SporesByDepthAllLakes

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# Initial stuff, including loading packages and importing data

##loading packages

library(tidyverse)  
library(here)  
library(ggpubr)  
library(ggplot2)  
library(dplyr)  
library(lubridate)  
library(scales)  
library(reshape2)  
library(RColorBrewer)

## loading files

# Tell R where files are stored  
here::i\_am("scripts/SporesByDepthAllLakes.Rmd")  
  
# Load Files  
a <- readr::read\_csv(here("data/SporeConcentrationsByDepthLocations.csv"))

## Making a 30-panel figure

col2 <-c("0"= "#AEC5DE", "1"= "#C6DBEF", "2"="#9ECAE1", "3"="#6BAED6","4"= "#4292C6","5"= "#2171B5","6"= "#084594", "7"="#08306B")  
col3 <- c( "0"="#F7FDFA", "1"= "#EFEFEF","2"= "#DFDFDF","3"= "#CFCFCF","4"= "#BFBFBF","5"= "#AFAFAF",  
 "6"= "#9F9F9F","7"= "#8F8F8F","8"= "#7F7F7F","9"= "#6F6F6F","10"= "#5F5F5F",  
 "11"= "#4F4F4F","12"= "#3F3F3F","13"= "#2F2F2F","14"= "#1F1F1F","15"= "#0F0F0F","16"= "#000000")  
  
######### Cedar  
cb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="Cedar",  
 Location == "Basin")  
  
conccb <- cb$ConcentrationLog10Plus1  
pcb <- cb$Parasite  
dcb <- cb$Depth  
dcb <- as.factor(dcb)  
yycb <- strptime(cb$Date, format = "%m/%d/%y")  
lcb <- as.POSIXct(yycb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
cedar.brood <- ggplot(cb) +  
 geom\_point(aes(x=lcb,y=conccb, group=dcb,color=dcb), size=.5) +  
 geom\_smooth(aes(x=lcb,y=conccb, group=dcb, color=dcb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Cedar:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(legend.title = element\_text(face = "bold",size = 8),  
 legend.text=element\_text(size=6),  
 legend.position = "bottom") + guides(color=guide\_legend(nrow=4,byrow=FALSE))+   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Cedar MicG  
co = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="Cedar",  
 Location == "Basin")  
  
concco <- co$ConcentrationLog10Plus1  
pco <- co$Parasite  
dco <- co$Depth  
dco <- as.factor(dco)  
yyco <- strptime(co$Date, format = "%m/%d/%y")  
lco <- as.POSIXct(yyco,format="%m/%d/%y",tz=Sys.timezone())  
  
  
cedar.micg <- ggplot(co) +  
 geom\_point(aes(x=lco,y=concco, group=dco,color=dco), size=.5) +  
 geom\_smooth(aes(x=lco,y=concco, group=dco, color=dco),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Cedar:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Cedar Metsch  
cm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="Cedar",  
 Location == "Basin")  
  
conccm <- cm$ConcentrationLog10Plus1  
pcm <- cm$Parasite  
dcm <- cm$Depth  
dcm <- as.factor(dcm)  
yycm <- strptime(cm$Date, format = "%m/%d/%y")  
lcm <- as.POSIXct(yycm,format="%m/%d/%y",tz=Sys.timezone())  
  
  
cedar.metsch <- ggplot(cm) +  
 geom\_point(aes(x=lcm,y=conccm, group=dcm,color=dcm), size=.5) +  
 geom\_smooth(aes(x=lcm,y=conccm, group=dcm, color=dcm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Cedar:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(legend.title = element\_text(face = "bold",size = 8),  
 legend.text=element\_text(size=6,face="bold"),  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
  
####### Cedar Past  
  
cp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="Cedar",  
 Location == "Basin")  
  
conccp <- cp$ConcentrationLog10Plus1  
pcp <- cp$Parasite  
dcp <- cp$Depth  
dcp <- as.factor(dcp)  
yycp <- strptime(cp$Date, format = "%m/%d/%y")  
lcp <- as.POSIXct(yycp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
cedar.past <- ggplot(cp) +  
 geom\_point(aes(x=lcp,y=conccp, group=dcp,color=dcp), size=.5) +  
 geom\_smooth(aes(x=lcp,y=conccp, group=dcp, color=dcp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Cedar:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Cedar Spiro  
  
cs = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="Cedar",  
 Location == "Basin")  
  
conccs <- cs$ConcentrationLog10Plus1  
pcs <- cs$Parasite  
dcs <- cs$Depth  
dcs <- as.factor(dcs)  
yycs <- strptime(cs$Date,format = "%m/%d/%y")  
lcs <- as.POSIXct(yycs,format="%m/%d/%y",tz=Sys.timezone())  
  
  
cedar.spiro <- ggplot(cs) +  
 geom\_point(aes(x=lcs,y=conccs, group=dcs,color=dcs), size=.5) +  
 geom\_smooth(aes(x=lcs,y=conccs, group=dcs, color=dcs),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Cedar:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Mill  
  
mb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="Mill",  
 Location == "Basin")  
  
concmb <- mb$ConcentrationLog10Plus1  
pmb <- mb$Parasite  
dmb <- mb$Depth  
dmb <- as.factor(dmb)  
yymb <- strptime(mb$Date, format = "%m/%d/%y")  
lmb <- as.POSIXct(yymb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
mill.brood <- ggplot(mb) +  
 geom\_point(aes(x=lmb,y=concmb, group=dmb,color=dmb), size=.5) +  
 geom\_smooth(aes(x=lmb,y=concmb, group=dmb, color=dmb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Mill:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Mill MicG  
mo = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="Mill",  
 Location == "Basin")  
  
concmo <- mo$ConcentrationLog10Plus1  
pmo <- mo$Parasite  
dmo <- mo$Depth  
dmo <- as.factor(dmo)  
yymo <- strptime(mo$Date, format = "%m/%d/%y")  
lmo <- as.POSIXct(yymo,format="%m/%d/%y",tz=Sys.timezone())  
  
  
mill.micg <- ggplot(mo) +  
 geom\_point(aes(x=lmo,y=concmo, group=dmo,color=dmo), size=.5) +  
 geom\_smooth(aes(x=lmo,y=concmo, group=dmo, color=dmo),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Mill:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Mill Metsch  
mm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="Mill",  
 Location == "Basin")  
  
concmm <- mm$ConcentrationLog10Plus1  
pmm <- mm$Parasite  
dmm <- mm$Depth  
dmm <- as.factor(dmm)  
yymm <- strptime(mm$Date, format = "%m/%d/%y")  
lmm <- as.POSIXct(yymm,format="%m/%d/%y",tz=Sys.timezone())  
  
mill.metsch <- ggplot(mm) +  
 geom\_point(aes(x=lmm,y=concmm, group=dmm,color=dmm), size=.5) +  
 geom\_smooth(aes(x=lmm,y=concmm, group=dmm, color=dmm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Mill:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
####### Mill Past  
  
mp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="Mill",  
 Location == "Basin")  
  
concmp <- mp$ConcentrationLog10Plus1  
pmp <- mp$Parasite  
dmp <- mp$Depth  
dmp <- as.factor(dmp)  
yymp <- strptime(mp$Date, format = "%m/%d/%y")  
lmp <- as.POSIXct(yymp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
mill.past <- ggplot(mp) +  
 geom\_point(aes(x=lmp,y=concmp, group=dmp,color=dmp), size=.5) +  
 geom\_smooth(aes(x=lmp,y=concmp, group=dmp, color=dmp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Mill:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Mill Spiro  
  
ms = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="Mill",  
 Location == "Basin")  
  
concms <- ms$ConcentrationLog10Plus1  
pms <- ms$Parasite  
dms <- ms$Depth  
dms <- as.factor(dms)  
yyms <- strptime(ms$Date, format = "%m/%d/%y")  
lms <- as.POSIXct(yyms,format="%m/%d/%y",tz=Sys.timezone())  
  
  
mill.spiro <- ggplot(ms) +  
 geom\_point(aes(x=lms,y=concms, group=dms,color=dms), size=.5) +  
 geom\_smooth(aes(x=lms,y=concms, group=dms, color=dms),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-17")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Mill:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Walsh  
  
wb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="Walsh",  
 Location == "Basin")  
  
concwb <- wb$ConcentrationLog10Plus1  
pwb <- wb$Parasite  
dwb <- wb$Depth  
dwb <- as.factor(dwb)  
yywb <- strptime(wb$Date, format = "%m/%d/%y")  
lwb <- as.POSIXct(yywb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
walsh.brood <- ggplot(wb) +  
 geom\_point(aes(x=lwb,y=concwb, group=dwb,color=dwb), size=.5) +  
 geom\_smooth(aes(x=lwb,y=concwb, group=dwb, color=dwb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Walsh:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Walsh MicG  
wo = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="Walsh",  
 Location == "Basin")  
  
concwo <- wo$ConcentrationLog10Plus1  
pwo <- wo$Parasite  
dwo <- wo$Depth  
dwo <- as.factor(dwo)  
yywo <- strptime(wo$Date, format = "%m/%d/%y")  
lwo <- as.POSIXct(yywo,format="%m/%d/%y",tz=Sys.timezone())  
  
  
walsh.micg <- ggplot(wo) +  
 geom\_point(aes(x=lwo,y=concwo, group=dwo,color=dwo), size=.5) +  
 geom\_smooth(aes(x=lwo,y=concwo, group=dwo, color=dwo),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Walsh:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Walsh Metsch  
wm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="Walsh",  
 Location == "Basin")  
  
concwm <- wm$ConcentrationLog10Plus1  
pwm <- wm$Parasite  
dwm <- wm$Depth  
dwm <- as.factor(dwm)  
yywm <- strptime(wm$Date, format = "%m/%d/%y")  
lwm <- as.POSIXct(yywm,format="%m/%d/%y",tz=Sys.timezone())  
  
walsh.metsch <- ggplot(wm) +  
 geom\_point(aes(x=lwm,y=concwm, group=dwm,color=dwm), size=.5) +  
 geom\_smooth(aes(x=lwm,y=concwm, group=dwm, color=dwm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Walsh:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
####### Walsh Past  
  
wp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="Walsh",  
 Location == "Basin")  
  
concwp <- wp$ConcentrationLog10Plus1  
pwp <- wp$Parasite  
dwp <- wp$Depth  
dwp <- as.factor(dwp)  
yywp <- strptime(wp$Date, format = "%m/%d/%y")  
lwp <- as.POSIXct(yywp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
walsh.past <- ggplot(wp) +  
 geom\_point(aes(x=lwp,y=concwp, group=dwp,color=dwp), size=.5) +  
 geom\_smooth(aes(x=lwp,y=concwp, group=dwp, color=dwp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Walsh:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Walsh Spiro  
  
ws = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="Walsh",  
 Location == "Basin")  
  
concws <- ws$ConcentrationLog10Plus1  
pws <- ws$Parasite  
dws <- ws$Depth  
dws <- as.factor(dws)  
yyws <- strptime(ws$Date, format = "%m/%d/%y")  
lws <- as.POSIXct(yyws,format="%m/%d/%y",tz=Sys.timezone())  
  
  
walsh.spiro <- ggplot(ws) +  
 geom\_point(aes(x=lws,y=concws, group=dws,color=dws), size=.5) +  
 geom\_smooth(aes(x=lws,y=concws, group=dws, color=dws),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-22")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Walsh:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Crooked W  
  
cwb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="CrookedW",  
 Location == "Basin")  
  
conccwb <- cwb$ConcentrationLog10Plus1  
pcwb <- cwb$Parasite  
dcwb <- cwb$Depth  
dcwb <- as.factor(dcwb)  
yycwb <- strptime(cwb$Date, format = "%m/%d/%y")  
lcwb <- as.POSIXct(yycwb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
crookedw.brood <- ggplot(cwb) +  
 geom\_point(aes(x=lcwb,y=conccwb, group=dcwb,color=dcwb), size=.5) +  
 geom\_smooth(aes(x=lcwb,y=conccwb, group=dcwb, color=dcwb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-03")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-21")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Crooked W:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Crooked W MicG  
cwo = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="CrookedW",  
 Location == "Basin")  
  
conccwo <- cwo$ConcentrationLog10Plus1  
pcwo <- cwo$Parasite  
dcwo <- cwo$Depth  
dcwo <- as.factor(dcwo)  
yycwo <- strptime(cwo$Date, format = "%m/%d/%y")  
lcwo <- as.POSIXct(yycwo,format="%m/%d/%y",tz=Sys.timezone())  
  
  
crookedw.micg <- ggplot(cwo) +  
 geom\_point(aes(x=lcwo,y=conccwo, group=dcwo,color=dcwo), size=.5) +  
 geom\_smooth(aes(x=lcwo,y=conccwo, group=dcwo, color=dcwo),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-03")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-21")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Crooked W:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Crooked W Metsch  
cwm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="CrookedW",  
 Location == "Basin")  
  
conccwm <- cwm$ConcentrationLog10Plus1  
pcwm <- cwm$Parasite  
dcwm <- cwm$Depth  
dcwm <- as.factor(dcwm)  
yycwm <- strptime(cwm$Date, format = "%m/%d/%y")  
lcwm <- as.POSIXct(yycwm,format="%m/%d/%y",tz=Sys.timezone())  
  
crookedw.metsch <- ggplot(cwm) +  
 geom\_point(aes(x=lcwm,y=conccwm, group=dcwm,color=dcwm), size=.5) +  
 geom\_smooth(aes(x=lcwm,y=conccwm, group=dcwm, color=dcwm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-03")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-21")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Crooked W:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
####### Crooked W Past  
  
cwp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="CrookedW",  
 Location == "Basin")  
  
conccwp <- cwp$ConcentrationLog10Plus1  
pcwp <- cwp$Parasite  
dcwp <- cwp$Depth  
dcwp <- as.factor(dcwp)  
yycwp <- strptime(cwp$Date, format = "%m/%d/%y")  
lcwp <- as.POSIXct(yycwp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
crookedw.past <- ggplot(cwp) +  
 geom\_point(aes(x=lcwp,y=conccwp, group=dcwp,color=dcwp), size=.5) +  
 geom\_smooth(aes(x=lcwp,y=conccwp, group=dcwp, color=dcwp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-03")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-21")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Crooked W:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Crooked W Spiro  
  
cws = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="CrookedW",  
 Location == "Basin")  
  
conccws <- cws$ConcentrationLog10Plus1  
pcws <- cws$Parasite  
dcws <- cws$Depth  
dcws <- as.factor(dcws)  
yycws <- strptime(cws$Date, format = "%m/%d/%y")  
lcws <- as.POSIXct(yycws,format="%m/%d/%y",tz=Sys.timezone())  
  
  
crookedw.spiro <- ggplot(cws) +  
 geom\_point(aes(x=lcws,y=conccws, group=dcws,color=dcws), size=.5) +  
 geom\_smooth(aes(x=lcws,y=conccws, group=dcws, color=dcws),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-03")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-09-21")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Crooked W:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### LilAp  
  
lb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="LilAp",  
 Location == "Basin")  
  
conclb <- lb$ConcentrationLog10Plus1  
plb <- lb$Parasite  
dlb <- lb$Depth  
dlb <- as.factor(dlb)  
yylb <- strptime(lb$Date, format = "%m/%d/%y")  
llb <- as.POSIXct(yylb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
lilap.brood <- ggplot(lb) +  
 geom\_point(aes(x=llb,y=conclb, group=dlb,color=dlb), size=.5) +  
 geom\_smooth(aes(x=llb,y=conclb, group=dlb, color=dlb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-27")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Little Appleton:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## LilAp MicG  
lo = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="LilAp",  
 Location == "Basin")  
  
conclo <- lo$ConcentrationLog10Plus1  
plo <- lo$Parasite  
dlo <- lo$Depth  
dlo <- as.factor(dlo)  
yylo <- strptime(lo$Date, format = "%m/%d/%y")  
llo <- as.POSIXct(yylo,format="%m/%d/%y",tz=Sys.timezone())  
  
  
lilap.micg <- ggplot(lo) +  
 geom\_point(aes(x=llo,y=conclo, group=dlo,color=dlo), size=.5) +  
 geom\_smooth(aes(x=llo,y=conclo, group=dlo, color=dlo),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-27")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Little Appleton:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### LilAp Metsch  
lm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="LilAp",  
 Location == "Basin")  
  
conclm <- lm$ConcentrationLog10Plus1  
plm <- lm$Parasite  
dlm <- lm$Depth  
dlm <- as.factor(dlm)  
yylm <- strptime(lm$Date, format = "%m/%d/%y")  
llm <- as.POSIXct(yylm,format="%m/%d/%y",tz=Sys.timezone())  
  
lilap.metsch <- ggplot(lm) +  
 geom\_point(aes(x=llm,y=conclm, group=dlm,color=dlm), size=.5) +  
 geom\_smooth(aes(x=llm,y=conclm, group=dlm, color=dlm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-27")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Little Appleton:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
####### LilAp Past  
  
lp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="LilAp",  
 Location == "Basin")  
  
conclp <- lp$ConcentrationLog10Plus1  
plp <- lp$Parasite  
dlp <- lp$Depth  
dlp <- as.factor(dlp)  
yylp <- strptime(lp$Date, format = "%m/%d/%y")  
llp <- as.POSIXct(yylp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
lilap.past <- ggplot(lp) +  
 geom\_point(aes(x=llp,y=conclp, group=dlp,color=dlp), size=.5) +  
 geom\_smooth(aes(x=llp,y=conclp, group=dlp, color=dlp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-27")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Little Appleton:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## LilAp Spiro  
  
ls = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="LilAp",  
 Location == "Basin")  
  
concls <- ls$ConcentrationLog10Plus1  
pls <- ls$Parasite  
dls <- ls$Depth  
dls <- as.factor(dls)  
yyls <- strptime(ls$Date, format = "%m/%d/%y")  
lls <- as.POSIXct(yyls,format="%m/%d/%y",tz=Sys.timezone())  
  
  
lilap.spiro <- ggplot(ls) +  
 geom\_point(aes(x=lls,y=concls, group=dls,color=dls), size=.5) +  
 geom\_smooth(aes(x=lls,y=concls, group=dls, color=dls),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col2)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 geom\_vline(xintercept = as.POSIXct(as.Date("2021-10-27")), linetype="dotted",   
 color = "#D55E00", size=.5)+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Little Appleton:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Bishop  
  
bb = a %>%  
 filter(Parasite== "Blastulidium",  
 Lake=="Bishop",  
 Location == "Basin")  
  
concbb <- bb$ConcentrationLog10Plus1  
pbb <- bb$Parasite  
dbb <- bb$Depth  
dbb <- as.factor(dbb)  
yybb <- strptime(bb$Date, format = "%m/%d/%y")  
lbb <- as.POSIXct(yybb,format="%m/%d/%y",tz=Sys.timezone())  
  
  
bishop.brood <- ggplot(bb) +  
 geom\_point(aes(x=lbb,y=concbb, group=dbb,color=dbb), size=.5) +  
 geom\_smooth(aes(x=lbb,y=concbb, group=dbb, color=dbb),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col3)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Bishop:"), bolditalic(" B. paedophthorum")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(legend.title = element\_text(face = "bold",size = 8),  
 legend.text=element\_text(size=6),  
 legend.position = "bottom") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######## Bishop MicG  
bo = a %>%  
 filter(Parasite== "Ordospora",  
 Lake=="Bishop",  
 Location == "Basin")  
  
concbo <- bo$ConcentrationLog10Plus1  
pbo <- bo$Parasite  
dbo <- bo$Depth  
dbo <- as.factor(dbo)  
yybo <- strptime(bo$Date, format = "%m/%d/%y")  
lbo <- as.POSIXct(yybo,format="%m/%d/%y",tz=Sys.timezone())  
  
  
bishop.micg <- ggplot(bo) +  
 geom\_point(aes(x=lbo,y=concbo, group=dbo,color=dbo), size=.5) +  
 geom\_smooth(aes(x=lbo,y=concbo, group=dbo, color=dbo),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col3)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Bishop:"), bolditalic(" O. pajunii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
######### Bishop Metsch  
bm = a %>%  
 filter(Parasite== "Metschnikowia",  
 Lake=="Bishop",  
 Location == "Basin")  
  
concbm <- bm$ConcentrationLog10Plus1  
pbm <- bm$Parasite  
dbm <- bm$Depth  
dbm <- as.factor(dbm)  
yybm <- strptime(bm$Date,format = "%m/%d/%y")  
lbm <- as.POSIXct(yybm,format="%m/%d/%y",tz=Sys.timezone())  
  
bishop.metsch <- ggplot(bm) +  
 geom\_point(aes(x=lbm,y=concbm, group=dbm,color=dbm), size=.5) +  
 geom\_smooth(aes(x=lbm,y=concbm, group=dbm, color=dbm),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col3)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Bishop:"), bolditalic(" M. bicuspidata")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
####### Bishop Past  
  
bp = a %>%  
 filter(Parasite== "Pasteuria",  
 Lake=="Bishop",  
 Location == "Basin")  
  
concbp <- bp$ConcentrationLog10Plus1  
pbp <- bp$Parasite  
dbp <- bp$Depth  
dbp <- as.factor(dbp)  
yybp <- strptime(bp$Date, format = "%m/%d/%y")  
lbp <- as.POSIXct(yybp,format="%m/%d/%y",tz=Sys.timezone())  
  
  
bishop.past <- ggplot(bp) +  
 geom\_point(aes(x=lbp,y=concbp, group=dbp,color=dbp), size=.5) +  
 geom\_smooth(aes(x=lbp,y=concbp, group=dbp, color=dbp),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col3)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Bishop:"), bolditalic(" P. ramosa")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
  
######## Bishop Spiro  
  
bs = a %>%  
 filter(Parasite== "Spirobacillus",  
 Lake=="Bishop",  
 Location == "Basin")  
  
concbs <- bs$ConcentrationLog10Plus1  
pbs <- bs$Parasite  
dbs <- bs$Depth  
dbs <- as.factor(dbs)  
yybs <- strptime(bs$Date, format = "%m/%d/%y")  
lbs <- as.POSIXct(yybs,format="%m/%d/%y",tz=Sys.timezone())  
  
  
bishop.spiro <- ggplot(bs) +  
 geom\_point(aes(x=lbs,y=concbs, group=dbs,color=dbs), size=.5) +  
 geom\_smooth(aes(x=lbs,y=concbs, group=dbs, color=dbs),method = "loess", size = .5, span=.5, se=FALSE)+  
 scale\_colour\_manual(values = col3)+  
 scale\_y\_continuous(limits=c(0,6.5), breaks = seq(0,6.5,1))+  
 scale\_x\_datetime(limits = c(as.POSIXct(as.Date("2021-06-07")), as.POSIXct(as.Date("2021-11-13"))))+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),   
 axis.line = element\_line(colour = "black"))+  
 ggtitle(expression(paste(bold("Bishop:"), bolditalic(" S. cienkowskii")))) +  
 theme(plot.title = element\_text(face = "bold",size = 8)) +  
 theme(axis.text=element\_text(size=6, face = "bold"),   
 axis.title=element\_text(size=8,face="bold")) +  
 theme(  
 legend.position = "none") +   
 labs(colour = "Depth (m)", x = (""), y = (""))  
  
  
#### ALL  
blank <- ggplot()+  
 theme\_bw() +  
 theme(panel.border = element\_blank(),   
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank())  
legcombo7 <- get\_legend(cedar.brood)  
cedar.brood <- cedar.brood + theme(legend.position = "none")  
legcombo16 <- get\_legend(bishop.brood)  
bishop.brood <- bishop.brood + theme(legend.position = "none")  
all.combined = ggarrange(walsh.brood, walsh.micg, walsh.metsch, walsh.past, walsh.spiro,  
 mill.brood, mill.micg, mill.metsch, mill.past, mill.spiro,  
 cedar.brood, cedar.micg, cedar.metsch, cedar.past, cedar.spiro,  
 crookedw.brood, crookedw.micg, crookedw.metsch, crookedw.past, crookedw.spiro,  
 lilap.brood, lilap.micg, lilap.metsch, lilap.past, lilap.spiro,  
 bishop.brood, bishop.micg, bishop.metsch, bishop.past, bishop.spiro, blank,  
 legcombo7, legcombo16,  
 nrow = 7, ncol = 5)  
  
all.combined = annotate\_figure(all.combined,  
 left = text\_grob("Log(Spore Concentration + 1)", color = "black", face = "bold", size = 10,rot=90))  
  
#### saving combined plot  
ggsave(here("figures", "AllCombinedSporesTurnover.jpg"), all.combined, units = "in", width = 11, height = 8, dpi = 600)