Envr_of_Origin_Length_Survival_Hatchery

2024-10-26

This code analyzes the effect of condition in the environments-of-origin on offspring oyster survival and shell length in the hatchery and nursery at VIMS ABC.

```
setwd("/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/src/NM")
```

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggplot2)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
##
## The following object is masked from 'package:dplyr':
##
##     combine
```

```
library(multcompView) #extract significance letters from Tukey-Kramer test
library(tidyverse)
library(grid)#for ggplot arranging
library(cowplot) #arrange ggplots
```

```
##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##     stamp
```

```
library(ggpmisc)
```

```
## Loading required package: ggpp
## Registered S3 methods overwritten by 'ggpp':
##   method                  from
##   heightDetails.titleGrob ggplot2
##   widthDetails.titleGrob  ggplot2
##
## Attaching package: 'ggpp'
##
## The following object is masked from 'package:ggplot2':
##
##     annotate
```

```
library(vegan) #for Mantel tests
```

```
## Loading required package: permute
## Loading required package: lattice
## This is vegan 2.6-8
```

#read in necessary files

```
#this file contains raw lengths of all oysters aged 15-78 days
length <- read.csv("/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/data/latestage_le

#this file has summary statistics on temperature and salinity for the 8 sites (DEBY, LOLA, JR, TX, LA,
envr_summary <-  read.csv("/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/data/envr_

#this file is a matrix of the environmental distances between each site
envr_dist <- read.csv("/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/data/envr_raw_

#this file contains survival rate data for larval oysters up to day 21 post hatching
survival <-  read.csv("/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/data/CViMVP_la
```

Extract survival rates from survival data frame, and reorganize data frame

```
summary(survival)
```

```
##  SpawnTrt_Key       Tank_naming        Group_Day_Key      Group_Day_Label
##  Length:120         Length:120         Length:120         Length:120
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##      Tank           Day_Treatment      Day_analysis            Day
##  Length:120         Length:120         Length:120         Min.   : 0.00
##  Class :character   Class :character   Class :character   1st Qu.: 0.00
##  Mode  :character   Mode  :character   Mode  :character   Median : 6.00
##                                                           Mean   :15.31
```

```
##                                                        3rd Qu.:19.00
##                                                        Max.   :78.00
##                                                        NA's   :9
##      Date           Filter_size_µm    Sample_count     Group_count
##  Length:120         Min.   : 35.00   Min.   :     0   Min.   :       0
##  Class :character   1st Qu.: 35.00   1st Qu.: 10000   1st Qu.:  287000
##  Mode  :character   Median : 48.00   Median : 30000   Median :  602000
##                     Mean   : 85.17   Mean   :100309   Mean   : 2726089
##                     3rd Qu.: 75.00   3rd Qu.:161250   3rd Qu.: 2912500
##                     Max.   :212.00   Max.   :600000   Max.   :15000000
##                     NA's   :38       NA's   :52       NA's   :30
##  Survival_rate_perc Vial_label        Notes
##  Min.   : 0.000     Mode:logical   Length:120
##  1st Qu.: 1.706     NA's:120       Class :character
##  Median : 5.346                    Mode  :character
##  Mean   : 7.880
##  3rd Qu.:11.250
##  Max.   :50.000
##  NA's   :52
```

```
#For survival rates, we only care about survival from day 21 (marked as day_an 15-21), so filter for th
survival_day21 <- survival %>%
  filter(Day_analysis == "15-21") %>%
  filter(Tank_naming != "MVP-LARMIX")

#Exclude any groups with "small" in their label. The length data only considers the eyed oysters.
#use grep function to make a vector of all indices in latestage_len with the phrase "small" in them, ig
small <- grep("small", survival_day21$Group_Day_Label, ignore.case = TRUE)

#make new dataframe WITHOUT any indices saved in small, mean remaining data are everything except small
survival_day21_sub <- survival_day21[-small, ]

#exclude "MVP" from group names to shorten them
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-DEBY"] <- "DEBY"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"]  == "MVP-FL"] <- "FL"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-JR"] <- "JR"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-LA"] <- "LA"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-LOLA"] <- "LOLA"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-ME"] <- "ME"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-NH"] <- "NH"
survival_day21_sub["Tank_naming"][survival_day21_sub["Tank_naming"] == "MVP-TX"] <- "TX"

#select only tank naming and survival rate columns
survival_filter <- survival_day21_sub[, c("Tank_naming", "Survival_rate_perc")]

#rename columns
colnames(survival_filter) <- c("site_name", "percent_survival")
```

#length df organizing

```
#select columns with group, day, and shell length in mm
length <- length[,c("group", "day_an", "shell_length_mm")]
```

```r
#filter out LARMIX from group
length_filter <- length %>%
  filter(group != "LARMIX")

#keep only data from days 15-21
length_21 <- length_filter %>%
  filter(day_an == "15-21")

length_78 <- length_filter %>%
  filter(day_an == "78")

#find mean shell lengths of each group on each day
means_mm_21 <- aggregate(shell_length_mm ~ group, FUN = mean, data = length_21)
colnames(means_mm_21) <- c("site_name", "mean_length_mm_21")

means_mm_78 <- aggregate(shell_length_mm ~ group, FUN = mean, data = length_78)
colnames(means_mm_78) <- c("site_name", "mean_length_mm_78")
```

#remove extra columns from environmental data frame

```r
#remove extra site label and standard deviations from envr_summary
envr <- envr_summary[,-c(2,6,10)]

summary(envr)
```

```
##       X             Mean_Annual_Temperature_C Mean_max_temperature_C
##  Length:8           Min.   :15.33             Min.   :23.46
##  Class :character   1st Qu.:16.86             1st Qu.:26.35
##  Mode  :character   Median :17.83             Median :28.65
##                     Mean   :19.09             Mean   :28.54
##                     3rd Qu.:22.33             3rd Qu.:30.98
##                     Max.   :23.11             Max.   :33.17
##  Mean_min_temperature_C Mean_Annual_Salinity_ppt Mean_max_Salinity_ppt
##  Min.   : 1.758         Min.   :10.46            Min.   :16.88
##  1st Qu.: 3.192         1st Qu.:14.87            1st Qu.:23.69
##  Median : 3.784         Median :18.99            Median :27.90
##  Mean   : 5.121         Mean   :20.02            Mean   :27.25
##  3rd Qu.: 7.481         3rd Qu.:23.01            3rd Qu.:30.54
##  Max.   :10.387         Max.   :32.35            Max.   :37.20
##  Mean_min_Salinity_ppt
##  Min.   : 0.9688
##  1st Qu.: 5.0596
##  Median : 9.3657
##  Mean   : 8.5100
##  3rd Qu.:12.6328
##  Max.   :15.4224
```

```r
#rename cols
colnames(envr) <- c("site_name", "Mean_Annual_Temperature_C", "Mean_max_temperature_C", "Mean_min_tempe

#add sampling site latitudes. Note that these latitudes ARE NOT the same as the latitudes of where envi
envr$lat <- c(37.249107, 37.98030, 37.1501163, 28.096000, 29.239925, 30.440030, 43.053746, 44.01330)
```

#Join data frames

```
surv_length_envr <- left_join(envr, means_mm_21, by = "site_name") %>%
  left_join(means_mm_78, by = "site_name") %>%
  left_join(survival_filter, by = "site_name")

write.csv(surv_length_envr, "/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/data/Surv
```

```
#compare mean length on day 21 to mean annual temp, mean annual salinity, and latitude

length21_temp_lm <- lm(mean_length_mm_21 ~ Mean_Annual_Temperature_C, data = surv_length_envr)
summary(length21_temp_lm)
```

```
##
## Call:
## lm(formula = mean_length_mm_21 ~ Mean_Annual_Temperature_C, data = surv_length_envr)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0153946 -0.0062781  0.0004731  0.0080888  0.0131565
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.3281427  0.0261835  12.532 1.58e-05 ***
## Mean_Annual_Temperature_C -0.0008187  0.0013556  -0.604    0.568
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01122 on 6 degrees of freedom
## Multiple R-squared:  0.0573, Adjusted R-squared:  -0.09982
## F-statistic: 0.3647 on 1 and 6 DF,  p-value: 0.568
```

```
#extract p-value (.568)
length21_temp_pval <- summary(length21_temp_lm)$coefficients[,4]
length21_temp_pval <- unname(length21_temp_pval[2])


length21_sal_lm <- lm(mean_length_mm_21 ~ Mean_Annual_Salinity_ppt, data = surv_length_envr)
#extract p-value (.411)
length21_sal_pval <- summary(length21_sal_lm)$coefficients[,4]
length21_sal_pval <- unname(length21_sal_pval[2])

length21_lat_lm <- lm(mean_length_mm_21 ~ lat, data = surv_length_envr)
summary(length21_lat_lm)
```

```
##
## Call:
## lm(formula = mean_length_mm_21 ~ lat, data = surv_length_envr)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.015881 -0.005571  0.001032  0.007308  0.013481
```

```
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.3003121  0.0255685  11.745  2.3e-05 ***
## lat         0.0003398  0.0007034   0.483    0.646
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01134 on 6 degrees of freedom
## Multiple R-squared:  0.03745,    Adjusted R-squared:  -0.123
## F-statistic: 0.2334 on 1 and 6 DF,  p-value: 0.6461
```

```r
#extract p-value (0.646)
length21_lat_pval <- summary(length21_lat_lm)$coefficients[,4]
length21_lat_pval <- unname(length21_lat_pval[2])

#compare percent survival to mean annual temp, mean annual salinity, and envr distance from DEBY
surv_temp_lm <- lm(percent_survival ~ Mean_Annual_Temperature_C, data = surv_length_envr)
summary(surv_temp_lm)
```

```
##
## Call:
## lm(formula = percent_survival ~ Mean_Annual_Temperature_C, data = surv_length_envr)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.0024 -0.5082  0.1592  0.3649  0.9948
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                -3.04143    1.87564  -1.622   0.1560
## Mean_Annual_Temperature_C   0.29084    0.09711   2.995   0.0242 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8037 on 6 degrees of freedom
## Multiple R-squared:  0.5992, Adjusted R-squared:  0.5324
## F-statistic:  8.97 on 1 and 6 DF,  p-value: 0.02416
```

```r
#extract p-value (0.024)
surv_temp_pval <- summary(surv_temp_lm)$coefficients[,4]
surv_temp_pval <- unname(surv_temp_pval[2])

surv_sal_lm <- lm(percent_survival ~ Mean_Annual_Salinity_ppt, data = surv_length_envr)
summary(surv_sal_lm)
```

```
##
## Call:
## lm(formula = percent_survival ~ Mean_Annual_Salinity_ppt, data = surv_length_envr)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.3035 -0.9805  0.2219  0.6144  1.4024
```

```
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)                4.18142    1.14239    3.66   0.0106 *
## Mean_Annual_Salinity_ppt -0.08341    0.05382   -1.55   0.1721
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.073 on 6 degrees of freedom
## Multiple R-squared:  0.2859, Adjusted R-squared:  0.1669
## F-statistic: 2.402 on 1 and 6 DF,  p-value: 0.1721
```

```
#extract p-value (0.172)
surv_sal_pval <- summary(surv_sal_lm)$coefficients[,4]
surv_sal_pval <- unname(surv_sal_pval[2])

surv_lat_lm <- lm(percent_survival ~ lat, data = surv_length_envr)
summary(surv_lat_lm)
```

```
##
## Call:
## lm(formula = percent_survival ~ lat, data = surv_length_envr)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.97500 -0.76479  0.03013  0.54583  1.11282
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  7.45699    2.00449   3.720  0.00985 **
## lat         -0.13775    0.05514  -2.498  0.04664 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8887 on 6 degrees of freedom
## Multiple R-squared:  0.5098, Adjusted R-squared:  0.4282
## F-statistic: 6.241 on 1 and 6 DF,  p-value: 0.04664
```

```
#extract p-value (0.0466)
surv_lat_pval <- summary(surv_lat_lm)$coefficients[,4]
surv_lat_pval <- unname(surv_lat_pval[2])

#compare length at day 78 to mean annual temp, mean annual salinity, and envr distance from DEBY
length78_temp_lm <- lm(mean_length_mm_78 ~ Mean_Annual_Temperature_C, data = surv_length_envr)
summary(length78_temp_lm)
```

```
##
## Call:
## lm(formula = mean_length_mm_78 ~ Mean_Annual_Temperature_C, data = surv_length_envr)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.1777 -0.5723 -0.0590  0.8314  3.9262
```

```
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 17.1980     5.7027   3.016   0.0235 *
## Mean_Annual_Temperature_C  -0.1900     0.2953  -0.644   0.5436
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.443 on 6 degrees of freedom
## Multiple R-squared:  0.06458,    Adjusted R-squared:  -0.09132
## F-statistic: 0.4142 on 1 and 6 DF,  p-value: 0.5436
```

```
#extract p-value (0.543)
length78_temp_pval <- summary(length78_temp_lm)$coefficients[,4]
length78_temp_pval <- unname(length78_temp_pval[2])


length78_sal_lm <- lm(mean_length_mm_78 ~ Mean_Annual_Salinity_ppt, data = surv_length_envr)
#extract p-value (0.983)
length78_sal_pval <- summary(length78_sal_lm)$coefficients[,4]
length78_sal_pval <- unname(length78_sal_pval[2])

length78_lat_lm <- lm(mean_length_mm_78 ~ lat, data = surv_length_envr)
#extract p-value (0.962)
length78_lat_pval <- summary(length78_lat_lm)$coefficients[,4]
length78_lat_pval <- unname(length78_lat_pval[2])
```

```
#test correlation between temperature and latitude. If they are highly correlated, one must be excluded
temp_lat_corr <- cor.test(surv_length_envr$Mean_Annual_Temperature_C, surv_length_envr$lat)
temp_lat_corr #significant correlation between temp and lat, cannot include both in multiple regression
```

```
##
##  Pearson's product-moment correlation
##
## data:  surv_length_envr$Mean_Annual_Temperature_C and surv_length_envr$lat
## t = -8.8851, df = 6, p-value = 0.0001132
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.9936754 -0.8088184
## sample estimates:
##        cor
## -0.9640364
```

```
#multiple regression testing effect of mean annual temp and mean annual salinity at the environments-of
surv_temp_sal_lm <- lm(percent_survival ~ Mean_Annual_Temperature_C + Mean_Annual_Salinity_ppt, data = s
summary(surv_temp_sal_lm) #both explanatory variables significant, whole model significant
```

```
##
## Call:
## lm(formula = percent_survival ~ Mean_Annual_Temperature_C + Mean_Annual_Salinity_ppt,
##     data = surv_length_envr)
##
```

```
## Residuals:
##       1       2       3       4       5       6       7       8
## -0.41864 -0.34440  0.61996  0.27276 -0.47766 -0.02476  0.68693 -0.31417
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)               -1.30130    1.44748  -0.899  0.40985
## Mean_Annual_Temperature_C  0.28004    0.06744   4.153  0.00889 **
## Mean_Annual_Salinity_ppt  -0.07660    0.02800  -2.736  0.04099 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5571 on 5 degrees of freedom
## Multiple R-squared:  0.8395, Adjusted R-squared:  0.7753
## F-statistic: 13.08 on 2 and 5 DF,  p-value: 0.01032
```

```
#multiple regression testing effect of mean annual temp and mean annual salinity at the environments-of
length21_temp_sal_lm <- lm(mean_length_mm_21 ~ Mean_Annual_Temperature_C + Mean_Annual_Salinity_ppt, da
summary(length21_temp_sal_lm) #neither explanatory variable significant, model not significant
```

```
##
## Call:
## lm(formula = mean_length_mm_21 ~ Mean_Annual_Temperature_C +
##     Mean_Annual_Salinity_ppt, data = surv_length_envr)
##
## Residuals:
##          1          2          3          4          5          6          7
## -0.0039705  0.0070959 -0.0008724 -0.0125143  0.0115745  0.0042660 -0.0145993
##          8
##  0.0090201
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                0.3176148  0.0300787  10.559 0.000132 ***
## Mean_Annual_Temperature_C -0.0007533  0.0014013  -0.538 0.613937
## Mean_Annual_Salinity_ppt   0.0004635  0.0005818   0.797 0.461836
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01158 on 5 degrees of freedom
## Multiple R-squared:  0.1635, Adjusted R-squared:  -0.1712
## F-statistic: 0.4885 on 2 and 5 DF,  p-value: 0.6401
```

```
#multiple regression testing effect of mean annual temp and mean annual salinity at the environments-of
length78_temp_sal_lm <- lm(mean_length_mm_78 ~ Mean_Annual_Temperature_C + Mean_Annual_Salinity_ppt, da
summary(length78_temp_sal_lm) #neither explanatory variable significant, model insignificant
```

```
##
## Call:
## lm(formula = mean_length_mm_78 ~ Mean_Annual_Temperature_C +
##     Mean_Annual_Salinity_ppt, data = surv_length_envr)
##
## Residuals:
```

```
##       1       2       3       4       5       6       7       8
##  1.0415  3.8777 -0.2769  0.1329 -1.0801  0.8543 -4.1905 -0.3589
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 17.367666   6.952154   2.498   0.0546 .
## Mean_Annual_Temperature_C -0.191080   0.323889  -0.590   0.5809
## Mean_Annual_Salinity_ppt  -0.007467   0.134480  -0.056   0.9579
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.676 on 5 degrees of freedom
## Multiple R-squared:  0.06516,    Adjusted R-squared:  -0.3088
## F-statistic: 0.1742 on 2 and 5 DF,  p-value: 0.845
```

```
#put multiple regression output table in results
```

#adjust p-values

```
p_values <- c(length21_temp_pval, length21_sal_pval, length21_lat_pval, surv_temp_pval, surv_sal_pval, s

p_adj <- p.adjust(p_values, method = "BH")

p_values
```

```
## [1] 0.56802380 0.41097924 0.64610781 0.02416428 0.17214151 0.04664046 0.54362971
## [8] 0.98297176 0.96196115
```

```
p_adj
```

```
## [1] 0.8307100 0.8307100 0.8307100 0.2098821 0.5164245 0.2098821 0.8307100
## [8] 0.9829718 0.9829718
```

ADJUSTED P-VALUES - Mean annual temp is not a significant predictor of mean length at day 21 (p = 0.831) - Mean annual salinity is not a significant predictor of mean length at day 21 (p = 0.831). - Latitude is not a significant predictor of mean length at day 21 (p = 0.831).

- Mean annual temp is no longer a significant predictor of percent survival at day 21 (p = 0.210).
- Mean annual salinity is not a significant predictor of percent survival at day 21 (p = 0.516).
- Latitude is not a significant predictor of percent survival at day 21 (p = 0.210).
- Mean annual temp is not a significant predictor of mean length at day 78 (p = 0.831)
- Mean annual salinity is not a significant predictor of mean length at day 78 (p = 0.983).
- Latitude is not a significant predictor of mean length at day 78 (p = 0.983).

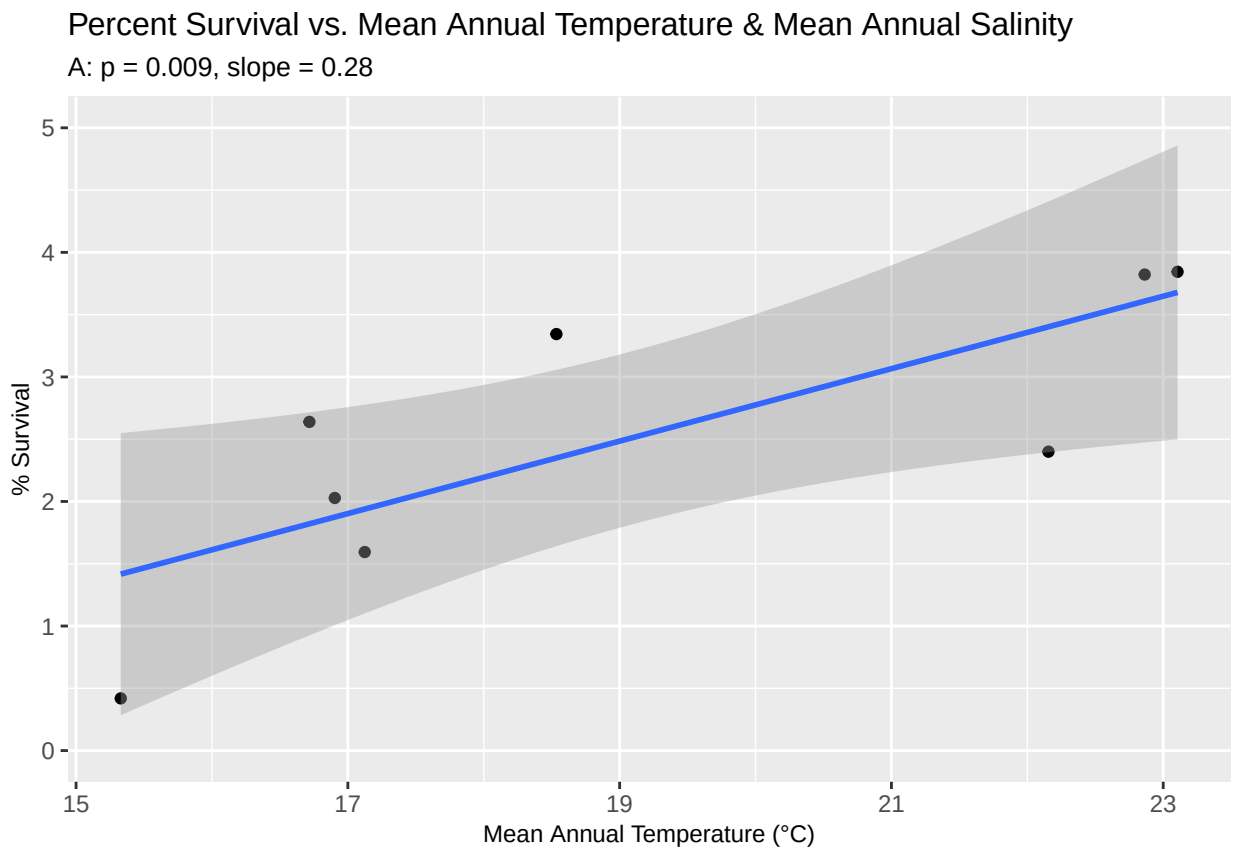
```
#make function to wrap title text
wrapper <- function(x, ...)
{
  paste(strwrap(x, ...), collapse = "\n")
```

```
}

surv_temp_plot <- surv_length_envr %>%
  ggplot(aes(x = Mean_Annual_Temperature_C, y = percent_survival))+
  geom_point()+
  labs(subtitle = "A: p = 0.009, slope = 0.28")+
  ggtitle("Percent Survival vs. Mean Annual Temperature & Mean Annual Salinity")+
  ylab("% Survival")+
  xlab("Mean Annual Temperature (°C)")+
  ylim(c(0,5))+
  theme(axis.title.y = element_text(size = 9), axis.title.x = element_text(size = 9), axis.text.x = ele
  geom_smooth(method = "lm", se = TRUE, fullrange = TRUE)

surv_temp_plot
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

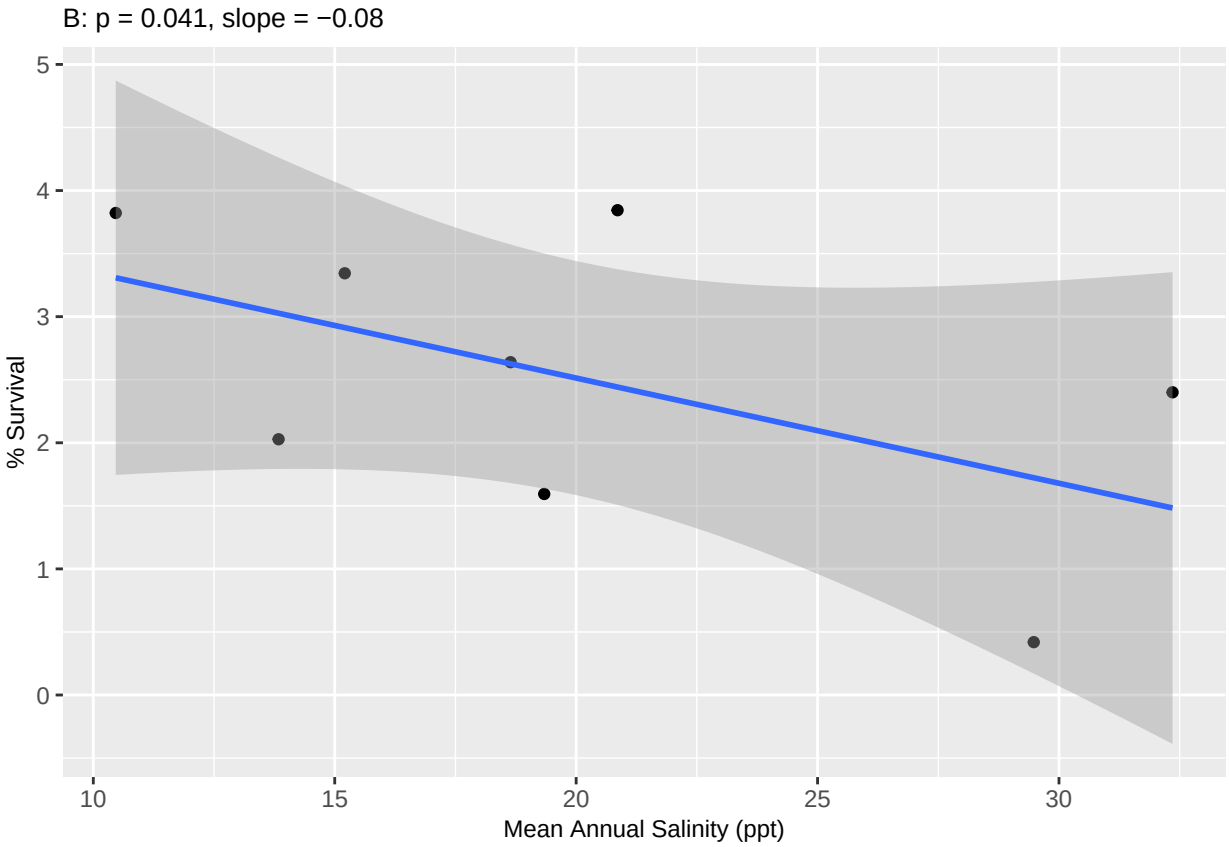



```
surv_sal_plot <- surv_length_envr %>%
  ggplot(aes(x = Mean_Annual_Salinity_ppt, y = percent_survival))+
  geom_point()+
  labs(subtitle = "B: p = 0.041, slope = -0.08")+
  ylab("% Survival")+
  xlab("Mean Annual Salinity (ppt)")+
  theme(axis.title.x = element_text(size = 9), plot.title = element_blank(), plot.subtitle = element_te
```

```
  geom_smooth(method = "lm", se = TRUE, fullrange = TRUE)

surv_sal_plot
```

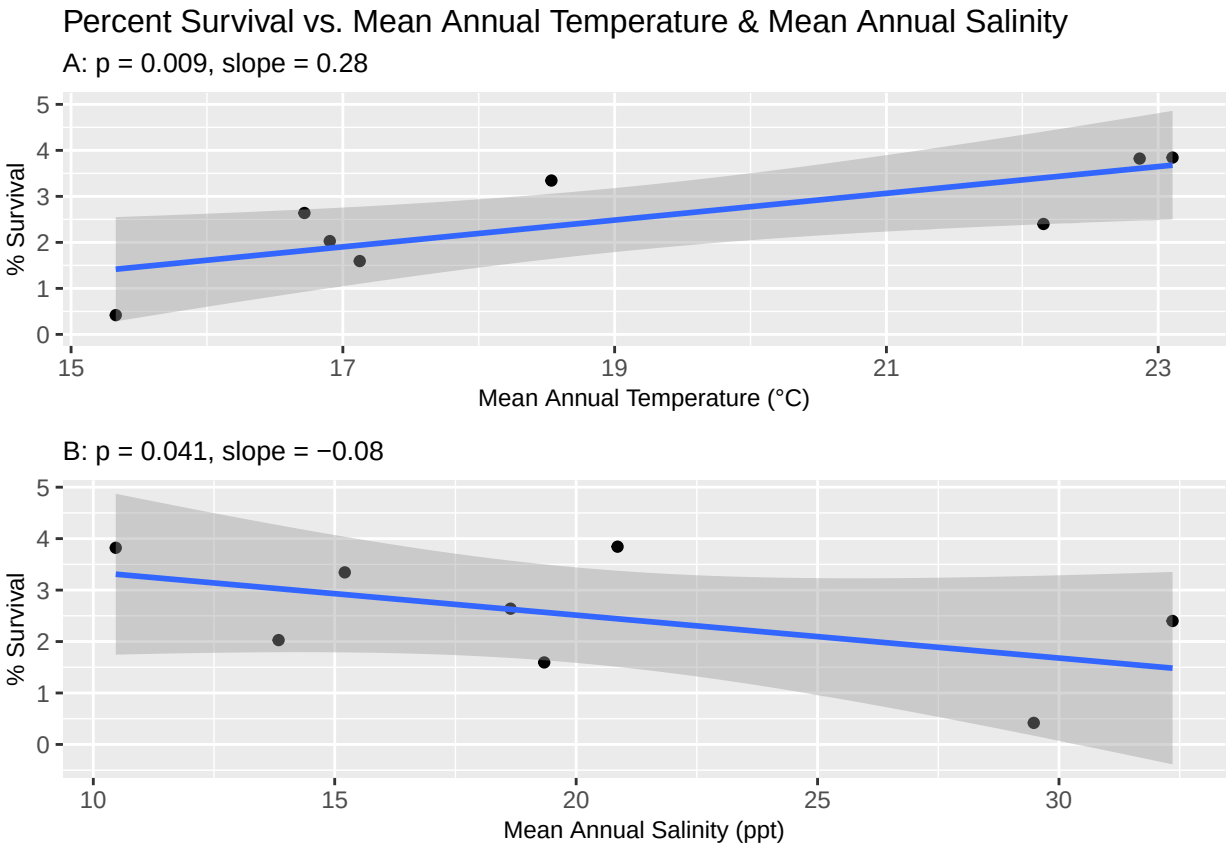
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
surv_plots <- plot_grid(surv_temp_plot, surv_sal_plot, ncol = 1, align = "v")
```

```
## `geom_smooth()` using formula = 'y ~ x'
## `geom_smooth()` using formula = 'y ~ x'
```

```
surv_plots
```




```
ggsave("surv_plots.png",
       plot = surv_plots,
       device = png,
       path = "/Users/nicolemongillo/Desktop/GitHub/MVP_Chesapeake_VIMS_hatchery/results/NM_results/Resu
```

```
## Saving 6.5 x 4.5 in image
```