

# Kotzebue Phytoplankton Community Composition in September-October 2019

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```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.2
```

```
## Warning: package 'tidyr' was built under R version 4.3.3
```

```
## Warning: package 'readr' was built under R version 4.3.3
```

```
## Warning: package 'dplyr' was built under R version 4.3.3
```

```
## Warning: package 'stringr' was built under R version 4.3.3
```

```
library(openintro)
```

```
## Warning: package 'openintro' was built under R version 4.3.2
```

```
## Warning: package 'airports' was built under R version 4.3.2
```

```
## Warning: package 'cherryblossom' was built under R version 4.3.2
```

```
## Warning: package 'usdata' was built under R version 4.3.2
```

```
library(dplyr)
```

```
library(ggplot2)
```

```
library(readr)
```

## Introduction

For my independent project, I compared phytoplankton community compositions between two of five sites in Kotzebue, Alaska that I will be assessing for my thesis. The goal of this project is to determine what environmental factors influence phytoplankton composition in the Kotzebue Sound, an aquatic region that can reflect anthropogenic activity in addition to natural systems (i.e. freshwater and nutrient input from rivers and streams). The motivation for this project came from a concern of “green slime” on the surface of the water near coastal Kotzebue- an indicator of possible harmful algae blooms which has never observed before around Kotzebue. By recording the phytoplankton community composition of Kotzebue, we can finally get a picture of what phytoplankton species reside in this region and how prominent harmful algae species may be, if any.

## Aim 2: Enumerate and Identify Phytoplankton

Starting with samples taken in 2019, we will build a “portfolio” of phytoplankton species of the Kotzebue Sound. The small dataset used for this independent project has phytoplankton counts from Kotzebue Lagoon and Kotzebue Shore from September to October of 2019. More details are in the dataset card here: <https://github.com/morenomg02/Alaska-HABs/blob/main/DATA/dataset-card.pdf>

## Aim 2: Enumerate and Identify Phytoplankton

Null hypothesis: Each site will have a different dominant phytoplankton species.

Alternative hypothesis: Both sites will have the same dominant phytoplankton species.

The data is displayed as stacked barplots, one for each site. Different colors represent different phytoplankton identified from lagoon and shore samples from 2019. I anticipate to see each sample site to have a different phytoplankton species dominate the community composition given the differences in locations (the lagoon is closed off and the shore is coastal). I will use an ANOVA test to determine if both sites have different or the same dominant phytoplankton species.

```
kotz_samples <- read.csv("kotz_samples.csv")
```

```
kotz_samples
```

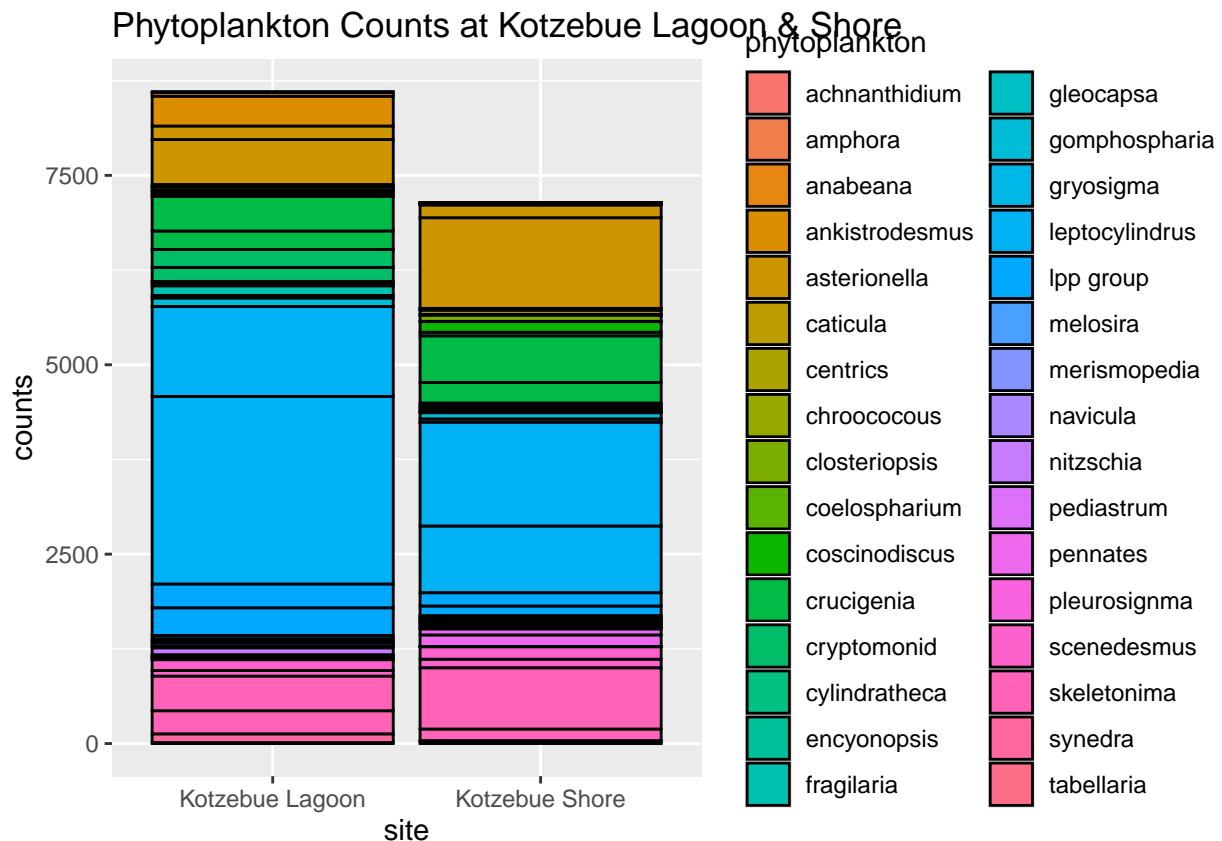
##		date	site	phytoplankton	counts
## 1	9/11/2019	Kotzebue	Lagoon	asterionella	596
## 2	9/11/2019	Kotzebue	Lagoon	leptocylindrus	2478
## 3	9/11/2019	Kotzebue	Lagoon	skeletonima	308
## 4	9/11/2019	Kotzebue	Lagoon	lpp group	366
## 5	9/11/2019	Kotzebue	Lagoon	nitzschia	94
## 6	9/11/2019	Kotzebue	Lagoon	ankistrodesmus	396
## 7	9/11/2019	Kotzebue	Lagoon	scenedesmus	76
## 8	9/11/2019	Kotzebue	Lagoon	cylindratheca	41
## 9	9/11/2019	Kotzebue	Lagoon	crucigenia	245
## 10	9/11/2019	Kotzebue	Lagoon	gomphospharia	114
## 11	9/11/2019	Kotzebue	Lagoon	pediastrum	10
## 12	9/11/2019	Kotzebue	Lagoon	cryptomonid	186
## 13	9/11/2019	Kotzebue	Lagoon	centrics	14
## 14	9/11/2019	Kotzebue	Lagoon	navicula	43
## 15	9/11/2019	Kotzebue	Lagoon	coscinodiscus	21
## 16	9/11/2019	Kotzebue	Lagoon	pleurosigma	10
## 17	9/11/2019	Kotzebue	Lagoon	chroococcus	24
## 18	9/11/2019	Kotzebue	Lagoon	fragilaria	126
## 19	9/11/2019	Kotzebue	Lagoon	synedra	114
## 20	9/11/2019	Kotzebue	Lagoon	melosira	44
## 21	9/17/2019	Kotzebue	Lagoon	asterionella	176
## 22	9/17/2019	Kotzebue	Lagoon	crucigenia	455
## 23	9/17/2019	Kotzebue	Lagoon	leptocylindrus	1186
## 24	9/17/2019	Kotzebue	Lagoon	lpp group	312
## 25	9/17/2019	Kotzebue	Lagoon	coscinodiscus	35
## 26	9/17/2019	Kotzebue	Lagoon	cylindratheca	18
## 27	9/17/2019	Kotzebue	Lagoon	skeletonima	455
## 28	9/17/2019	Kotzebue	Lagoon	centrics	22
## 29	9/17/2019	Kotzebue	Lagoon	pennates	27
## 30	9/17/2019	Kotzebue	Lagoon	cryptomonid	236

## 31	9/17/2019	Kotzebue Lagoon	scenedesmus	142
## 32	9/17/2019	Kotzebue Lagoon	ankistrodesmus	49
## 33	9/17/2019	Kotzebue Lagoon	gomphospharia	32
## 34	9/17/2019	Kotzebue Lagoon	chroococous	40
## 35	9/17/2019	Kotzebue Lagoon	merismopedia	29
## 36	9/17/2019	Kotzebue Lagoon	nitzschia	21
## 37	9/17/2019	Kotzebue Lagoon	pediastrum	17
## 38	9/17/2019	Kotzebue Lagoon	navicula	25
## 39	9/17/2019	Kotzebue Lagoon	amphora	12
## 40	9/17/2019	Kotzebue Lagoon	tabellaria	11
## 41	10/7/2019	Kotzebue Shore	asterionella	1197
## 42	10/7/2019	Kotzebue Shore	scenedesmus	116
## 43	10/7/2019	Kotzebue Shore	cryptomonid	23
## 44	10/7/2019	Kotzebue Shore	merismopedia	35
## 45	10/7/2019	Kotzebue Shore	skeletonima	156
## 46	10/7/2019	Kotzebue Shore	crucigenia	274
## 47	10/7/2019	Kotzebue Shore	gomphospharia	45
## 48	10/7/2019	Kotzebue Shore	ankistrodesmus	12
## 49	10/7/2019	Kotzebue Shore	coscinodiscus	51
## 50	10/7/2019	Kotzebue Shore	melosira	17
## 51	10/7/2019	Kotzebue Shore	synedra	12
## 52	10/7/2019	Kotzebue Shore	anabeana	9
## 53	10/7/2019	Kotzebue Shore	gryosigma	1
## 54	10/7/2019	Kotzebue Shore	pleurosigma	2
## 55	10/7/2019	Kotzebue Shore	tabellaria	24
## 56	10/7/2019	Kotzebue Shore	centrics	57
## 57	10/7/2019	Kotzebue Shore	cylindratheca	30
## 58	10/7/2019	Kotzebue Shore	pediastrum	12
## 59	10/7/2019	Kotzebue Shore	lpp group	131
## 60	10/7/2019	Kotzebue Shore	pennates	153
## 61	10/7/2019	Kotzebue Shore	melosira	21
## 62	10/7/2019	Kotzebue Shore	leptocylindrus	883
## 63	10/7/2019	Kotzebue Shore	navicula	34
## 64	10/7/2019	Kotzebue Shore	coelospharium	4
## 65	10/7/2019	Kotzebue Shore	chroococous	3
## 66	10/7/2019	Kotzebue Shore	gleocapsa	12
## 67	10/7/2019	Kotzebue Shore	achnanthidium	2
## 68	10/7/2019	Kotzebue Shore	amphora	2
## 69	10/7/2019	Kotzebue Shore	encyonopsis	1
## 70	10/7/2019	Kotzebue Shore	closteriopsis	81
## 71	9/17/2019	Kotzebue Shore	asterionella	165
## 72	9/17/2019	Kotzebue Shore	crucigenia	612
## 73	9/17/2019	Kotzebue Shore	leptocylindrus	1368
## 74	9/17/2019	Kotzebue Shore	lpp group	173
## 75	9/17/2019	Kotzebue Shore	coscinodiscus	139
## 76	9/17/2019	Kotzebue Shore	cylindratheca	27
## 77	9/17/2019	Kotzebue Shore	skeletonima	806
## 78	9/17/2019	Kotzebue Shore	scenedesmus	163
## 79	9/17/2019	Kotzebue Shore	cryptomonid	34
## 80	9/17/2019	Kotzebue Shore	gomphospharia	80
## 81	9/17/2019	Kotzebue Shore	melosira	5
## 82	9/17/2019	Kotzebue Shore	pennates	77
## 83	9/17/2019	Kotzebue Shore	ankistrodesmus	9
## 84	9/17/2019	Kotzebue Shore	pediastrum	22

```
## 85 9/17/2019 Kotzebue Shore centrics 5
## 86 9/17/2019 Kotzebue Shore amphora 2
## 87 9/17/2019 Kotzebue Shore merismopedia 20
## 88 9/17/2019 Kotzebue Shore centrics 7
## 89 9/17/2019 Kotzebue Shore caticula 10
## 90 9/17/2019 Kotzebue Shore navicula 8
## 91 9/17/2019 Kotzebue Shore pleurosigma 2
## 92 9/17/2019 Kotzebue Shore chroococcus 8
```

```
# stacked barplot of lagoon and shore counts
kotz_community <- ggplot(kotz_samples, aes(fill=phytoplankton, y=counts, x=site))+
  geom_bar(position="stack", stat="identity", colour="black")+
  ggtitle("Phytoplankton Counts at Kotzebue Lagoon & Shore")

kotz_community
```



Both sites have almost the same relative proportion of phytoplankton species abundance. The most abundant group for each site is “Leptocylindrus” followed by “Asterionella.”

```
# filter data by location
lagoon <- data.frame(filter(kotz_samples, site=="Kotzebue Lagoon"))
lagoon1 <- aggregate(counts~phytoplankton, data=lagoon, sum)
lagoon1
```

```
## phytoplankton counts
```

```
## 1      amphora      12
## 2 ankistrodesmus  445
## 3      asterionella 772
## 4      centrics    36
## 5      chroococcus  64
## 6      coscinodiscus 56
## 7      crucigenia  700
## 8      cryptomonid 422
## 9      cylindratheca 59
## 10     fragilaria  126
## 11     gomphospharia 146
## 12 leptocylindrus 3664
## 13     lpp group   678
## 14     melosira    44
## 15     merismopedia 29
## 16     navicula    68
## 17     nitzschia   115
## 18     pediatrum   27
## 19     pennates    27
## 20     pleurosigma  10
## 21     scenedesmus 218
## 22     skeletonima 763
## 23     synedra     114
## 24     tabellaria  11
```

```
# finding max of phytoplankton populations
summary(lagoon1)
```

```
## phytoplankton      counts
## Length:24      Min.   : 10.00
## Class :character 1st Qu.: 34.25
## Mode :character  Median : 91.00
##                      Mean   : 358.58
##                      3rd Qu.: 427.75
##                      Max.   :3664.00
```

```
shore <- data.frame(filter(kotz_samples, site=="Kotzebue Shore"))
shore1 <- aggregate(counts~phytoplankton, data=shore,sum)
shore1
```

```
## phytoplankton counts
## 1 achnanthidium      2
## 2      amphora       4
## 3      anabeana       9
## 4 ankistrodesmus     21
## 5 asterionella    1362
## 6      caticula      10
## 7      centrics     69
## 8      chroococcus   11
## 9 closteriopsis     81
## 10 coelospharium     4
## 11 coscinodiscus    190
## 12      crucigenia   886
```

```
## 13 cryptomonid 57
## 14 cylindratheca 57
## 15 encyonopsis 1
## 16 gleocapsa 12
## 17 gomphospharia 125
## 18 gryosigma 1
## 19 leptocylindrus 2251
## 20 lpp group 304
## 21 melosira 43
## 22 merismopedia 55
## 23 navicula 42
## 24 pediastrum 34
## 25 pennates 230
## 26 pleurosigma 4
## 27 scenedesmus 279
## 28 skeletonima 962
## 29 synedra 12
## 30 tabellaria 24
```

```
summary(shore1)
```

```
## phytoplankton counts
## Length:30 Min. : 1.00
## Class :character 1st Qu.: 10.25
## Mode :character Median : 42.50
## Mean : 238.07
## 3rd Qu.: 173.75
## Max. :2251.00
```

## ANOVA analysis

```
two.way <- aov(counts~phytoplankton+site, data=kotz_samples)
```

```
summary(two.way)
```

```
##          Df Sum Sq Mean Sq F value    Pr(>F)
## phytoplankton 31 9085664 293086   6.492 4.44e-10 ***
## site          1  29879   29879   0.662   0.419
## Residuals    59 2663546   45145
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

I reject my null hypothesis b/c of a very small (insignificant) p-value, and both sites have the same dominant phytoplankton species.