Building article figures

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Contents

1 Library

```
library(dplyr)
library(ggplot2)
library(Hmisc)
library(corrplot)
library(gridExtra)
library(PerformanceAnalytics)
library(stats)
library(plyr)
library("ggpubr")
library("grid")
library(MASS)
```

2 Required data sets

```
WD <- ".."
PATH_OUTPUT <- file.path(WD, "Outputs")
PATH_FUNC <- file.path(WD, "Functions")
PATH_DATA <- file.path(WD, "Data")
PATH_FIG <- file.path(WD, "Figures_and_stats/Figures")
source(file.path(PATH_FUNC, "Prep_obs.R"))
source(file.path(PATH_FUNC, "stepAIC_gam.R"))
source(file.path(PATH_FUNC, "plot_gam_predictions.R"))

raw_obs <- read.csv(file.path(
  PATH_DATA,
  "all_operations_on_fobs_observe_v9_fr_2005-2023.csv")
  )
Ob7 <- prep.obs(Ob7 = raw_obs)
```

```
## Starting fob.null function
## Starting conver.fob function
## Starting doubl.obs function
```

```
## Preparation of observers data: 0.732 sec elapsed
```

```
Ob7 <- Ob7[Ob7$year>2013,]
Ob7 <- Ob7[Ob7$year<2023,]
Ob7_NLOG = Ob7 %>% filter(obj_conv=="NLOG")
Ob7_NLOG$Zone <- as.factor(
  ifelse(Ob7_NLOG$latitude<(-10) & Ob7_NLOG$longitude <= 50,"MOZ","WIO")
  )
world <- map_data("world")

NLOG_VE <- read.csv(file.path(PATH_OUTPUT, "NLOG_VE.csv"), header = TRUE)
VE <- NLOG_VE[,c(8,10,12,14,16)]
colnames(VE) <- c("Chla","SST","SLA","FSLE","SSCI")

NLOG_VE_sup_zero <- read.csv(file.path(PATH_OUTPUT,
                                       "NLOG_VE_sup_zero.csv"), head = T)
NLOG_VE_sup_zero$logNLOG <- log(NLOG_VE_sup_zero$NLOG_stand)

NLOG_VE_sup_zero_Moz <- read.csv(file.path(PATH_OUTPUT,
                                           "NLOG_VE_sup_zero_Moz.csv"),
                                 head = T)
NLOG_VE_sup_zero_North <- read.csv(file.path(PATH_OUTPUT,
                                             "NLOG_VE_sup_zero_North.csv"),
                                   head = T)

NLOG_VE_zero_Moz <- read.csv(file.path(PATH_OUTPUT,
                                       "NLOG_VE_zero_Moz.csv"),
                             head = T)
NLOG_VE_zero_North <- read.csv(file.path(PATH_OUTPUT,
                                         "NLOG_VE_zero_North.csv"),
                               head = T)

NLOG_VE_sup_zero_North$chlacr <- scale(NLOG_VE_sup_zero_North$chlamean)
NLOG_VE_sup_zero_North$slacr <- scale(NLOG_VE_sup_zero_North$slamean)
NLOG_VE_sup_zero_North$SSCIcr <- scale(NLOG_VE_sup_zero_North$SSCImean)
NLOG_VE_sup_zero_North$FSLEcr <- scale(NLOG_VE_sup_zero_North$FSLEmean)
NLOG_VE_sup_zero_North$MNcr <- scale(NLOG_VE_sup_zero_North$MNmean)
NLOG_VE_sup_zero_North$logNLOG <- log(NLOG_VE_sup_zero_North$NLOG_stand)

NLOG_VE_sup_zero_Moz$chlacr <- scale(NLOG_VE_sup_zero_Moz$chlamean)
NLOG_VE_sup_zero_Moz$slacr <- scale(NLOG_VE_sup_zero_Moz$slamean)
NLOG_VE_sup_zero_Moz$SSCIcr <- scale(NLOG_VE_sup_zero_Moz$SSCImean)
NLOG_VE_sup_zero_Moz$FSLEcr <- scale(NLOG_VE_sup_zero_Moz$FSLEmean)
NLOG_VE_sup_zero_Moz$MNcr <- scale(NLOG_VE_sup_zero_Moz$MNmean)
NLOG_VE_sup_zero_Moz$logNLOG <- log(NLOG_VE_sup_zero_Moz$NLOG_stand)

LM4_North_chla <- lm(logNLOG ~ chlacr + slacr, data = NLOG_VE_sup_zero_North)
LM5_Moz_chla <- lm(logNLOG ~ slacr, data = NLOG_VE_sup_zero_Moz)

dfMN_epi<-read.csv(file.path(PATH_OUTPUT, "MN_epi_mean.csv"), header = T)
dfMN_u<-read.csv(file.path(PATH_OUTPUT, "MN_umeso_mean.csv"), header = T)
dfMN_mu<-read.csv(file.path(PATH_OUTPUT, "MN_mumeso_mean.csv"), header = T)
dfMN_ml<-read.csv(file.path(PATH_OUTPUT, "MN_mlmeso_mean.csv"), header = T)
dfMN_hml<-read.csv(file.path(PATH_OUTPUT, "MN_hmlmeso_mean.csv"), header = T)
```

```
df_eff <- read.csv(file.path(PATH_OUTPUT, "df_eff.csv"), head = T)
df_eff_new <- read.csv(file.path(PATH_OUTPUT, "df_eff_new_100.csv"), head = T)
```

3 Figure 1 : Study area (map)

```
fig1 <- ggplot(aes(x=c(35, 85), y=c(-25, 25)), data=Ob7_NLOG) +
  geom_point(data = Ob7_NLOG, mapping = aes(x = longitude, y = latitude),
             colour = "blue", shape=1,size=.5) +
  geom_segment(aes(x=40,y=(-10),xend=50,yend=(-10)),linetype=2)+
  geom_segment(aes(x=50,y=(-10),xend=50,yend=(-15)),linetype=2)+
  geom_map(data = world, map = world, aes(long, lat, map_id = region),
           color =  "black", fill = "lightgray", size = 0.1) +
  xlim(min(35),max(85))+
  ylim(min(-25),max(20))+
  xlab("Longitude (deg)") +
  ylab("Latitude (deg)")+
  theme(panel.border = element_rect(fill = NA, colour = "black"))+
  theme(text = element_text(size = 10))+
  theme(axis.text.x = element_text(size = 10))+
  theme(axis.text.y = element_text(size = 10))+
  annotate(geom="label", x=55, y=-5, label="WIO",
              color="black", fontface="bold", size=3)+
  geom_segment(aes(x=54,y=(-15),xend=45,yend=(-13)),
               linetype=1, linewidth = .25)+
  annotate(geom="label", x=55, y=-15, label="MOZ",
              color="black", fontface="bold", size=3)
```

3.1 Save plot

```
ggsave(file=file.path(PATH_FIG, "Fig1_Study Area.png"), fig1,
       width = 10, height = 9, units = "cm")
ggsave(file=file.path(PATH_FIG, "Fig1.eps"), fig1,
       width = 10, height = 9, units = "cm")
```

4 Figure 2 : Yearly number of NLOG observations (histograms)

```
fig2 <- ggplot(data = Ob7_NLOG) +
  geom_bar(mapping = aes(x = year, fill=as.factor(Zone)),
           binwidth=0.5, color = "black",
           position = position_dodge2(width = 1,
                                      preserve = "single",
                                      padding = 0))+
  stat_count(aes(x = year, y=..count.., fill=as.factor(Zone), label=..count..),
             size = 6, geom="text", vjust=-0.5,
             position = position_dodge2(width = 0.9,
                                        preserve = "single",
                                        padding = 0))+
  ylab("Number of observations")+
  scale_x_continuous(name="Years", breaks=2014:2022,
                     labels = 2014:2022)+
```

```
  scale_fill_manual(values = c("grey48","grey86"), name = "Zone")+
  theme(panel.border = element_rect(fill = NA, colour = "black"))+
  theme(text = element_text(size = 25))+
  theme(axis.text.x = element_text(size = 25))+
  theme(axis.text.y = element_text(size = 25))+
  theme(legend.text = element_text(size=25))+
  theme(legend.key.size = unit(1, 'cm'))
```

4.1 Save plot

```
ggsave(file=file.path(PATH_FIG, "Fig2_Nb of NLOGs.png"), fig2,
       width = 30, height = 18, units = "cm")
ggsave(file=file.path(PATH_FIG, "Fig2.eps"), fig2,
       width = 30, height = 18, units = "cm")
```

5 Figure 3 : Distribution of the environmental variables according to NLOG = 0 or NLOG > 0

5.1 SSCI - Moz

```
## SSCI
#Moz
b.width = 0.02
f3.ssci.moz <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=SSCImean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_Moz, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=SSCImean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_sup_zero_Moz, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0,0.1,0.2,0.3,0.4,0.5,0.6,0.7))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean SSCI (m.s-1)")+
  ylab("Frequency (%)")+
  ggtitle("MOZ")+
  theme(text = element_text(size = 20))+
  theme(plot.title = element_text(hjust = 0.5))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.445, y=8.75,
           label=paste("P =",
                       round(
                         wilcox.test(
                           NLOG_VE_zero_Moz$SSCImean,
```

```
                          NLOG_VE_sup_zero_Moz$SSCImean)$p.value,
                        digits = 3)),
           color="black", fontface="bold.italic", size=6)
```

5.2 SSCI - North

```
## SSCI
#North
f3.ssci.north <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=SSCImean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_North, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=SSCImean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_sup_zero_North, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0,0.1,0.2,0.3,0.4,0.5,0.6))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean SSCI (m.s-1)")+
  ylab(" ")+
  ggtitle("WIO")+
  theme(text = element_text(size = 20))+
  theme(plot.title = element_text(hjust = 0.5))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.62, y=4.3,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_North$SSCImean,
                             NLOG_VE_sup_zero_North$SSCImean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.3 SLA - Moz

```
## SLA
#Moz
f3.sla.moz <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=slamean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02,  bins = 30, size = 1,
                 data = NLOG_VE_zero_Moz, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=slamean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02,  bins = 30, size = 1,
```

```
                data = NLOG_VE_sup_zero_Moz, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(-0.10,-0.05,0,0.05,0.10,0.15,0.20,0.25,0.30))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean SLA (m)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.14, y=13,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_Moz$slamean,
                             NLOG_VE_sup_zero_Moz$slamean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.4 SLA - North

```
## SLA
#North
f3.sla.north <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=slamean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_North, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=slamean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_sup_zero_North, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(-0.10,-0.05,0,0.05,0.10,0.15,0.20,0.25,0.30))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean SLA (m)")+
  ylab(" ")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 18))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.28, y=5,
           label = paste("P =",
                         round(
                           wilcox.test(
```

```
                              NLOG_VE_zero_North$slamean,
                              NLOG_VE_sup_zero_North$slamean)$p.value,
                            digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.5 FSLE - Moz

```
## FSLE
#Moz
f3.fsle.moz <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=FSLEmean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_Moz, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=FSLEmean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_sup_zero_Moz, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(-0.14,-0.12,-0.10,-0.08,-0.06,-0.04,-0.02,0))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean FSLE (days-1)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=-0.037, y=15,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_Moz$FSLEmean,
                             NLOG_VE_sup_zero_Moz$FSLEmean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.6 FSLE - North

```
## FSLE
#North
f3.fsle.north <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=FSLEmean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_North, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=FSLEmean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
```

```
                data = NLOG_VE_sup_zero_North, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(-0.14,-0.12,-0.10,-0.08,-0.06,-0.04,-0.02,0))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean FSLE (days-1)")+
  ylab(" ")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0, y=21,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_North$FSLEmean,
                             NLOG_VE_sup_zero_North$FSLEmean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.7 MN - Moz

```
## MN_Epi
#Moz
f3.mn.moz <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=MNmean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.04,  bins = 30, size = 1,
                 data = NLOG_VE_zero_Moz, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=MNmean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.04,  bins = 30, size = 1,
                 data = NLOG_VE_sup_zero_Moz, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0.25,0.50,0.75,1.00,1.25))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean MN (g.m-2)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=1.2, y=4.5,
           label = paste("P =",
                         round(
                           wilcox.test(
```

```
                              NLOG_VE_zero_Moz$MNmean,
                              NLOG_VE_sup_zero_Moz$MNmean)$p.value,
                            digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.8 MN - North

```
## MN
#North
f3.mn.north <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=MNmean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.025, size = 1,
                 data = NLOG_VE_zero_North, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=MNmean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.025, size = 1,
                 data = NLOG_VE_sup_zero_North, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0.3,0.6,0.9))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean MN (g.m-2)")+
  ylab(" ")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=1.04, y=2.8,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_North$MNmean,
                             NLOG_VE_sup_zero_North$MNmean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.9 Chla - Moz

```
## Chla
#Moz
f3.chla.moz <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=chlamean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = b.width, bins = 30, size = 1,
                 data = NLOG_VE_zero_Moz, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=chlamean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = b.width, bins = 30, size = 1,
```

```
                data = NLOG_VE_sup_zero_Moz, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0,0.10,0.20,0.30,0.40,0.50,0.60,0.70,0.80,0.90,1))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean Chl-a (mg.m-3)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.93, y=9.1,
           label = paste("P =",
                         round(
                           wilcox.test(
                             NLOG_VE_zero_Moz$chlamean,
                             NLOG_VE_sup_zero_Moz$chlamean)$p.value,
                           digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.10 Chla - North

```
## Chla
#North
f3.chla.north <- ggplot()+
  geom_histogram(stat = 'bin', aes(x=chlamean,
                                   y = ..density.., fill = "NLOG = 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_zero_North, alpha=0.5)+
  geom_histogram(stat = 'bin', aes(x=chlamean,
                                   y = ..density.., fill = "NLOG > 0"),
                 binwidth = 0.02, size = 1,
                 data = NLOG_VE_sup_zero_North, alpha = 0.5)+
  scale_fill_manual(name = "NLOG abundance index (Number per observation effort)",
                    values = c("NLOG = 0" = "steelblue3",
                               "NLOG > 0" = "yellow1"))+
  scale_x_continuous(breaks=c(0,0.10,0.20,0.30,0.40,0.50,0.60,0.70,0.80,0.90,1))+
  scale_y_continuous(labels = function(x) x*100*b.width)+
  xlab("Mean Chl-a (mg.m-3)")+
  ylab(" ")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  annotate(geom="text", x=0.69, y=6.5,
           label = paste("P =",
                         round(
                           wilcox.test(
```

```
                              NLOG_VE_zero_North$chlamean,
                              NLOG_VE_sup_zero_North$chlamean)$p.value,
                            digits = 3)),
              color="black", fontface="bold.italic", size=6)
```

5.11 Combine plots

```
fig3 <- ggarrange(f3.ssci.moz, f3.ssci.north,
                  f3.sla.moz, f3.sla.north,
                  f3.fsle.moz,f3.fsle.north,
                  f3.mn.moz, f3.mn.north,
                  f3.chla.moz, f3.chla.north,
                  labels = c("(a)","(b)","(c)","(d)","(e)",
                             "(f)","(g)","(h)","(i)","(j)"),
                  font.label = list(size = 20),
                  label.x = 0.85,
                  label.y = 0.85,
                  ncol = 2, nrow = 5,
                  common.legend = TRUE, legend = "bottom",
                  widths = c(1, 1),
                  heights = c(1, 1))
```

5.12 Save plots

```
ggsave(file=file.path(PATH_FIG, "Fig3_Distributions of VE.png"), fig3,
       width = 35, height = 50, units = "cm")
ggsave(file=file.path(PATH_FIG, "Fig3.eps"), fig3,
       width = 35, height = 50, units = "cm")
```

6 Figure 4 : Scatter plots : NLOGs vs VE

6.1 SSCI

```
#SSCI
f4.ssci <- ggplot(NLOG_VE_sup_zero)+
  geom_point(aes(x = SSCImean, y = NLOG_stand, shape = Zone),size = 3)+
  scale_shape_manual(values = c(17, 1))+
  scale_x_continuous(breaks=c(0,0.1,0.2,0.3,0.4,0.5,0.6,0.7))+
  xlab("Mean SSCI (m.s-1)")+
  ylab(expression(A["i,m"]))+
  scale_y_continuous(breaks=c(0,0.5,1,1.5,2,2.5))+
  theme(text = element_text(size = 17))+
  theme(axis.text.x = element_text(size = 18))+
  theme(axis.text.y = element_text(size = 18))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(legend.position = "none")+
  theme(legend.key.size = unit(1, 'cm'))
```

6.2 SLA

```
#SLA
f4.sla <- ggplot(NLOG_VE_sup_zero)+
  geom_point(aes(x = slamean, y = NLOG_stand, shape = Zone),size = 3)+
  scale_shape_manual(values = c(17, 1))+
  scale_x_continuous(breaks=c(-0.10,-0.05,0,0.05,0.10,0.15,0.20,0.25,0.30))+
  xlab("Mean SLA (m)")+
  ylab(" ")+
  scale_y_continuous(breaks=c(0,0.5,1,1.5,2,2.5))+
  theme(text = element_text(size = 17))+
  theme(axis.text.x = element_text(size = 16))+
  theme(axis.text.y = element_text(size = 18))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(legend.position = "none")+
  theme(legend.key.size = unit(1, 'cm'))
```

6.3 FSLE

```
#FSLE
f4.fsle <- ggplot(NLOG_VE_sup_zero)+
  geom_point(aes(x = FSLEmean, y = NLOG_stand, shape = Zone),size = 3)+
  scale_shape_manual(values = c(17, 1))+
  scale_x_continuous(breaks=c(-0.14,-0.12,-0.10,-0.08,-0.06,-0.04,-0.02,0))+
  xlab("Mean FSLE (days-1)")+
  ylab(expression(A["i,m"]))+
  scale_y_continuous(breaks=c(0,0.5,1,1.5,2,2.5))+
  theme(text = element_text(size = 17))+
  theme(axis.text.x = element_text(size = 18))+
  theme(axis.text.y = element_text(size = 18))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(legend.position = "none")+
  theme(legend.key.size = unit(1, 'cm'))
```

6.4 MN_Epi

```
#MN_Epi
f4.mn <- ggplot(NLOG_VE_sup_zero)+
  geom_point(aes(x = MNmean, y = NLOG_stand, shape = Zone),size = 3)+
  scale_shape_manual(values = c(17, 1))+
  scale_x_continuous(breaks=seq(0.25,1.25,0.25))+
  xlab("Mean MN (g.m-2)")+
  ylab(" ")+
  scale_y_continuous(breaks=c(0,0.5,1,1.5,2,2.5))+
  theme(text = element_text(size = 17))+
  theme(axis.text.x = element_text(size = 18))+
  theme(axis.text.y = element_text(size = 18))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(legend.position = "none")+
  theme(legend.key.size = unit(1, 'cm'))
```

6.5 Chla

```
#Chla
f4.chla <- ggplot(NLOG_VE_sup_zero)+
  geom_point(aes(x = chlamean, y = NLOG_stand, shape = Zone),size = 3)+
  scale_shape_manual(values = c(17, 1))+
  scale_x_continuous(breaks=seq(0,1,.1))+
  xlab("Mean Chl-a (mg.m-3)")+
  ylab(expression(A["i,m"]))+
  scale_y_continuous(breaks=seq(0,2.5,.5))+
  theme(text = element_text(size = 17))+
  theme(axis.text.x = element_text(size = 18))+
  theme(axis.text.y = element_text(size = 18))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(legend.position = "none")+
  theme(legend.key.size = unit(1, 'cm'))
```

6.6 Combine plots

```
fig4 <- ggarrange(f4.ssci,
                  f4.sla,
                  f4.fsle,
                  f4.mn,
                  f4.chla,
          labels = c("(a)","(b)","(c)","(d)","(e)"),
                  font.label = list(size = 20),
                  label.x = 0.85,
                  label.y = 0.95,
          ncol = 2, nrow = 3,
          common.legend = TRUE, legend = "bottom")
```

6.7 Save plots

```
ggsave(file=file.path(PATH_FIG, "Fig4_Scatter plots.png"), fig4,
       width = 30, height = 25, units = "cm")
ggsave(file=file.path(PATH_FIG, "Fig4.eps"), fig4,
       width = 30, height = 25, units = "cm")
```

7 Figure 5 : GAM predictions

```
GAM_North <- mgcv::gam(
  logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) + s(MNcr, k = 3), 
  )
GAM_North2 <- stepAIC.gam(GAM_North, verbose = T)
```

```
## ~~~ Iteration 1 ~~~
##
## Initial model: mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr
## AIC: 627.5595
##
## mgcv::gam( logNLOG ~ s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) + s(MNcr, k = 3) , data =
```

```
## AIC: 636.5523
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) + s(MNcr, k = 3) , data =
## AIC: 642.0972
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(FSLEcr, k = 3) + s(MNcr, k = 3) , data =
## AIC: 626.4458
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) + s(MNcr, k = 3) , data =
## AIC: 626.3752
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) , data
## AIC: 625.5617
##
## ~~~ Iteration 2 ~~~
##
## Initial model: mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr
## AIC: 625.5617
##
## mgcv::gam( logNLOG ~ s(slacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) , data = NLOG_VE_sup_zero_
## AIC: 634.7419
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(SSCIcr, k = 3) + s(FSLEcr, k = 3) , data = NLOG_VE_sup_zero
## AIC: 640.1069
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(FSLEcr, k = 3) , data = NLOG_VE_sup_zero_
## AIC: 624.4525
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(SSCIcr, k = 3) , data = NLOG_VE_sup_zero_
## AIC: 624.4625
##
## ~~~ Iteration 3 ~~~
##
## Initial model: mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) + s(FSLEcr, k = 3) , data = NL
## AIC: 624.4525
##
## mgcv::gam( logNLOG ~ s(slacr, k = 3) + s(FSLEcr, k = 3) , data = NLOG_VE_sup_zero_North )
## AIC: 635.0201
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(FSLEcr, k = 3) , data = NLOG_VE_sup_zero_North )
## AIC: 639.8062
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) , data = NLOG_VE_sup_zero_North )
## AIC: 623.5236
##
## ~~~ Iteration 4 ~~~
##
## Initial model: mgcv::gam( logNLOG ~ s(chlacr, k = 3) + s(slacr, k = 3) , data = NLOG_VE_sup_zero_Nort
## AIC: 623.5236
##
## mgcv::gam( logNLOG ~ s(slacr, k = 3) , data = NLOG_VE_sup_zero_North )
## AIC: 634.0928
##
## mgcv::gam( logNLOG ~ s(chlacr, k = 3) , data = NLOG_VE_sup_zero_North )
```

```
## AIC: 638.1162
```

```
p1 <- plot.gam.prediction(data = NLOG_VE_sup_zero_North,
                      my_gam = GAM_North2,
                      vars = c("chlacr","slacr","MNcr"),
                      var_to_predict = "chlacr",
                      xlabel = "Chl-a",
                      ylabel = expression("Predicted"~A[im]),
                      lims.y = c(0,NA),
                      trans.back = exp)
p2 <- plot.gam.prediction(data = NLOG_VE_sup_zero_North,
                      my_gam = GAM_North2,
                      vars = c("chlacr","slacr","MNcr"),
                      var_to_predict = "slacr",
                      xlabel = "SLA",
                      ylabel = expression("Predicted"~A[im]),
                      lims.y = c(0,NA),
                      trans.back = exp)
fig5 <- ggarrange(p1,
                  p2,
                  labels = c("(a)","(b)"),
                  font.label = list(size = 12),
                  label.x = 0,
                  label.y = 0.95,
          ncol = 1, nrow = 2)
ggsave(file=file.path(PATH_FIG, "Fig5_gam_predict.png"), fig5,
       width = 8, height = 15, units = "cm")
ggsave(file=file.path(PATH_FIG, "Fig5.eps"), fig5,
       width = 8, height = 15, units = "cm")
```

7.0.0.1 APPENDICES FIGURES

8 Appendix A1 : correlation matrix of Environmental variables (VE)

```
# change significance levels in chart.Correlation function:
chart.Correlation.modif <- function (R, histogram = TRUE,
                                     method = c("pearson", "kendall", "spearman"),
                                     ...)
{
  x = checkData(R, method = "matrix")
  if (missing(method))
    method = method[1]
  cormeth <- method
  panel.cor <- function(x, y, digits = 2, prefix = "",
                        use = "pairwise.complete.obs",
                        method = cormeth, cex.cor, ...) {
    usr <- par("usr")
    on.exit(par(usr))
    par(usr = c(0, 1, 0, 1))
    r <- cor(x, y, use = use, method = method)
    txt <- format(c(r, 0.123456789), digits = digits)[1]
```

```
    txt <- paste(prefix, txt, sep = "")
    if (missing(cex.cor))
      cex <- 0.8/strwidth(txt)
    test <- cor.test(as.numeric(x), as.numeric(y), method = method)
    Signif <- symnum(test$p.value, corr = FALSE, na = FALSE,
                     cutpoints = c(0, 1/3*10**-2, 1), symbols = c("*"," "))
    text(0.5, 0.5, txt, cex = cex * (abs(r) + 0.3)/1.3)
    text(0.8, 0.8, Signif, cex = cex, col = 2)
  }
  f <- function(t) {
    dnorm(t, mean = mean(x), sd = sd.xts(x))
  }
  dotargs <- list(...)
  dotargs$method <- NULL
  rm(method)
  hist.panel = function(x, ... = NULL) {
    par(new = TRUE)
    hist(x, col = "light gray", probability = TRUE, axes = FALSE,
         main = "", breaks = "FD")
    lines(density(x, na.rm = TRUE), col = "red", lwd = 1)
    rug(x)
  }
  if (histogram)
    pairs(x, gap = 0, lower.panel = panel.smooth, upper.panel = panel.cor,
          diag.panel = hist.panel)
  else pairs(x, gap = 0, lower.panel = panel.smooth, upper.panel = panel.cor)
}
```

```
names(NLOG_VE)
```

```
##  [1] "lat_grid"   "lon_grid"   "year"       "month"      "NumNLOG"
##  [6] "NumOBS"     "NLOG_stand" "chlamean"   "chlasd"     "sstmean"
## [11] "sstsd"      "slamean"    "slasd"      "FSLEmean"   "FSLEsd"
## [16] "SSCImean"   "SSCIsd"     "MNmean"     "MNsd"       "Zone"
## [21] "Season"
```

```
my_data_ve <- NLOG_VE %>% dplyr::select(sstmean, SSCImean,
                                        slamean, FSLEmean, MNmean, chlamean)
colnames(my_data_ve) <- c("SST","SSCI","SLA","FSLE", "MN","Chl-a")
png(filename = file.path(PATH_FIG, "Appendix_A1_corrMatrixEnv.png"),
    width = 20, height = 12, units = "cm", res = 300)
chart.Correlation.modif(my_data_ve, histogram=TRUE, pch=20, method = "kendall")
dev.off()
```

```
## pdf
##   2
```

9 Appendix A2 : Predicted vs Observed Aim values

9.1 WIO

```
#North
pred.north <- predict(GAM_North2)
NLOG_VE_sup_zero_North$pred<-pred.north
```

```
A2.north <- ggplot(NLOG_VE_sup_zero_North, aes(x = logNLOG, y = pred))+
  geom_point()+
  xlim(min(NLOG_VE_sup_zero_North$logNLOG),max(NLOG_VE_sup_zero_North$logNLOG))+
  ylim(min(NLOG_VE_sup_zero_North$logNLOG),max(NLOG_VE_sup_zero_North$logNLOG))+
  geom_abline(slope = 1, intercept = 0)+
  xlab(expression("Observed"~A[im]))+
  ylab(expression("Predicted"~A[im]))+
  theme(text = element_text(size = 15))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))
```

9.2 Moz

```
LM_Moz <- lm(logNLOG ~ chlacr + slacr + SSCIcr + FSLEcr + MNcr,
             data = NLOG_VE_sup_zero_Moz)
LM_Moz2 <- stepAIC(LM_Moz)
```

```
## Start:  AIC=-3.19
## logNLOG ~ chlacr + slacr + SSCIcr + FSLEcr + MNcr
##
##          Df Sum of Sq    RSS     AIC
## - chlacr  1   0.05227 18.136 -5.0998
## - FSLEcr  1   0.09244 18.176 -5.0335
## - SSCIcr  1   0.35652 18.440 -4.6007
## - MNcr    1   0.43575 18.519 -4.4721
## <none>                18.083 -3.1864
## - slacr   1   1.43521 19.518 -2.8952
##
## Step:  AIC=-5.1
## logNLOG ~ slacr + SSCIcr + FSLEcr + MNcr
##
##          Df Sum of Sq    RSS     AIC
## - FSLEcr  1   0.12561 18.261 -6.8928
## - SSCIcr  1   0.32672 18.462 -6.5642
## - MNcr    1   0.56817 18.704 -6.1744
## <none>                18.136 -5.0998
## - slacr   1   1.38581 19.521 -4.8908
##
## Step:  AIC=-6.89
## logNLOG ~ slacr + SSCIcr + MNcr
##
##          Df Sum of Sq    RSS     AIC
## - SSCIcr  1   0.47470 18.736 -8.1229
## - MNcr    1   0.50722 18.768 -8.0709
## <none>                18.261 -6.8928
## - slacr   1   2.16105 20.422 -5.5374
##
## Step:  AIC=-8.12
## logNLOG ~ slacr + MNcr
##
##         Df Sum of Sq    RSS     AIC
## - MNcr   1   0.14633 18.882 -9.8895
## <none>               18.736 -8.1229
```

```
## - slacr  1   1.81132 20.547 -7.3543
##
## Step:  AIC=-9.89
## logNLOG ~ slacr
##
##         Df Sum of Sq    RSS     AIC
## <none>               18.882 -9.8895
## - slacr  1    1.9138 20.796 -8.9932
```

```
#Moz
pred.moz <- predict(LM_Moz2)
NLOG_VE_sup_zero_Moz$pred<-pred.moz
A2.moz <- ggplot(NLOG_VE_sup_zero_Moz, aes(x = logNLOG, y = pred))+
  geom_point()+
  xlim(min(NLOG_VE_sup_zero_Moz$logNLOG),max(NLOG_VE_sup_zero_Moz$logNLOG))+
  ylim(min(NLOG_VE_sup_zero_Moz$logNLOG),max(NLOG_VE_sup_zero_Moz$logNLOG))+
  geom_abline(slope = 1, intercept = 0)+
  xlab(expression("Observed"~A[im]))+
  ylab(expression("Predicted"~A[im]))+
  theme(text = element_text(size = 15))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))
```

9.3 Combine plots

```
ApxA2 <- ggarrange(A2.north, A2.moz+
                     rremove("ylab"),
          labels = c("(a)", "(b)"),
          font.label = list(size = 20),
                     label.x = 0.1,
                     label.y = 0.95,
          ncol = 2, nrow = 1)
```

9.4 Save plots

```
ggsave(file=file.path(PATH_FIG, "Appendix_A2_pred vs obs.png"), ApxA2,
       width = 35, height = 10, units = "cm")
ggsave(file=file.path(PATH_FIG, "Appendix_A2_pred vs obs.eps"), ApxA2,
       width = 35, height = 10, units = "cm")
```

10 Appendix B1 : Distribution of the environmental variables according to used data or rendom data

10.1 SSCI - Moz

```
## SSCI
#Moz
B1.ssci.moz <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=SSCImean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="MOZ",],
```

```
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=SSCImean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="MOZ",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean SSCI (m.s-1)")+
  ylab("Frequency (%)")+
  ggtitle("MOZ")+
    theme(text = element_text(size = 20))+
  theme(plot.title = element_text(hjust = 0.5))+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.2 SSCI - North

```
## SSCI
#North
B1.ssci.north <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=SSCImean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="WIO",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=SSCImean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="WIO",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean SSCI (m.s-1)")+
  ylab("Frequency (%)")+
  ggtitle("WIO")+
  theme(text = element_text(size = 20))+
  theme(plot.title = element_text(hjust = 0.5))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.3 SLA - Moz

```
## SLA
#Moz
B1.sla.moz <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=slamean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="MOZ",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=slamean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="MOZ",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean SLA (m)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.4 SLA - North

```
## SLA
#North
B1.sla.north <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=slamean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="WIO",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=slamean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="WIO",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean SLA (m)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
```

```
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.5 FSLE - Moz

```
## FSLE
#Moz
B1.fsle.moz <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=FSLEmean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="MOZ",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=FSLEmean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="MOZ",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean FSLE (days-1)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.6 FSLE - North

```
## FSLE
#North
B1.fsle.north <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=FSLEmean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="WIO",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=FSLEmean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="WIO",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
```

```
                                "Data used" = "steelblue"))+
  xlab("Mean FSLE (days-1)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.7 MN - Moz

```
## MN_Epi
#Moz
B1.mn.moz <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=micronec_epi, y = ..density.., fill = "Data used"),
    binwidth = 0.04, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="MOZ",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=micronec_epi, y = ..density.., fill = "Random data"),
    binwidth = 0.04, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="MOZ",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean MN (g.m-2)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.8 MN - North

```
## MN_Epi
#North
B1.mn.north <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=micronec_epi, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="WIO",],
    alpha=0.5
    )+
  geom_histogram(
```

```
    stat = 'bin', aes(x=micronec_epi, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="WIO",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean MN (g.m-2)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.9 Chla - Moz

```
## Chla
#Moz
B1.chla.moz <- ggplot()+
  geom_histogram(
    stat = 'bin', aes(x=chlamean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="MOZ",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=chlamean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="MOZ",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean Chl-a (mg.m-3)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.10 Chla - North

```
## Chla
#North
B1.chla.north <- ggplot()+
  geom_histogram(
```

```
    stat = 'bin', aes(x=chlamean, y = ..density.., fill = "Data used"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff[df_eff$threshold=="Fisheries" & df_eff$Zone=="WIO",],
    alpha=0.5
    )+
  geom_histogram(
    stat = 'bin', aes(x=chlamean, y = ..density.., fill = "Random data"),
    binwidth = 0.02, bins = 30, size = 1,
    data = df_eff_new[df_eff_new$Zone=="WIO",], alpha=0.5
    )+
  scale_fill_manual(name = "Data used vs Random data",
                    values = c("Random data" = "yellow1",
                               "Data used" = "steelblue"))+
  xlab("Mean Chl-a (mg.m-3)")+
  ylab("Frequency (%)")+
  ggtitle(" ")+
  theme(text = element_text(size = 20))+
  theme(axis.text.x = element_text(size = 20))+
  theme(axis.text.y = element_text(size = 20))+
  theme(legend.text = element_text(size=20))+
  theme(legend.title = element_text(size=20))+
  theme(plot.margin = grid::unit(c(0,0.75,0,0), "cm"))
```

10.11 Combine plots

```
ApxB1 <- ggarrange(B1.ssci.moz, B1.ssci.north + rremove("ylab"),
                   B1.sla.moz, B1.sla.north + rremove("ylab"),
                   B1.fsle.moz, B1.fsle.north + rremove("ylab"),
                   B1.mn.moz, B1.mn.north + rremove("ylab"),
                   B1.chla.moz, B1.chla.north + rremove("ylab"),
                   labels = c("(a)","(b)","(c)","(d)","(e)",
                              "(f)","(g)","(h)","(i)","(j)"),
                   font.label = list(size = 20),
                   label.x = 0.85,
                   label.y = 0.90,
                   ncol = 2, nrow = 5,
                   common.legend = TRUE, legend = "bottom",
                   widths = c(1, 1),
                   heights = c(1, 1))
```

10.12 Save plots

```
ggsave(file=file.path(PATH_FIG, "Appendix_B1_sampling bias.png"), ApxB1,
       width = 35, height = 50, units = "cm")
ggsave(file=file.path(PATH_FIG, "Appendix_B1_sampling bias.eps"), ApxB1,
       width = 35, height = 50, units = "cm")
```