

Lake O Call Updates - Select Environmental Parameters

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Load the packages

```
library(readxl)
library(dplyr)
library(tidyverse)
library(ggplot2)
library(ggprism)
```

Load the data

Load past years' data and current quarter's data.

```
ec<-read_excel("~/Desktop/SMS-BEL/SMS-EnvlAnalysis/Data/20221102_UpToOct22Envl (1).xlsx")
jan23e<-read_excel("~/Desktop/SMS-BEL/SMS-EnvlAnalysis/Data/2023.01.09_Jan23EnvlData.xlsx", sheet=2)
```

Tidy the data

Rename and convert turbidity, bottom salinity, bottom oxygen, and bottom temperature values to numeric.

```
ec$turb<-as.numeric(ec$`Turbidity (NTU)`)
ec$bs<-as.numeric(ec$`Bottom salinity (ppt)`)
ec$bo<-as.numeric(ec$`Bottom oxygen`)

jan23e$turb<-as.numeric(jan23e$`Turbidity (NTU)`)
jan23e$bs<-as.numeric(jan23e$`Bottom salinity (ppt)`)
jan23e$bo<-as.numeric(jan23e$`Bottom oxygen`)
```

Add a column that codes sediment firmness as a numeric variable.

```
ec<-ec %>% mutate(sf =
  case_when(Firmness == "very_soft" ~ 1,
            Firmness == "soft" ~ 2,
            Firmness == "medium_stiff" ~ 3,
            Firmness == "stiff" ~ 4,
            Firmness == "very_Stiff" ~ 5))
```

```
jan23e<-jan23e %>% mutate(sf =
  case_when(Firmness == "very_soft" ~ 1,
            Firmness == "soft" ~ 2,
            Firmness == "medium_stiff" ~ 3,
            Firmness == "stiff" ~ 4,
            Firmness == "very_Stiff" ~ 5))
```

Add a column for Quarter based on the numeric value of the month when sampling was performed.

```
ec<-ec %>% mutate(Q =
  case_when(M == 1 ~ 1,
            M == 2 ~ 1,
            M == 4 ~ 2,
            M == 5 ~ 2,
            M == 6 ~ 3,
            M == 7 ~ 3,
            M == 9 ~ 4,
            M == 10 ~ 4))

jan23e <- jan23e %>%
  add_column(Q = 1)
```

Calculate the 95% CIs for one parameter at a time by site and quarter.

Turbidity: Calculate the mean, standard deviation, and n by site and quarter.

```
turbsq <- ec %>%
  group_by(Site,Q) %>%
  summarize(mean=mean(turb, na.rm=TRUE), s=sd(turb, na.rm=TRUE), n=length(na.omit(turb)))
```

Calculate the margin of error by site and quarter.

```
turbs<-turbsq%>%group_by(Site,Q)%>%
  summarize(marg=qt(0.975,df=n-1)*s/sqrt(n))
```

Bind the margin of error data with the calculated means and rename the added column "mean".

```
t<-cbind(turbs, turbsq$mean)
t<-t%>%rename(mean=`...4`)
```

Calculate the 95% CIs by subtracting and adding the margin of error from and to the calculated mean by site and quarter.

```
t2<-t%>%group_by(Site,Q)%>%
  summarize(tlo=mean-marg,thi=mean+marg)
```

Repeat for the remaining parameters (salinity, oxygen, and sediment firmness).

```

#Salinity
bssq <- ec %>%
  group_by(Site, Q) %>%
  summarize(mean=mean(bs, na.rm=TRUE), s=sd(bs, na.rm=TRUE), n=length(na.omit(bs)))

bss<-bssq%>%group_by(Site,Q)%>%
  summarize(marg=qt(0.975,df=n-1)*s/sqrt(n))

bs1<-cbind(bss, bssq$mean)
bs1<-bs1%>%rename(mean=`...4`)

bs2<-bs1%>%group_by(Site,Q)%>%
  summarize(slo=mean-marg,shi=mean+marg)

#Oxygen
bosq <- ec %>%
  group_by(Site, Q) %>%
  summarize(mean=mean(bo, na.rm=TRUE), s=sd(bo, na.rm=TRUE), n=length(na.omit(bo)))

bos<-bosq%>%group_by(Site,Q)%>%
  summarize(marg=qt(0.975,df=n-1)*s/sqrt(n))

bo1<-cbind(bos, bosq$mean)
bo1<-bo1%>%rename(mean=`...4`)

bo2<-bo1%>%group_by(Site,Q)%>%
  summarize(olo=mean-marg,ohi=mean+marg)

#Sediment Firmness
sfsq <- ec %>%
  group_by(Site, Q) %>%
  summarize(mean=mean(sf, na.rm=TRUE), s=sd(sf, na.rm=TRUE), n=length(na.omit(sf)))

sfs<-sfsq%>%group_by(Site,Q)%>%
  summarize(marg=qt(0.975,df=n-1)*s/sqrt(n))

sf1<-cbind(sfs, sfsq$mean)
sf1<-sf1%>%rename(mean=`...4`)

sf2<-sf1%>%group_by(Site,Q)%>%
  summarize(flo=mean-marg,fhi=mean+marg)

```

Bind all of those datasets together and rename the respective newly bound columns.

```

tso <- cbind(t2, bs2$slo)
tso <- cbind(tso, bs2$shi)
tso <- cbind(tso, bo2$olo)
tso <- cbind(tso, bo2$ohi)
tso <- cbind(tso, sf2$flo)
tso <- cbind(tso, sf2$fhi)

```

```
tso <- tso%>%
  rename(slo = `...5`,
         shi = `...6`,
         olo=`...7`,
         ohi=`...8`,
         flo=`...9`,
         fhi=`...10`)
```

Then, filter for the current quarter. Change the number after Q== to reflect the current quarter. (1 = Jan, 2 = Apr, 3 = Jul, 4 = Oct)

```
tso2<-tso%>%filter(Q==1)
```

Then, bind the current quarter's data to the tso2 dataframe and rename those bound columns.

```
tso2 <- cbind(tso2, jan23e$turb)
tso2 <- cbind(tso2, jan23e$bs)
tso2 <- cbind(tso2, jan23e$bo)
tso2 <- cbind(tso2, jan23e$sf)
```

```
tso2 <- tso2%>%
  rename(turb = `...11`,
         bs = `...12`,
         bo=`...13`,
         sf=`...14`)
```

Plot the turbidity data.

```
turb0123<-tso2 %>%
  mutate(Site = factor(Site, levels=c("M15","M01","M02","M14","M04","M03","M05","M06",
    "M07","M08","M09","M10","M11","M12","M13"))) %>%
  ggplot( aes(x=Site, y=turb)) +
  geom_segment( aes(xend=Site,y=tlo, yend=thi),color="grey",alpha=0.6,size=8) +
  geom_point( size=4, color="black",fill="black",shape=15) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
        panel.background = element_blank(), axis.line = element_line(colour = "black"))+
  theme(legend.position = "none")+
  theme(axis.text.x=element_text(face="bold",colour=c("#471164","#471164","#471164", "#471164",
    "#471164", "#F98400", "#F98400", "#F98400", "#F98400", "#F98400", "#46ACC8", "#46ACC8", "#46ACC8",
    "#46ACC8", "#46ACC8", "#46ACC8" )),
        plot.margin = margin(0.1, 0, 0, 0.1, "cm"))+
  labs(x=NULL, y=NULL)+
  ggtitle("Turbidity (NTU)") +
  theme(plot.title = element_text(hjust = 0.5,size=14))+
  scale_x_discrete(guide = guide_prism_bracket(outside=FALSE))
```

Save the plot as a jpg.

```

ggsave(
  "Jan23_Turb.jpg",#file name
  plot = turb0123,#plot to save, defaults to last plot displayed
  device = "jpg",#file format (jpg, pdf, png, eps, etc)
  path = NULL, #defaults to working directory
  scale = 1,
  width =12,
  height = 8,
  units = "cm", #c("in", "cm", "mm", "px")
  dpi = 300,
  limitsize = TRUE)

```

Plot the salinity data.

```

sal0123<-tso2 %>%
  mutate(Site = factor(Site, levels=c("M15","M01","M02","M14","M04","M03","M05","M06",
    "M07","M08","M09","M10","M11","M12","M13"))) %>%
  ggplot( aes(x=Site, y=bs)) +
  geom_segment( aes(xend=Site,y=slo, yend=shi),color="grey",alpha=0.6,size=8) +
  geom_point( size=4, color="black",fill="black",shape=15) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
    panel.background = element_blank(), axis.line = element_line(colour = "black"))+
  theme(legend.position = "none")+
  theme(axis.text.x=element_text(face="bold",colour=c("#471164","#471164","#471164", "#471164",
    "#471164","#F98400","#F98400","#F98400","#F98400","#F98400","#46ACC8", "#46ACC8", "#46ACC8",
    "#46ACC8", "#46ACC8", "#46ACC8" )),
    plot.margin = margin(0.1, 0, 0, 0.1, "cm"))+
  labs(x=NULL, y=NULL)+
  ggtitle("Salinity (ppt)") +
  theme(plot.title = element_text(hjust = 0.5,size=14))+
  scale_x_discrete(guide = guide_prism_bracket(outside=FALSE))

```

Save the plot as a jpg.

```

ggsave(
  "Jan23_Sal.jpg",#file name
  plot = sal0123,#plot to save, defaults to last plot displayed
  device = "jpg",#file format (jpg, pdf, png, eps, etc)
  path = NULL, #defaults to working directory
  scale = 1,
  width =12,
  height = 8,
  units = "cm", #c("in", "cm", "mm", "px")
  dpi = 300,
  limitsize = TRUE)

```

Plot the oxygen data.

```
bo0123<-tso2 %>%
  mutate(Site = factor(Site, levels=c("M15","M01","M02","M14","M04","M03","M05","M06",
    "M07","M08","M09","M10","M11","M12","M13"))) %>%
  ggplot( aes(x=Site, y=bo)) +
  geom_segment( aes(xend=Site,y=olo, yend=ohi),color="grey",alpha=0.6,size=8) +
  geom_point( size=4, color="black",fill="black",shape=15) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
    panel.background = element_blank(), axis.line = element_line(colour = "black"))+
  theme(legend.position = "none")+
  theme(axis.text.x=element_text(face="bold",colour=c("#471164","#471164","#471164", "#471164",
    "#471164","#F98400","#F98400","#F98400","#F98400","#F98400","#46ACC8", "#46ACC8", "#46ACC8",
    "#46ACC8", "#46ACC8", "#46ACC8" )),
    plot.margin = margin(0.1, 0, 0, 0.1, "cm"))+
  labs(x=NULL, y=NULL)+
  ggtitle("Dissolved Oxygen (mg/L)") +
  theme(plot.title = element_text(hjust = 0.5,size=14))+
  scale_x_discrete(guide = guide_prism_bracket(outside=FALSE))
```

Save the plot as a jpg.

```
ggsave(
  "Jan23_BDO.jpg",#file name
  plot = bo0123,#plot to save, defaults to last plot displayed
  device = "jpg",#file format (jpg, pdf, png, eps, etc)
  path = NULL, #defaults to working directory
  scale = 1,
  width =12,
  height = 8,
  units = "cm", #c("in", "cm", "mm", "px")
  dpi = 300,
  limitsize = TRUE)
```

Plot the sediment firmness data.

First, convert the sediment firmness variable into a factor for plotting purposes.

```
tso2$sf<-as.factor(tso2$sf)
```

Plot sediment firmness.

```
sf0123<-tso2 %>%
  mutate(Site = factor(Site, levels=c("M15","M01","M02","M14","M04","M03","M05","M06",
    "M07","M08","M09","M10","M11","M12","M13"))) %>%
  ggplot( aes(x=Site, y=sf)) +
  geom_segment( aes(xend=Site,y=flo, yend=fhi),color="grey",alpha=0.6,size=8) +
  geom_point( size=4, color="black",fill="black",shape=15) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
    panel.background = element_blank(), axis.line = element_line(colour = "black"))+
  scale_y_discrete(labels = c("Very Soft","Soft", "Med Stiff","Stiff","Very Stiff"))+
  scale_x_discrete(guide = guide_prism_bracket(outside=FALSE))+
  theme(axis.text.y = element_text(angle = 45))+
```

```

theme(legend.position = "none")+
theme(axis.text.x=element_text(face="bold",colour=c("#471164", "#471164", "#471164", "#471164",
"#471164", "#F98400", "#F98400", "#F98400", "#F98400", "#F98400", "#46ACC8", "#46ACC8", "#46ACC8",
"#46ACC8", "#46ACC8", "#46ACC8" )),
      plot.margin = margin(0.1, 0, 0, 0.1, "cm"))+
labs(x=NULL, y=NULL)+
ggtitle("Sediment Firmness") +
theme(plot.title = element_text(hjust = 0.5,size=14))

```

Save the plot.

```

ggsave(
  "Jan23_SedFirmness.jpg", #file name
  plot = sf0123, #plot to save, defaults to last plot displayed
  device = "jpg", #file format (jpg, pdf, png, eps, etc)
  path = NULL, #defaults to working directory
  scale = 1,
  width = 12,
  height = 8,
  units = "cm", #c("in", "cm", "mm", "px")
  dpi = 300,
  limitsize = TRUE)

```





