divisions by month in Utah Lake 2017.

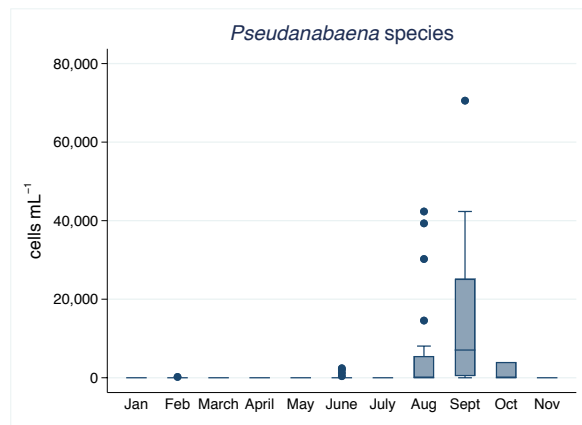
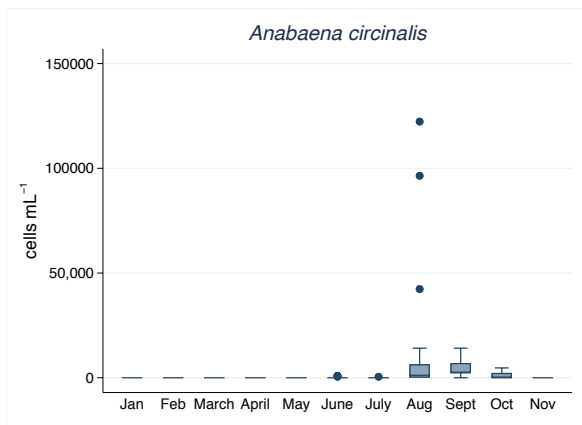
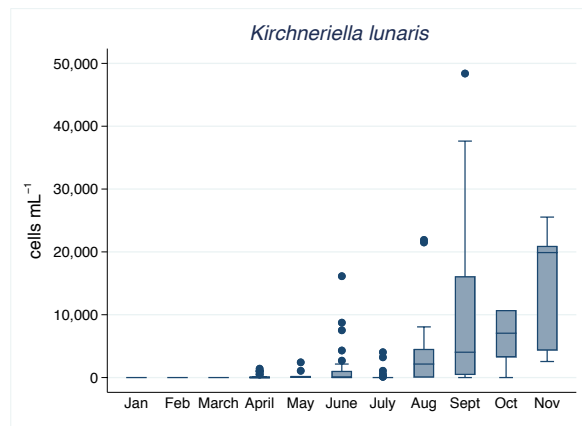
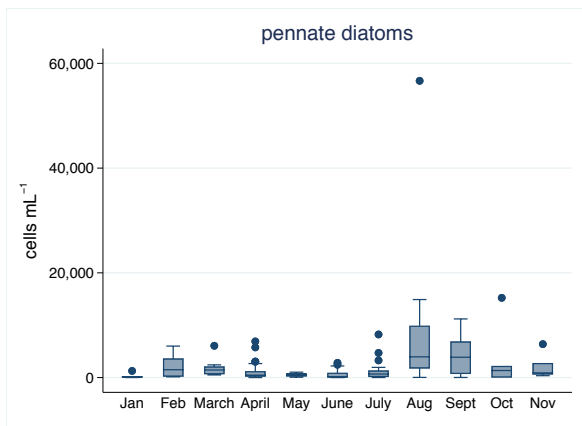
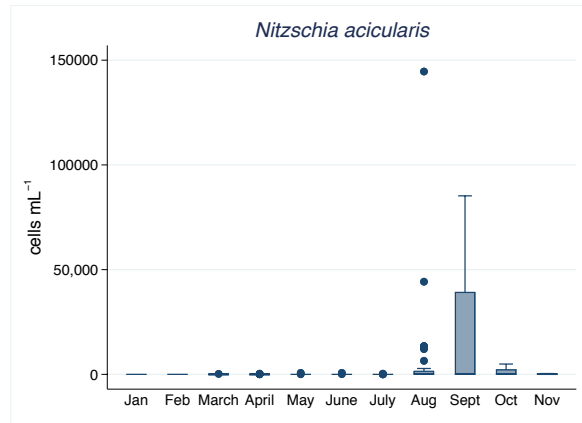
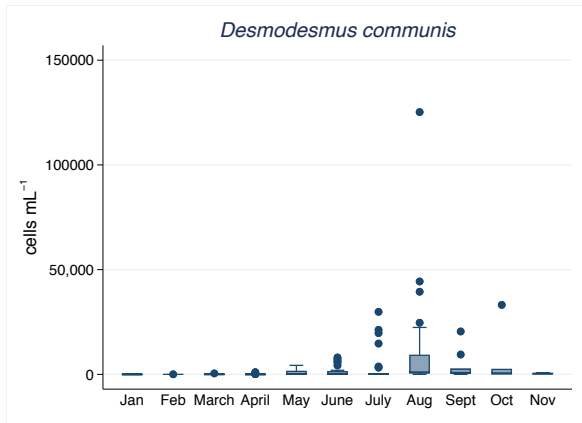
Phytoplankton Taxa Abundance, Richness, and Diversity 2017

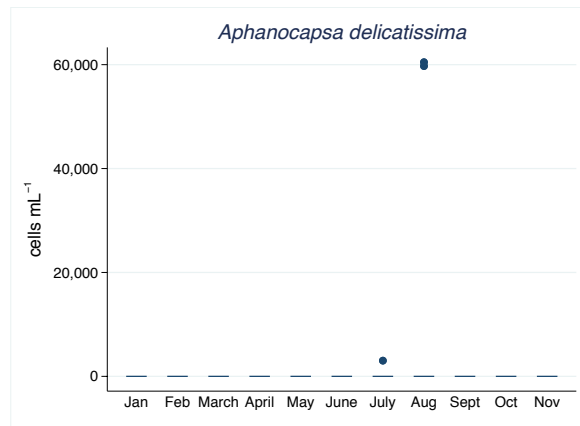
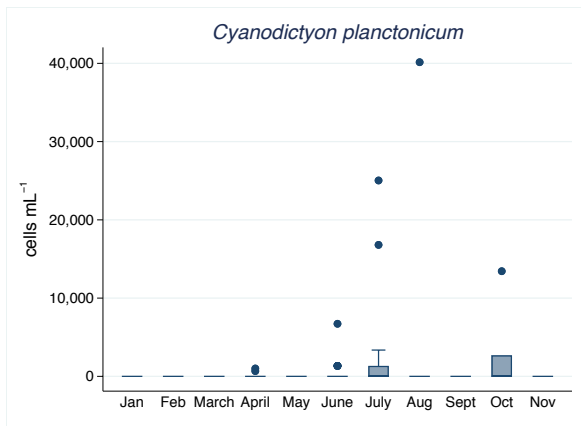
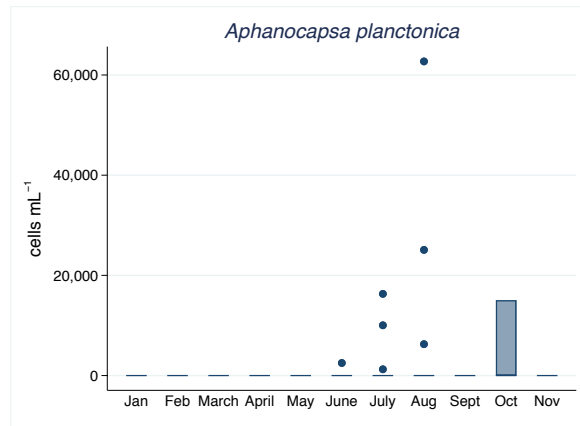
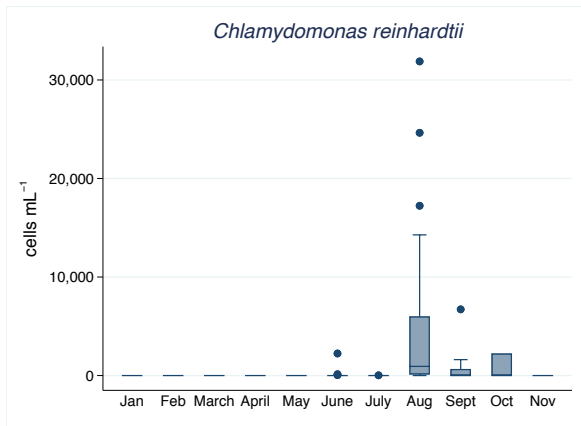
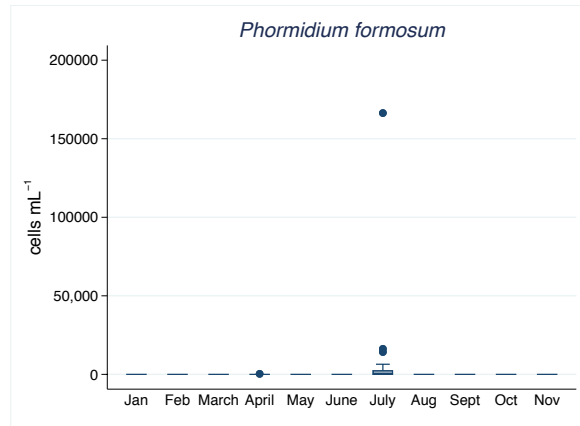
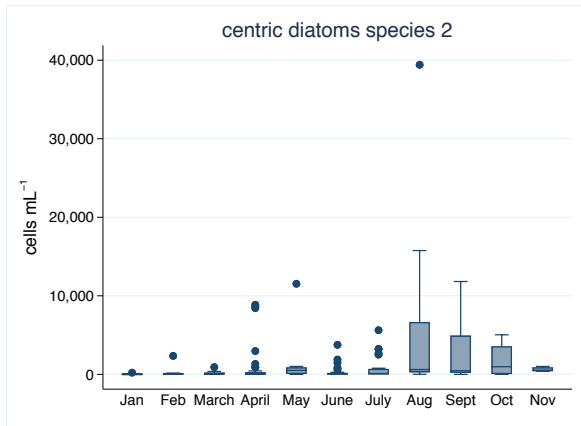
We observed 171 phytoplankton taxa in Utah Lake 2017 (Appendix 1). Estimated total taxa richness was between 202 and 219 based on several estimators including; First order jackknife, second-order jackknife, Chao2 classic, and Chao2 bias corrected methods (McCune and Grace 2011).

Box plots of monthly densities (cells mL⁻¹) of the twenty-six most abundant taxa in Utah Lake 2017 are in the following figure, Figure 5. The box plots include; median, 25th, 75th percentiles and lower and upper adjacent values, and outside values. The adjacent values are defined as the lowest and highest observations that are still inside the region defined by the following limits: Lower Limit: $Q1 - 1.5 \times \text{Interquartile range}$. Upper Limit: $Q3 + 1.5 \times \text{Interquartile range}$.









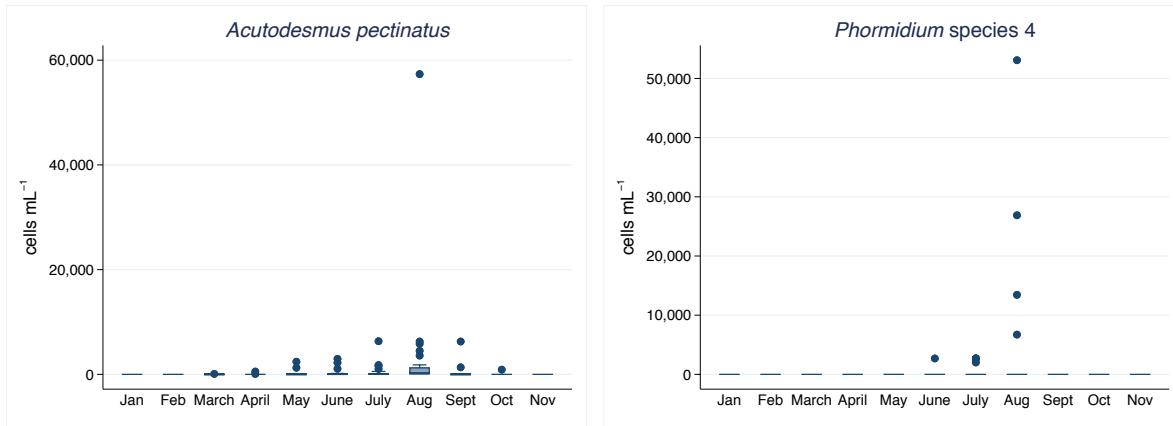


Figure 5. Twenty-six most abundant phytoplankton taxa in Utah Lake 2017.

Phytoplankton taxa richness was significantly lower in winter increase throughout the growing season and was significantly greatest in August, then declined (Figure 6). The effective number of taxa (ENT) showed a similar trend but significantly declined in July when chlorophyte and cyanophyte blooms began (Figure 6). The largest gaps between taxa richness and ENT were in summer and the smallest gaps in winter, when there were fewer taxa but more evenly distributed (balanced) in abundances.

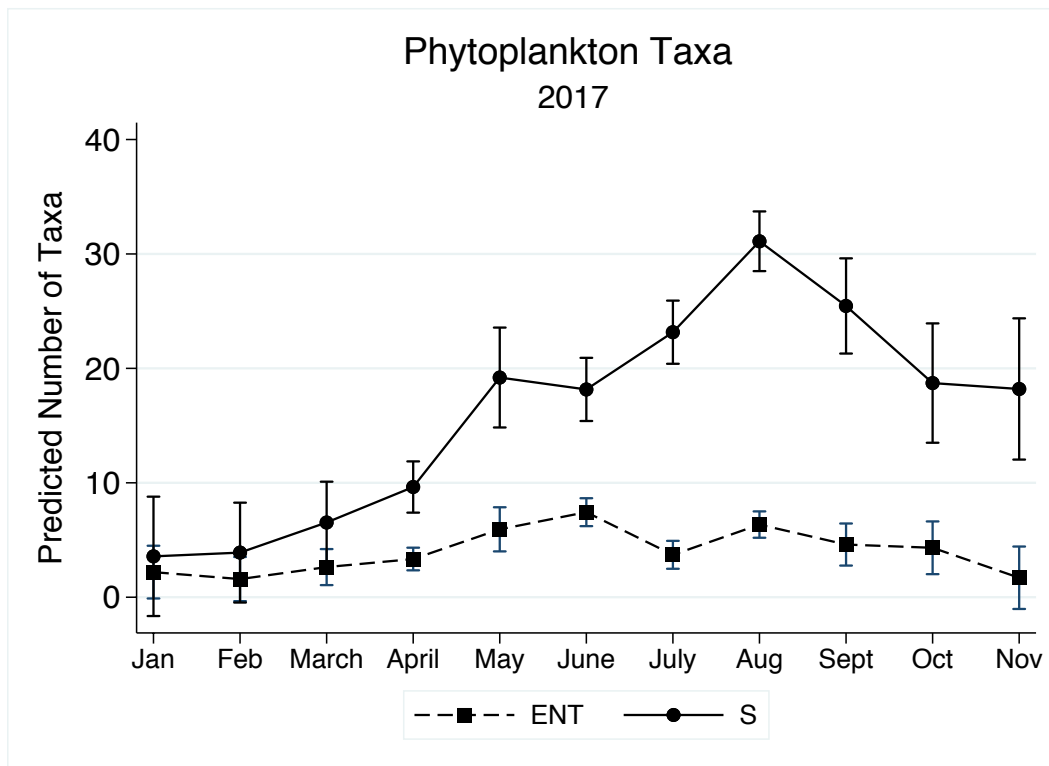


Figure 6. Seasonal variation in phytoplankton taxa richness (S) and effective number of taxa (ENT) in Utah Lake 2017. Mean and 95% CIs.

The lowest diversity tended to be in February and November with a dip in July, when cyanophyte blooms dominated. However, the highest diversity occurred in June when environmental conditions were ideal (temperature, sunlight, etc.) and interspecific competition effects had not yet caused declines in diversity. The sharp decline in diversity in July likely was due to interspecific competition and the increase in August was likely due to intraspecific competition within the dominant taxa causing a decrease in their dominance and allowing other taxa to participate in primary production in the lake.

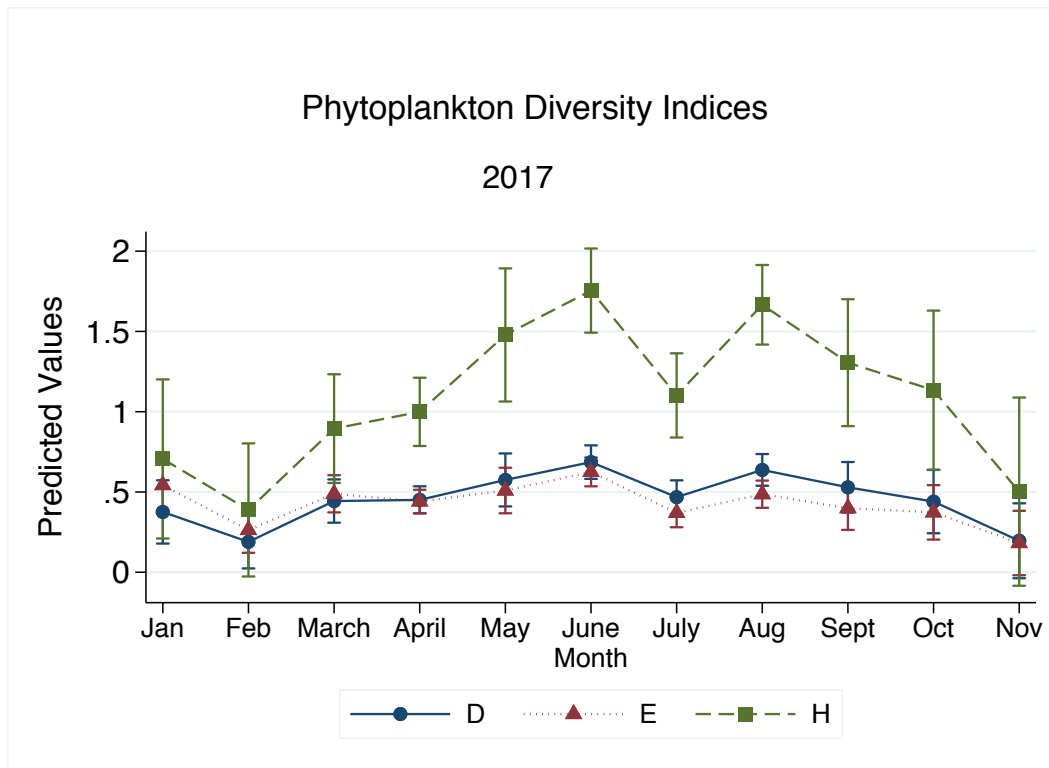


Figure 7. Seasonal variation in phytoplankton evenness (E), Shannon diversity (H), and Simpson diversity (D) in Utah Lake 2017.

Phytoplankton Indicator Species Analysis in Utah Lake 2017

As demonstrated by NMS and MRPP, phytoplankton taxa seasonally varied in abundances. Many taxa therefore, were found to be significant indicators of each month using indicator species analysis (Table 1). Some taxa were significant indicators for spring and autumn months (e.g. *Fragilaria virescens*, *Monoraphidium convolutus*, *Kirchneriella* species, etc.), however the majority of indicators occurred in summer months, including several cyanophytes that can cause cyanoHABs (Table 1).

Table 1. List of phytoplankton taxa that we consider to be significant monthly indicators of assemblages in Utah Lake 2017.

March	<i>Fragilaria virescens</i>	August	<i>Chlamydomonas globosa</i>
May	<i>Monoraphidium convolutus</i>		<i>Chlamydomonas reinhardtii</i>
June	<i>Schroederia robusta</i>		<i>Gymnodinium</i> species
			<i>Cryptomonas</i> species

July	<i>Dolichospermum crassum</i>		<i>Phormidium</i> species
	<i>Phormidium formosum</i>		<i>Anabaena circinalis</i>
	<i>Phormidium</i> species 3		<i>Merismopedia glauca</i>
	<i>Crucigenia rectangularis</i>		<i>Chroococcus limeticus</i>
	<i>Dolichospermum</i> species		<i>Monoraphidium arcuatum</i>
	<i>Nodularia spumigena</i> ¹		<i>Pediastrum angulosum</i>
	<i>Phormidium</i> species 5		<i>Chroomonas</i> species 2
	Unknown cryptomonad		<i>Desmodesmus communis</i>
September	<i>Aphanizomenon flosaquae</i>		<i>Chlamydomonas</i> species 2
	<i>Pseudanabaena</i> species		<i>Lepocinclus</i> species
	<i>Desmodesmus bicellularis</i>		<i>Aphanocapsa grevillei</i>
	<i>Tetraëdron</i> species		<i>Chlorogonium minimum</i>
	<i>Aphanocapsa</i> species		<i>Crucigenia</i> species
	<i>Microcystis aeruginosa</i>		<i>Closteriopsis longissima</i>
	<i>Komma</i> species 2	November	<i>Kirchneriella</i> species
	<i>Tetraëdron caudatum</i>		<i>Crucigeniella rectangularis</i>
	<i>Ceratium hirundinella</i>		Unknown spherical chlorophyte 2
	<i>Kirchneriella lunaris</i>		
		<i>Spirulina</i> species	
		<i>Oocystis gigas</i>	
		Unknown filamentous cyanophyte	

¹ *Nodularia spumigena* was found in a single sample from Lindon Marina sample in July 2017. It had low cell abundance = 918 cells mL⁻¹. This species has not been recorded in Utah Lake (2) but does occur at very high densities in Great Salt Lake. Further investigation is needed to ensure that this was not a false positive. If it truly was found in Lindon Marina, *N. spumigena* may have been transported to Lindon Marina from Great Salt Lake, may not be able to survive low salinities, or may be expanding its range into Utah Lake.

2018 Phytoplankton

We observed 119 phytoplankton taxa (γ diversity) in Utah Lake in 2018 and estimated there were between 137 and 155 taxa based on four species- area- curve estimators (first-order jackknife, second-order jackknife, and Chao classic and Chao bias corrected estimators (Chao 1987; Colwell and Coddington 1994; Palmer 1990; Palmer 1991; Heltshe and Forrester 1983; Burnham and Overton 1979; McCune and Mefford 2011). Mean β -diversity = 21 taxa and mean effective number of taxa (β -diversity) was 5.68 (Figure 8 and Figure 9). Mean evenness = 0.53 and mean Shannon diversity (H) = 1.52 (Figure 10 and Figure 11). ENT was substantially higher at Utah Lake State Park (ULSP) marina in July than anywhere else. Evenness and Shannon diversity were also greater in ULSP. This may have been due to the marina recently being dredged.

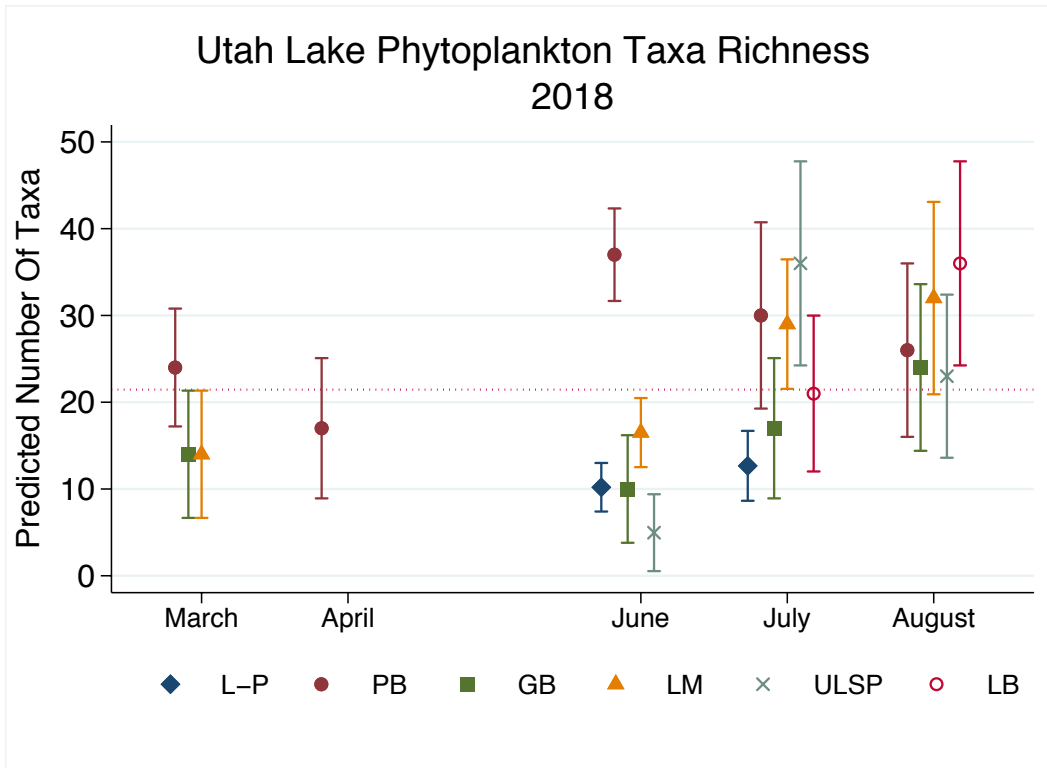


Figure 8. Predicted mean and 95% CIs of number of phytoplankton taxa (β -diversity) by month and location in Utah Lake in 2018. Red dotted reference line is grand mean. Predicted values were derived from best fit regression models.

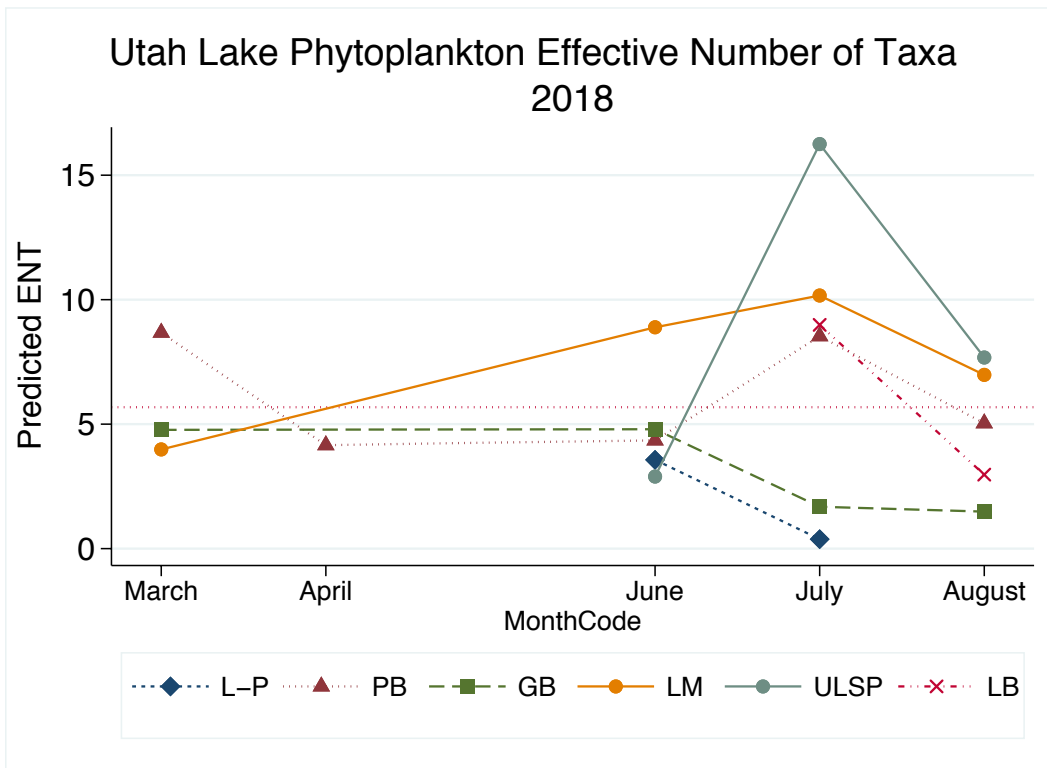


Figure 9. Predicted mean and 95% CIs of effective number of phytoplankton taxa (β -diversity) by month and location in Utah Lake in 2018. Red dotted reference line is grand mean. Predicted values were derived from best fit regression models.

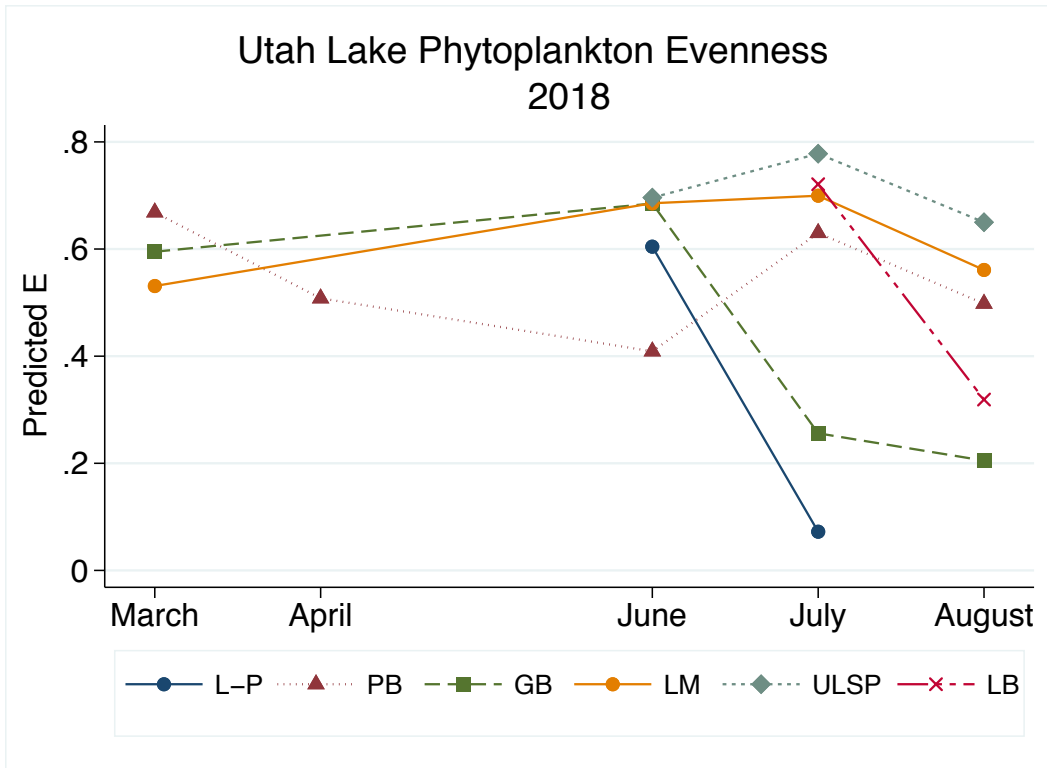


Figure 10. Predicted mean and 95% CIs of phytoplankton taxa evenness (β -diversity) by month and location in Utah Lake in 2018. Predicted values were derived from best fit regression models.

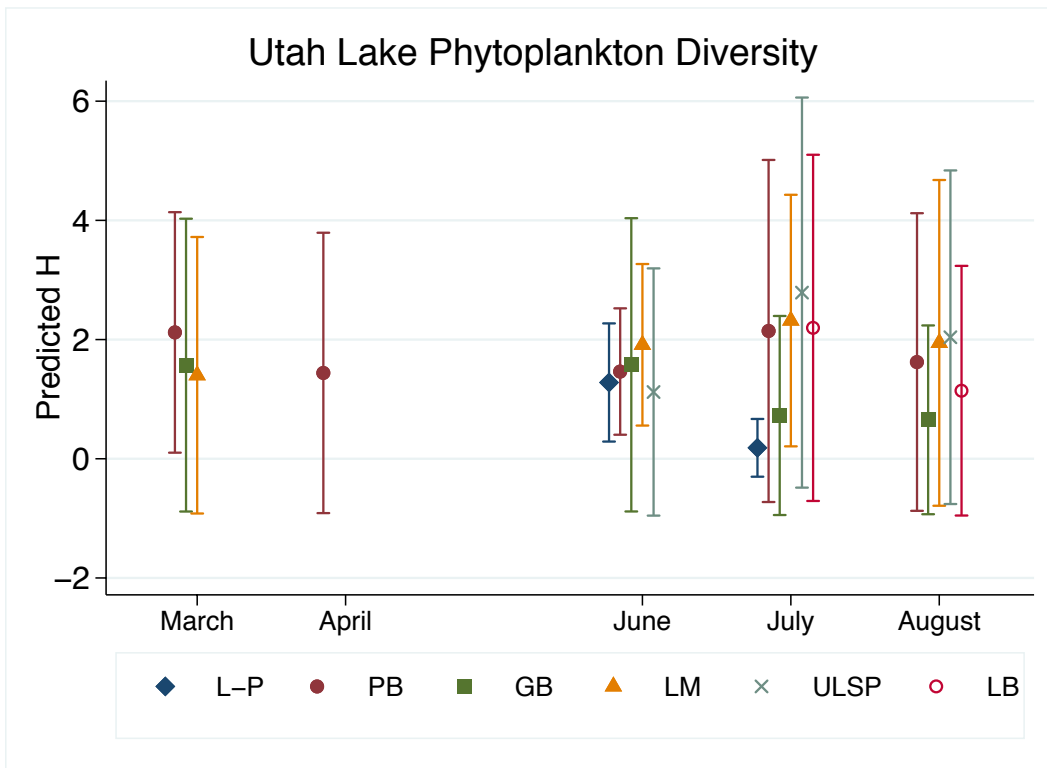


Figure 11. Predicted mean and 95% CIs of phytoplankton taxa diversity (β -diversity) by month and location in Utah Lake in 2018. Predicted values were derived from best fit regression models.

NMS results

The best fit NMS model used Beals smoothing with taxa that occurred in < 10% of the samples dropped from analysis resulting in 36 samples and 60 taxa. Final stress = 10.69; final instability < 0.001; iterations = 49 and post hoc R^2 Axis 1 = 0.73, Axis 2 = 0.20. Figure 12 shows phytoplankton relationships by month and Figure 13 relationships by site.

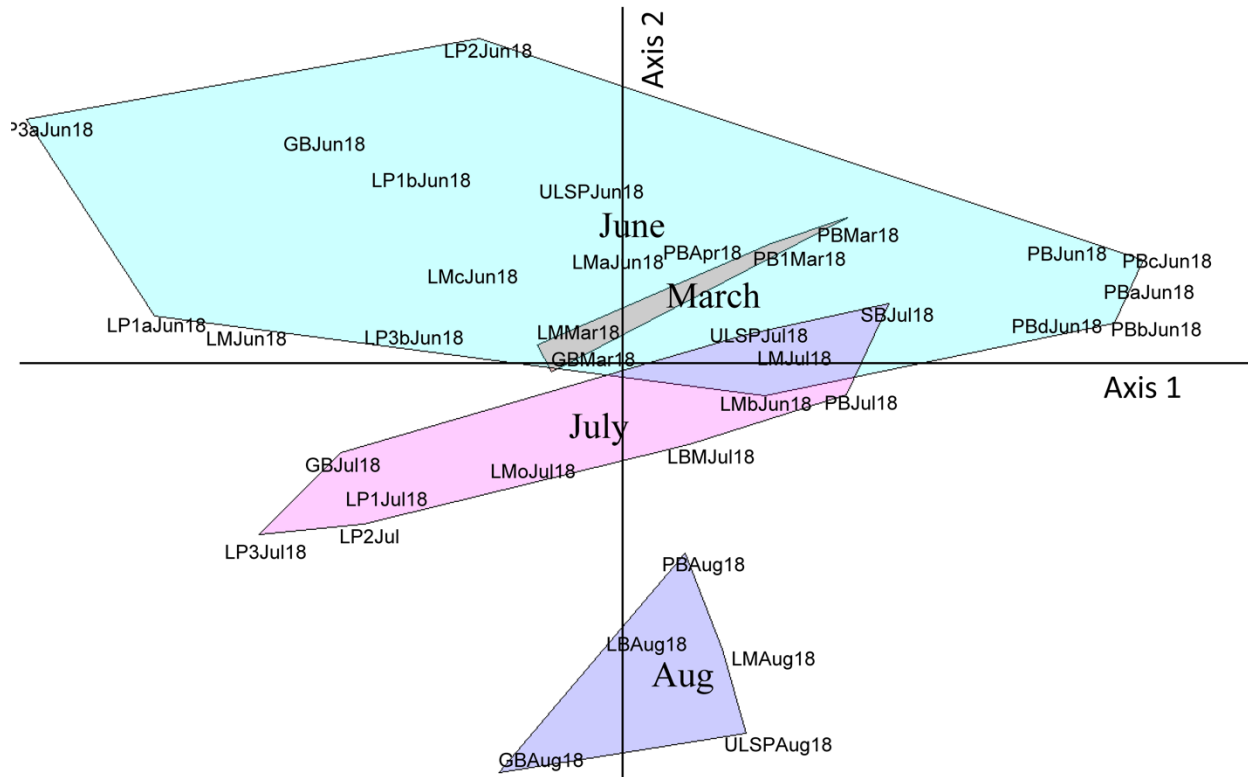


Figure 12. NMS ordination Axis 1 and Axis 2 of Utah Lake phytoplankton assemblages in 2018 in relation to month. Site-month codes are in Appendix 2

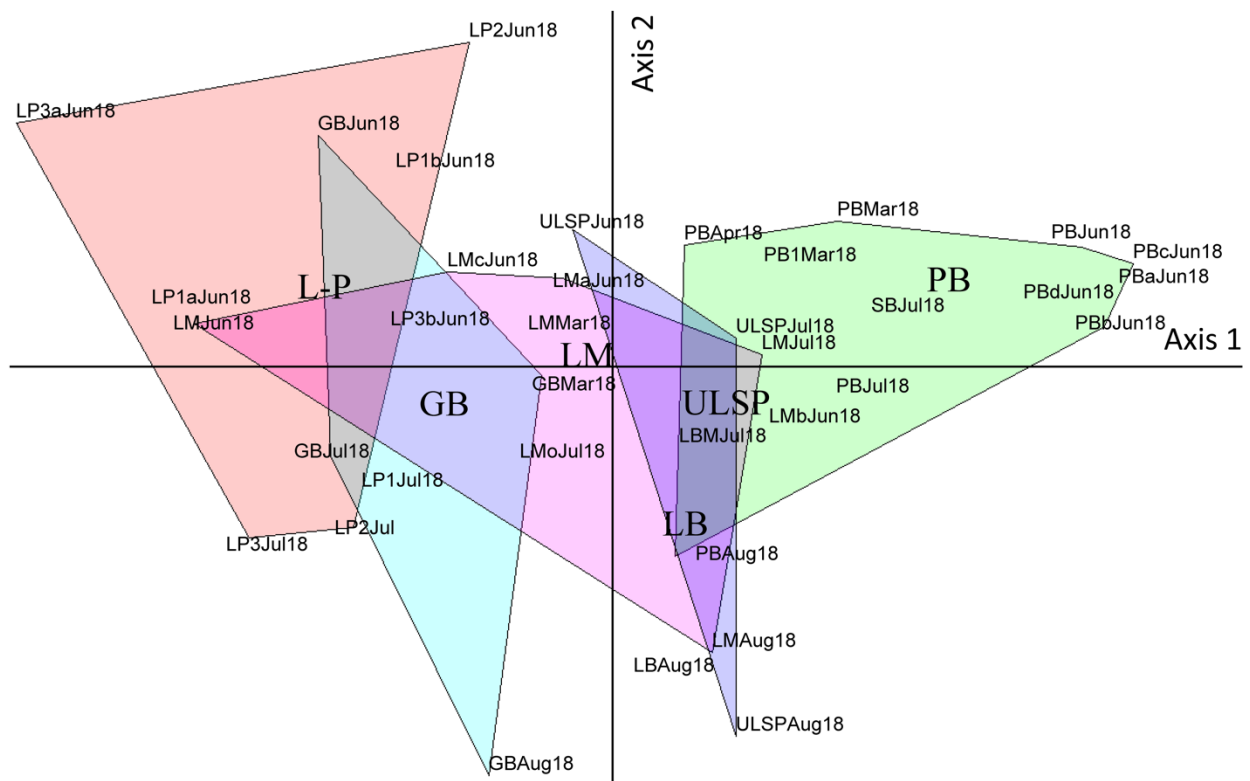


Figure 13. NMS ordination Axis 1 and Axis 2 of Utah Lake phytoplankton assemblages in 2018 in relation to site. Site-month codes are in Appendix 2

Multiple response permutation procedure (MRPP) results showed that phytoplankton assemblages in Utah Lake 2018 significantly differed by month ($A = 0.15$; $p \ll 0.001$) (Appendix 25) and by site ($A = 0.22$; $p \ll 0.001$) (Appendix 26). March vs. June and March vs. July were the only months that did not significantly differ and most assemblages differed by location (Appendix 26).

Phytoplankton Functional Traits

Although all biological interactions occur at the species level, to better understand biodiversity-ecosystem functioning relationships; knowledge and analysis of species functional traits are required (Hillebrand & Matthiessen, 2009; Naeem & Li, 1997; Ptacnik et al., 2008b; Striebel, Behl & Stibor, 2009; Abonyi et al. 2017; Reynolds et al. 2002; Reynolds 1984, 1997). We are in the process of compiling functional traits of all phytoplankton taxa found in Utah Lake and will then analyze phytoplankton assemblages using several methods including those used in this chapter as well as formal functional diversity analysis and fourth corner analysis (McCune and Mefford 2018). Appendix 19, Appendix 20, Appendix 21, and Appendix 22 contain our functional traits database, to date.

Discussion

Utah Lake phytoplankton analyses provided in this progress report continue to be refined and combined with other ecosystem and environmental data collected by us and others including; zooplankton, phytoplankton-zooplankton interactions, benthic invertebrate, and nutrient data to more completely understand the intricate interactions of Utah Lake's food web particularly as they relate to cyanohABs. These results will be included as separate chapters in our progress reports.

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Appendices

Appendix 1. Utah Lake Phytoplankton 2017 taxa list and codes from Rushforth Labs

Taxon	Code
<i>Actinastrum gracillimum</i> Smith	ACGR
<i>Actinastrum hantzschii</i> Lagerheim	ACHA
<i>Actinastrum</i> species	ACSP
<i>Acutodesmus acuminatus</i> (Lagerheim) Tsarenko	ACAC
<i>Acutodesmus pectinatus</i> (Meyen) Tsarenko	ACPE
<i>Anabaena circinalis</i> (= <i>Dolichospermum circinalis</i> (Nygaard) Wacklin, L.Hoffmann & Komárek)	ANCI
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs	ANFA
<i>Ankistrodesmus fusiformis</i>	ANFU
<i>Ankyra judayi</i> (= <i>Schroederia judayi</i> (Smith) Fott)	ANJU
<i>Ankyra lanceolata</i> (= <i>Lanceola spatulifera</i> (Korshikov) Hindák)	ANLA
<i>Aphanizomenon flosaquae</i> Ralfs ex Bornet & Flahault	APFL
<i>Aphanocapsa delicatissima</i> West & West	APDE
<i>Aphanocapsa grevillei</i> (Berkeley) Rabenhorst	APGR
<i>Aphanocapsa planctonica</i> (G.M.Smith) Komárek & Anagnostidis	APPL
<i>Aphanocapsa</i> species	APSP
<i>Aphanothece</i> species	APTSP
<i>Asterionella formosa</i> Hassall	ASFO
<i>Aulacoseira</i> species 1	AUSP
<i>Botryococcus braunii</i> Kützing	BOBR
<i>Botryococcus sudeticus</i> (= <i>Botryosphaerella sudetica</i> (Lemmermann) Silva)	BOSU
<i>Calothrix</i> species	CASP
centric diatoms species	CEDI
centric diatoms species 2	CEDI2
<i>Ceratium hirundinella</i> (Müller) Dujardin	CEHI
<i>Chlamydomonas globosa</i> Snow	CHGL
<i>Chlamydomonas reinhardtii</i> Dangeard	CHRE
<i>Chlamydomonas</i> species	CHSP
<i>Chlamydomonas</i> species 2	CHS2
<i>Chlorococcum</i> species	CHLS
<i>Chlorogonium minimum</i> Playfair	CHLM
<i>Chlorogonium</i> species	CHGS
<i>Chroococcus dispersus</i> (Keissler) Lemmermann	CHDI

<i>Chroococcus limeticus</i> (= <i>Limnococcus limneticus</i> (Lemmermann) Komárková, Jezberová, Komárek & Zapomelová)	CHRL
<i>Chroococcus minor</i> (Kützing) Nägeli	CHMI
<i>Chroococcus</i> species	CHRS
<i>Chroomonas</i> species	CHRO
<i>Chroomonas</i> species 2	CHR2
<i>Closteriopsis longissima</i> (Lemmermann) Lemmermann	CLLO
<i>Closteriopsis longissima</i> var. <i>tropica</i> West & West	CLLT
<i>Closteriopsis</i> species	CLOS
<i>Coelastrum</i> species	COES
<i>Coelosphaerium</i> species	COEL
<i>Coenococcus planktonicus</i> Korshikov	COPL
<i>Cosmarium</i> species	COSP
<i>Cosmarium</i> species 2	COSP2
<i>Cosmarium</i> species 3	COS3
<i>Crucigenia fenestrata</i> (Schmidle) Schmidle	CRFE
<i>Crucigenia quadrata</i> Morren	CRQU
<i>Crucigenia rectangularis</i> (= <i>Willea rectangularis</i> (Braun) John, Wynne & Tsarenko)	CRRE
<i>Crucigenia</i> species	CRSP
<i>Crucigenia</i> species 2	CRS2
<i>Crucigeniella rectangularis</i>	CRRT
<i>Crucigeniella</i> species	CRUS
<i>Cryptomonas</i> species	CRYP
<i>Cryptomonas</i> species 2	CRYP2
<i>Cryptomonas</i> species 3	CYS3
<i>Cryptomonas</i> species 4	CRYS4
<i>Cyanodictyon planctonicum</i> Mayer	CYPL
<i>Cylindrospermopsis catemaco</i> Komárková-Legnerová & Tavera	CYCA
<i>Desmidium</i> species	DESP
<i>Desmodesmus bicellularis</i> (R. Chodat) An, Friedl & Hegewald	DEBI
<i>Desmodesmus communis</i> (Hegewald) Hegewald	DECO
<i>Desmodesmus magnus</i> (Meyen) Tsarenko	DEMA
<i>Desmodesmus microspina</i> (Chodat) Tsarenko	DEMI
<i>Desmodesmus opoliensis</i> (Richter) Hegewald	DEOP
<i>Desmodesmus protuberans</i> (Fritsch & Rich) Hegewald	DEPO
<i>Desmodesmus</i> species	DSSP
<i>Didymogenes anomala</i> (Smith) Hindák	DIAN
<i>Didymogenes palatina</i> Schmidle	DIPA
<i>Didymogenes</i> species	DIDS

<i>Dinobryon divergens</i> Imhof	DIDI
<i>Dolichospermum crassa</i>	DOCR
<i>Dolichospermum crassum</i>	DOCM
<i>Dolichospermum crassum</i> (Lemmermann) Wacklin, Hoffmann & Komárek	DOCR
<i>Dolichospermum flosaquae</i>	DOFL
<i>Dolichospermum planktonicum</i> (Burn.) Wacklin et al.	DOPL
<i>Dolichospermum</i> species	DOSP
<i>Euglena</i> species	EUSP
<i>Euglena</i> species 2	EUS2
<i>Fragilaria crotonensis</i> Kitton	FRCR
<i>Fragilaria virescens</i> (= <i>Fragilariforma virescens</i> (Ralfs) Williams & Round)	FRVI
<i>Glenodinium</i> species	GLEN
<i>Gloeocapsa</i> species	GLEO
<i>Gymnodinium</i> species	GYSP
<i>Kirchneriella contorta</i> (= <i>Raphidocelis danubiana</i> (Hindák) Marvan, Komárek & Comas)	KICO
<i>Kirchneriella lunaris</i> (Kirchner) Möbius (= <i>Kirchneriella lunata</i>)	KILU
<i>Kirchneriella</i> species	KISP
<i>Komma</i> species	KOSP
<i>Komma</i> species 2	KOS2
<i>Lepocinclus</i> species	LESP
<i>Leptolyngbya</i> species	LEPS
<i>Melosira distans</i> (= <i>Aulacoseira distans</i> (Ehrenberg) Simonsen)	MEDI
<i>Melosira granulata</i> (= <i>Aulacoseira granulata</i> (Ehrenberg) Simonsen)	MEGR
<i>Melosira granulata</i> var. <i>angustissima</i> (= <i>Aulacoseira granulata</i> var. <i>angustissima</i> (Müller) Simonsen)	MEGA
<i>Melosira varians</i> Agardh	MEVA
<i>Merismopedia glauca</i> (Ehrenberg) Kützing	MEGL
<i>Merismopedia</i> species	MESP
<i>Microcystis aeruginosa</i> (Kützing) Kützing	MIAE
<i>Microcystis</i> species	MICR
<i>Monoraphidium arcuatum</i> (= <i>Ankistrodesmus arcuatus</i> Korshikov}	MOAR
<i>Monoraphidium contortum</i> (Thuret) Komárková-Legnerová	MOCO
<i>Monoraphidium convolutus</i>	MOCN
<i>Monoraphidium dybowskii</i> (Woloszynska) Hindák & Komárková-Legnerová	MODY
<i>Monoraphidium komarkovae</i> Nygaard	MOKO
<i>Monoraphidium minutum</i> (Nägeli) Komárková-Legnerová	MOMI
<i>Monoraphidium</i> species	MRSP
<i>Mougeotia</i> species	MOSP
<i>Nitzschia acicularis</i> (Kützing) Smith	NIAC

<i>Nodularia spumigena</i> Mertens ex Bornet & Flahault	NODS
<i>Oocystis borgei</i> Snow	OOBO
<i>Oocystis ellipticus</i> West	OOEL
<i>Oocystis gigas</i> (<i>Eremosphaera gigas</i> (Archer) Fott & Kalina)	OOGI
<i>Oocystis natans</i> (Lemmermann) Lemmermann	OONA
<i>Oocystis parva</i> West & West	OOPA
<i>Oocystis species</i>	OOSP
<i>Oocystis species 2</i>	OOS2
<i>Oocystis species 3</i>	OOSP3
<i>Pandorina morum</i> (Müller) Bory	PAMO
<i>Pediastrum angulosum</i> Ehrenberg ex Meneghini	PEAN
<i>Pediastrum boryanum</i> (= <i>Pseudopediastrum boryanum</i> (Turpin) Hegewald)	PEBO
<i>Pediastrum duplex</i>	PEDU
<i>Pediastrum duplex</i> var. <i>clathratum</i>	PEDC
<i>Pediastrum species</i>	PESP
<i>Pediastrum tetras</i> (= <i>Stauridium tetras</i> (Ehrenberg) Hegewald)	PETE
pennate diatoms	PEDI
<i>Peridinium species 2</i>	PES2
<i>Phacus species</i>	PHSP
<i>Phormidium formosum</i> (= <i>Kamptonema formosum</i> (Bory ex Gomont) Strunecký, Komárek & Smarda)	PHFO
<i>Phormidium species</i>	PHOS
<i>Phormidium species 2</i>	PHSP2
<i>Phormidium species 3</i>	PHSP3
<i>Phormidium species 4</i>	PHS4
<i>Phormidium species 5</i>	PHSP5
<i>Planktolyngbya species</i>	PLSP
<i>Planktosphaeria gelatinosa</i> Smith	PLGE
<i>Pseudanabaena species</i>	PSSP
<i>Quadrigula chodatii</i> (Tanner-Füllemann) Smith	QUCH
<i>Quadrigula lacustris</i> (= <i>Gregiochloris lacustris</i> (Chodat) Marvan, Komárek & Comas)	QULA
<i>Quadrigula species</i>	QUSP
<i>Scenedesmus arcuatus</i> (Lemmermann) Lemmermann	SCAR
<i>Scenedesmus ellipticus</i> Corda	SCEL
<i>Scenedesmus obtusus</i> Meyen	SCOB
<i>Scenedesmus species</i>	SCSP
<i>Schroederia robusta</i> (= <i>Pseudoschroederia robusta</i> (Korshikov) Hegewald & Schnepf)	SCRO
<i>Schroederia setigera</i> (Schröder) Lemmermann	SCSE
<i>Sphaerocystis schroeteri</i> Chodat	SPSC

Spirogyra species	SPIS
Spirulina species	SPSP
Staurastrum species 3	STS3
Stephanodiscus niagarae Ehrenberg	STNI
Tetraëdron caudatum (Corda) Hansgirg	TECA
Tetraëdron minimum (Braun) Hansgirg	TEMI
Tetraëdron species	TESP
Trachelomonas species	TRSP
Ulothrix species	ULOS
Unknown colonial chlorophyte	UNCC
Unknown colonial cyanophyte	UNCY
Unknown colonial cyanophyte species 2	UNCY 2
Unknown cryptomonad	UNCR
Unknown cryptomonad 2	UNC2
Unknown cryptomonad 3	UNC3
unknown elongate chlorophyte	UNEC
unknown filamentous chlorophyta	UNFC
Unknown filamentous cyanophyte	UNFY
unknown filamentous cyanophyte 2	UNFC2
Unknown filamentous cyanophyte 3	UNFC3
Unknown filamentous cyanophyte 4	UNFC4
Unknown spherical chlorophyte	UNSC
Unknown spherical chlorophyte 2	UNSch 2
Unknown spherical chlorophyte 3	UNS3
Unknown spherical chrysophyte	UNCH Y
Unknown spherical cyanophyte 2	USC2
Unknown spherical chlorophyte 2	UNSC2

Appendix 2. Rushforth Phycology lab code, location description, location code, sample date, and location-date code for phytoplankton 2017. Latitude and longitude coordinates can be found in Richards and Miller 2017.

RP Lab ID	Location	Location Code	Date	Location-Date Code
SR170001	Utah Lake State Park	SP	1/20/17	ULSPJan17
SR170002	Utah Lake Lincoln Beach	LB	1/20/17	LBJan17
SR170003	Utah Lake Provo Bay	PB	1/30/17	PBJan17
SR170004	Utah Lake State Park	SP	1/30/17	ULSPJan17
SR170005	Utah Lake Lindon Marina	LM	1/30/17	LMJan17

SR170006	Utah Lake Goose Point North	GB-GP	1/31/17	GBGPJan17
SR170007	Utah Lake Sandy Beach	SB	1/31/17	SBJan17
SR170008	Utah Lake Lincoln Beach	LB	2/12/17	LBFeb17
SR170009	Utah Lake Lindon Marina	LM	2/12/17	LMFeb17
SR170010	Utah Lake Provo Airport South	PA	2/12/17	PAFeb17
SR170011	Utah Lake Goshen Bay	GB	2/12/17	GBFeb17
SR170012	Utah Lake Lindon Marina South	LM-S	2/17/17	LMSFeb17
SR170013	Utah Lake Provo Airport	PA	2/17/17	PAFeb17
SR170014	Utah Lake Spanish Fork River	SF	2/17/17	SFFeb17
SR170015	Utah Lake Sandy Beach	SB	2/17/17	SBFeb17
SR170016	Utah Lake Lincoln Beach	LB	2/17/17	LBFeb17
SR170017	Utah Lake Goshen Bay North	GB-N	2/17/17	GBNFeb17
SR170023	Utah Lake Lindon Marina Inside	LM-in	3/14/17	LMiMar17
SR170024	Utah Lake Lindon Marina South	LM-S	3/14/17	LMSMar17
SR170025	Utah Lake Utah Lake State Park	SP	3/14/17	ULSPMar17
SR170026	Utah Lake Provo Bay	PB	3/14/17	PBMar17
SR170027	Utah Lake Sandy Beach	SB	3/14/17	SBMar17
SR170028	Utah Lake Lincoln Beach	LB	3/14/17	LBMar17
SR170029	Utah Lake Goshen Bay	GB	3/14/17	GBMar17
SR170030	Utah Lake Lindon Marina	LM	3/21/17	LMMar17
SR170031	Utah Lake ; Utah Lake State Park	SP	3/21/17	ULSPMar17
SR170032	Utah Lake Provo Bay 1	PB- 1	3/22/17	PB1Mar17
SR170033	Utah Lake Provo Bay 2	PB- 2	3/22/17	PB2Mar17
SR170034	Utah Lake Provo Bay 3	PB- 3	3/22/17	PB3Mar17
SR170035	Utah Lake Sandy Beach	SB1	3/21/17	SB1Mar17
SR170036	Utah Lake Lincoln Beach	LB	3/21/17	LBMar17
SR170037	Utah Lake Goshen Bay	GB	3/21/17	GBMar17
SR170044	Utah Lake Lindon Marina	LM	4/4/17	LMApr17
SR170045	Utah Lake State Park	SP	4/4/17	ULSPAApr17
SR170046	Utah Lake Lincoln Beach	LB	4/4/17	LBApr17
SR170047	Utah Lake Goshen Bay	GB	4/4/17	GBApr17
SR170048	Utah Lake Provo Bay #1	PB -1	4/5/17	PB1Apr17
SR170049	Utah Lake Provo Bay #2	PB-2	4/5/17	PB2Apr17
SR170050	Utah Lake Provo Bay #3	PB -3	4/5/17	PB3Apr17
SR170051	Utah Lake Lindon Marina	LM	4/13/17	LMApr17
SR170052	Utah Lake; Utah Lake State Park	SP	4/13/17	ULSPAApr17
SR170053	Utah Lake Lincoln Beach Marina	LB- M	4/13/17	LBMApr17
SR170054	Utah Lake Lincoln Beach Marina	LB- M	4/13/17	LBMApr17
SR170055	Utah Lake Goshen Bay	GB	4/13/17	GBApr17

SR170056	Utah Lake Lincoln Beach Study Site 1	LB-1	4/14/17	LB1Apr17
SR170057	Utah Lake Lincoln Beach Study Site 2	LB-2	4/14/17	LB2Apr17
SR170058	Utah Lake Lincoln Beach Study Site 3	LB-3	4/14/17	LB3Apr17
SR170059	Utah Lake Lincoln Beach Study Site 4	LB-4	4/14/17	LB4Apr17
SR170060	Utah Lake Lincoln Beach Study Site 5	LB-5	4/14/17	LB5Apr17
SR170061	Utah Lake Lincoln Beach Study Site Site 6	LB-6	4/14/17	LB6Apr17
SR170062	Utah Lake Lincoln Beach Study Site 7	LB-7	4/14/17	LB7Apr17
SR170145	Provo Bay Site 1	PB-1	4/15/17	PB1Apr17
SR170146	Provo Bay Site 2	PB-2	4/15/17	PB2Apr17
SR170147	Provo Bay Site 3	PB-3	4/15/17	PB3Apr17
SR170148	Utah Lake Lindon Marina 1	LM -1	4/21/17	LM1Apr17
SR170149	Utah Lake Lindon Marina 2	LM -2	4/21/17	LM2Apr17
SR170150	Utah Lake Lindon Marina 3	LM- 3	4/2/17	LM3Apr17
SR170151	Utah Lake at State Park Marina	SP	4/21/17	ULSPApr17
SR170152	Utah Lake at Utah Lake State Park 1	SP-1	4/21/17	ULSP1Apr17
SR170153	Utah Lake at State Park 2	SP-2	4/21/17	ULSP2Apr17
SR170154	Utah Lake at State Park #3	SP-3	4/21/17	ULSP3Apr17
SR170155	Utah Lake Pelican Marina 1	PM-1	4/21/17	PM1Apr17
SR170156	Utah Lake Pelican Marina 2	PM-2	4/21/17	PM2Apr17
SR170157	Utah Lake Pelican Marina 3	PM-3	4/21/17	PM3Apr17
SR170171	Utah Lake Goshen Bay 1	GB- 1	4/22/17	GB1Apr17
SR170172	Utah Lake Goshen Bay 2	GB- 2	4/22/17	GB2Apr17
SR170173	Utah Lake Goshen Bay 3	GB- 3	4/22/17	GB3Apr17
SR170174	Utah Lake Provo Bay 1	PB -1	4/23/17	PB1Apr17
SR170175	Utah Lake Provo Bay 2	PB- 2	4/23/17	PB2Apr17
SR170176	Utah Lake Provo Bay 3	PB- 3	4/23/17	PB3Apr17
SR170177	Utah Lake at State Park	SP	5/13/17	ULSPMay17
SR170178	Utah Lake @ Lincoln Beach	LB	5/13/17	LBMay17
SR170179	Utah Lake Goshen Bay	GB	5/13/17	GBMay17
SR170180	Utah Lake Lindon Marina	LM	5/15/17	LMMay17
SR170181	Utah Lake @ State Park	SP	5/15/17	ULSPMay17
SR170182	Utah Lake Provo Bay	PB	5/15/17	PBMay17
SR170391	Utah Lake Lindon Marina	LM	6/15/17	LMJun17
SR170392	Utah Lake 1/4 way between Lindon Harbor and Pelican Point	L-P 1/4	6/15/17	LP1Jun17
SR170393	1/2 way between Lindon Marina and Pelican Point	L-P 1/2	6/15/17	LP2Jun17
SR170394	Utah Lake 3/4 Distance between Lindon Marina and Pelican Point	L-P 3/4	6/15/17	LP3Jun17
SR170395	Utah Lake Pelican Marina Outlet	PM-out	6/15/17	PMoJun17
SR170397	Utah Lake Provo Bay Center	PB-C	6/19/17	PBCJun17

SR170398	Utah Lake Provo Bay Neck	PB-N	6/19/17	PBNJun17
SR170399	Utah Lake Provo Bay at Hobbie Creek	PB-HC	6/19/17	PBHCJun17
SR170400	Utah Lake Lincoln Beach #1	LB-1	6/19/17	LB1Jun17
SR170410	Utah Lake Lindon Marina	LM	6/28/17	LMJun17
SR170411	Utah Lake at State Park	SP	6/28/17	ULSPJun17
SR170412	Utah Lake Provo Bay	PB	6/28/17	PBJun17
SR170413	Utah Lake Lincoln Beach	LB	6/28/17	LBJun17
SR170414	Utah Lake Goshen Bay	GB	6/28/17	GBJun17
SR170422	Lindon Marina	LM	7/5/17	LMJul17
SR170423	Utah Lake State Park	SP	7/5/17	ULSPJul17
SR170424	Provo Bay	PB	7/5/17	PBJul17
SR170425	Provo Bay Center	PB-C	7/6/17	PBCJul17
SR170426	Lincoln Beach	LB	7/5/17	LBJul17
SR170538	Utah Lake State Park	SP	7/18/17	ULSPJul17
SR170539	Lindon Marina	LM	7/19/17	LMJul17
SR170540	1/4 way from Lindon Marina to Pelican Point	L-P 1/4	7/19/17	LP1Jul17
SR170541	1/2 way between Lindon Marina and Pelican Point	L-P 1/2	7/19/17	LP2Jul17
SR170542	3/4 Way from Lindon Marina to Pelican Point	L-P 3/4	7/19/17	LP3Jul17
SR170543	Pelican Marina	PM-out	7/19/17	PMoJul17
SR170544	Provo Bay Center	PB-C	7/21/17	PBCJul17
SR170545	Lincoln Beach Marina	LB-M	7/21/17	LBMJul17
SR170546	Goshen Bay	GB	7/21/17	GBJul17
SR170547	Lindon Bay Marina (labeled LBM)	LM	7/1/17	LMJul17
SR170548	Provo Bay Center	PB-C	7/1/17	PBCJul17
SR170549	Neck of Provo Bay	PB-N	7/1/17	PBNJul17
SR170550	Lindon Marina (inside)	LM-In	7/2/17	LMiJul17
SR170551	Lindon Marina Out	LM-out	7/2/17	LMoJul17
SR170552	1/4 Distance From Lindon Marina to Pelican Marina	L-P 1/4	7/2/17	LP1Jul17
SR170553	1/2 Distance from Lindon Marina to Pelican Marina	L-P 1/2	7/2/17	LP2Jul17
SR170554	3/4 Distance from Lindon Marina to Pelican Marina	L-P 3/4	7/2/17	LP3Jul17
SR170555	Pelican Marina	PM	7/2/17	PMJul17
SR170556	Goshen Bay	GB	7/2/17	GBJul17
SR170726	Lindon Marina	LM-1	8/17/17	LM1Aug17
SR170727	Lindon Marina (Sample 2)	LM-2	8/21/17	LM2Aug17
SR170728	Lindon Marina (Sample 3)	LM-3	8/23/17	LM3Aug17
SR170729	Lindon Marina Beach	LM-B	8/23/17	LMBAug17
SR170730	Lindon Marina, (Sample 4)	LM-4	8/24/17	LM4Aug17
SR170732	Utah Lake, Provo Bay Center	PB-C	8/15/17	PBCAug17
SR170733	Lincoln Marina	LM	8/15/17	LMAug17

SR170734	Goshen Bay	GB	8/18/17	GBAug17
SR170735	Provo Bay, Neck	PB-N	8/15/17	PBNAug17
SR170737	Lincoln Bay	Lbay	8/15/17	LbayAug17
SR170765	Lindon Marina	LM	8/16/17	LMAug17
SR170766	1/4 Distance from Lindon to Pelican Point	L-P 1/4	8/16/17	LP1Aug17
SR170767	Provo Bay Swee. (?)	PB-S	8/17/17	PBSAug17
SR170768	Lincoln Bay	LB	8/17/17	LBAug17
SR170769	Goshen Bay	GB	8/17/17	GBAug17
SR170770	UL State Park	SP	8/17/17	ULSPAUG17
SR170771	Utah Lake, Lindon Bay	Lbay	8/24/17	LbayAug17
SR170772	Utah Lake, Goshen Bay	GB	8/24/17	GBAug17
SR170773	Utah Lake, Provo Bay Sweed.	PB-S	8/24/17	PBSAug17
SR170774	Utah Lake, Lindon Marina	LM	8/29/17	LMAug17
SR170775	Utah Lake, Provo Bay Neck	PB-N	8/29/17	PBNAug17
SR170776	Utah Lake, Provo Bay Center	PB-C	8/29/17	PBCAug17
SR170777	Utah Lake, Provo Bay Center (Mystery Phyto)	PB-Cmystery	8/29/17	PBCmysteryAug17
SR170798	Goshen Bay	GB	8/31/17	GBAug17
SR170799	Lindon Marina Outlet	LM-out	8/31/17	LMoAug17
SR170800	Lincoln Beach	LB	8/31/17	LBAug17
SR170801	1/4 Distance from Lindon Harbor to Pelican Point	L-P 1/4	8/31/17	LP1Aug17
SR170809	State Park (ULSP)	SP	9/5/17	ULSPSep17
SR170810	Goshen Bay	GB	9/5/17	GBSep17
SR170822	Lindon Marina	LM	8/31/17	LMAug17
SR170823	Goshen Bay	GB	9/12/17	GBSep17
SR170824	Lincoln Beach	LB	9/12/17	LBSep17
SR170825	Provo Bay Swe.	PB-S	9/12/17	PBSSep17
SR170826	Provo Bay - Sweede.	PB-S	9/26/17	PBSSep17
SR170827	Provo Bay--Sweede (?)	PB-S	9/26/17	PBSSep17
SR170828	Goshen Bay	GB	9/26/17	GBSep17
SR170829	Lincoln Beach	LB	9/26/17	LBSep17
SR170885	Lindon Marina	LM	9/26/17	LMSep17
SR170886	1/4 Distance from Lincoln Marina to Pelican Point	L-P 1/4	9/26/17	LP1Sep17
SR170887	Goshen Bay	GB	10/5/17	GBOct17
SR170888	Provo Bay Center	PB-C	10/5/17	PBCOct17
SR170889	Lincoln Beach	LB	10/5/17	LBOct17
SR170990	Utah Lake, Provo Bay Sweede (?)	PB-S	6/7/17	PBSJun17
SR170992	Utah Lake, Goshen Bay	GB	6/3/17	GBJun17
SR170993	Utah Lake, Goshen Bay N.	GB-N	6/7/17	GBNJun17
SR170994	Utah Lake, Provo Bay 1	PB-1	5/28/17	PB1May17

SR170995	Utah Lake, Provo Bay Neck	PB-N	5/28/17	PBNMay17
SR170996	Utah Lake, Provo Bay Center	PB-C	5/28/17	PBCMay17
SR170997	Utah Lake, Provo Bay Center	PB-C	6/7/17	PBCJun17
SR170998	Utah Lake, Lindon Marina	LM	6/6/17	LMJun17
SR170999	Utah Lake, Lindon Marina	LM	6/7/17	LMJun17
SR171000	Utah Lake, Lindon Marina	LM	6/7/17	LMJun17
SR171001	Utah Lake, Lindon Marina	LM	6/15/17	LMJun17
SR171002	Lincoln Marina	LM	10/31/17	LMOct17
SR171003	Utah Lake, Lincoln Beach	LB	5/25/17	LBMay17
SR171004	Utah Lake, Lincoln Beach	LB	6/6/17	LBJun17
SR171005	Utah Lake, Lincoln Beach	LB	7/7/17	LBJul17
SR171006	Utah Lake, Lincoln Beach Marina	LB-M	6/14/17	LBMJun17
SR171014	Utah Lake, ULSP	SP	6/7/17	ULSPJun17
SR171015	1/2 Distnce Between Linden Marina and Peican Point	L-P 1/2	10/31/17	LP2Oct17
SR171016	3/4 to Pelican Point From Lindon Marina	L-P 3/4	10/31/17	LP3Oct17
SR171017	1/4 Distance from Lindon Marina to Pelican Point	L-P 1/4	10/31/17	LP1Oct17
SR171040	Provo Bay, Swede	PB-S	11/30/17	PBSNov17
SR171041	Lindon Marina	LM	11/30/17	LMNov17
SR171042	Utah Lake State Park	SP	11/30/17	ULSPNov17
SR171043	Lincoln Beach	LB	11/30/17	LBNov17
SR171044	Goshen Bay	GB	11/30/17	GBNov17

Appendix 3. Descriptive statistics and four diversity indices phytoplankton Utah Lake 2017 by month

January

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
ULSPJan1	7.64	96.76	1313.20	1268.40	2.00	0.22	0.15	0.07
LBJan17	2.36	19.27	406.00	218.40	5.00	0.69	1.11	0.61
PBJan17	1.29	14.41	221.20	187.60	4.00	0.40	0.55	0.27
ULSPJan1	0.72	5.73	123.20	70.00	6.00	0.71	1.28	0.62
LMJan17	0.42	3.67	72.80	42.00	3.00	0.85	0.93	0.56
GBGPJan1	0.44	4.39	75.60	56.00	3.00	0.68	0.75	0.42
SBJan17	0.39	4.91	67.20	64.40	2.00	0.25	0.17	0.08

February

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
LBFeb17	16.36	149.37	2814.00	1822.80	5.00	0.57	0.92	0.51

LMFeb17	14.78	179.71	2542.40	2352.00	4.00	0.22	0.30	0.14
PAFeb17	17.84	213.49	3068.80	2797.20	7.00	0.22	0.42	0.17
GBFeb17	35.52	458.19	6109.60	6008.80	2.00	0.12	0.08	0.03
LMSFeb17	22.25	277.98	3827.60	3642.80	3.00	0.19	0.21	0.09
PAFeb17	35.70	454.57	6140.40	5961.20	3.00	0.14	0.15	0.06
SFFeb17	12.67	164.82	2178.40	2161.60	2.00	0.07	0.05	0.02
SBFeb17	7.64	89.93	1313.20	1176.00	4.00	0.30	0.41	0.19
LBFeb17	2.30	18.55	394.80	201.60	6.00	0.66	1.19	0.62
GBNFeb17	6.19	78.58	1064.00	1030.40	3.00	0.14	0.15	0.06
Means	17.12	208.50	2945.00	2715.00	3.90	0.26	0.39	0.19

March

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D`
LMiMar17	117.18	1434.92	20154.40	18816.00	9.00	0.16	0.36	0.13
LMSMar17	87.13	1012.29	14985.60	13171.20	4.00	0.28	0.39	0.21
ULSPMar1	20.82	138.51	3581.20	1444.80	8.00	0.75	1.55	0.74
PBMar17	41.77	372.86	7184.80	4256.00	6.00	0.53	0.95	0.53
SBMar17	25.41	195.58	4370.80	1881.60	8.00	0.62	1.28	0.65
LBMar17	45.53	355.09	7831.60	3477.60	7.00	0.58	1.13	0.64
GBMar17	5.97	62.70	1027.60	817.60	8.00	0.41	0.85	0.36
LMMar17	7.23	49.18	1243.20	546.00	6.00	0.84	1.50	0.73
ULSPMar1	124.99	1055.53	21498.40	11188.80	11.00	0.45	1.09	0.58
PB1Mar17	113.97	971.16	19602.80	11188.80	8.00	0.53	1.11	0.57
PB2Mar17	15.17	162.57	2609.60	2119.60	6.00	0.42	0.75	0.33
PB3Mar17	15.30	162.88	2632.00	2116.80	5.00	0.45	0.72	0.34
SB1Mar17	3.73	46.39	641.20	607.60	2.00	0.30	0.21	0.10
LBMar17	4.23	42.24	728.00	548.80	7.00	0.49	0.96	0.42
GBMar17	11.10	119.56	1909.60	1534.40	3.00	0.52	0.57	0.32
Means	42.64	412.10	7333.00	4914.00	6.50	0.49	0.89	0.44

April

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D`
LMApr17	85.66	875.23	14733.60	11188.80	9.00	0.36	0.78	0.39
ULSPApr1	14.05	101.48	2416.40	1069.60	9.00	0.68	1.49	0.69
LBApr17	19.45	181.43	3346.00	2049.60	5.00	0.48	0.78	0.49
GBApr17	17.92	233.78	3082.80	3066.00	2.00	0.05	0.03	0.01
PB1Apr17	31.16	232.60	5359.20	2671.20	12.00	0.61	1.50	0.67
PB2Apr17	21.62	149.86	3718.40	1444.80	8.00	0.72	1.49	0.72
PB3Apr17	17.04	135.78	2931.60	1461.60	5.00	0.72	1.15	0.63
LMApr17	23.74	227.98	4082.40	2968.00	15.00	0.43	1.17	0.46

ULSPApr1	571.49	7251.67	98296.80	95104.80	7.00	0.09	0.18	0.06
LBMApr17	55.58	642.53	9559.20	8391.60	10.00	0.22	0.50	0.22
LBMApr17	9.21	80.52	1584.80	940.80	7.00	0.54	1.04	0.55
GBApr17	87.03	1067.46	14968.80	13986.00	10.00	0.13	0.30	0.12
LB1Apr17	21.08	138.55	3626.00	1411.20	9.00	0.72	1.58	0.74
LB2Apr17	15.56	116.79	2676.80	1075.20	8.00	0.61	1.28	0.67
LB3Apr17	5.44	44.44	935.20	470.40	8.00	0.55	1.15	0.61
LB4Apr17	5.24	61.15	901.60	800.80	6.00	0.29	0.51	0.21
LB5Apr17	3.79	47.01	652.40	616.00	4.00	0.18	0.25	0.11
LB6Apr17	5.78	46.18	994.00	574.00	9.00	0.65	1.43	0.63
LB7Apr17	3.00	30.55	515.20	394.80	7.00	0.44	0.86	0.39
PB1Apr17	195.74	1005.19	33667.20	8859.20	20.00	0.73	2.18	0.84
PB2Apr17	48.24	314.55	8296.40	3371.20	13.00	0.66	1.70	0.75
PB3Apr17	85.76	689.70	14750.40	8433.60	11.00	0.58	1.38	0.62
LM1Apr17	7.44	79.04	1279.60	1024.80	5.00	0.44	0.71	0.34
LM2Apr17	4.74	24.72	814.80	235.20	10.00	0.87	2.00	0.84
LM3Apr17	15.74	92.86	2707.60	882.00	10.00	0.76	1.74	0.79
ULSPApr1	91.99	1068.90	15822.80	13986.00	14.00	0.21	0.54	0.21
ULSP1Apr	196.99	2559.31	33882.80	33566.40	7.00	0.03	0.07	0.02
ULSP2Apr	4.25	48.70	730.80	635.60	7.00	0.27	0.52	0.23
ULSP3Apr	34.17	426.55	5877.20	5594.40	10.00	0.12	0.28	0.09
PM1Apr17	33.18	426.55	5706.40	5594.40	7.00	0.06	0.12	0.04
PM2Apr17	65.87	853.10	11328.80	11188.80	6.00	0.05	0.08	0.02
PM3Apr17	34.02	426.56	5852.00	5594.40	10.00	0.11	0.26	0.09
GB1Apr17	2.80	15.87	481.60	142.80	12.00	0.79	1.96	0.81
GB2Apr17	50.99	639.86	8769.60	8391.60	12.00	0.10	0.25	0.08
GB3Apr17	72.72	602.67	12507.60	5594.40	17.00	0.40	1.14	0.60
PB1Apr17	15.91	81.60	2735.60	663.60	13.00	0.81	2.06	0.84
PB2Apr17	29.43	168.85	5062.40	1512.00	12.00	0.75	1.85	0.80
PB3Apr17	423.79	2752.73	72892.40	27972.00	20.00	0.55	1.65	0.75
Means	63.88	630.10	10990.00	7709.00	9.60	0.44	1.00	0.45

May

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
ULSPMay1	138.83	1706.56	23878.40	22377.60	17.00	0.12	0.35	0.12
LBMay17	27.92	208.89	4802.00	2464.00	16.00	0.52	1.44	0.67
GBMay17	6.41	66.74	1103.20	862.40	10.00	0.36	0.82	0.37
LMMay17	95.30	906.10	16391.20	11530.40	21.00	0.35	1.05	0.47
ULSPMay1	30.61	225.11	5264.00	2797.20	23.00	0.57	1.77	0.68

PBMay17	3773.23	48127.98	648995.19	631276.81	25.00	0.06	0.20	0.05
PB1May17	17.91	87.92	3080.00	683.20	21.00	0.76	2.30	0.85
PBNMay17	136.87	562.87	23542.40	4480.00	24.00	0.81	2.57	0.90
PBCMay17	168.81	724.77	29036.00	6809.60	25.00	0.79	2.55	0.89
LBMay17	11.46	74.84	1971.20	873.60	10.00	0.75	1.73	0.75
Means	440.70	5269.00	75810.00	68420.00	19.00	2 0.508	1.48	0.58

June

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D`
LMJun17	52.40	256.14	9013.20	2150.40	27.00	0.71	2.34	0.86
LP1Jun17	14.80	120.79	2545.20	1478.40	9.00	0.59	1.29	0.61
LP2Jun17	11.01	114.46	1892.80	1478.40	9.00	0.36	0.78	0.37
LP3Jun17	11.43	102.55	1965.60	1293.60	10.00	0.49	1.12	0.53
PMoJun17	4.84	31.91	831.60	341.60	10.00	0.72	1.66	0.74
PBCJun17	3402.23	42971.81	585183.13	563640.00	21.00	0.08	0.24	0.07
PBNJun17	341.24	2630.24	58693.61	33868.80	23.00	0.57	1.80	0.65
PBHCJun1	52.00	413.28	8943.20	4782.40	9.00	0.57	1.25	0.63
LB1Jun17	33.99	339.32	5846.40	4250.40	8.00	0.37	0.77	0.42
LMJun17	10.06	51.87	1730.40	369.60	11.00	0.82	1.96	0.84
ULSPJun1	119.57	729.47	20566.00	8246.00	25.00	0.63	2.03	0.78
PBJun17	7598.86	97473.30	1307003.50	1278368.00	15.00	0.05	0.13	0.04
LBJun17	77.02	491.53	13246.80	5174.40	19.00	0.62	1.81	0.76
GBJun17	1.34	9.28	229.60	86.80	9.00	0.69	1.51	0.72
PBSJun17	163.44	685.19	28112.00	6451.20	29.00	0.78	2.64	0.89
GBJun17	3.71	24.17	638.40	268.80	8.00	0.80	1.66	0.75
GBNJun17	2.70	21.67	464.80	268.80	6.00	0.73	1.31	0.62
PBCJun17	356.25	1290.40	61275.20	8736.00	31.00	0.81	2.78	0.92
LMJun17	115.39	420.13	19846.40	2688.00	29.00	0.82	2.77	0.92
LMJun17	273.11	1075.20	46975.60	7526.40	28.00	0.80	2.66	0.90
LMJun17	638.04	3038.04	109743.20	31920.00	34.00	0.70	2.48	0.86
LMJun17	14.88	71.65	2559.20	582.40	17.00	0.78	2.22	0.86
LBJun17	42.07	284.07	7235.20	3584.00	21.00	0.66	2.01	0.73
LBMJun17	111.28	363.46	19140.80	2150.40	28.00	0.87	2.90	0.93
ULSPJun1	174.25	1135.30	29971.20	11379.20	18.00	0.60	1.74	0.75
Mean	545.00	6166.00	93750.00	79240.00	18.20	0.62	1.75	0.69

July

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D`
LMJul17	308.78	2231.46	53110.40	27972.00	33.00	0.52	1.81	0.69
ULSPJul1	3754.88	45033.23	645839.63	590209.19	23.00	0.14	0.45	0.16

PBJul17	132300.00	1720000.00	22760000.00	22560000.00	24.00	0.02	0.06	0.02
PBCJul17	69130.00	897900.00	11890000.00	11780000.00	28.00	0.02	0.08	0.02
LBJul17	342.28	2104.19	58872.80	22377.60	25.00	0.63	2.02	0.78
ULSPJul1	1788.91	14288.94	307691.97	162260.00	31.00	0.38	1.32	0.63
LMJul17	2960.48	34174.63	509202.44	447552.00	24.00	0.19	0.61	0.22
LP1Jul17	962.57	10357.24	165561.19	134265.59	11.00	0.28	0.66	0.33
LP2Jul17	1569.66	17166.48	269981.56	223776.00	16.00	0.25	0.68	0.30
LP3Jul17	1540.49	17156.08	264964.00	223776.00	19.00	0.23	0.66	0.28
PMoJul17	388.19	2819.08	66768.80	27776.00	13.00	0.52	1.32	0.69
PBCJul17	7907.71	64034.61	1360125.25	760838.38	22.00	0.44	1.34	0.62
LBMJul17	11560.00	88260.00	1989000.00	889500.00	27.00	0.39	1.28	0.66
GBJul17	18340.00	228000.00	3154000.00	2990000.00	23.00	0.09	0.29	0.10
LMJul17	401.26	4386.06	69017.20	57358.00	26.00	0.24	0.79	0.30
PBCJul17	17360.00	196800.00	2986000.00	2573000.00	39.00	0.17	0.62	0.25
PBNJul17	59830.00	718200.00	10290000.00	9399000.00	36.00	0.11	0.39	0.16
LMiJul17	1435.96	9708.21	246985.23	111888.00	39.00	0.50	1.83	0.73
LMoJul17	568.29	6826.73	97745.19	89510.40	20.00	0.16	0.48	0.16
LP1Jul17	24.13	127.87	4149.60	1064.00	22.00	0.68	2.10	0.83
LP2Jul17	80.00	590.33	13759.20	6652.80	15.00	0.55	1.48	0.68
LP3Jul17	18.75	123.38	3225.60	1428.00	17.00	0.64	1.80	0.74
PMJul17	13.02	91.69	2240.00	952.00	7.00	0.72	1.40	0.71
GBJul17	68.49	358.87	11779.60	3192.00	18.00	0.71	2.05	0.84
LBJul17	69.81	406.48	12006.40	4099.20	21.00	0.67	2.02	0.80
Means	13310.00	163200.00	2289000.00	2123000.00	23.20	0.37	1.10	0.47

August

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
LM1Aug17	3096.15	16667.80	532537.63	171360.00	42.00	0.60	2.22	0.83
LM2Aug17	1873.27	8757.81	322201.59	94640.00	37.00	0.70	2.54	0.87
LM3Aug17	794.21	4024.41	136603.59	42560.00	30.00	0.70	2.37	0.85
LMBAug17	5876.60	56628.20	1010774.75	728364.00	21.00	0.35	1.08	0.46
LM4Aug17	591.19	2274.28	101684.80	17231.20	29.00	0.79	2.65	0.91
PBCAug17	6887.35	33882.24	1184624.00	332640.00	43.00	0.63	2.37	0.85
LMAug17	3826.80	34406.15	658210.06	447552.00	34.00	0.42	1.48	0.53
GBAug17	1704.88	17616.36	293238.41	229370.41	21.00	0.31	0.94	0.38
PBNAug17	15790.00	85640.00	2716000.00	887000.00	43.00	0.58	2.19	0.82
LbayAug1	248.09	1198.65	42672.00	10248.00	24.00	0.71	2.24	0.86
LMAug17	2205.42	11675.40	379332.81	136640.00	33.00	0.70	2.44	0.83
LP1Aug17	1336.51	17450.91	229880.00	228872.00	8.00	0.02	0.04	0.01

PBSAug17	1852.77	11298.25	318676.41	110586.00	36.00	0.57	2.03	0.78
LBAug17	201.03	2249.56	34577.20	29377.60	27.00	0.21	0.69	0.27
GBAug17	730.02	6300.93	125563.20	78321.60	28.00	0.38	1.26	0.56
ULSPAug1	5071.73	56415.54	872337.19	738460.81	49.00	0.20	0.79	0.28
LbayAug1	2299.91	18986.23	395584.00	223776.00	15.00	0.45	1.21	0.60
GBAug17	8693.59	71420.58	1495297.88	895104.00	26.00	0.44	1.44	0.60
PBSAug17	5149.31	42097.75	885682.00	529200.00	32.00	0.44	1.51	0.61
LMAug17	1386.57	8895.45	238490.00	111888.00	37.00	0.60	2.15	0.76
PBNAug17	4488.95	36001.42	772100.00	431004.00	38.00	0.40	1.47	0.62
PBCAug17	12100.00	89240.00	2080000.00	1082000.00	49.00	0.42	1.64	0.68
PBCmyste	956.88	7371.43	164584.00	94080.00	27.00	0.53	1.74	0.65
GBAug17	2238.80	11662.74	385072.78	102480.00	32.00	0.62	2.15	0.84
LMoAug17	251.71	1640.31	43293.60	20496.00	22.00	0.66	2.04	0.75
LBAug17	1859.69	11716.09	319866.41	111888.00	28.00	0.55	1.83	0.76
LP1Aug17	895.24	7659.97	153980.41	89510.40	26.00	0.36	1.18	0.57
LMAug17	6335.07	68287.93	1089631.25	895104.00	34.00	0.27	0.96	0.32
Means	3526.00	26480.00	606500.00	316800.00	31.10	0.49	1.67	0.64

September

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
ULSPSep1	7328.35	53456.02	1260475.88	676922.38	34.00	0.54	1.89	0.69
GBSep17	1596.52	9679.69	274601.59	111888.00	28.00	0.59	1.97	0.78
GBSep17	1271.07	14904.54	218624.00	194712.00	12.00	0.18	0.44	0.20
LBSep17	1203.67	9486.54	207032.00	102480.00	17.00	0.48	1.37	0.64
PBSSep17	2039.51	12937.81	350795.19	136080.00	28.00	0.54	1.79	0.76
PBSep17	8706.13	58710.73	1497454.00	580720.00	39.00	0.50	1.83	0.73
PBSep17	572.11	3535.71	98403.20	39424.00	42.00	0.51	1.91	0.77
GBSep17	5140.38	66546.54	884144.69	872788.00	15.00	0.03	0.08	0.03
LBSep17	886.02	4566.64	152395.59	37576.00	19.00	0.71	2.08	0.84
LMSep17	8051.86	97422.35	1384919.25	1277584.00	21.00	0.14	0.44	0.15
LP1Sep17	5982.84	69010.09	1029047.63	901824.00	25.00	0.17	0.56	0.23
Means	3889.00	36390.00	668900.00	448400.00	25.50	0.40	1.31	0.53

October

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
GBOct17	245.68	1152.00	42257.60	8820.00	19.00	0.78	2.30	0.87
PBCOct17	2811.43	19113.92	483565.59	223776.00	29.00	0.55	1.84	0.73
LBOct17	661.08	3880.32	113705.20	35280.00	25.00	0.62	2.01	0.80
LMOct17	2385.21	25655.84	410256.00	335664.00	21.00	0.29	0.88	0.33
LP2Oct17	2525.41	30727.64	434369.66	402796.81	14.00	0.14	0.37	0.14

LP3Oct17	4500.02	58009.92	774004.00	760838.38	12.00	0.05	0.11	0.03
LP1Oct17	1436.47	17093.65	247072.00	223776.00	11.00	0.18	0.43	0.18
Means	2081.00	22230.00	357900.00	284400.00	18.00	7 0.372	1.13	0.44

November

Site	Mean	Stand.Dev.	Sum	Maximum	S	E	H	D'
PBSNov17	1682.51	18827.69	289391.19	246153.59	24.00	0.22	0.68	0.27
LMNov17	2689.53	34121.23	462599.16	447552.00	20.00	0.07	0.22	0.06
ULSPNov1	5719.81	72520.09	983807.88	951048.00	21.00	0.07	0.20	0.07
LBNNov17	4074.65	46974.28	700840.00	615384.00	15.00	0.22	0.61	0.23
GBNov17	816.22	8600.33	140389.20	111888.00	11.00	0.33	0.80	0.35
Means	2997.00	36210.00	515400.00	474400.00	18.20	0.18	0.50	0.20

Appendix 4. Taxa that were dropped from NMS and MRPP analyses. Taxa occurred in < 10 samples. Codes and taxa full names are in Appendix 20.

Dropped taxa

Deletion of 98 taxa:

ACSP ANFU ANLA APDE APPL APTSP ASFO AUSP BOBR
 BOSU CASP CHS2 CHLS CHGS CHDI CHMI CHR2 CLLT
 CLOS COES COEL COSP COSP2 COS3 CRQU CRSP CRS2
 CRUS CRYP2 CYS3 CRY4 CYCA DESP DEMA DEMI DIAN
 DIPA DIDS DIDI DOCR DOFL DOPL EUS2 FRCR FRVI
 GLEN GLEO KICO KOSP MEDI MESP MIAE MICR MOKO
 MRSP MOSP NODS OOGI OONA OOPA OOS2 OOSP3 PAMO
 PEBO PEDC PESP PETE PES2 PHSP PHS4 PLSP PLGE
 QUCH QULA QUSP SCAR SCSP SCRO SPSC SPIS SPSP
 STS3 STNI TEMI TRSP ULOS UNCY UNCY2 UNC2 UNC3
 UNFC UNFC2 UNFC3 UNFC4 UNSch2 UNS3 UNCHY USC2

Appendix 5. NMS Measures of Fit Utah Lake phytoplankton 2017

MEASURES OF FIT

R²n (nonmetric fit) = 0.9919 Intrinsic measure for NMS. Null: all points co-located.

R²l (linear fit) = 0.9635 Null: all ordination distances equal.

R²m (metric fit) = 0.9607 Null: no linear relationship with observed dissimilarities.

CHANCE-CORRECTED EVALUATIONS

Improvement: I = 0.7879

Null model: final configuration no better than initial random configuration.

Interpretation: 0 = random expectation, 1 = perfect fit, <0 = worse than random expectation

Basis:

2 dimensions

250 = number of random initial configurations used

42.3870 = average initial stress

8.9897 = final stress

Association: A = 0.6492
 Null model: relationships among columns no stronger than expected chance, based on shuffling within columns.
 Interpretation: 0 = random expectation, 1 = perfect fit, <0 = worse than random expectation
 Basis: 2 dimensions
 500 = number of randomizations used
 25.6284 = average final stress from randomizations
 8.9897 = final stress

Appendix 6. NMS axis 1 and axis 2 site (sample) coordinates.

Site	Axis 1	Axis 2
ULSPJan17	1.404	0.209
LBJan17	0.909	0.162
PBJan17	1.260	-0.064
ULSPJan1	1.081	0.618
LMJan17	1.694	-0.417
GBGPJan1	0.925	-0.056
SBJan17	1.663	0.059
LBFeb17	1.288	0.291
LMFeb17	1.525	0.152
PAFeb17	0.466	0.148
GBFeb17	0.795	0.000
LMSFeb17	1.411	0.083
PAFeb17	1.411	0.083
SFFeb17	1.404	0.209
SBFeb17	1.695	-0.418
LBFeb17	0.659	0.547
GBNFeb17	1.557	0.287
LMiMar17	0.279	-0.457
LMSMar17	0.686	-0.272
ULSPMar1	0.239	-0.451
PBMar17	0.062	-0.417
SBMar17	0.887	0.028
LBMar17	1.155	0.248
GBMar17	1.588	0.203
LMMar17	1.299	-0.062
ULSPMar1	0.093	-0.248
PB1Mar17	0.678	-0.140

PB2Mar17	0.830	-0.280
PB3Mar17	0.836	-0.177
SB1Mar17	1.663	0.059
LBMar17	0.850	-0.315
GBMar17	1.708	0.215
LMApr17	0.646	0.075
ULSPApr1	0.609	0.088
LBApr17	0.898	-0.123
GBApr17	1.663	0.059
PB1Apr17	0.659	-0.199
PB2Apr17	0.432	-0.194
PB3Apr17	0.922	-0.234
LMApr17	0.879	-0.268
ULSPApr1	0.371	0.578
LBMApr17	1.021	0.386
LBMApr17	0.554	0.124
GBApr17	0.864	0.051
LB1Apr17	0.472	0.018
LB2Apr17	0.812	0.052
LB3Apr17	0.730	0.270
LB4Apr17	1.228	0.060
LB5Apr17	1.212	-0.084
LB6Apr17	1.003	0.003
LB7Apr17	0.819	0.307
PB1Apr17	-0.804	-0.378
PB2Apr17	0.570	-0.003
PB3Apr17	0.264	0.216
LM1Apr17	0.578	0.261
LM2Apr17	0.833	0.074
LM3Apr17	1.275	0.102
ULSPApr1	0.664	0.246
ULSP1Apr	0.740	0.216
ULSP2Apr	0.584	-0.098
ULSP3Apr	0.882	0.406
PM1Apr17	0.762	0.632
PM2Apr17	0.278	0.475
PM3Apr17	0.832	0.275
GB1Apr17	0.702	0.484
GB2Apr17	0.695	0.494

GB3Apr17	0.397	0.117
PB1Apr17	0.952	0.042
PB2Apr17	1.059	-0.477
PB3Apr17	-0.041	-0.608
ULSPMay1	0.401	0.233
LBMay17	0.617	0.114
GBMay17	0.912	-0.539
LMMay17	-0.184	-0.357
ULSPMay1	0.621	0.192
PBMay17	-0.344	-0.460
LMJun17	0.150	-0.284
LP1Jun17	0.611	-0.724
LP2Jun17	0.838	1.290
LP3Jun17	0.593	-0.252
PMoJun17	0.499	-0.124
PBCJun17	0.117	-0.942
PBNJun17	0.081	-0.726
PBHCJun1	-0.211	-0.302
LB1Jun17	0.193	-0.943
LMJun17	-0.245	-0.860
ULSPJun1	-0.252	-0.253
PBJun17	-0.783	-1.159
LBJun17	0.371	-0.330
GBJun17	0.675	-0.361
LMJul17	-0.515	-0.736
ULSPJul1	-0.107	-0.740
PBJul17	-0.490	-1.022
PBCJul17	-0.605	-0.993
LBJul17	-0.069	-0.499
ULSPJul1	-0.194	-1.016
LMJul17	0.040	-0.644
LP1Jul17	-0.112	-0.480
LP2Jul17	-0.300	-0.616
LP3Jul17	-0.343	0.781
PMoJul17	-0.294	-0.373
PBCJul17	-0.694	-0.833
LBMJul17	-0.998	-1.134
GBJul17	-0.311	-1.441
LMJul17	-0.807	-0.892

PBCJul17	-0.764	-0.681
PBNJul17	-0.573	-0.812
LMiJul17	-0.584	-0.710
LMoJul17	-0.275	0.296
LP1Jul17	-0.955	0.675
LP2Jul17	-0.451	0.802
LP3Jul17	-0.597	-0.349
PMJul17	-0.042	-1.358
GBJul17	-0.117	-1.047
LM1Aug17	-0.991	-0.252
LM2Aug17	-1.110	-0.125
LM3Aug17	-1.288	-0.101
LMBAug17	-1.608	0.030
LM4Aug17	-1.339	0.009
PBCAug17	-1.564	-0.114
LMAug17	-0.949	0.027
GBAug17	-1.222	0.707
PBNAug17	-1.477	-0.022
LbayAug1	-0.865	0.263
LMAug17	-1.178	0.277
LP1Aug17	-0.003	0.916
PBSAug17	-1.420	0.000
LBAug17	-0.639	0.194
GBAug17	-1.101	0.386
ULSPAug1	-0.780	0.058
LbayAug1	-0.975	0.389
GBAug17	-1.160	0.261
PBSAug17	-1.253	-0.181
LMAug17	-1.375	-0.096
PBNAug17	-1.328	-0.054
PBCAug17	-1.218	-0.018
PBCmyste	-0.747	0.085
GBAug17	-1.032	0.179
LMAug17	-1.005	0.291
LBAug17	-1.024	0.486
LP1Aug17	-1.018	0.408
ULSPSep1	-1.463	0.388
GBSep17	-0.910	0.504
LMAug17	-1.061	0.143

GBSep17	-1.094	0.432
LBSep17	-0.936	0.556
PBSep17	-1.037	0.010
PBSep17	-1.393	-0.044
PBSep17	-1.421	0.163
GBSep17	-1.193	0.317
LBSep17	-0.944	0.362
LMSep17	-1.525	0.565
LP1Sep17	-1.234	0.601
GBOct17	-0.979	0.290
PBCOct17	-0.816	-0.023
LBOct17	-1.111	0.124
PBSJun17	-0.468	0.286
GBJun17	-0.142	0.347
GBNJun17	-0.636	0.622
PB1May17	-0.233	0.254
PBNMay17	-0.218	-0.018
PBCMay17	-0.194	0.191
PBCJun17	-0.682	0.098
LMJun17	-0.806	0.244
LMJun17	-0.689	0.331
LMJun17	-0.698	0.220
LMJun17	-0.263	0.273
LMOct17	-0.631	0.413
LBMay17	0.269	0.162
LBJun17	-0.627	0.352
LBJul17	-0.551	0.287
LBMJun17	-0.814	0.218
ULSPJun1	-0.309	0.485
LP2Oct17	-0.177	0.780
LP3Oct17	0.184	0.445
LP1Oct17	0.192	0.693
PBSNov17	-0.337	0.005
LMNov17	-0.114	0.293
ULSPNov1	-0.259	0.163
LBNov17	-0.403	0.839
GBNov17	-0.125	0.966

Appendix 7. NMS Axis 1 and Axis 2 phytoplankton taxa coordinates Utah Lake 2017. Taxa names are in Appendix 20

Taxon	Axis 1	Axis 2
ACGR	-0.180	-0.062
ACHA	-0.144	-0.063
ACAC	-0.166	-0.064
ACPE	-0.095	-0.054
ANCI	-0.221	0.026
ANFA	-0.053	0.029
ANJU	-0.046	0.052
APFL	-0.164	0.008
APGR	-0.255	0.011
APSP	-0.158	-0.010
CEDI	0.021	-0.009
CEDI2	-0.019	0.005
CEHI	-0.211	0.032
CHGL	-0.196	0.035
CHRE	-0.213	0.027
CHSP	-0.117	0.022
CHLM	-0.218	0.040
CHRL	-0.199	0.033
CHRS	-0.231	0.016
CHRO	-0.166	0.047
CLLO	-0.154	-0.024
COPL	-0.230	0.025
CRFE	-0.071	0.018
CRRE	-0.118	-0.089
CRRT	-0.064	0.057
CRYP	-0.164	0.016
CYPL	-0.055	-0.088
DEBI	-0.106	0.009
DECO	-0.067	-0.005
DEOP	-0.037	-0.043
DEPO	-0.129	-0.028
DSSP	-0.084	0.027
DOCM	-0.007	-0.112
DOSP	-0.120	-0.139
EUSP	-0.011	-0.027
GYSP	-0.184	-0.029

KILU	-0.096	0.030
KISP	-0.126	0.061
KOS2	-0.197	0.067
LESP	-0.123	-0.056
LEPS	-0.108	-0.001
MEGR	0.035	-0.057
MEGA	-0.042	-0.008
MEVA	0.122	-0.015
MEGL	-0.146	-0.023
MOAR	-0.113	-0.017
MOCO	0.017	-0.011
MOCN	0.229	0.040
MODY	-0.066	-0.009
MOMI	0.024	-0.100
NIAC	-0.009	-0.024
OOBO	-0.091	0.010
OOEL	-0.171	0.047
OOSP	-0.044	0.002
PEAN	-0.181	-0.001
PEDU	-0.080	-0.047
PEDI	0.000	0.000
PHFO	-0.058	-0.134
PHOS	-0.210	0.003
PHSP2	-0.176	-0.065
PHSP3	-0.136	-0.120
PHSP5	-0.170	-0.087
PSSP	-0.203	0.056
SCEL	-0.089	-0.053
SCOB	-0.101	-0.018
SCSE	-0.192	0.011
TECA	-0.231	0.013
TESP	-0.224	-0.001
UNCC	0.015	-0.017
UNCR	-0.045	-0.079
UNEC	0.197	0.005
UNFY	-0.180	-0.032
UNSC	0.060	0.008
UNSC2	-0.005	0.042

Appendix 8. Correlations between phytoplankton taxa and NMS Axis 1 and Axis 2 Utah Lake 2017.

Axis 1		Axis 2	
taxa	r	taxa	r
PEAN	-0.945	DOSP	-0.732
APSP	-0.926	DOCM	-0.720
CRYP	-0.926	EUSP	-0.678
ANCI	-0.921	ACPE	-0.650
CHRE	-0.917	PHFO	-0.637
DEBI	-0.914	UNCR	-0.618
GYSP	-0.913	PHSP3	-0.606
MOAR	-0.905	CYPL	-0.605
CHRS	-0.902	SCEL	-0.560
CHGL	-0.901	MOMI	-0.544
DECO	-0.897	ACAC	-0.528
PHOS	-0.895	ACHA	-0.519
APFL	-0.889	DEOP	-0.512
CHLM	-0.877	LESP	-0.502
MEGL	-0.876	CRRE	-0.486
CHRL	-0.866	ACGR	-0.468
COPL	-0.860	PEDU	-0.461
OOBO	-0.858	PHSP5	-0.455
TECA	-0.829	PHSP2	-0.449
APGR	-0.824	CEDI	-0.329
TESP	-0.824	DEPO	-0.304
CHRO	-0.819	NIAC	-0.301
PSSP	-0.811	MEGR	-0.291
CLLO	-0.808	GYSP	-0.274
SCOB	-0.804	SCOB	-0.272
KILU	-0.775	MOAR	-0.263
CHSP	-0.773	MEGL	-0.256
KOS2	-0.767	UNCC	-0.246
LEPS	-0.742	CLLO	-0.243
DEPO	-0.740	UNFY	-0.238
ACAC	-0.732	MOCO	-0.223
OOEL	-0.730	MEGA	-0.194
UNFY	-0.721	DECO	-0.123
ACGR	-0.715	APSP	-0.115
SCSE	-0.693	MODY	-0.105

CEHI	-0.659	MEVA	-0.081
OOSP	-0.657	PEDI	-0.068
PHSP2	-0.647	LEPS	-0.016
ACHA	-0.632	PEAN	-0.012
CEDI2	-0.630	TESP	-0.009
ACPE	-0.601	PHOS	0.024
LESP	-0.586	UNEC	0.027
MEGA	-0.538	OOSP	0.053
SCEL	-0.497	APGR	0.065
KISP	-0.477	SCSE	0.075
PHSP5	-0.471	APFL	0.079
ANFA	-0.470	TECA	0.089
DSSP	-0.470	CHRS	0.119
PEDU	-0.422	DEBI	0.145
CRRT	-0.408	UNSC	0.150
MODY	-0.406	CRYP	0.173
CRFE	-0.370	CRFE	0.174
PHSP3	-0.365	MOCN	0.174
CRRE	-0.344	COPL	0.175
DOSP	-0.335	OOBO	0.179
DEOP	-0.235	CEHI	0.187
CYPL	-0.201	ANCI	0.203
UNCR	-0.185	CHRE	0.220
EUSP	-0.152	CHSP	0.273
PHFO	-0.146	CHRL	0.273
ANJU	-0.139	DSSP	0.290
NIAC	-0.059	ANJU	0.296
UNSC2	-0.028	CHGL	0.301
DOCM	-0.026	CHLM	0.305
PEDI	0.053	CEDI2	0.307
MOMI	0.071	OOEL	0.379
MEGR	0.094	PSSP	0.424
UNCC	0.115	UNSC2	0.432
MOCO	0.176	KISP	0.435
MEVA	0.347	CHRO	0.440
CEDI	0.431	KILU	0.450
MOCN	0.529	ANFA	0.488
UNEC	0.589	KOS2	0.491
UNSC	0.597	CRRT	0.683

Appendix 9. MRPP phytoplankton by month 2017. <10 taxa occurrences removed, Beal smoothed data.

Month	<i>T</i>	<i>A</i>	<i>p</i>
January vs. February	1.334	-0.033	0.961
January vs. March	-2.083	0.044	0.046
January vs. April	-6.348	0.044	0.000
January vs. May	-7.644	0.226	0.000
January vs. June	-11.467	0.185	0.000
January vs. July	-17.966	0.291	0.000
January vs. August	-21.185	0.407	0.000
January vs. September	-11.310	0.540	0.000
January vs. October	-7.507	0.360	0.000
January vs. November	-6.765	0.380	0.001
February vs. March	-2.708	0.051	0.025
February vs. April	-8.317	0.055	0.000
February vs. May	-8.580	0.223	0.000
February vs. June	-14.211	0.211	0.000
February vs. July	-20.339	0.330	0.000
February vs. August	-23.318	0.442	0.000
February vs. September	-13.061	0.534	0.000
February vs. October	-8.755	0.340	0.000
February vs. November	-7.601	0.336	0.000
March vs. April	-4.166	0.026	0.004
March vs. May	-6.973	0.123	0.000
March vs. June	-12.764	0.150	0.000
March vs. July	-21.378	0.270	0.000
March vs. August	-26.124	0.408	0.000
March vs. September	-15.887	0.454	0.000
March vs. October	-10.348	0.254	0.000
March vs. November	-8.503	0.224	0.000
April vs. May	-8.101	0.057	0.000
April vs. June	-22.721	0.149	0.000
April vs. July	-35.277	0.284	0.000
April vs. August	-40.446	0.407	0.000
April vs. September	-28.986	0.350	0.000
April vs. October	-16.532	0.146	0.000
April vs. November	-12.788	0.109	0.000
May vs. June	-2.462	0.031	0.031

May	vs.	July	-12.732	0.149	0.000
May	vs.	August	-19.016	0.249	0.000
May	vs.	September	-12.018	0.345	0.000
May	vs.	October	-4.358	0.111	0.003
May	vs.	November	-3.288	0.089	0.008
June	vs.	July	-10.915	0.090	0.000
June	vs.	August	-19.817	0.179	0.000
June	vs.	September	-12.311	0.189	0.000
June	vs.	October	-2.595	0.041	0.027
June	vs.	November	-2.749	0.048	0.022
July	vs.	August	-27.593	0.255	0.000
July	vs.	September	-19.059	0.284	0.000
July	vs.	October	-9.960	0.134	0.000
July	vs.	November	-9.817	0.148	0.000
August	vs.	September	-3.012	0.029	0.017
August	vs.	October	-6.086	0.073	0.001
August	vs.	November	-10.993	0.144	0.000
September	vs.	October	-4.615	0.124	0.002
September	vs.	November	-8.082	0.254	0.000
October	vs.	November	-0.514	0.020	0.233

Appendix 10. Indicator species analysis phytoplankton by month 2017. Derived from raw data. Significant ($p < 0.05$) indicators are highlighted in yellow.

			Random IV		
Taxon	MaxGroup	Observed IV	mean	S.Dev.	p
STNI	February	10	6.1	4.18	0.22
MEDI	February	5.6	6.4	4.25	0.53
UNSch	February	2.7	6.4	4.42	0.88
FRVI	March	19.7	7	4.59	0.01
CEDI	March	36.4	24.1	8.45	0.09
ULOS	March	6.7	6.1	4.18	0.37
ASFO	April	5.3	6.4	4.29	0.58
CYS3	April	4.5	6.6	4.33	0.64
OOSP3	April	3.5	6.5	4.19	0.75
FRCR	April	2.6	6	4.12	1.00
MOCN	May	26.1	8.6	5.34	0.02
MEVA	May	16.3	8.2	5.29	0.07
UNEC	May	11.8	7.5	4.84	0.13
MODY	May	16.1	10.2	6.02	0.13
OONA	May	10	6.1	4.17	0.21
UNC2	May	7.9	6.4	4.13	0.24
SCSP	May	7.1	6.5	4.35	0.32
PEDU	May	8.1	8.8	5.39	0.44
MOMI	May	6.4	7.5	4.9	0.46
DEOP	May	9.5	11.1	5.83	0.51
CRQU	May	4.8	7.3	4.83	0.63
AUSP	May	3.4	6.6	4.62	0.72
MRSP	May	2.5	6.8	4.76	0.93
SCRO	June	20	6.7	4.35	0.02
QUSP	June	7.8	6.9	4.7	0.28
PES2	June	8	6.4	4.18	0.29
DIDI	June	7.1	6.5	4.39	0.37
UNC3	June	4	6	4.12	0.63
UNCHY	June	4	6.1	4.22	0.64
COES	June	4	6.1	4.16	0.64
DESP	June	4	6.1	4.2	0.64
DOCR	June	4	6.1	4.2	0.64

OOPA	June	4	6.1	4.2	0.64
SCAR	June	4	6.1	4.2	0.64
ANLA	June	4	6.1	4.23	0.65
MOSP	June	4	6.1	4.23	0.65
OOS2	June	2.7	6.5	4.37	0.85
DOCM	July	65.6	12.5	6.76	0.00
PHFO	July	40	9.3	6.21	0.00
PHSP3	July	45.4	9.6	6.38	0.00
CRRE	July	33.1	8.4	5.04	0.00
DOSP	July	29.4	7.5	4.62	0.00
NODS	July	19.1	6.7	4.47	0.03
PHSP5	July	21.4	8	4.92	0.03
UNCR	July	19.2	7.7	4.52	0.03
EUSP	July	21.3	13.5	4.75	0.07
PHSP2	July	16	8.2	5.22	0.08
COEL	July	10.5	6.6	4.22	0.13
CYPL	July	13.9	9	5.22	0.14
PHSP	July	10.6	6.8	4.57	0.16
DOPL	July	11.5	7.5	5.06	0.18
PEBO	July	10.1	7.6	5.28	0.21
SCEL	July	10.9	9.9	5.15	0.30
PETE	July	8	6.5	4.28	0.32
CYCA	July	8	6.4	4.26	0.33
COSP2	July	4	6	4.08	0.63
CHDI	July	4.5	6.7	4.53	0.63
MICR	July	4	6.1	4.19	0.64
PAMO	July	4	6.2	4.33	0.64
COSP	July	3.4	6.7	4.67	0.68
GLEN	July	3.3	6.2	4.22	0.72
CHGL	August	60	13	6.27	0.00
CHRE	August	65.3	10.6	5.31	0.00
GYSP	August	44.3	9.2	4.83	0.00
CRYP	August	52.7	12.9	6.55	0.00
PHOS	August	45	9.8	5.7	0.00
ANCI	August	38.4	11.9	6.59	0.01
MEGL	August	29.8	11.3	5.21	0.01
CHRL	August	29.7	9.1	5.6	0.01
MOAR	August	39.1	18.2	7.36	0.02
PEAN	August	32.1	12.9	6.49	0.02

CHR2	August	21.2	7.5	4.88	0.02
DECO	August	40.8	20	7.66	0.02
CHS2	August	21	6.9	4.79	0.03
LESP	August	19	7.4	4.49	0.03
APGR	August	20.1	8.7	5.72	0.04
CHLM	August	27.5	12.7	7.42	0.04
CRSP	August	16.3	6.7	4.48	0.05
CLLO	August	18.8	8.7	5.15	0.05
ACPE	August	32.4	16.8	8.54	0.06
COPL	August	17.8	8.1	5.3	0.06
CEDI2	August	32.7	20.4	6.65	0.06
OOBO	August	22.6	13.9	5.26	0.06
SCSE	August	14.4	7.5	4.74	0.08
ACAC	August	17.8	9.7	5.5	0.08
SCOB	August	15.7	9.6	4.35	0.09
PEDI	August	29.8	20.9	6.32	0.11
ACGR	August	15.2	9.3	5.84	0.13
PHS4	August	12.5	7.6	4.98	0.13
MESP	August	11.7	7	4.52	0.13
UNS3	August	10.7	6.4	4.05	0.13
GLEO	August	10.7	6.9	4.9	0.14
CRYS4	August	10.7	6.6	4.3	0.15
CRS2	August	10.7	6.5	4.39	0.15
EUS2	August	10.4	6.7	4.11	0.15
TEMI	August	10.3	6.8	4.6	0.15
ACHA	August	12.2	9.3	5.58	0.22
MOCO	August	22.2	20.3	9.14	0.31
DEPO	August	10.9	10.3	5.36	0.32
UNCC	August	19.7	18.8	8.71	0.36
CASP	August	7.1	6.3	4.13	0.39
COS3	August	7	6.7	4.52	0.41
APDE	August	6.9	6.7	4.42	0.43
UNFC3	August	7.1	6.4	4.26	0.43
DIPA	August	6.4	6.6	4.24	0.45
MEGA	August	12.4	13.4	5.45	0.47
CRYP2	August	6.1	8.1	5.41	0.54
MOKO	August	4.8	6.8	4.43	0.62
ANFA	August	9.9	14.3	6.73	0.73
UNCY	August	3.6	6	4.13	0.78

ANFU	August	3.6	6.1	4.19	0.78
BOSU	August	3.6	6	4.2	0.79
CHLS	August	3.6	6	4.13	0.79
USC2	August	3.6	6.1	4.19	0.79
CLOS	August	3.6	6.1	4.18	0.79
QUCH	August	3.6	6.1	4.18	0.79
SPIS	August	3.6	6	4.1	0.79
ACSP	August	3.6	6	4.08	0.80
APTSP	August	3.5	6.5	4.44	0.80
QULA	August	3.4	6.5	4.1	0.82
DIAN	August	2.9	6.3	4.27	0.86
UNCY2	August	2.9	6.4	4.42	0.88
PLGE	August	2.3	6.5	4.26	0.95
UNFC	August	2.3	6.5	4.41	0.95
APFL	September	71	14.1	6.92	0.00
PSSP	September	62.4	9.7	5.18	0.00
DEBI	September	41.7	13	5.21	0.00
TESP	September	26.8	7.8	5.08	0.01
APSP	September	24.7	11.7	5.16	0.03
MIAE	September	18.2	6.4	4.25	0.03
KOS2	September	23.7	11.4	5.99	0.05
TECA	September	15.8	7	4.5	0.05
CEHI	September	19.1	8.8	5.25	0.05
LEPS	September	27	14.4	7.26	0.06
DSSP	September	14.9	8.3	5.12	0.09
CHRO	September	24.3	14.2	7.99	0.10
DIDS	September	12.1	6.8	4.52	0.11
CHRS	September	9	7.3	4.81	0.24
BOBR	September	8.4	6.3	4.38	0.25
CHMI	September	9.1	6	4.14	0.26
UNFC4	September	8.4	6.6	4.75	0.26
DEMA	September	9.1	6	4.17	0.27
DEMI	September	9.1	6	4.17	0.27
NIAC	September	16.8	14.5	7.12	0.27
KICO	September	9.1	6	4.15	0.27
CHGS	September	7.4	6.8	4.49	0.31
CHSP	September	14.2	13.1	7.25	0.31
TRSP	September	6.8	6.3	4.11	0.45
DOFL	September	6.3	6.5	4.3	0.45

SPSC	September	4.7	6.7	4.45	0.63
CRUS	September	3.5	6.6	4.38	0.67
MEGR	September	5.4	8.3	5.4	0.68
OOSP	October	28.5	13.3	4.3	0.01
CLLT	October	14.9	6.9	4.41	0.06
UNFC2	October	14.3	6.9	4.55	0.06
OOEL	October	18.9	9	5.62	0.06
APPL	October	13.9	7.1	4.64	0.07
PLSP	October	14.3	6	4.08	0.10
STS3	October	14.3	6.1	4.23	0.10
ANJU	October	8.3	7.7	4.84	0.32
KISP	November	53.7	7.4	4.84	0.00
CRRT	November	46.9	11.6	4.93	0.00
UNSC2	November	43.3	10.7	5.58	0.00
KILU	November	37.6	12.3	4.88	0.00
SPSP	November	20	6.1	4.14	0.03
OOGI	November	19.5	6.7	4.68	0.03
UNFY	November	20.5	8.4	5.43	0.04
KOSP	November	15.6	7.1	4.54	0.06
PESP	November	11.3	6.9	4.38	0.11
CRFE	November	11	8.4	5.56	0.21
UNSC	November	13	19.6	8.91	0.79

Appendix 11.
MRPP for
phytoplankton
taxa in Utah Lake

2017 by month.

		T	A	p
January	vs. February	-5.193	0.183	0.002
January	vs. March	-7.065	0.165	0.000
January	vs. April	-8.480	0.085	0.000
January	vs. May	-6.087	0.165	0.000
January	vs. June	-9.837	0.130	0.000
January	vs. July	-10.405	0.138	0.000
January	vs. August	-15.011	0.195	0.000
January	vs. September	-9.176	0.265	0.000
January	vs. October	-7.218	0.314	0.000
January	vs. November	-6.378	0.350	0.000
February	vs. March	0.495	-0.009	0.624
February	vs. April	-3.521	0.035	0.009
February	vs. May	-2.477	0.057	0.025
February	vs. June	-10.854	0.124	0.000

February	vs. July	-12.233	0.146	0.000
February	vs. August	-17.621	0.211	0.000
February	vs. September	-10.653	0.256	0.000
February	vs. October	-8.395	0.280	0.000
February	vs. November	-7.656	0.302	0.000
March	vs. April	-2.878	0.025	0.018
March	vs. May	-1.843	0.033	0.056
March	vs. June	-11.585	0.110	0.000
March	vs. July	-14.566	0.145	0.000
March	vs. August	-20.887	0.217	0.000
March	vs. September	-12.724	0.229	0.000
March	vs. October	-9.900	0.229	0.000
March	vs. November	-9.300	0.241	0.000
April	vs. May	0.697	-0.007	0.731
April	vs. June	-7.819	0.049	0.000
April	vs. July	-18.542	0.108	0.000
April	vs. August	-28.696	0.178	0.000
April	vs. September	-15.717	0.131	0.000
April	vs. October	-10.672	0.106	0.000
April	vs. November	-9.720	0.105	0.000
May	vs. June	-1.855	0.021	0.055
May	vs. July	-5.822	0.067	0.000
May	vs. August	-11.595	0.124	0.000
May	vs. September	-6.998	0.145	0.000
May	vs. October	-6.423	0.168	0.000
May	vs. October	-6.885	0.203	0.000
June	vs. July	-6.577	0.054	0.000
June	vs. August	-17.580	0.138	0.000
June	vs. September	-9.992	0.119	0.000
June	vs. October	-7.975	0.108	0.000
June	vs. November	-8.668	0.124	0.000
July	vs. August	-7.394	0.057	0.000
July	vs. September	-2.424	0.030	0.027
July	vs. October	-6.539	0.091	0.000
July	vs. November	-7.535	0.116	0.000
August	vs. September	-0.074	0.001	0.378
August	vs. October	-2.335	0.034	0.031
August	vs. November	-4.123	0.065	0.003
September	vs. October	-4.020	0.119	0.003

September	vs. November	-4.882	0.175	0.001
October	vs. November	0.146	-0.007	0.486

Appendix 12. Phytoplankton taxa in Utah Lake 2017 listed in order of total abundances (cells mL⁻¹). Taxa names are in Appendix 1.

Taxon	Total
DOCM	54747644
CRRT	10147718
APFL	4644735.2
PEAN	3334464
PHOS	2972928
LEPS	2359602
PHSP5	1345414
APSP	1336650
APGR	1000090
PHSP3	989049.6
MEGL	823384.8
PHSP2	673288
DECO	542192
NIAC	423242.4
PEDI	419795.6
KILU	409785.6
ANCI	383140.8
PSSP	357789.6
CEDI2	248892
PHFO	219203.6
CHRE	157155.6
APPL	154291.2
CYPL	127008
APDE	123228
ACPE	118395.2
PHS4	112896
CHGL	110135.2
OOBO	99948.8
MOAR	91128.8
CEDI	80735.2
PEBO	77873.6
MEGA	76356
CHRS	74289.6

UNCC	74202.8
ACAC	61152
KISP	60883.2
DEPO	57041.6
OOSP	51464
COPL	47947.2
DEOP	45617.6
SCEL	41753.6
DEBI	41664
UNFC2	40476.8
CHRL	38707.2
CRRE	37228.8
PEDU	37184
APTSP	37128
DOSP	36176
KOS2	35067.2
DOPL	35005.6
UNSC	32877.6
SCOB	32144
UNSC2	31654
CRYP	31334.8
DOFL	29612.8
CRYS4	28862.4
UNFC4	26342.4
ACGR	26252.8
MIAE	24500
CHRO	23480.8
PESP	21579.6
BOBR	21504
EUSP	21131.6
SPSC	20697.6
ACHA	19135.2
MESP	18748.8
KICO	18424
CHSP	17211.6
MOCO	16626.4
GYSO	16430.4
ANFA	15710.8
CRSP	14851.2

OOEL	14632.8
SPIS	13440
UNFY	12734.4
CHLM	12398.4
CHR2	10981.6
UNFC3	10752
CRS2	10035.2
DSSP	9766.4
SPSP	8232
CRFE	8198.4
CHLS	7168
CHDI	6182.4
FRVI	5443.2
CHMI	5376
PLGE	5286.4
MEVA	5138
CLLO	4838.4
CASP	4390.4
TESP	4356.8
MEGR	4278.4
DIPA	3942.4
UNC2	3696
CRQU	3628.8
UNCY	3584
QUSP	3539.2
CRUS	3427.2
CYCA	3404.8
PLSP	2912
GLEO	2800
CEHI	2794.4
COEL	2732.8
CHS2	2696.4
MODY	2489.2
TECA	2324
NODS	2181.2
DOCR	2032.8
UNCR	2032.8
DIDS	1859.2
CRYP2	1850.8

BOSU	1792
AUSP	1780.8
MICR	1568
CHGS	1461.6
TEMI	1377.6
LESP	1330
MOMI	1047.2
DIDI	1008
CYS3	896
QULA	896
MRSP	828.8
SCSP	716.8
PAMO	716.8
SCSE	674.8
UNS3	672
CLOS	660.8
UNFC	579.6
COS3	565.6
EUS2	565.6
DIAN	537.6
MOSP	537.6
ANJU	495.6
MOKO	487.2
QUCH	448
UNEC	439.6
ASFO	436.8
OOGI	436.8
TRSP	420
CLLT	403.2
MOCN	392
COES	358.4
UNCHY	336
KOSP	333.2
MEDI	268.8
PETE	268.8
DEMA	224
DEMI	224
STS3	224
PES2	201.6

ANLA	134.4
GLEN	134.4
OONA	134.4
OOS2	123.2
OOPA	112
USC2	112
PHSP	100.8
UNFC	95.2
OOSP3	89.6
FRCR	67.2
SCRO	61.6
COSP2	56
ACSP	44.8
UNC2	44.8
COSP	28
ULOS	25.2
ANFU	22.4
SCAR	22.4
UNC3	22.4
STNI	11.2
DESP	5.6

Appendix 13. Best fit model taxa richness, S as a function of month (categorical) for phytoplankton in Utah Lake 2017.

```

Truncated negative binomial regression      Number of obs   =      181
Truncation point: 0                       Wald chi2(10)   =     526.36
Dispersion = mean                         Prob > chi2     =     0.0000
Log pseudolikelihood = -563.85404         Pseudo R2      =     0.1616

```

s	Robust		z	P> z	[95% Conf. Interval]	
	IRR	Std. Err.				
month						
Jan	0.15	0.03	-10.32	0.00	0.10	0.21
Feb	0.16	0.03	-11.35	0.00	0.12	0.22
March	0.28	0.03	-11.00	0.00	0.22	0.35
April	0.42	0.04	-9.09	0.00	0.34	0.50
May	0.83	0.09	-1.65	0.10	0.66	1.04
June	0.78	0.09	-2.05	0.04	0.62	0.99
July	1.00	(base)				
Aug	1.34	0.12	3.29	0.00	1.13	1.60
Sept	1.10	0.14	0.72	0.47	0.85	1.42
Oct	0.81	0.12	-1.47	0.14	0.61	1.07
Nov	0.79	0.10	-1.81	0.07	0.61	1.02
_cons	23.16	1.61	45.28	0.00	20.21	26.53
/lnalpha	-2.50	0.18			-2.85	-2.14
alpha	0.08	0.01			0.06	0.12

Appendix 14. Predicted marginal means, 95% CIs of phytoplankton taxa richness in Utah Lake, 2017 based on truncated negative binomial regression model.

```

Adjusted predictions      Number of obs   =      181
Model VCE      : Robust

```

Expression : Predicted number of events, predict()

	Delta-method		z	P> z	[95% Conf. Interval]	
	Margin	Std. Err.				
month						
Jan	3.391988	.5863438	5.78	0.000	2.242775	4.541201
Feb	3.751577	.5431556	6.91	0.000	2.687011	4.816142
March	6.497397	.6006844	10.82	0.000	5.320078	7.674717
April	9.623509	.6469711	14.87	0.000	8.355468	10.89155
May	19.19981	1.724201	11.14	0.000	15.82044	22.57918
June	18.15973	1.746446	10.40	0.000	14.73675	21.5827
July	23.15995	1.607155	14.41	0.000	20.00998	26.30991
Aug	31.10714	1.771473	17.56	0.000	27.63511	34.57916
Sept	25.45452	2.834431	8.98	0.000	19.89913	31.0099
Oct	18.71406	2.386242	7.84	0.000	14.03711	23.39101
Nov	18.19973	2.072818	8.78	0.000	14.13708	22.26238

Appendix 15. Best fit truncated negative binomial regression model of effective number of taxa, ENT as a function of month (categorical) in Utah Lake, 2017.

Truncated negative binomial regression	Number of obs	=	181
Truncation point: 0	Wald chi2(10)	=	125.61
Dispersion = mean	Prob > chi2	=	0.0000
Log pseudolikelihood = -393.02752	Pseudo R2	=	0.0794

ENT	IRR	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
month						
Jan	0.48	0.14	-2.53	0.01	0.27	0.85
Feb	0.25	0.10	-3.62	0.00	0.12	0.53
March	0.64	0.13	-2.14	0.03	0.42	0.96
April	0.88	0.18	-0.64	0.52	0.59	1.31
May	1.71	0.50	1.84	0.07	0.97	3.01
June	2.17	0.45	3.73	0.00	1.44	3.26
July	1.00	(base)				
Aug	1.84	0.35	3.19	0.00	1.26	2.67
Sept	1.29	0.31	1.05	0.30	0.80	2.08
Oct	1.20	0.44	0.50	0.62	0.58	2.46
Nov	0.30	0.08	-4.31	0.00	0.17	0.52
_cons	3.37	0.52	7.80	0.00	2.48	4.57
/lnalpha	-1.31	0.21			-1.71	-0.90
alpha	0.27	0.06			0.18	0.41

Appendix 16. Predicted marginal means, 95% CIs of phytoplankton effective number of taxa (ENT) in Utah Lake, 2017 based on truncated negative binomial regression model.

		Delta-method				
	Margin	Std. Err.	t	P>t	[95% Conf.	Interval]
Index # month						
E#Jan	0.54	0.09	6.32	0.00	0.37	0.71
E#Feb	0.26	0.07	3.66	0.00	0.12	0.40
E#March	0.49	0.06	8.33	0.00	0.37	0.60
E#April	0.44	0.04	11.96	0.00	0.37	0.51
E#May	0.51	0.07	7.08	0.00	0.37	0.65
E#June	0.62	0.05	13.75	0.00	0.54	0.71
E#July	0.37	0.05	8.14	0.00	0.28	0.46
E#Aug	0.49	0.04	11.32	0.00	0.40	0.57
E#Sept	0.40	0.07	5.82	0.00	0.26	0.53
E#Oct	0.37	0.09	4.34	0.00	0.20	0.54
E#Nov	0.18	0.10	1.79	0.08	-0.02	0.38
H#Jan	0.71	0.25	2.81	0.01	0.21	1.20
H#Feb	0.39	0.21	1.85	0.07	-0.03	0.80
H#March	0.89	0.17	5.22	0.00	0.56	1.23
H#April	1.00	0.11	9.27	0.00	0.79	1.21
H#May	1.48	0.21	7.04	0.00	1.06	1.89
H#June	1.75	0.13	13.21	0.00	1.49	2.02
H#July	1.10	0.13	8.29	0.00	0.84	1.36
H#Aug	1.67	0.13	13.27	0.00	1.42	1.91
H#Sept	1.31	0.20	6.52	0.00	0.91	1.70
H#Oct	1.13	0.25	4.52	0.00	0.64	1.63
H#Nov	0.50	0.30	1.69	0.09	-0.08	1.09
D#Jan	0.38	0.10	3.76	0.00	0.18	0.57
D#Feb	0.19	0.08	2.26	0.03	0.02	0.35
D#March	0.44	0.07	6.50	0.00	0.31	0.58
D#April	0.45	0.04	10.51	0.00	0.37	0.54
D#May	0.58	0.08	6.88	0.00	0.41	0.74
D#June	0.69	0.05	12.98	0.00	0.58	0.79
D#July	0.47	0.05	8.85	0.00	0.36	0.57
D#Aug	0.64	0.05	12.76	0.00	0.54	0.74
D#Sept	0.53	0.08	6.64	0.00	0.37	0.69
D#Oct	0.44	0.10	4.40	0.00	0.24	0.64
D#Nov	0.20	0.12	1.66	0.10	-0.04	0.43

Appendix 19. Trait based functional groups of phytoplankton from Reynolds et al. 2002.

Table I: Trait-separated functional groups of phytoplankton (updated from Reynolds, 1997)

Codon	Habitat	Typical representatives	Tolerances	Sensitivities
A	Clear, often well-mixed, base poor, lakes	<i>Urosolenia</i> , <i>Cyclotella comensis</i>	Nutrient deficiency	pH rise
B	Vertically mixed, mesotrophic small-medium lakes	<i>Aulacoseira subarctica</i> <i>Aulacoseira islandica</i>	Light deficiency	pH rise, Si depletion stratification
C	Mixed, eutrophic small-medium lakes	<i>Asterionella formosa</i> <i>Aulacoseira ambigua</i> <i>Stephanodiscus rotula</i>	Light, C deficiencies	Si exhaustion stratification
D	Shallow, enriched turbid waters, including rivers	<i>Synedra acus</i> <i>Nitzschia spp</i> <i>Stephanodiscus hantzschii</i>	Flushing	nutrient depletion
N	mesotrophic epilimnia	<i>Tabellaria</i> <i>Cosmarium</i> <i>Staurodesmus</i>	Nutrient deficiency	stratification pH rise
P	eutrophic epilimnia	<i>Fragilaria crotonensis</i> <i>Aulacoseira granulata</i> <i>Closterium aciculare</i> <i>Staurastrum pingue</i>	Mild light and C deficiency	stratification Si depletion
T	deep, well-mixed epilimnia	<i>Geminella</i> <i>Mougeotia</i> <i>Tribonema</i>	Light deficiency	Nutrient deficiency
S1	turbid mixed layers	<i>Planktothrix agardhii</i> <i>Limnothrix redekei</i> <i>Pseudanabaena</i>	highly light deficient conditions	flushing
S2	shallow, turbid mixed layers	<i>Spirulina</i> <i>Arthrospira</i> <i>Raphidiopsis</i>	light deficient conditions	flushing
S_N	warm mixed layers	<i>Cylindrospermopsis</i> <i>Anabaena minutissima</i>	light-,nitrogen-deficient conditions	flushing
Z	clear, mixed layers	<i>Synechococcus</i> prokaryote picoplankton	low nutrient	light deficiency grazing
X3	shallow, clear, mixed layers	<i>Koliella</i> <i>Chrysococcus</i> eukaryote picoplankton	low base status	mixing, grazing
X2	shallow, clear mixed layers in meso-eutrophic lakes	<i>Plagioselmis</i> <i>Chrysochromulina</i>	stratification	mixing, filter feeding
X1	shallow mixed layers in enriched conditions	<i>Chlorella</i> , <i>Ankyra</i> <i>Monoraphidium</i>	stratification	nutrient deficiency filter feeding
Y	usually, small, enriched lakes	<i>Cryptomonas</i>	low light	phagotrophs!
E	usually small, oligotrophic, base poor lakes or heterotrophic ponds	<i>Dinobryon</i> <i>Mallomonas</i> <i>(Synura)</i>	low nutrients (resort to mixotrophy)	CO ₂ deficiency
F	Clear epilimnia	colonial Chlorophytes e.g. <i>Botryococcus</i> <i>Pseudosphaerocystis</i> <i>Coenochloris</i> <i>Oocystis lacustris</i>	low nutrients high turbidity	?CO ₂ deficiency

Appendix 20. Utah Lake phytoplankton taxa and functional groups based on Reynolds et al. 2002 (Appendix 19).

Species	Functional Group
<i>Actinastrum hantzschii</i>	J
<i>Acutodesmis obliquus</i>	NA
<i>Acutodesmus dimorphus</i>	NA
<i>Acutodesmus pectinatus</i>	NA
<i>Anabaenopsis sp</i>	H1
<i>Ankistrodesmus falcatus</i>	X1
<i>Ankyra judayi</i>	X1
<i>Aphanizomenon flos aquae</i>	H1
<i>Aphanocapsa sp</i>	K
<i>Aphanothece sp</i>	K
<i>Asterionella formosa</i>	C
<i>Biddulphia laevis</i>	NA
<i>Botryococcus braunii</i>	F
<i>Calothrix sp</i>	NA
centric diatom sp 2	NA
centric diatoms	NA
<i>Ceratium hirundinella</i>	L0
<i>Characiopsis sp</i>	NA
<i>Chlamydomonas sp</i>	X2
<i>Chroococcus dispersus</i>	L0
<i>Chrysocapsa planktonica</i>	NA
<i>Closteriopsis longissima</i>	P
<i>Closteriopsis longissima var tropica</i>	NA
<i>Coelastrum microporum</i>	J
<i>Coelastrum sp</i>	J
<i>Coelosphaerium sp</i>	L0
<i>Crucigenia fenestrata</i>	J
<i>Crucigenia quadrata</i>	J
<i>Crucigenia rectangularis</i>	J
<i>Crucigenia sp</i>	J
<i>Crucigenia tetrapedia</i>	J
<i>Crucigeniella rectangularis</i>	J
<i>Cryptomonas sp</i>	Y
<i>Cryptomonas sp 2</i>	Y
<i>Cyanodictyon planktonicum</i>	L0
<i>Cylindrospermopsis sp</i>	NA
<i>Cyllindarospemopsis catemaco</i>	NA

<i>Cyellarospermopsis catemca</i>	NA
<i>Desmidium sp</i>	MP
<i>Desmodesmus sp</i>	NA
<i>Desmodesmus aculeolatus</i>	NA
<i>Desmodesmus bicellularis</i>	NA
<i>Desmodesmus communis</i>	NA
<i>Desmodesmus intermedius</i>	NA
<i>Desmodesmus obtusus</i>	NA
<i>Desmodesmus opoliensis</i>	NA
<i>Desmodesmus protrubans</i>	NA
<i>Desmodesmus bicellularis</i>	NA
<i>Dinobryon divergens</i>	E
<i>Dolichospermum crassa</i>	NA
<i>Dolichospermum flosaquae</i>	NA
<i>Euglena sp</i>	W1
<i>Fragilaria crotonensis</i>	P
<i>Fragilaria virescens</i>	MP
<i>Gomphosphaeria aponina</i>	L0
<i>Gomphosphaeria lacustris</i>	NA
<i>Gymnodinium sp</i>	L0
<i>Keratococcus sp</i>	X1
<i>Kirchneriella lunaris</i>	F
<i>Kirchneriella sp</i>	F
<i>Lagerheimia sp</i>	J
<i>Lepocinclis sp</i>	NA
<i>Leptolyngbya sp</i>	NA
<i>Leptolyngbya sp 2</i>	NA
<i>Melosira granulata</i>	MP
<i>Melosira granulata var angustissima</i>	MP
<i>Melosira varians</i>	MP
<i>Merismopedia glauca</i>	L0
<i>Merismopedia sp</i>	L0
<i>Micractinium sp</i>	NA
<i>Microcystis aeruginosa</i>	M
<i>Microcystis flos aquae</i>	M
<i>Microcystis incerta</i>	M
<i>Microcystis sp</i>	M
<i>Microspora sp</i>	NA
<i>Monoraphidium arcuatum</i>	X1

<i>Monoraphidium contortum</i>	X1
<i>Monoraphidium convolutum</i>	X1
<i>Monoraphidium dybowskii</i>	X1
<i>Monoraphidium griffithii</i>	X1
<i>Monoraphidium irregulare</i>	X1
<i>Monoraphidium komarkovae</i>	X1
<i>Monoraphidium sp</i>	X1
<i>Nitzschia acicularis</i>	D
<i>Nitzschia reversa</i>	MP
<i>Oocystis borgei</i>	F
<i>Oocystis sp</i>	F
<i>Oocystis sp 2</i>	F
<i>Oocystis sp 3</i>	F
<i>Oscillatoria sp</i>	NA
<i>Pandorina morum</i>	G
<i>Pediastrum duplex</i>	J
<i>Pediastrum duplex var clathratum</i>	J
<i>Pediastrum sp</i>	J
<i>pennate diatoms</i>	NA
<i>Perionella sp</i>	NA
<i>Phacus sp</i>	W1
<i>Phormidium sp</i>	NA
<i>Phormidium sp 3</i>	NA
<i>Phormidium sp 4</i>	NA
<i>Phormidium formosum</i>	NA
<i>Pseudanabaena sp</i>	S1
<i>Quadrigula lacustris</i>	F
<i>Quadrigula sp</i>	F
<i>Scenedesmus ellipticus</i>	J
<i>Scenedesmus obtusus</i>	J
<i>Scenedesmus sp</i>	J
<i>Schroederia setigera</i>	X3
<i>Sphaerocystis schroeteri</i>	F
<i>spherical chlorophyta</i>	NA
<i>Stephanodiscus niagarae</i>	NA
<i>Tetraedron minimum</i>	J
<i>Trachelomonas sp</i>	W2
<i>Ulothrix sp</i>	MP
Unknown colonial chlorophyte	NA

Unknown colonial cyanophyte	NA
Unknown colonial cyanophyte sp 2	NA
unknown elongate chlorophyte	NA
unknown filamentous cyanophyte sp 2	NA
Unknown filamentous cyanophyte 4	NA
unknown spherical chlorophyte	NA
unknown spherical chlorophyte 2	NA
Unknown spherical chlorophyte 3	NA

Appendix 21. Morphological, physiological, and behavioral traits of phytoplankton based on Weithoff (2003), Litchman and Klausmeier (2008), and Abonyi et al. (2017)(Table1).

TABLE 1 Morphological, physiological and behavioural traits of phytoplankton according to Weithoff (2003) and Litchman and Klausmeier (2008)

Traits	Categories	Abbreviation
Morphological traits		
Biovolume	<100 μm^3 , 100–1,000 μm^3 , 1,000–10,000 μm^3 , >10,000 μm^3	Sma, Med, Lar, Xla
Greatest axial linear dimension (GALD)	<35 μm or >35 μm	Gal
Life form	Single celled, colonial, filamentous	Sin, Col, Fil
Physiological traits		
N ₂ fixation	Yes/no	N2f
Si requirements	Yes/no	Sil
Mixotrophy (phagotrophy)	Yes/no	Mix
Heterotrophy	Yes/no	Het
Pigment composition	Chl- <i>b</i> , Chl- <i>c</i> , phycobiliproteins	ChlB, ChlC, Phy
Behavioural traits		
Motility	Presence/absence of flagella	Fla
Vacuolated	Yes/no	Vac

Appendix 22. Morphological, physiological, and behavioral traits of Utah Lake phytoplankton in 2017 and 2018 based on Weithoff (2003), Litchman and Klausmeier (2008), and Abonyi et al. (2017)(Table1). See Appendix 21 for descriptions of traits. 1 = yes; 0 = no.

Species	Small	Medium	Large	Extra large	GA LD	Flagella	Singular	Colonial	Filamentous	Mixotrophy	Heterotrophy	Si_requirement	Vacuolated	N2_fixation	CHL-B	CHL-C	Phycobiliproteins
<i>Actinastrum hantzschii</i>	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Acutodesmis obliquus</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Acutodesmus dimorphus</i>	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Acutodesmus pectinatus</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Anabaenopsis</i> sp	0	0	1	0	1	0	0	0	1	0	0	0	1	1	0	0	1
<i>Ankistrodesmus falcatus</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Ankyra judayi</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Aphanizomenon flos aquae</i>	0	0	1	0	1	0	0	0	1	0	0	0	1	1	0	0	1
<i>Aphanocapsa</i> sp	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Aphanothece</i> sp	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Asterionella formosa</i>	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
<i>Biddulphia laevis</i>	1	0	0	0	1	0	1	0	1	NA	NA	1	0	0	NA	NA	NA
<i>Botryococcus braunii</i>	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0
<i>Calothrix</i> sp	0	0	0	1	NA	0	0	0	1	NA	NA	0	NA	1	NA	NA	NA
centric diatom sp 2	1	0	0	0	0	0	1	0	0	NA	NA	1	0	0	NA	NA	NA
centric diatoms	1	0	0	0	0	0	1	0	0	NA	NA	1	0	0	NA	NA	NA
<i>Ceratium hirundinella</i>	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	1	0
<i>Characiopsis</i> sp	1	0	0	0	0	0	1	0	0	NA	NA	0	NA	0	NA	NA	NA
<i>Chlamydomonas</i> sp	0	1	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0
<i>Chroococcus dispersus</i>	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Chrysocapsa planktonica</i>	1	0	0	0	0	NA	0	1	0	NA	NA	NA	NA	NA	NA	NA	NA
<i>Closteriopsis longissima</i>	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0
<i>Closteriopsis longissima</i> var <i>tropica</i>	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0
<i>Coelastrum microporum</i>	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Coelastrum</i> sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Coelosphaerium</i> sp	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1

Crucigenia fenestrata	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Crucigenia quadrata	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Crucigenia rectangularis	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Crucigenia sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Crucigenia tetrapedia	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Crucigeniella rectangularis	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Cryptomonas sp	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	1
Cryptomonas sp 2	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	1
Cyanodictyon planktonicum	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Cylindrospermopsis sp	1	0	0	0	0	0	0	0	1	NA	NA	0	NA	1	NA	NA	NA
Cyllindarospemopsis catemaco	1	0	0	0	0	0	0	0	1	NA	NA	0	NA	1	NA	NA	NA
Cyllindarospemopsis catemca	1	0	0	0	0	0	0	0	1	NA	NA	0	NA	1	NA	NA	NA
Desmidium sp	0	1	0	0	0	0	0	0	1	NA	NA	0	NA	0	NA	NA	NA
Desmodesmus aculeolatus	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus bicellularis	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus communis	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus intermedius	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus obtusus	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus opoliensis	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus protrubans	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desmodesmus sp	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	0	NA	NA	NA
Desodesmus bicellularis	0	1	0	0	0	0	0	1	0	NA	NA	NA	NA	NA	NA	NA	NA
Dinobryon divergens	0	1	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0
Dolichospermum crassa	1	0	0	0	0	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Dolichospermum flosaquae	1	0	0	0	0	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Euglena sp	0	0	1	0	1	1	1	0	0	1	0	0	0	0	1	0	0
Fragilaria crotonensis	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0

<i>Fragilaria virescens</i>	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
<i>Gomphosphaeria aponina</i>	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Gomphosphaeria lacustris</i>	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Gymnodinium</i> sp	0	0	1	0	1	1	1	0	0	1	0	0	0	0	0	1	0
<i>Keratococcus</i> sp	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Kirchneriella lunaris</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Kirchneriella</i> sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Lagerheimia</i> sp	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Lepocinclis</i> sp	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>Leptolyngbya</i> sp	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>Leptolyngbya</i> sp 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>Melosira granulata</i>	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
<i>Melosira granulata</i> var <i>angustissima</i>	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
<i>Melosira varians</i>	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	1	0
<i>Merismopedia glauca</i>	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Merismopedia</i> sp	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
<i>Micractinium</i> sp	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0
<i>Microcystis aeruginosa</i>	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	1
<i>Microcystis flos aquae</i>	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	0	1
<i>Microcystis incerta</i>	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	1
<i>Microcystis</i> sp	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	1
<i>Microspora</i> sp	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>Monoraphidium arcuatum</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Monoraphidium</i> <i>contortum</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Monoraphidium</i> <i>convolutum</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Monoraphidium</i> <i>dybowski</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Monoraphidium griffithii</i>	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0

Monoraphidium irregulare	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Monoraphidium komarkovae	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Monoraphidium sp	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Nitzschia acicularis	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0
Nitzschia reversa	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0
Oocystis borgei	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Oocystis lacustris	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Oocystis sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Oocystis sp 2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Oocystis sp 3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Oscillatoria sp	0	0	0	1	NA	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Pandorina morum	0	0	1	0	1	1	0	1	0	1	0	0	0	0	1	0	0
Pediastrum duplex	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0
Pediastrum duplex var clathratum	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0
Pediastrum sp	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0
pennate diatoms	1	0	0	0	NA	0	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA
Phacus sp	0	0	1	0	1	1	1	0	0	1	0	0	0	0	1	0	0
Phormidium formosum	0	0	0	1	NA	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Phormidium sp	0	0	0	1	NA	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Phormidium sp 3	0	0	0	1	NA	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Phormidium sp 4	0	0	0	1	NA	0	0	0	1	NA	NA	NA	NA	1	NA	NA	NA
Pseudanabaena sp	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Quadrigula lacustris	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Quadrigula sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Scenedesmus ellipticus	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Scenedesmus obtusus	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Scenedesmus sp	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0

Schroederia setigera	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0
Sphaerocystis schroeteri	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
spherical chlorophyta	0	1	0	0	NA	NA	1	0	0	NA	NA	0	NA	0	NA	NA	NA
Stephanodiscus niagarae	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0
Tetraedron minimum	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Trachelomonas sp	0	0	1	0	0	1	1	0	0	1	0	0	0	0	1	0	0
Ulothrix sp	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0
Unknown colonial chlorophyte	0	0	1	0	NA	NA	0	1	0	NA	NA	0	NA	0	NA	NA	NA
Unknown colonial cyanophyte	0	0	1	0	NA	NA	0	1	0	NA	NA	0	NA	1	NA	NA	NA
Unknown colonial cyanophyte sp 2	0	0	1	0	NA	NA	0	1	0	NA	NA	0	NA	1	NA	NA	NA
unknown elongate chlorophyte	0	1	0	0	NA	NA	1	0	0	NA	NA	0	NA	0	NA	NA	NA
unknown filamentous cyanophyta sp 2	0	0	0	1	NA	NA	0	0	1	NA	NA	0	NA	1	NA	NA	NA
Unknown filamentous cyanophyte 4	0	0	0	1	NA	NA	0	0	1	NA	NA	0	NA	1	NA	NA	NA
unknown spherical chlorophyta	0	1	0	0	NA	NA	1	0	0	NA	NA	0	NA	0	NA	NA	NA
unknown spherical chlorophyta 2	0	1	0	0	NA	NA	1	0	0	NA	NA	0	NA	0	NA	NA	NA
Unknown spherical chlorophyte 3	0	1	0	0	NA	NA	1	0	0	NA	NA	0	NA	0	NA	NA	NA

2018 Phytoplankton

Appendix 23. Phytoplankton taxa that were deleted for final NMS ordination Utah Lake 2018. Taxa codes are in Appendix 1 and 2.

Deletion of 59 taxa

ACOB	ACSP	ANSP	APGR	APPL	APTSP
AUGR	AUGRA	CASP			
CHSP	CHLM	CHRL	CHMI	CHRS	CLLT
CONA	COPL	CRTE			
CYPL	DEBID	DEMI	DEOPM	DIPA	ERGI
FRCR	GLEO	KISP2			
LEAC	MEGR	MIAE	MOCOV	MODY	NELI
OOGI	OOS2	PEBO			
PEDC	PECI	PES2	PHS4	PHSP5	PLSP
PLAG	PSSP	QULA			
QUSP	SPSP	STS3	TELA	TECA	TEMI
TESP	TETR	UNCY2			
UNC2	UNC3	UNDI	UNFC2	WIRE	

Appendix 24. NMS measures of fit for phytoplankton NMS ordination Utah Lake 2018.

MEASURES OF FIT

R^2_n (nonmetric fit) = 0.9886 Intrinsic measure for NMS. Null: all points co-located.

R^2_l (linear fit) = 0.9467 Null: all ordination distances equal.

R^2_m (metric fit) = 0.9333 Null: no linear relationship with observed dissimilarities.

CHANCE-CORRECTED EVALUATIONS

Improvement: I = 0.7462

Null model: final configuration no better than initial random configuration.

Interpretation: 0 = random expectation, 1 = perfect fit, <0 = worse than random expectation

Basis:

2 dimensions

250 = number of random initial configurations used

42.1119 = average initial stress

10.6886 = final stress

Association: A = 0.5314

Null model: relationships among columns no stronger than expected chance, based on shuffling within columns.

Interpretation: 0 = random expectation, 1 = perfect fit, <0 = worse than random expectation

Basis:

2 dimensions

500 = number of randomizations used

22.8081 = average final stress from randomizations

10.6886 = final stress

Appendix 25. Multiple response permutation procedure results for phytoplankton assemblages in Utah Lake 2018 by month.

		T	A	p
June vs.	March	-1.31	0.04	0.1
June vs.	July	-3.05	0.06	0.02
June vs.	August	-5.06	0.13	0.00
March vs.	July	-1.72	0.07	0.07
March vs.	August	-4.74	0.32	0.00
July vs.	August	-5.00	0.17	0.00

Appendix 26. Multiple response permutation procedure results for phytoplankton assemblages in Utah Lake 2018 by site.

			T	A	p
LP	vs.	PB	-8.77	0.33	0.00
LP	vs.	GB	0.71	-0.02	0.74
LP	vs.	LM	-3.55	0.08	0.01
LP	vs.	ULSP	-3.03	0.10	0.01
LP	vs.	LB	-3.15	0.15	0.01
PB	vs.	GB	-4.80	0.23	0.00
PB	vs.	LM	-5.78	0.19	0.00
PB	vs.	ULSP	-1.97	0.10	0.05
PB	vs.	LB	-1.87	0.14	0.05
GB	vs.	LM	-0.29	0.01	0.34
GB	vs.	ULSP	-0.38	0.02	0.33
GB	vs.	LB	-0.69	0.07	0.22
LM	vs.	ULSP	-0.02	0.00	0.44
LM	vs.	LB	-0.59	0.03	0.24
ULSP	vs.	LB	-0.01	0.00	NaN

Appendix 27. Some descriptive statistics of phytoplankton samples in Utah Lake 2018. Taxa richness (S), Evenness (E), Shannon's Diversity (H), and Simpson's Diversity (D).

Site Code	Mean	Stand.Dev.	Sum	Minimum	Maximum	S	E	H'	D
LP1aJun18	1.506	8.942	179.200	0.000	89.600	6.000	0.830	1.487	0.698
PBMar18	109.788	416.456	13064.800	0.000	2478.000	29.000	0.715	2.408	0.872
GBMar18	32.494	190.007	3866.800	0.000	1542.800	14.000	0.595	1.571	0.707
PB1Mar18	18.918	100.784	2251.200	0.000	929.600	19.000	0.622	1.831	0.755
PBApr18	30.706	190.842	3654.000	0.000	1708.000	17.000	0.508	1.440	0.670
LMMar18	37.835	271.840	4502.400	0.000	2912.000	14.000	0.531	1.401	0.561
LMJun18	7.765	41.218	924.000	0.000	394.800	9.000	0.787	1.729	0.757
LMaJun18	46.353	433.968	5516.000	0.000	4720.800	9.000	0.291	0.639	0.261

LP2Jun18	3.176	18.941	378.000	0.000	179.200	8.000	0.710	1.477	0.695
LP3aJun18	3.059	24.975	364.000	0.000	268.800	5.000	0.575	0.926	0.436
ULSPJun18	15.224	100.342	1811.600	0.000	921.200	5.000	0.696	1.120	0.630
PBJun18	2136.353	16304.633	254225.969	0.000	177133.594	37.000	0.396	1.429	0.506
PBaJun18	3460.165	25925.322	411759.594	0.000	281755.594	48.000	0.394	1.523	0.524
PBbJun18	812.141	5069.201	96644.805	0.000	54040.000	29.000	0.531	1.787	0.667
PBcJun18	1414.988	11935.397	168383.625	0.000	130152.398	38.000	0.328	1.192	0.399
LMbJun18	148.541	485.885	17676.400	0.000	3458.000	22.000	0.846	2.616	0.902
LP1bJun18	40.659	316.285	4838.399	0.000	3416.000	17.000	0.425	1.203	0.487
LP3bJun18	7.106	49.859	845.600	0.000	512.400	15.000	0.482	1.306	0.581
LMcJun18	17.671	55.609	2102.800	0.000	313.600	26.000	0.818	2.664	0.909
GBJun18	8.729	49.478	1038.800	0.000	448.000	10.000	0.685	1.576	0.724
PBdJun18	2498.847	17797.252	297362.813	0.000	184766.406	33.000	0.396	1.385	0.569
LBMJul18	339.200	1342.655	40364.801	0.000	8554.000	21.000	0.721	2.196	0.861
SBJul18	442.000	2200.064	52598.004	0.000	20266.400	34.000	0.586	2.065	0.785
ULSPJul18	305.835	1019.428	36394.398	0.000	8601.600	36.000	0.778	2.788	0.899
GBJul18	303.600	2739.585	36128.398	0.000	29719.199	17.000	0.256	0.726	0.313
LMJul18	1058.706	5171.566	125986.000	0.000	52852.801	36.000	0.638	2.286	0.793
LMoJul18	355.976	1439.684	42361.199	0.000	13160.000	22.000	0.761	2.351	0.855
LP1Jul18	529.929	5615.603	63061.602	0.000	61264.000	13.000	0.065	0.167	0.056
LP2Jul	428.047	4555.902	50937.602	0.000	49702.801	13.000	0.056	0.144	0.048
LP3Jul18	192.635	2004.535	22923.604	0.000	21862.400	12.000	0.096	0.239	0.089
PBJul18	2149.482	9941.363	255788.391	0.000	92316.000	30.000	0.630	2.144	0.813
LMAug18	1742.306	10007.506	207334.391	0.000	104384.000	32.000	0.561	1.944	0.717
ULSPAUG18	1063.341	5320.348	126537.602	0.000	53312.000	23.000	0.650	2.039	0.783
PBAUG18	1003.012	7184.214	119358.406	0.000	77946.398	26.000	0.498	1.623	0.564
GBAUG18	2472.094	23289.322	294179.156	0.000	253612.797	24.000	0.205	0.653	0.252
LBAUG18	3028.893	25238.643	360438.313	0.000	274400.000	36.000	0.319	1.142	0.413

Appendix 28. Best fit truncated Poisson regression model for phytoplankton taxa richness (*S*) in Utah Lake 2018.

Truncated Poisson regression		Number of obs	=	36	
Limits:	lower =	0	Wald chi2(9)	=	.
	upper =	+inf	Prob > chi2	=	.
Log pseudolikelihood	=	-104.42859	Pseudo R2	=	0.4502

S	Robust					
	IRR	Std. Err.	z	P> z	[95% Conf. Interval]	
monthcode						
March	1.00	(base)				
April	0.71	0.11	-2.31	0.02	0.53	0.95
June	1.07	0.23	0.33	0.74	0.70	1.65
July	1.33	0.00	8.5e+06	0.00	1.33	1.33
August	2.29	0.00	1.3e+07	0.00	2.29	2.29
sitecode						
L-P	1.00	(base)				
PB	2.53	0.38	6.14	0.00	1.88	3.40
GB	1.47	0.03	17.79	0.00	1.41	1.54
LM	1.47	0.03	17.79	0.00	1.41	1.54
ULSP	1.06	0.02	2.64	0.01	1.01	1.11
LB	1.66	0.04	23.20	0.00	1.59	1.73
SB	2.68	0.06	45.31	0.00	2.57	2.80
monthcode#sitecode						
March#L-P	1.00	(empty)				
March#PB	1.00	(base)				
March#GB	1.00	(base)				
March#LM	1.00	(base)				
March#ULSP	1.00	(empty)				
March#LB	1.00	(empty)				
March#SB	1.00	(empty)				
April#L-P	1.00	(empty)				
April#GB	1.00	(empty)				
April#LM	1.00	(empty)				
April#ULSP	1.00	(empty)				
April#LB	1.00	(empty)				
April#SB	1.00	(empty)				
June#L-P	1.00	(base)				
June#PB	1.44	0.40	1.31	0.19	0.84	2.46
June#GB	0.67	0.14	-1.87	0.06	0.43	1.02
June#LM	1.10	0.35	0.29	0.77	0.59	2.06
June#ULSP	0.46	0.10	-3.57	0.00	0.30	0.70
June#LB	1.00	(empty)				
June#SB	1.00	(empty)				
July#L-P	1.00	(base)				
July#PB	0.94	0.14	-0.43	0.67	0.70	1.26
July#GB	0.91	0.00	-1.1e+06	0.00	0.91	0.91
July#LM	1.55	0.27	2.55	0.01	1.11	2.18
July#ULSP	2.68	0.00	2.9e+07	0.00	2.68	2.68
August#L-P	1.00	(empty)				
August#PB	0.47	0.07	-5.00	0.00	0.35	0.64
August#GB	0.75	0.00	-9.2e+06	0.00	0.75	0.75
August#SB	1.00	(empty)				
_cons	9.50	0.21	103.31	0.00	9.10	9.91