SalidasInformeFinal-junio 2021

PRIMER PARTE: CORRE CÓDIGOS Y FUNCIONES

```
library(knitr) # para generar reporte Rmarkdown
library(stringr)
library(reshape)
library(dplyr)
library(ggplot2)
library(ggthemes) # para ggplot
library(patchwork) # para unir gráficos de ggplot
library(strucchange) # libreria utilizada para análisis de quiebres

dir.Fig     <-"Figuras/" # carpeta de las figuras utilizadas y generadas en este estudio
fig         <-c("pdf") # formato de figuras generadas por este código
dir.0       <-getwd() # directorio de trabajo
dir.1       <-paste(dir.0,"/codigos_admb",sep="") # carpeta de códigos ADMB
dir.2       <-paste(dir.0,"/Retrospectivobase",sep="") # carpeta de códigos ADMB
dir.3       <-paste(dir.0,"/Retrospectivoalternativo",sep="") # carpeta de códigos ADMB
dir.4       <-paste(dir.0,"/Verosimilitudalternativo",sep="") # carpeta de códigos ADMB
dir.5       <-paste(dir.0,"/Verosimilitudbase",sep="") # carpeta de códigos ADMB

dir.fun     <-paste(dir.0,"/funciones/",sep="") # carpeta de funciones utilizadas en este informe
source(paste(dir.fun,"functions.R",sep="")) # funciones para leer .dat y .rep
source(paste(dir.fun,"Fn_PBRs.R",sep="")) # funciones para leer .dat y .rep
```

```
setwd(dir.1)
#Asesoría septiembre 2020 MODELO BASE
data.0   <- lisread(paste(dir.1,"MTT0920.dat", sep='/'));
names(data.0)<-str_trim(names(data.0), side="right")
rep0     <- reptoRlist("MTT0920.rep")
std0     <- read.table("MTT0920.std",header=T,sep="",na="NA",fill=T)

#Asesoría junio 2021 MODELO BASE
data.1   <- lisread(paste(dir.1,"MTT0621.dat", sep='/'));
names(data.1)<-str_trim(names(data.1), side="right")
rep1     <- reptoRlist("MTT0621.rep")
std1     <- read.table("MTT0621.std",header=T,sep="",na="NA",fill=T)
```

FUNCIÓN DE RETROSPECTIVO

FUNCIÓN DE VEROSIMILITUD

FUNCIÓN DE CBA

CORRE CODIGOS DE ASESORÍAS PREVIAS MODELO BASE Y ALTERNATIVO

```
#Primer paso correr códigos
setwd(dir.1)
################################################################################
# MODELO BASE
################################################################################
#modelo base junio 2020 - Hito 2
#system("~/admb-12.2/admb MTT0520")
#system("./MTT0520")

#modelo base septiembre 2019 - Hito 1
#system("./MTT0819")
##system("~/admb-12.2/admb MTT0819")
```

LEE SALIDAS DE ASESORÍAS PREVIAS MODELO BASE Y ALTERNATIVO

```
setwd(dir.1)
################################################################################
# MODELO BASE
################################################################################
#modelo base junio 2020 - Hito 2
data0b        <- lisread(paste(dir.1,"MTT0520.dat", sep='/'));
names(data0b) <- str_trim(names(data0b), side="right")
rep.0b        <- reptoRlist("MTT0520.rep")
std.0b        <- read.table("MTT0520.std",header=T,sep="",na="NA",fill=T)

#modelo base septiembre 2019 - Hito 1
data0a        <- lisread(paste(dir.1,"MTT0819.dat", sep='/'));
names(data0a) <- str_trim(names(data0a), side="right")
rep.0a        <- reptoRlist("MTT0819.rep")
std.0a        <- read.table("MTT0819.std",header=T,sep="",na="NA",fill=T)
```

CÁLCULO DE TAMAÑO DE MUESTRA

```
#=========================================================#
# II. COMPOSICI?N EDAD DE LAS CAPTURAS                    #
#=========================================================#
years  <- data.1$Ind[,1]
nyears <- data.1$nanos
age  <-seq(5.5,20,0.5)
nage<-length(age)
#Proporci?n observada
pobsF<-rep1$Propfl_obs
pobsR<-rep1$Propcru_obs
```

```r
#Proporci?n predicha
ppredF<-rep1$Propfl_pred
ppredR<-rep1$Propcru_pred

#=================================================================#
# M?TODO de Francis
#=================================================================#
Nf1 <-60
Nr1 <-34
#---------------------------------------#
#FLOTA
fanos<-years
fobs <-pobsF
fpre <-ppredF
#RECLAS
ranos<-years
robs <-pobsR[rowSums(pobsR)>0,]
rpre <-ppredR[rowSums(pobsR)>0,]
#composicion de edad Flota
Of  <- rep(0,length(fanos))
Ef  <- rep(0,length(fanos))
vf  <- rep(0,length(fanos))
vNf <- rep(0,length(fanos))
#composicion de edad crucero de verano reclas
Or  <- rep(0,length(robs[,1]))
Er  <- rep(0,length(robs[,1]))
vr  <- rep(0,length(robs[,1]))
vNr <- rep(0,length(robs[,1]))
#---------------------------------------#
#composicion de edad Flota
for(i in 1:length(fanos)){
    Of[i]  <- sum(fobs[i,]*age)
    Ef[i]  <- sum(fpre[i,]*age)
    vf[i]  <- sum(fpre[i,]*age^2)-Ef[i]^2
    vNf[i] <- vf[i]/Nf1}
#composicion de edad crucero de verano reclas
for(i in 1:length(robs[,1])){
    Or[i]  <- sum(robs[i,]*age)
    Er[i]  <- sum(rpre[i,]*age)
    vr[i]  <- sum(rpre[i,]*age^2)-Er[i]^2
    vNr[i] <- vr[i]/Nr1}
#---------------------------------------#
wf  <- 1/var((Of-Ef)/sqrt(vNf)) #Flota
wr  <- 1/var((Or-Er)/sqrt(vNr)) #Reclas
Nf2 <- Nf1*wf                   # NM FLOTA
Nr2 <- Nr1*wr                   # NM RECLAS

#-----------------------------------------------------------------#
#NM_Fran <- data.frame(nmF=c(Nf1,Nf2),nmR=c(Nr1,Nr2));NM_Fran
#-----------------------------------------------------------------#
#=================================================================#
# M?todo de Ianelli 2002
#=================================================================#
```

```r
#Composici?n de edad de la FLOTA
Ofl <-ppredF[rowSums(pobsF)>0,]*(1-ppredF[rowSums(pobsF)>0,])
Efl <-(pobsF[rowSums(pobsF)>0,]-ppredF[rowSums(pobsF)>0,])^2
wfl <-rep(0,length(Ofl[,1]))
for(i in 1:length(Ofl[,1])){
    wfl[i] <-sum(Ofl[i,])/sum(Efl[i,])}

nmf_ari <-mean(wfl)                       # MEDIA ARITMETICA
nmf_geo <-exp(sum(log(wfl))/length(wfl)) # MEDIA GEOM?TRICA
nmf_arm <-1/mean(1/wfl)                   # MEDIA ARM?NICA

#-------------------------------------------------------------
#Composici?n de edad Crucero de verano RECLAS
Ore <-ppredR[rowSums(pobsR)>0,]*(1-ppredR[rowSums(pobsR)>0,])
Ere <-(pobsR[rowSums(pobsR)>0,]-ppredR[rowSums(pobsR)>0,])^2
wre <-rep(0,length(Ore[,1]))
for(i in 1:length(Ore[,1])){
    wre[i] <-sum(Ore[i,])/sum(Ere[i,])}
nmr_ari <-mean(wre)                       # MEDIA ARITMETICA
nmr_geo <-exp(sum(log(wre))/length(wre)) # MEDIA GEOM?TRICA
nmr_arm <-1/mean(1/wre)                   # MEDIA ARM?NICA
#-------------------------------------------------------------
#-------------------------------------------------------------
NM_Ian <- data.frame(nmF=c(nmf_ari,nmf_geo,nmf_arm),nmR=c(nmr_ari,nmr_geo,nmr_arm));NM_Ian
```

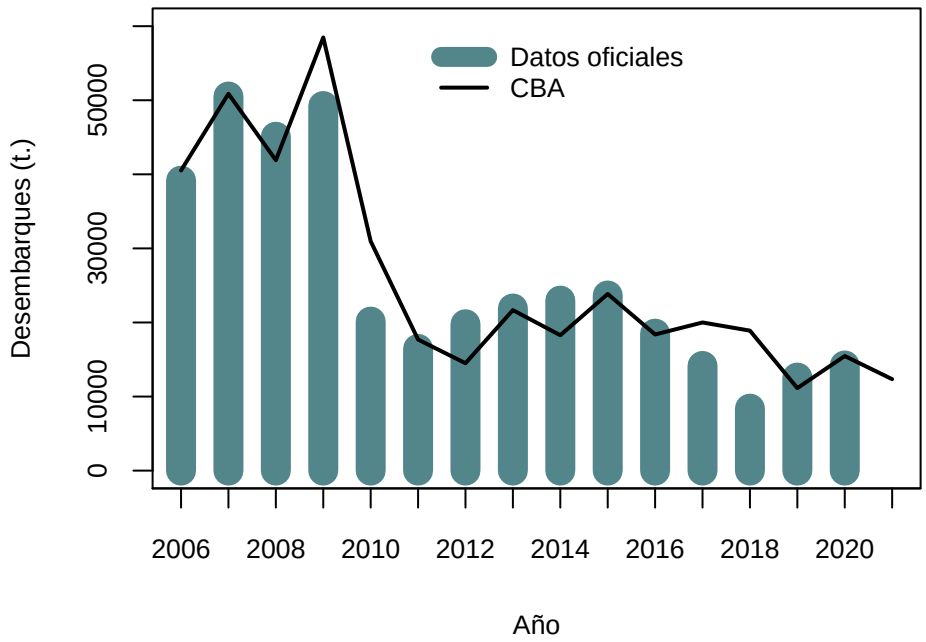
```
##        nmF      nmR
## 1 56.59619 50.78137
## 2 52.80846 43.21859
## 3 48.78160 37.90656
```

```r
#-------------------------------------------------------------
```

SEGUNDA PARTE: GENERA GRÁFICAS Y TABLAS

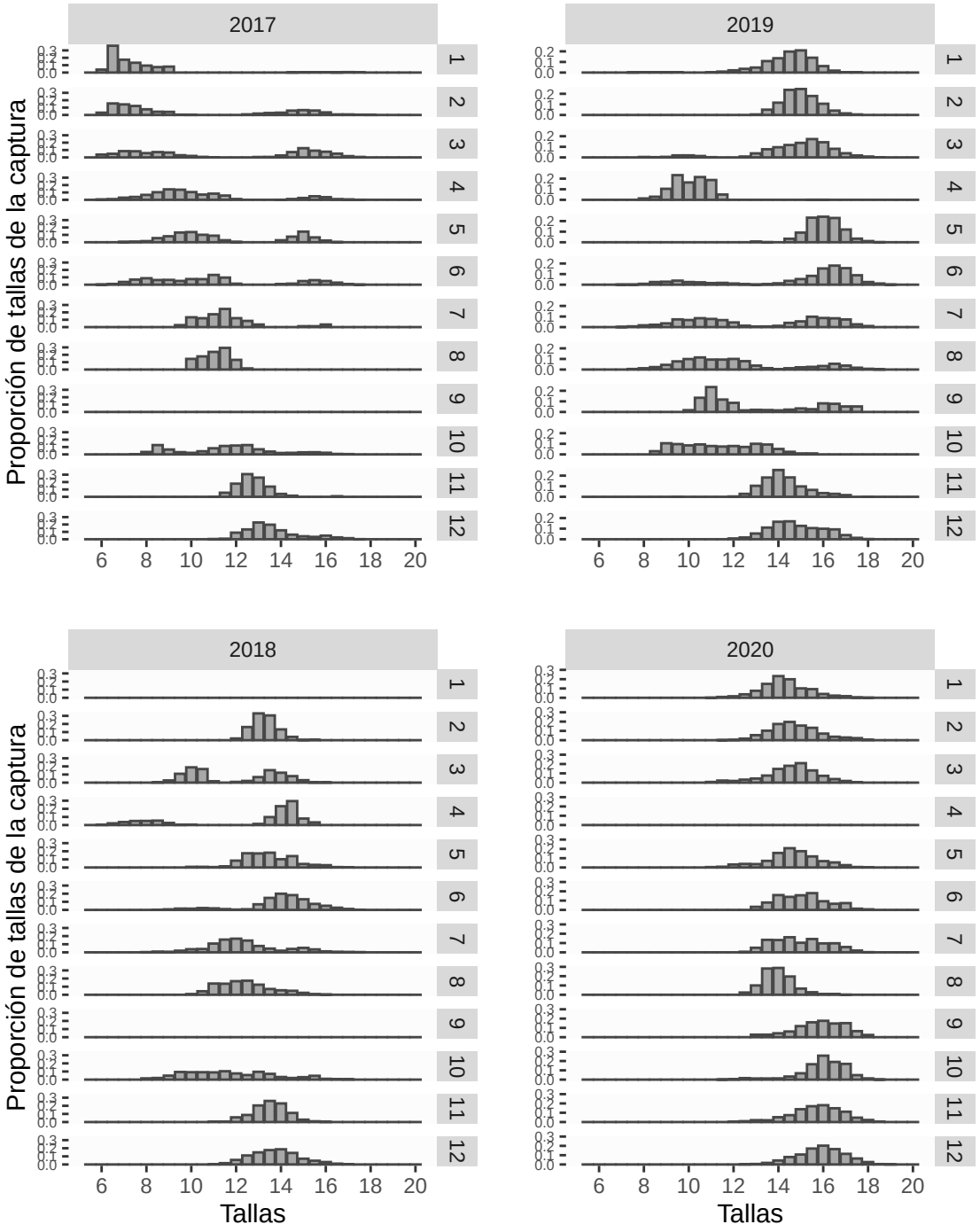
1. Antecedentes

```
year<-seq(2006,2021,1)
desemb<-c(39146,50506,45078,49225,20123,16429,19763,21888,22951,23643,18495,14134,8366,12565,14194,NA)
cuota<-c(40522,50872,41904,58481,30966,17693,14500,21670,18276,23848,18380,20000,18897,11137,15471,1234


par(mfcol=c(1,1),mar=c(4,4,1,1))
plot(year,desemb,type="h",lwd=15,ylab="Desembarques (t.)",xlab="Año",ylim=c(0,60000),xaxp=c(2000,2022,2
lines(year,cuota,type="l",lwd=2,col=1)
legend(2011,60000,c("Datos oficiales","CBA"),lwd=c(10,2),col=c("cadetblue4",1),bty="n",cex=0.8)
```



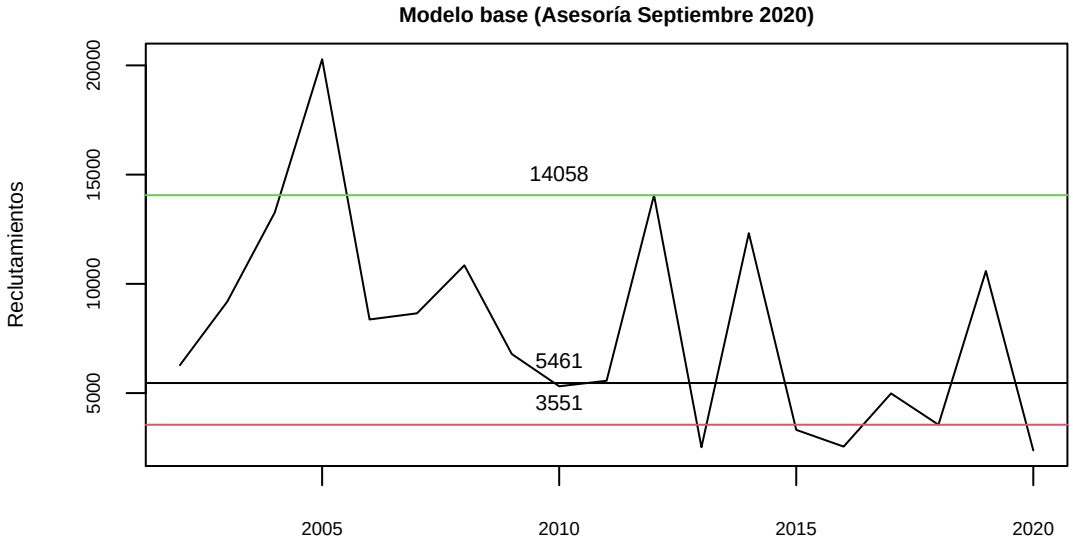

```
datafrec<-read.table(paste(getwd(),"/Tallasmensuales.txt",sep=""),header = FALSE, sep = "")

tallas     <-seq(5.5,20,0.5)
ntallas    <-length(tallas)
etf_obs <- data.frame(datafrec[,3:32])
yearf   <- datafrec[,1]
nyearf  <-length(yearf)
month <- datafrec[,2]
nmonth <-length(month)

obs  <- as.data.frame(etf_obs) %>% mutate(year=yearf) %>% mutate(mes=month) %>% melt(id.vars=c('year','m
          mutate(talla = rep(tallas, each=nyearf))


fig0 <-   ggplot(filter(obs,year==2017)) +
          geom_bar(aes(x = talla, y = value), stat="identity", fill='gray66', color = 'gray28') +
          facet_grid(mes~year) +
          labs(x = '', y = 'Proporción de tallas de la captura')  +
```

```
          theme(panel.background = element_rect(fill ="gray99"),axis.text.y = element_text(hjust = 1, si
          theme(panel.grid=element_line(color=NA)) +
          scale_x_continuous(breaks = seq(from = 2, to = 20, by = 2))+
          scale_y_continuous(breaks = seq(from = 0, to = 0.3, by = 0.1))

fig1 <-   ggplot(filter(obs,year==2018)) +
          geom_bar(aes(x = talla, y = value), stat="identity", fill='gray66', color = 'gray28') +
          facet_grid(mes~year) +
          labs(x = 'Tallas', y = 'Proporción de tallas de la captura')  +
          theme(panel.background = element_rect(fill ="gray99"),axis.text.y = element_text(hjust = 1, si
          theme(panel.grid=element_line(color=NA)) +
          scale_x_continuous(breaks = seq(from = 2, to = 20, by = 2)) +
          scale_y_continuous(breaks = seq(from = 0, to = 0.3, by = 0.1))

fig2 <-   ggplot(filter(obs,year==2019)) +
          geom_bar(aes(x = talla, y = value), stat="identity", fill='gray66', color = 'gray28') +
          facet_grid(mes~year) +
          labs(x = '', y = '')  +
          theme(panel.background = element_rect(fill ="gray99"),axis.text.y = element_text(hjust = 1, si
          theme(panel.grid=element_line(color=NA)) +
          scale_x_continuous(breaks = seq(from = 2, to = 20, by = 2))+
          scale_y_continuous(breaks = seq(from = 0, to = 0.3, by = 0.1))

fig3 <-   ggplot(filter(obs,year==2020)) +
          geom_bar(aes(x = talla, y = value), stat="identity", fill='gray66', color = 'gray28') +
          facet_grid(mes~year) +
          labs(x = 'Tallas', y = '')  +
          theme(panel.background = element_rect(fill ="gray99"),axis.text.y = element_text(hjust = 1, si
          theme(panel.grid=element_line(color=NA)) +
          scale_x_continuous(breaks = seq(from = 2, to = 20, by = 2))+
          scale_y_continuous(breaks = seq(from = 0, to = 0.3, by = 0.1))



fig0+fig2+fig1+fig3
```


2017
2019
2018
2020
Proporción de tallas de la captura
Tallas
1
2
3
4
5
6
7
8
9
10
11
12
6
8
10
12
14
16
18
20

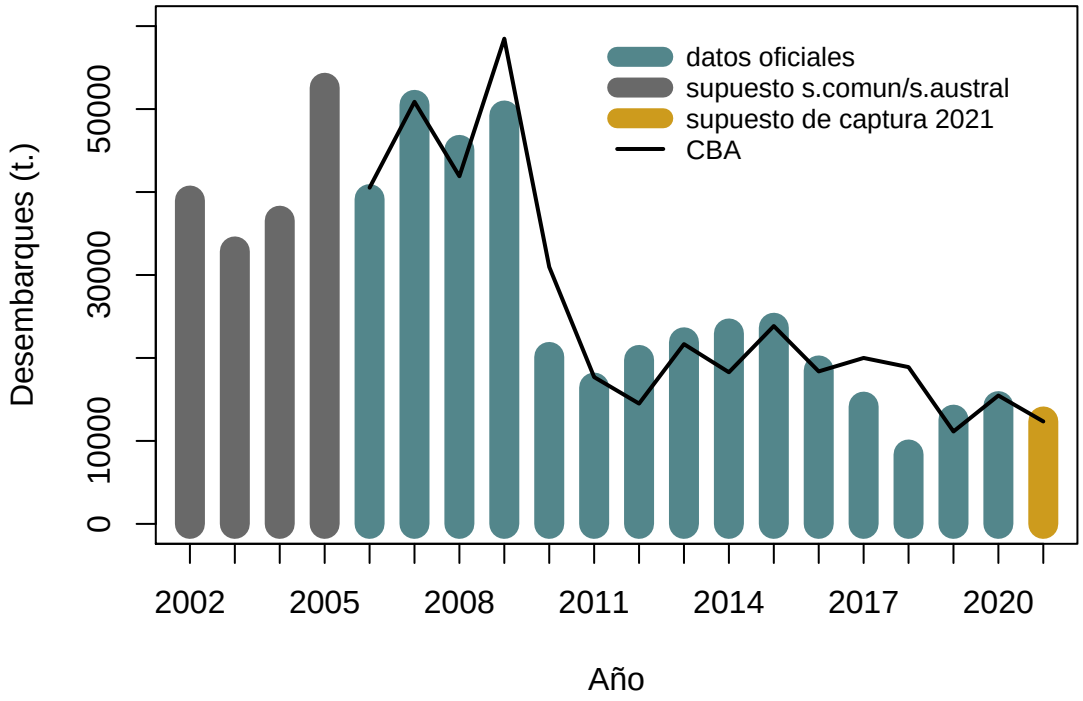
2. Metodología

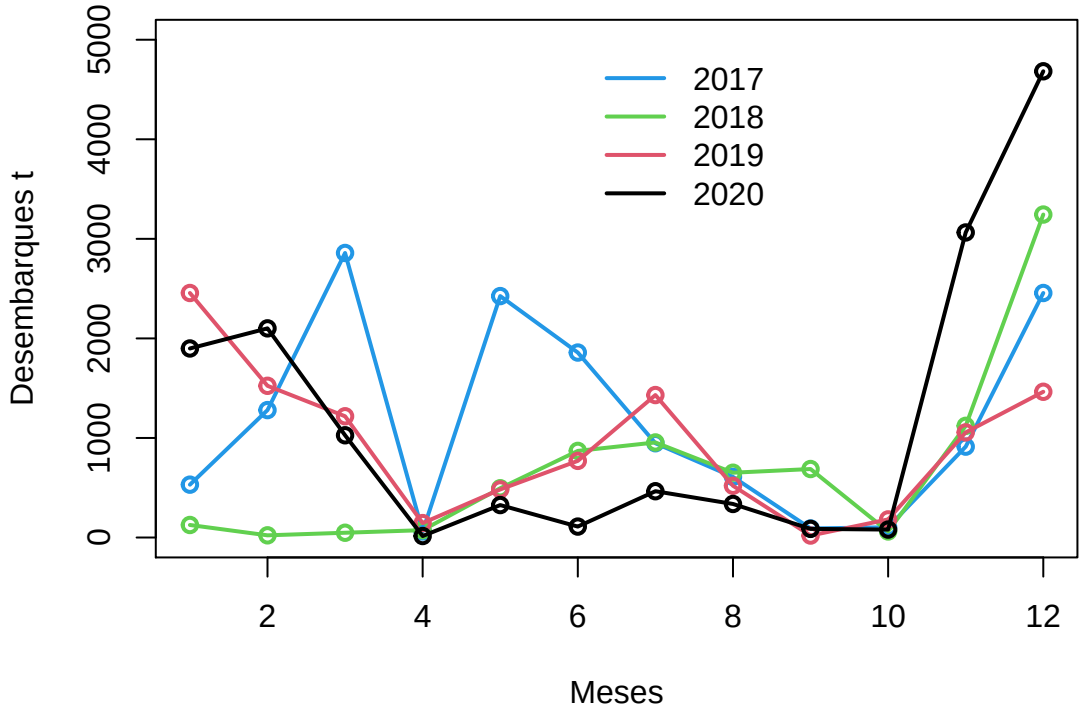
```
dirb<-paste(dir.0,"/cba_septiembre2020_base",sep="")
setwd(dirb)
reps1b     <- reptoRlist("MTT0920s1.rep")
reps2b     <- reptoRlist("MTT0920s2.rep")
reps3b     <- reptoRlist("MTT0920s3.rep")



par(mfcol=c(1,1),mar=c(2,4,1,1)+0.5)

# modelo base
plot(reps1b$Years,reps1b$Reclutamiento,type="l",ylab="Reclutamientos",xlab="",main="Modelo base (Asesori
abline(h=c(exp(8.6053e+000),reps2b$Reclutamiento[11],reps3b$Reclutamiento[17]),col=c(1,3,2))
text(2010,c(exp(8.6053e+000),reps2b$Reclutamiento[11],reps3b$Reclutamiento[17])+1000,round(c(exp(8.6053
```

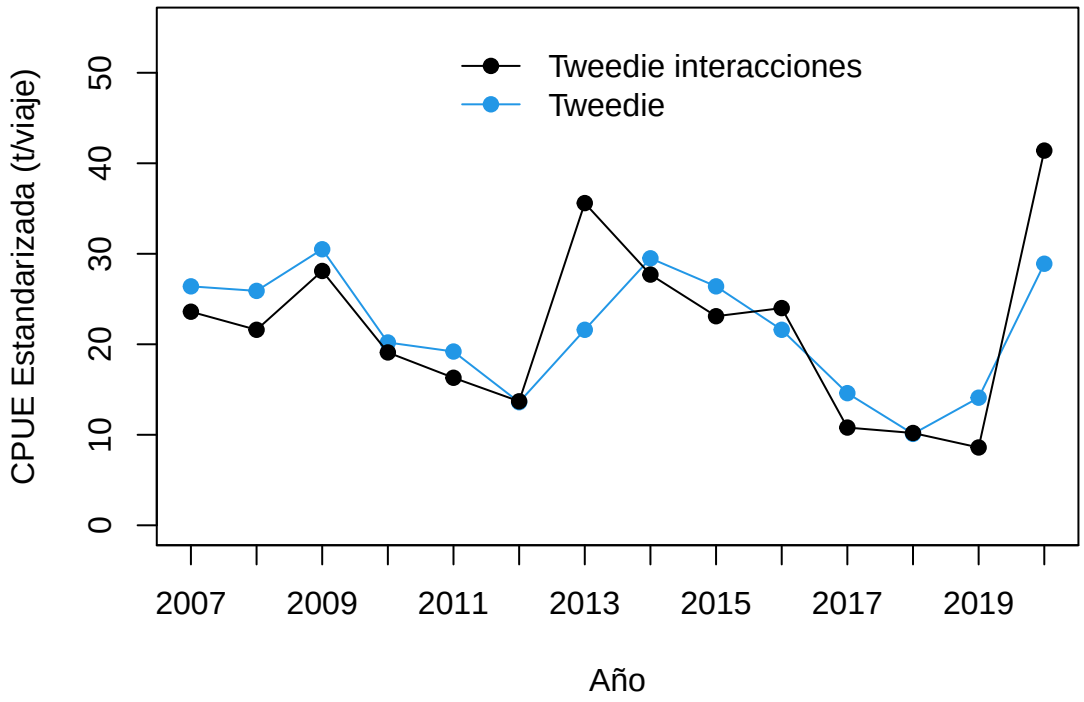


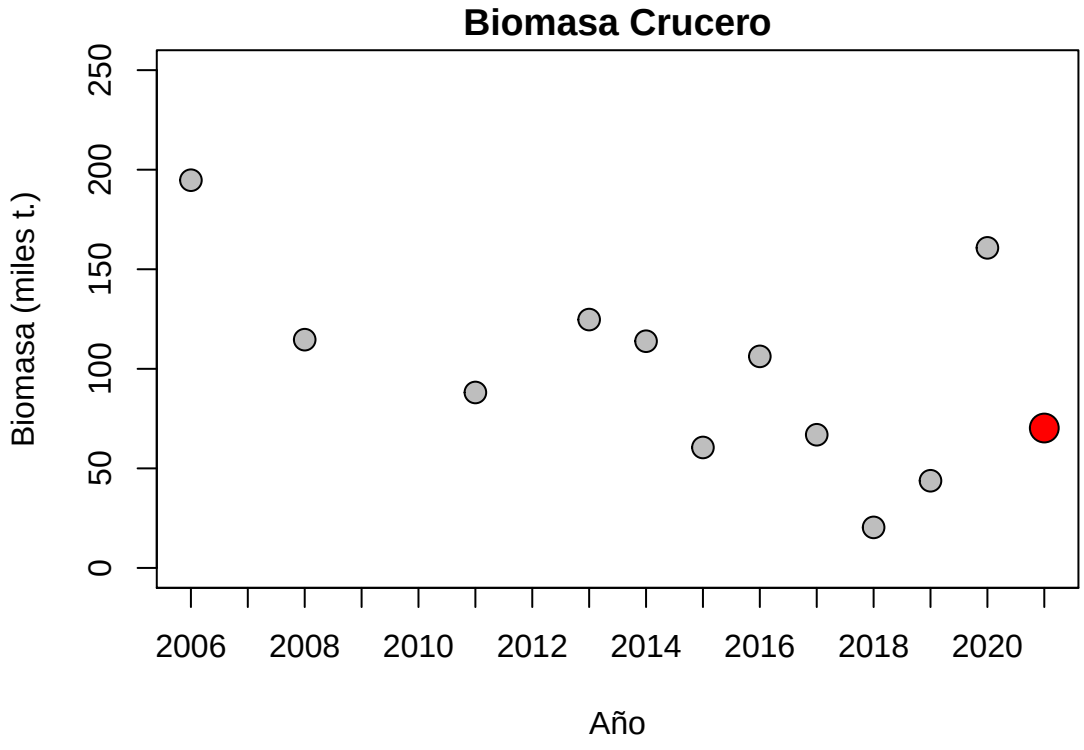
3. RESULTADOS OBJETIVO 1

3.1. Descripción de los datos de entrada al modelo de evaluación de stock





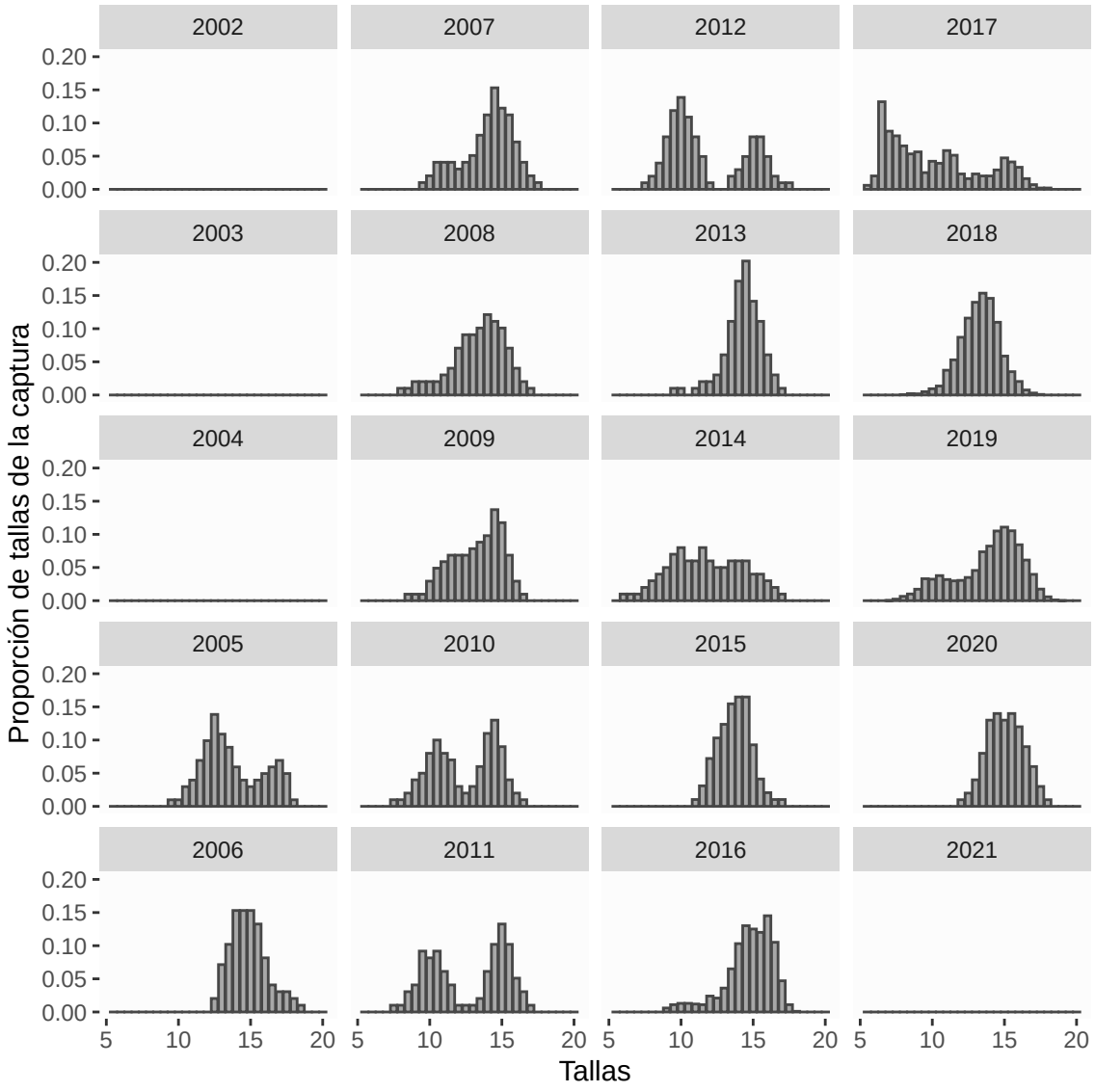




ESTRUCTURA DE TALLAS DE LA FLOTA

```
##############################################################################
# AREGLOS DE DATOS
```

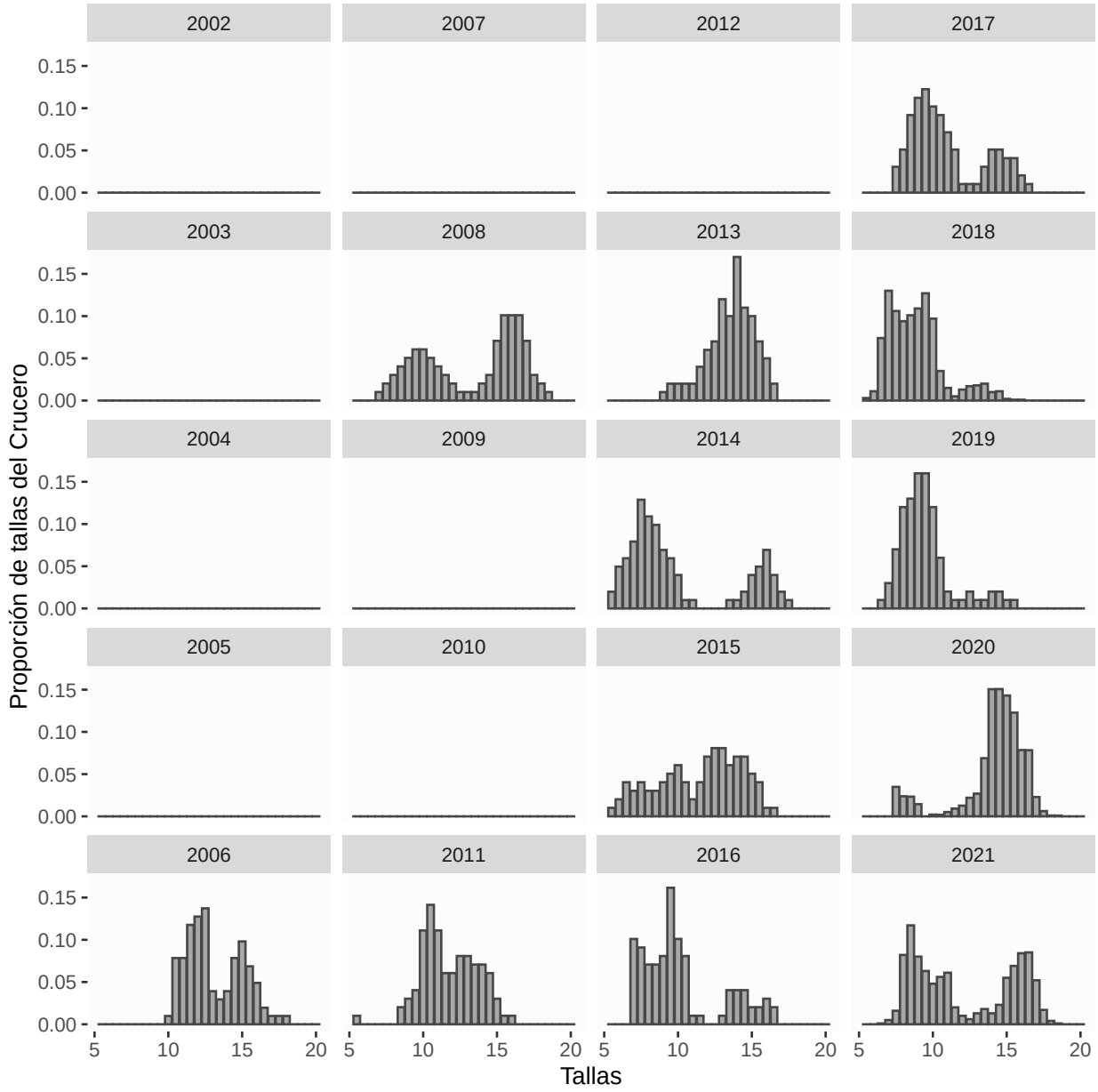
```r
#############################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)
etf_obs_jun <- data.frame(rep1$Propfl_obs)


yearf   <- rep1$Years
nyearf  <- length(yearf)

 obs       <- as.data.frame(etf_obs_jun) %>% mutate(year=yearf) %>% melt(id.vars='year') %>%
              mutate(edad = rep(age, each=nyearf)) %>% mutate(type='obs')

 mat  <- rbind(obs)

#############################################################################################
# GRAFICAS
#############################################################################################
 fig1 <- ggplot(filter(mat, type=='obs')) +
         geom_bar(aes(x = edad, y = value),
                  stat="identity", fill='gray66', color = 'gray28') +
         facet_wrap(~year, dir = 'v', as.table = TRUE) +
         labs(x = 'Tallas', y = 'Proporción de tallas de la captura') +
         theme(panel.background = element_rect(fill ="gray99")) +
         theme(panel.grid=element_line(color=NA))
 fig1
```



ESTRUCTURA DE TALLAS DEL CRUCERO

```
##############################################################################################
# AREGLOS DE DATOS
##############################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)
etc_obs_jun <- data.frame(rep1$Propcru_obs)
yearc   <- rep1$Years
nyearc  <-length(yearc)

 obs      <- as.data.frame(etc_obs_jun) %>% mutate(year=yearc) %>% melt(id.vars='year') %>%
             mutate(edad = rep(age, each=nyearc)) %>% mutate(type='obs')
 mat  <- rbind(obs)

##############################################################################################
# GRAFICAS
```

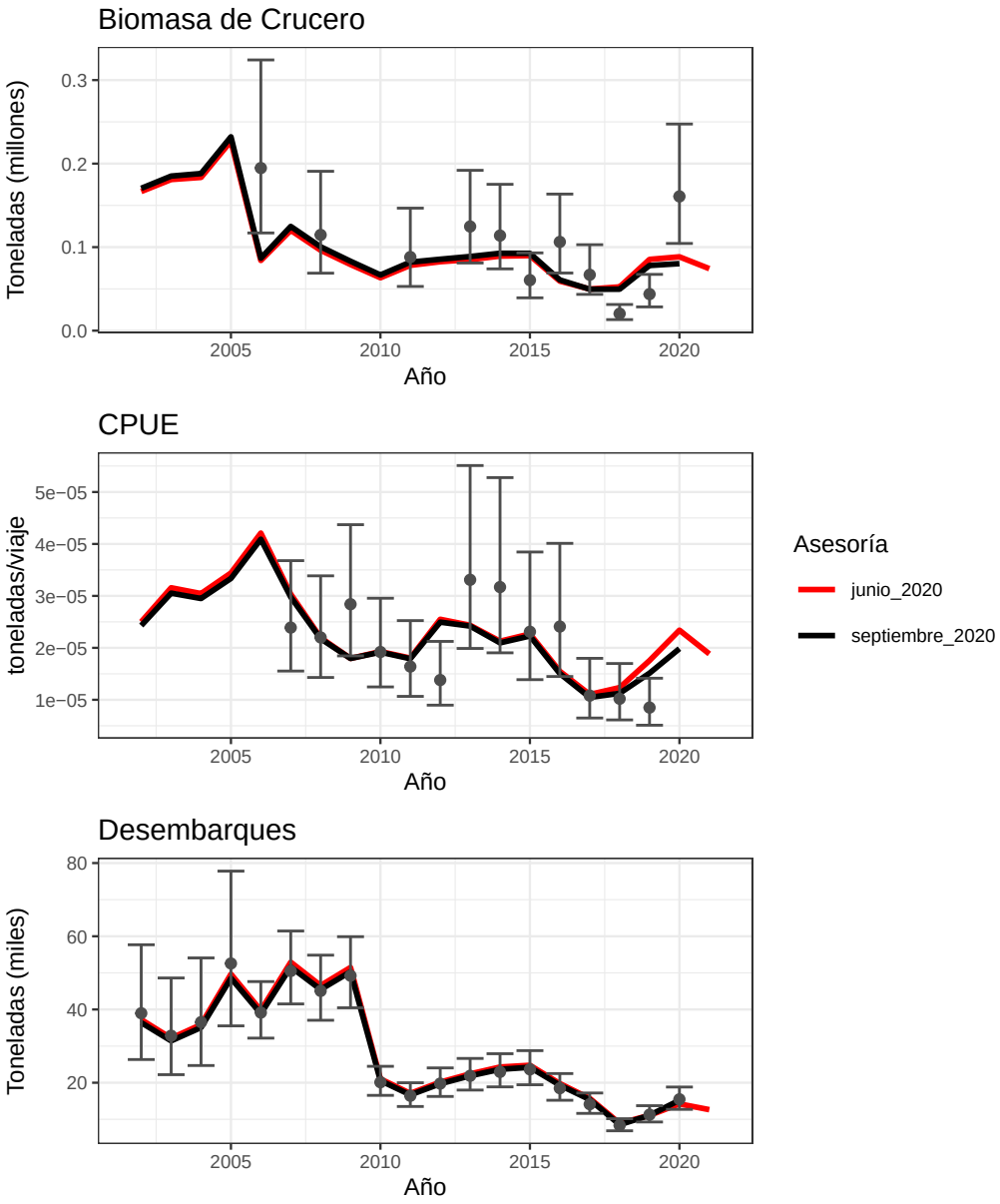
```
##############################################################################################
fig1 <- ggplot(filter(mat, type=='obs')) +
        geom_bar(aes(x = edad, y = value),
                 stat="identity", fill='gray66', color = 'gray28') +
        facet_wrap(~year, dir = 'v', as.table = TRUE) +
        labs(x = 'Tallas', y = 'Proporción de tallas del Crucero') +
        theme(panel.background = element_rect(fill ="gray99")) +
        theme(panel.grid=element_line(color=NA))
fig1
```



3.2. Ajustes del modelo a los datos de índices

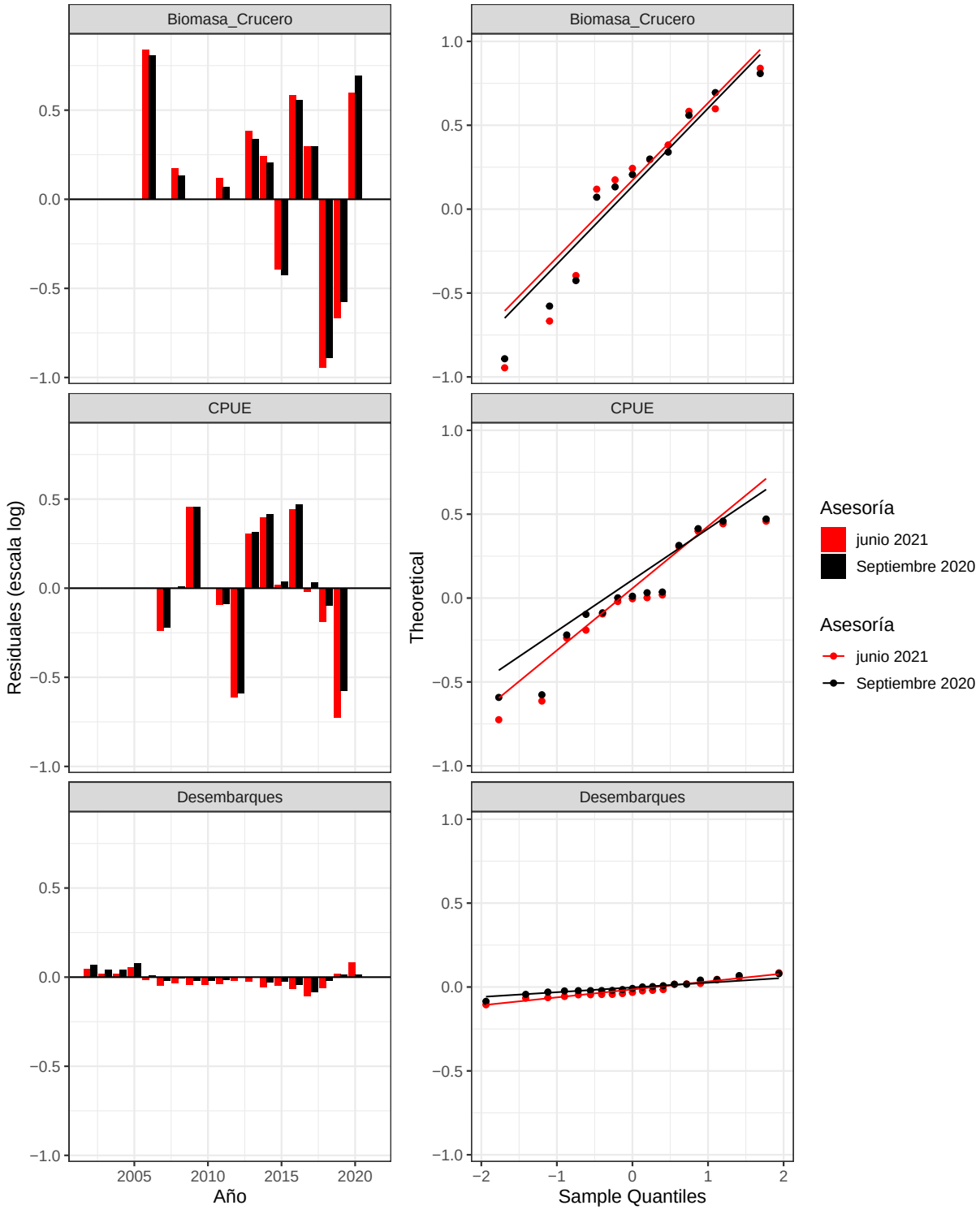
```
##################################################################################################
# AREGLOS DE DATOS
##################################################################################################

library(patchwork)

yrs   <- rep1$Years
nyrs  <- length(yrs)
lasty <- yrs[nyrs]
cvCB   <-data.1$Ind[,7]
cvcpue <-data.1$Ind[,5]
cvdes  <-data.1$Ind[,3]

ind_obs  <- cbind(c(rep0$Bcru_obs,NA),c(rep0$CPUE_obs,NA),c(rep0$Desemb_obs,NA)); ind_obs[ind_obs==0] <-
colnames(ind_obs) <- c('Biomasa_Crucero', 'CPUE', 'Desembarques')

ind_jun   <- cbind(c(rep1$Bcru_pred), c(rep1$CPUE_pred), c(rep1$Desemb_pred))
colnames(ind_jun) <- c('Biomasa_Crucero', 'CPUE', 'Desembarques')

ind_sept <- cbind(c(rep0$Bcru_pred,NA), c(rep0$CPUE_pred,NA), c(rep0$Desemb_pred,NA))
colnames(ind_sept) <- c('Biomasa_Crucero', 'CPUE', 'Desembarques')

ind     <- data.frame(ind_obs) %>% mutate(Asesoría='observado') %>%
           mutate (yrs= yrs) %>% melt(id.var=c('yrs', 'Asesoría'))
junio   <- data.frame(ind_jun) %>% mutate (Asesoría='junio_2020') %>%
           mutate (yrs= yrs)  %>% melt(id.var=c('yrs', 'Asesoría'))
sept    <- data.frame(ind_sept) %>% mutate (Asesoría='septiembre_2020') %>%
           mutate (yrs= yrs)  %>% melt(id.var=c('yrs', 'Asesoría'))

base1 <- data.frame(rbind(ind,junio, sept))

##################################################################################################
# GRAFICAS
##################################################################################################

f1 <- ggplot(base1 %>% filter(Asesoría!='observado', variable=='Biomasa_Crucero'),
        aes(yrs,value/1000000)) +
        geom_line(aes(colour=Asesoría), size=1) +
        scale_colour_manual(values=c('red','black')) +
        geom_point(data = base1 %>% filter(Asesoría=='observado',
                                           variable=='Biomasa_Crucero'),
        aes(yrs,value/1000000), shape = 19, colour = 'gray30') +
        geom_errorbar(data = base1 %>% filter(Asesoría=='observado',
                                              variable=='Biomasa_Crucero'),
        aes(ymin = value*exp(-1.96*cvCB)*10^-6,
            ymax = value*exp(1.96*cvCB)*10^-6), color = 'gray30') +
        scale_x_continuous(breaks = seq(from = 1985, to = 2020, by = 5)) +
        labs(title='Biomasa de Crucero', x = 'Año', y = 'Toneladas (millones)') +
        theme_bw(base_size=9)

f2 <- ggplot(base1 %>% filter(Asesoría!='observado', variable=='CPUE'),
            aes(yrs,value/1000000)) +
```

```
        geom_line(aes(colour=Asesoría), size=1) +
        scale_colour_manual(values=c('red','black')) +
        geom_point(data = base1 %>% filter(Asesoría=='observado',
                                           variable=='CPUE'),
        aes(yrs,value/1000000), shape = 19, colour = 'gray30') +
        geom_errorbar(data = base1 %>% filter(Asesoría=='observado',
                                              variable=='CPUE'),
        aes(ymin = value*exp(-1.96*cvcpue)*10^-6,
            ymax = value*exp(1.96*cvcpue)*10^-6), color = 'gray30') +
        scale_x_continuous(breaks = seq(from = 1985, to = 2020, by = 5)) +
        labs(title='CPUE', x = 'Año', y = 'toneladas/viaje') +
        theme_bw(base_size=9)

f3 <- ggplot(base1 %>% filter(Asesoría!='observado', variable=='Desembarques'),
        aes(yrs,value/1000)) + geom_line(aes(colour=Asesoría), size=1) +
        scale_colour_manual(values=c('red','black')) +
        geom_point(data = base1 %>% filter(Asesoría=='observado',
                                           variable=='Desembarques'),
        aes(yrs,value/1000), shape = 19, colour = 'gray30') +
        geom_errorbar(data = base1 %>% filter(Asesoría=='observado',
                                              variable=='Desembarques'),
        aes(ymin = value*exp(-1.96*cvdes)*10^-3,
            ymax = value*exp(1.96*cvdes)*10^-3), color = 'gray30') +
        scale_x_continuous(breaks = seq(from = 1985, to = 2020, by = 5)) +
        labs(title='Desembarques', x = 'Año', y = 'Toneladas (miles)') +
        theme_bw(base_size=9)

f1/f2/f3 + plot_layout(guides="collect")
```


Biomasa de Crucero
Toneladas (millones)
0.0
0.1
0.2
0.3
2005
2010
2015
2020
Año
CPUE
toneladas/viaje
1e−05
2e−05
3e−05
4e−05
5e−05
2005
2010
2015
2020
Año
Asesoría
junio_2020
septiembre_2020
Desembarques
Toneladas (miles)
20
40
60
80
2005
2010
2015
2020
Año

3.2. Análisis de Residuales de los índices

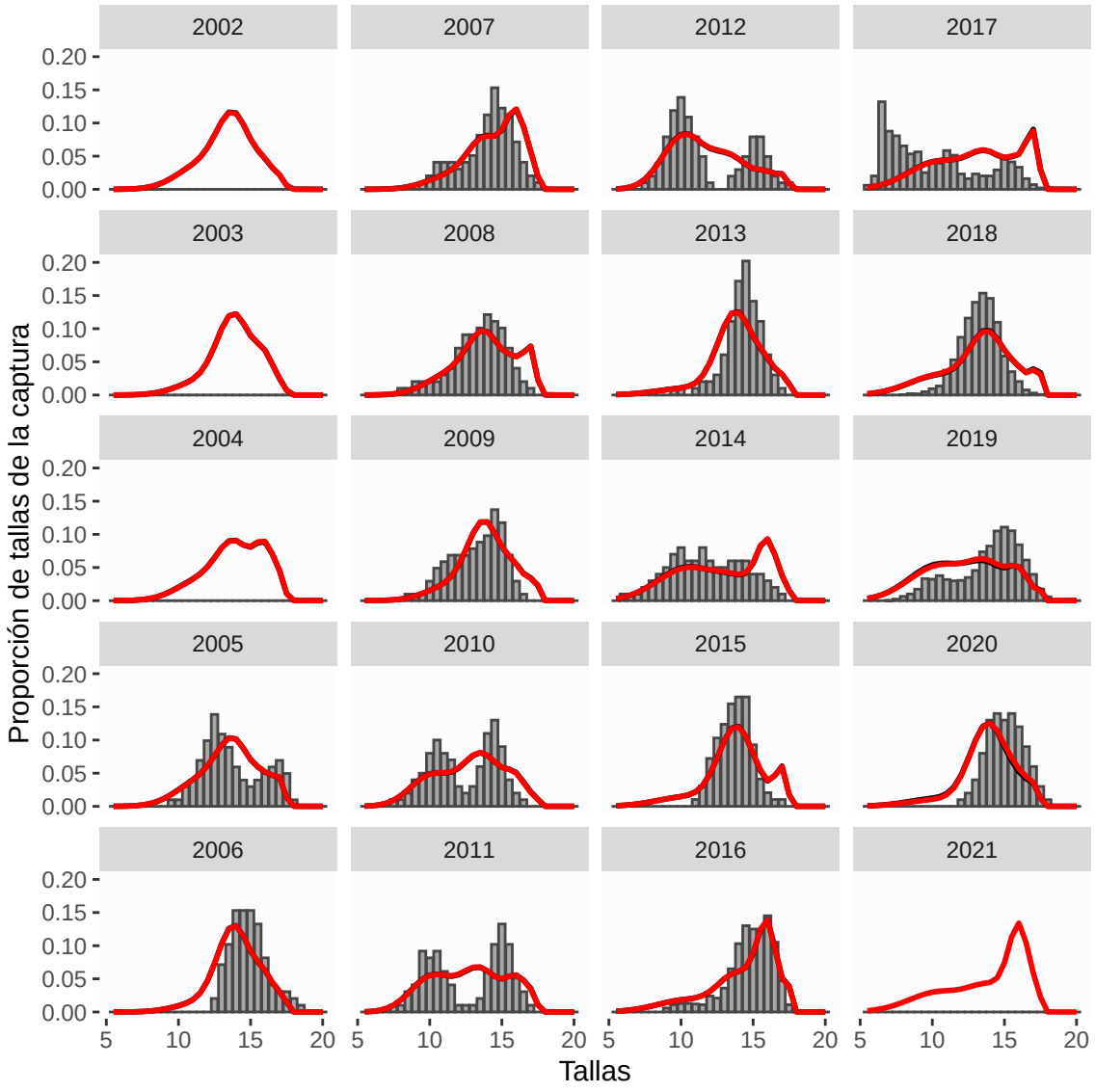
```
#############################################################################################
# AREGLOS DE DATOS
#############################################################################################

Res_maet <- data.frame(log(ind_obs) - log(ind_jun)) %>%
            mutate(yrs = yrs) %>% mutate(Asesoría = 'junio 2021')
Res_matt <- data.frame(log(ind_obs) - log(ind_sept)) %>%
            mutate(yrs = yrs) %>% mutate(Asesoría = 'Septiembre 2020')

Res      <- rbind(Res_maet, Res_matt) %>% melt(id.vars= c('yrs','Asesoría'))
pred     <- base1 %>% filter(Asesoría!='observado') %>% mutate (pred = log(value))
predm    <- pred$pred
Res2     <- cbind(Res,predm)

#############################################################################################
# GRAFICAS
#############################################################################################
r1 <- ggplot(Res, aes(yrs,value)) +
      geom_bar(aes(fill=Asesoría), stat='identity', position='dodge') +
      scale_fill_manual(values=c("red","black"))+
      geom_hline(yintercept = 0) +
      facet_wrap(. ~ variable,  ncol = 1) +
      labs(x= 'Año', y = 'Residuales (escala log)') +
      theme_bw(base_size=12)

r2 <- ggplot(Res2, aes(predm,value)) +
      geom_point(aes(colour=Asesoría), size = 1.5) +
      scale_colour_manual(values=c('red',"black")) +
      geom_hline(yintercept = 0) +
      facet_wrap(. ~ variable, ncol = 1) +
      labs(x= 'Predicho (log)', y = 'Residuales') +
      theme_bw(base_size=12)

r3 <- ggplot(Res, aes(value, colour=Asesoría)) +
      geom_histogram(fill='white', position  = 'dodge') +
      facet_wrap(. ~ variable, ncol = 1) +
      labs(x= 'Residuales', y ='Histograma de Residuos (Frecuencia)') +
      theme_bw(base_size=12)

r4 <- ggplot(Res, aes(sample = value, colour = Asesoría)) +
      stat_qq() +
      stat_qq_line() +
      scale_colour_manual(values=c('red',"black")) +
      facet_wrap(. ~ variable, ncol = 1) +
      labs(x= 'Sample Quantiles', y ='Theoretical') +
      theme_bw(base_size=12)

 r1+r4 + plot_layout(guides="collect")
```


Biomasa_Crucero
Biomasa_Crucero
CPUE
CPUE
Desembarques
Desembarques
Residuales (escala log)
Theoretical
Año
Sample Quantiles
Asesoría
junio 2021
Septiembre 2020
Asesoría
junio 2021
Septiembre 2020

3.3. Ajustes del modelo a los datos de Composiciones de tallas

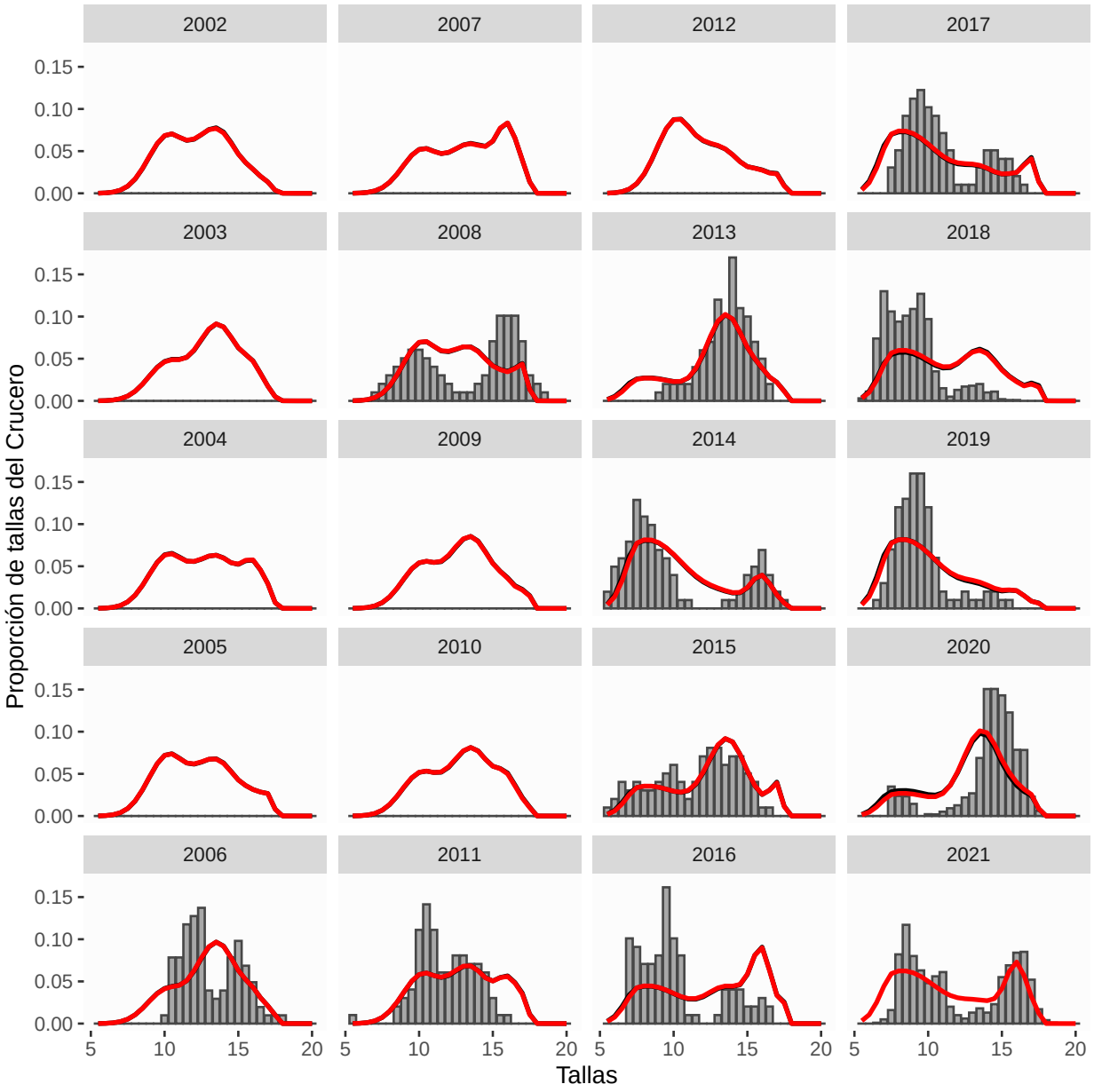
FLOTA

```
#################################################################################################
# AREGLOS DE DATOS
#################################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)

etf_obs_jun <- data.frame(rep1$Propfl_obs)
etf_pre_jun <- rep1$Propfl_pred

etf_obs_sept <- data.frame(rbind(rep0$Propfl_obs,rep(NA,nage)))
etf_pre_sept <- data.frame(rbind(rep0$Propfl_pred,rep(NA,nage)))

yearf   <- rep1$Years
nyearf  <- length(yearf)

 obs       <- as.data.frame(etf_obs_jun) %>% mutate(year=yearf) %>% melt(id.vars='year') %>%
              mutate(edad = rep(age, each=nyearf)) %>% mutate(type='obs')
 pred_jun  <- as.data.frame(etf_pre_jun) %>% mutate(year=yearf) %>% melt(id.vars='year') %>%
              mutate(edad = rep(age, each=nyearf)) %>% mutate(type='pred_jun')
 pred_sept <- as.data.frame(etf_pre_sept) %>% mutate(year=yearf) %>% melt(id.vars='year') %>%
              mutate(edad = rep(age, each=nyearf)) %>% mutate(type='pred_sept')

 mat  <- rbind(obs,pred_jun,pred_sept)

#################################################################################################
# GRAFICAS
#################################################################################################
 fig1 <- ggplot(filter(mat, type=='obs')) +
         geom_bar(aes(x = edad, y = value),
                  stat="identity", fill='gray66', color = 'gray28') +
         facet_wrap(~year, dir = 'v', as.table = TRUE) +
         labs(x = 'Tallas', y = 'Proporción de tallas de la captura') +
         geom_line(data = filter(mat, type=='pred_sept'),
                   aes(x = edad, y = value), color = 'black', size = 1) +
         geom_line(data = filter(mat, type=='pred_jun'),
                   aes(x = edad, y = value), color = 'red', size = 1) +
         theme(panel.background = element_rect(fill ="gray99")) +
         theme(panel.grid=element_line(color=NA))
 fig1
```


2002
2007
2012
2017
2003
2008
2013
2018
2004
2009
2014
2019
2005
2010
2015
2020
2006
2011
2016
2021
Proporción de tallas de la captura
0.20
0.15
0.10
0.05
0.00
5
10
15
20
Tallas

CRUCERO

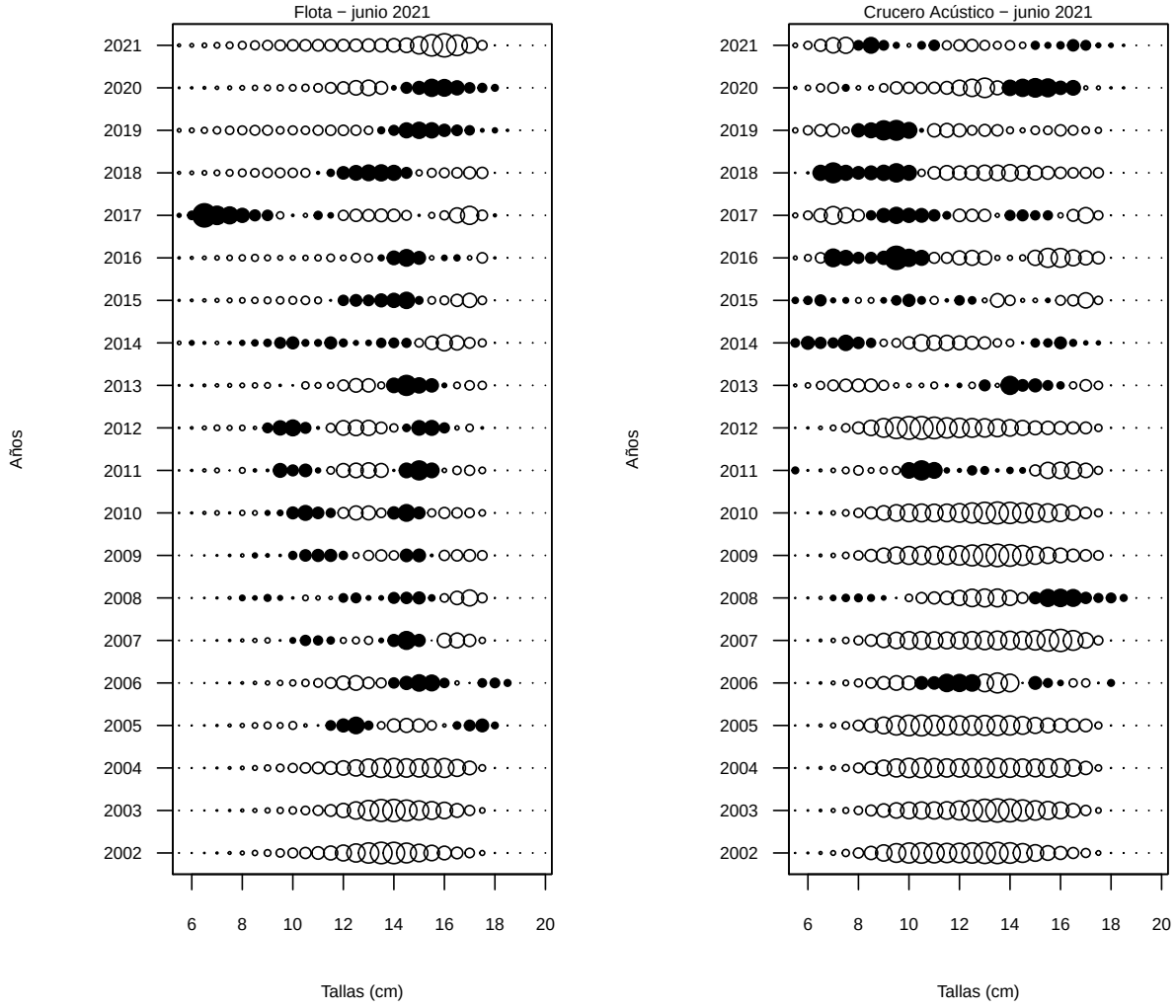
```
#############################################################################################
# AREGLOS DE DATOS
#############################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)

etc_obs_sept <- data.frame(rbind(rep0$Propcru_obs,rep(NA,nage)))
etc_pre_sept <- data.frame(rbind(rep0$Propcru_pred,rep(NA,nage)))

etc_obs_jun <- data.frame(rep1$Propcru_obs)
etc_pre_jun <- rep1$Propcru_pred

yearc   <- rep1$Years
nyearc  <-length(yearc)

 obs      <- as.data.frame(etc_obs_jun) %>% mutate(year=yearc) %>% melt(id.vars='year') %>%
             mutate(edad = rep(age, each=nyearc)) %>% mutate(type='obs')

 pred_jun <- as.data.frame(etc_pre_jun) %>% mutate(year=yearc) %>% melt(id.vars='year') %>%
             mutate(edad = rep(age, each=nyearf)) %>% mutate(type='pred_jun')

 pred_sept <- as.data.frame(etc_pre_sept) %>% mutate(year=yearc) %>% melt(id.vars='year') %>%
              mutate(edad = rep(age, each=nyearf)) %>% mutate(type='pred_sept')

 mat  <- rbind(obs,pred_jun,pred_sept)

#############################################################################################
# GRAFICAS
#############################################################################################
 fig1 <- ggplot(filter(mat, type=='obs')) +
         geom_bar(aes(x = edad, y = value),
                  stat="identity", fill='gray66', color = 'gray28') +
         facet_wrap(~year, dir = 'v', as.table = TRUE) +
         labs(x = 'Tallas', y = 'Proporción de tallas del Crucero') +
         geom_line(data = filter(mat, type=='pred_sept'),
                   aes(x = edad, y = value),color = 'black', size = 1) +
         geom_line(data = filter(mat, type=='pred_jun'),
                   aes(x = edad, y = value),color = 'red', size = 1) +
         theme(panel.background = element_rect(fill ="gray99")) +
         theme(panel.grid=element_line(color=NA))
 fig1
```


2002
2007
2012
2017
2003
2008
2013
2018
2004
2009
2014
2019
2005
2010
2015
2020
2006
2011
2016
2021
0.15
0.10
0.05
0.00
5
10
15
20
Proporción de tallas del Crucero
Tallas

3.4. Análisis de Residuales de Composiciones de tallas

```
par(mfcol=c(1,2))
#Flota
cx<-0.7
#############################################################################################
# Residuales Flota
#############################################################################################
anos        <-rep1$Years
obsF_alt    <-rep1$Propfl_obs
preF_alt    <-rep1$Propfl_pred
resF_alt    <-obsF_alt-preF_alt

rng <-range(resF_alt,na.rm=T)
dd  <-dim(resF_alt)
est <-matrix(NA,nrow=dd[1],ncol=dd[2])

for(j in 1:dd[1]){for(k in 1:dd[2]){val<-resF_alt[j,k]
if(val>0){est[j,k]<-val/rng[2]}
else{est[j,k]<-val/rng[1]*-1}}}

par(mar=c(5.4,6.7,2,1),cex.axis=cx,cex.lab=cx)
image(age,anos,t(est),col=0,yaxt="n",xlab="",ylab="")
ee  <-dim(est)
for(n in 1:ee[1]){for(m in 1:ee[2]){vol<-est[n,m]
if(is.na(vol)==FALSE){
    if(vol>0){points(age[m],anos[n],pch=19,cex=2*sqrt(vol),col=1)}
    if(vol<0){points(age[m],anos[n],pch=1,cex=2*sqrt(vol*-1),col=1)}
}}}
mtext("Flota - junio 2021",side=3,cex=cx)
mtext("Tallas (cm)",side=1,line=3.2,cex=cx);posi<-seq(1,57,by=4)
axis(2,at=anos,labels=anos,las=2,cex=cx)
mtext("Años",side=2,line=4.7,cex=cx)
box()
#############################################################################################
# Residuales Cruceros
#############################################################################################
obsB_alt <-rep1$Propcru_obs
preB_alt <-rep1$Propcru_pred
resB_alt <-obsB_alt-preB_alt

rng <-range(resB_alt,na.rm=T)
dd  <-dim(resB_alt)
est <-matrix(NA,nrow=dd[1],ncol=dd[2])

for(j in 1:dd[1]){for(k in 1:dd[2]){val<-resB_alt[j,k]
if(val>0){est[j,k]<-val/rng[2]}
else{est[j,k]<-val/rng[1]*-1}}}

par(mar=c(5.4,6.7,2,1),cex.axis=cx,cex.lab=cx)
image(age,anos,t(est),col=0,yaxt="n",xlab="",ylab="")
ee  <-dim(est)
for(n in 1:ee[1]){for(m in 1:ee[2]){vol<-est[n,m]
if(is.na(vol)==FALSE){
```

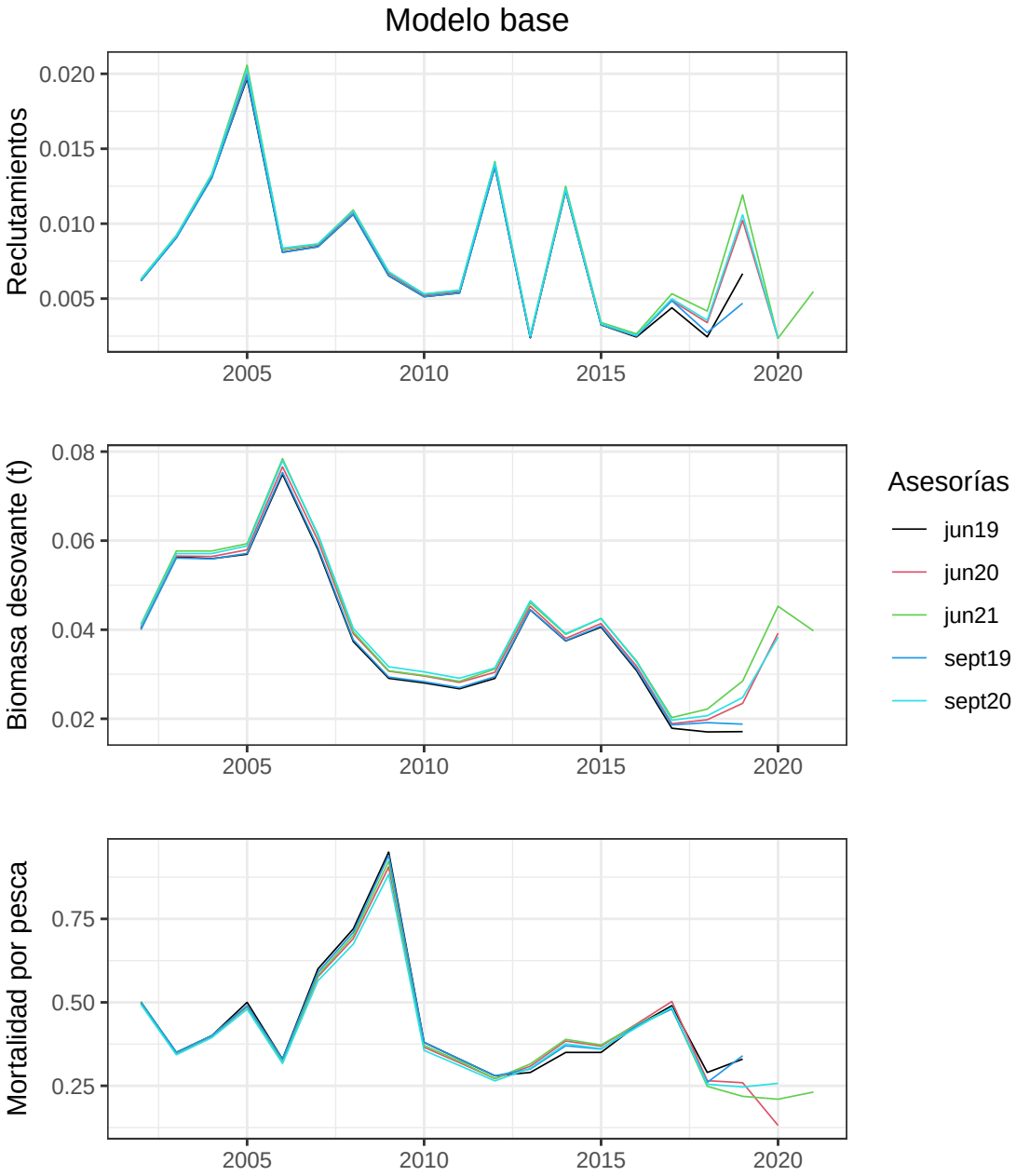
```
    if(vol>0){points(age[m],anos[n],pch=19,cex=2*sqrt(vol),col=1)}
    if(vol<0){points(age[m],anos[n],pch=1,cex=2*sqrt(vol*-1),col=1)}
}}}
mtext("Crucero Acústico - junio 2021",side=3,cex=cx)
mtext("Tallas (cm)",side=1,line=3.2,cex=cx);posi<-seq(1,57,by=4)
axis(2,at=anos,labels=anos,las=2,cex=cx)
mtext("Años",side=2,line=4.7,cex=cx)
box()
```



3.5. Comparación con evaluaciones anteriores

```
#############################################################################################
# AREGLOS DE DATOS
#############################################################################################
years.1   <- data.1$Ind[,1]  ; nyears.1  <- data.1$nanos
years.0   <- data.1$Ind[,1]  ; nyears.0  <- data.1$nanos

R_jun19   <- c(6215,9079,13095,19689,8096,8467,10623,6528,5133,5375,13802,2383,12211,
               3249,2441,4388,2445,6665,NA,NA)
R_sept19  <- c(6174,9049,13026,19810,8084,8452,10630,6544,5134,5369,13770,2410,12176,
               3261,2505,4861,2735,4690,NA,NA)
BD_jun19  <- c(40355,56370,55954,56952,74917,58016,37351,29081,28055,26737,29062,44469,
               37477,40608,30858,17861,17043,17109,NA,NA)
BD_sept19 <- c(39991,56080,55914,57142,75339,58468,37718,29360,28317,26985,29433,44484,
               37546,40817,31226,18630,19126,18793,NA,NA)
F_jun19   <- c(0.5,0.35,0.4,0.5,0.33,0.6,0.72,0.95,0.38,0.33,0.28,0.29,0.35,0.35,0.43,
               0.49,0.29,0.33,NA,NA)
F_sept19  <- c(0.5,0.35,0.4,0.49,0.33,0.59,0.71,0.94,0.38,0.33,0.28,0.3,0.37,0.36,0.43,
               0.48,0.26,0.34,NA,NA)

dat3c <- data.frame(years=years.0,
                    Rt=c(R_jun19),
                    SSBt=c(BD_jun19),
                    Ft=c(F_jun19))%>%
         mutate(Series=rep("jun19",nyears.0))%>%mutate(Modelo=rep("M_base",nyears.0))%>%
         melt(id.var=c('years', 'Series','Modelo'))

dat2c <- data.frame(years=years.0,
                    Rt=c(R_sept19),
                    SSBt=c(BD_sept19),
                    Ft=c(F_sept19))%>%
         mutate(Series=rep("sept19",nyears.0))%>%mutate(Modelo=rep("M_base",nyears.0))%>%
         melt(id.var=c('years', 'Series','Modelo'))

dat1c <- data.frame(years=years.0,
                    Rt=c(rep.0b$Reclutamiento,NA),
                    SSBt=c(rep.0b$Biomasa_desovante,NA),
                    Ft=c(rep.0b$F,NA))%>%
         mutate(Series=rep("jun20",nyears.0))%>%mutate(Modelo=rep("M_base",nyears.0))%>%
         melt(id.var=c('years', 'Series','Modelo'))

dat0c <- data.frame(years=years.0,
                    Rt=c(rep0$Reclutamiento,NA),
                    SSBt=c(rep0$Biomasa_desovante,NA),
                    Ft=c(rep0$F,NA))%>%
         mutate(Series=rep("sept20",nyears.0))%>%mutate(Modelo=rep("M_base",nyears.0))%>%
         melt(id.var=c('years', 'Series','Modelo'))

datc <- data.frame(years=years.1,
                   Rt=c(rep1$Reclutamiento),
                   SSBt=c(rep1$Biomasa_desovante),
                   Ft=c(rep1$F))%>%
         mutate(Series=rep("jun21",nyears.0))%>%mutate(Modelo=rep("M_base",nyears.1))%>%
```

```
         melt(id.var=c('years', 'Series','Modelo'))

data <- data.frame(rbind(dat3c,dat2c,dat1c,dat0c,datc))

#############################################################################################
# GRAFICAS
#############################################################################################
f1<- ggplot(data %>% filter(variable=='Rt',Modelo=='M_base'),
            aes(years,value/10^6)) +
     geom_line(aes(colour=Series), size=0.3)+
     labs(x = '', y = 'Reclutamientos',colour='Asesorías')  +
     scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
     scale_colour_manual(values=seq(1,5,1))+
     theme_bw(base_size=11) +
     ggtitle('Modelo base')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

f2<- ggplot(data %>% filter(variable=='SSBt',Modelo=='M_base'),
            aes(years,value/10^6)) +
     geom_line(aes(colour=Series), size=0.3)+
     labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías')  +
     scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
     scale_colour_manual(values=seq(1,5,1))+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5),legend.position="right")

f3<- ggplot(data %>% filter(variable=='Ft',Modelo=='M_base'),
            aes(years,value)) +
     geom_line(aes(colour=Series), size=0.3)+
     labs(x = '', y = 'Mortalidad por pesca',colour='Asesorías')  +
     scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
     scale_colour_manual(values=seq(1,5,1))+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

 (f1/f2/f3)
```


Modelo base
Reclutamientos
0.020
0.015
0.010
0.005
2005
2010
2015
2020
Biomasa desovante (t)
0.08
0.06
0.04
0.02
Mortalidad por pesca
0.75
0.50
0.25
Asesorías
jun19
jun20
jun21
sept19
sept20

3.6. Análisis retrospectivo

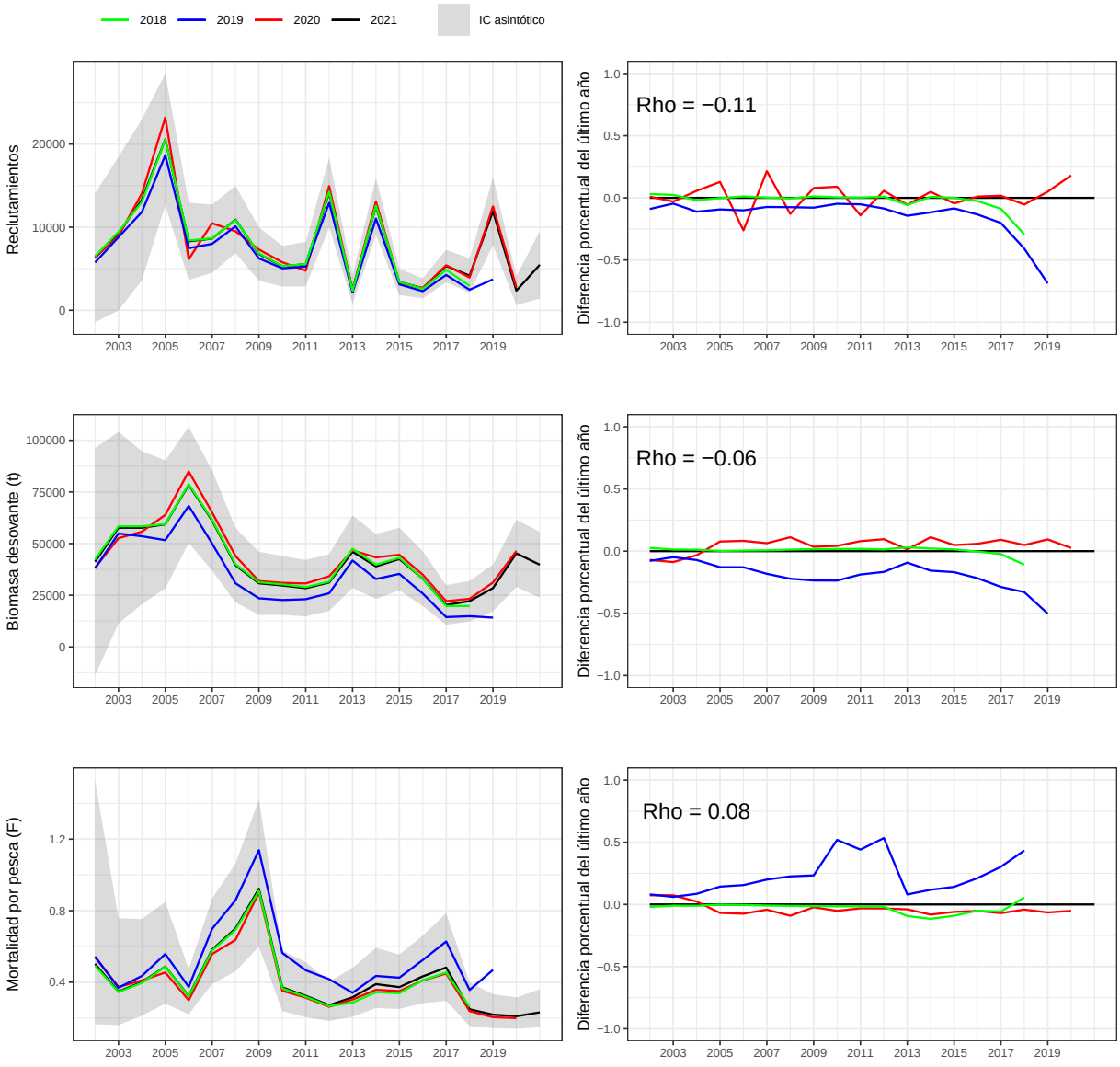
```
years<-rep1$Years
nyears<-length(years)

Rt1      <- subset(std1,name=="Reclutas")$value
Rt1std   <- subset(std1,name=="Reclutas")$std
BT1      <- subset(std1,name=="BT")$value
BT1std   <- subset(std1,name=="BT")$std
BD1      <- subset(std1,name=="BD")$value
BD1std   <- subset(std1,name=="BD")$std
Ft1      <- subset(std1,name=="log_F")$value
Ft1std   <- subset(std1,name=="log_F")$std

VarPob_jun<- data.frame(x=years, Rt1=Rt1,BT1=BT1,BD1=BD1,Ft1=exp(Ft1),
         lowerRt1 = (Rt1 -1.96*Rt1std), upperRt1 = (Rt1+1.96*Rt1std),
         lowerBT1 = (BT1 -1.96*BT1std), upperBT1 = (BT1+1.96*BT1std),
         lowerBD1 = (BD1 -1.96*BD1std), upperBD1 = (BD1+1.96*BD1std),
         lowerFt1 = exp(Ft1 -1.96*Ft1std), upperFt1 = exp(Ft1+1.96*Ft1std))
```

```
#########################################################################################
# AREGLOS DE DATOS
#########################################################################################
dir<-paste(dir.0,"/RetrospectivobaseJun",sep="")
setwd(dir)
admb<-"MTT0621"
#########################################################################################

years       <- rep1$Years
nyears      <- length(years)
retros      <- seq(1,4)
nretros     <- length(retros)
year_retros <- as.factor(years[(nyears-(nretros-1)):nyears])

retroR      <- matrix(0,nrow=nyears,ncol=nretros+1)
retroBD     <- matrix(0,nrow=nyears,ncol=nretros+1)
retroF      <- matrix(0,nrow=nyears,ncol=nretros+1)

for(i in 1:length(retros)){
  rep <- reptoRlist(paste(admb,"s",i,".rep",sep=""))
  retroR[,i+1]  <- c(rep$Reclutamiento,rep(NA,i-1))
  retroBD[,i+1] <- c(rep$Biomasa_desovante,rep(NA,i-1))
  retroF[,i+1]  <- c(rep$F,rep(NA,i-1)) }

#########################################################################################
# retrospectivo relativo (cálculo)
#########################################################################################
    mohn.r       <- rep(NA, nretros)
    rel.diff.r   <- matrix(NA, nrow=nyears, ncol=(nretros))
    mohn.ssb     <- rep(NA, nretros)
    rel.diff.ssb <- matrix(NA, nrow=nyears, ncol=(nretros))
    mohn.f       <- rep(NA, nretros)
    rel.diff.f   <- matrix(NA, nrow=nyears, ncol=(nretros))
```

```
    for(j in 1:nretros){
      rel.diff.r[,j]   <- (retroR[,(j+1)]-retroR[,2])/retroR[,2]
      mohn.r[j]        <- rel.diff.r[(nyears-j),j]
      rel.diff.ssb[,j] <- (retroBD[,(j+1)]-retroBD[,2])/retroBD[,2]
      mohn.ssb[j]      <- rel.diff.ssb[(nyears-j),j]
      rel.diff.f[,j]   <- (retroF[,(j+1)]-retroF[,2])/retroF[,2]
      mohn.f[j]        <- rel.diff.f[(nyears-j),j]}

    ave.mohn.r    <- mean(mohn.r)
    ave.mohn.ssb  <- mean(mohn.ssb)
    ave.mohn.f    <- mean(mohn.f)

##############################################################################################
# Para retrospectivo tradicional
##############################################################################################
Rt_retro <- data.frame(x=years,
                       y1=retroR[,2],
                       y2=retroR[,3],
                       y3=retroR[,4],
                       y4=retroR[,5],
                       lower = (Rt1 -1.96*Rt1std),
                       upper = (Rt1+1.96*Rt1std))
BD_retro <- data.frame(x=years,
                       y1=retroBD[,2],
                       y2=retroBD[,3],
                       y3=retroBD[,4],
                       y4=retroBD[,5],
                       lower = (BD1 -1.96*BD1std),
                       upper = (BD1+1.96*BD1std))
Ft_retro <- data.frame(x=years,
                       y1=retroF[,2],
                       y2=retroF[,3],
                       y3=retroF[,4],
                       y4=retroF[,5],
                       lower = exp(Ft1-1.96*Ft1std),
                       upper = exp(Ft1+1.96*Ft1std))

##############################################################################################
# Para restrospectivo relativo
##############################################################################################
Rt_retroRel <- data.frame(x=years,
                          y1=rel.diff.r[,1],
                          y2=rel.diff.r[,2],
                          y3=rel.diff.r[,3],
                          y4=rel.diff.r[,4])
BD_retroRel <- data.frame(x=years,
                          y1=rel.diff.ssb[,1],
                          y2=rel.diff.ssb[,2],
                          y3=rel.diff.ssb[,3],
                          y4=rel.diff.ssb[,4])
Ft_retroRel <- data.frame(x=years,
                          y1=rel.diff.f[,1],
                          y2=rel.diff.f[,2],
```

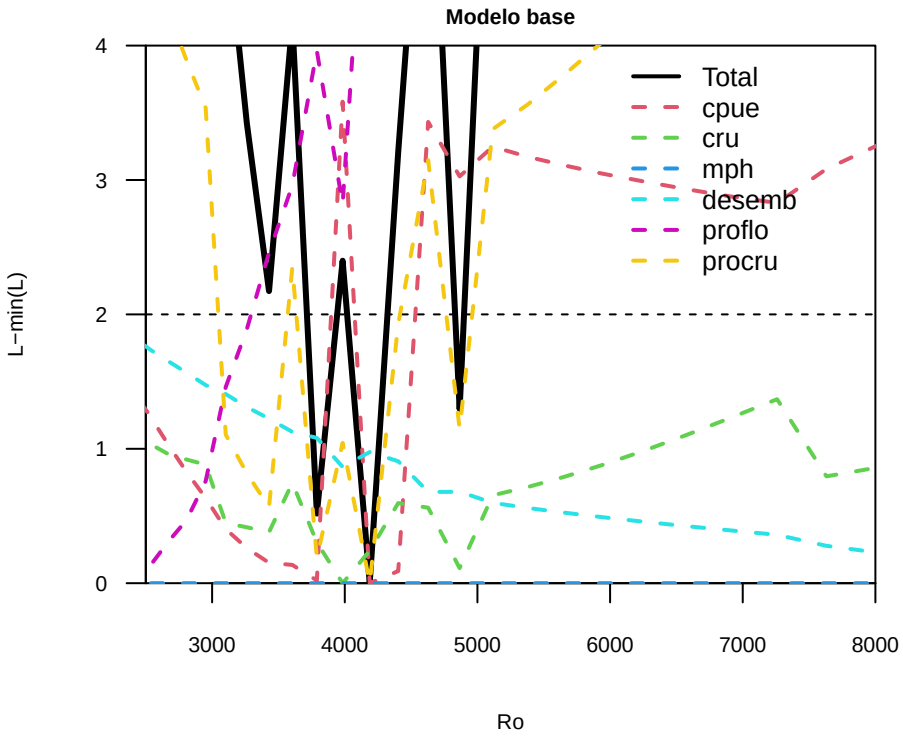
```
                        y3=rel.diff.f[,3],
                        y4=rel.diff.f[,4])

##############################################################################################
# GRAFICAS
##############################################################################################
#Retrospectivo tradicional
##############################################################################################
Rt <- ggplot(Rt_retro) +
      geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = "IC asintótico"), alpha = 0.2)+
      geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
      geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
      geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
      geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
      labs(x = '', y = 'Reclutamientos ',colour='Asesorías')  +
      scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
      scale_colour_manual("",values=c("green","blue","red","black"))+
      scale_fill_manual("",values=c("grey30"))+
      theme_bw(base_size=8) +
      ggtitle('')+
      theme(plot.title = element_text(hjust = 0.5),legend.position="top")

BD <- ggplot(BD_retro) +
      geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = ""), alpha = 0.2)+
      geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
      geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
      geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
      geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
      labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías')  +
      scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
      scale_colour_manual("",values=c("green","blue","red","black"))+
      scale_fill_manual("",values=c("grey30"))+
      theme_bw(base_size=8) +
      ggtitle('')+
      theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Ft <- ggplot(Ft_retro) +
      geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = ""), alpha = 0.2)+
      geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
      geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
      geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
      geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
      labs(x = '', y = 'Mortalidad por pesca (F)',colour='Asesorías')  +
      scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
      scale_colour_manual("",values=c("green","blue","red","black"))+
      scale_fill_manual("",values=c("grey30"))+
      theme_bw(base_size=8) +
      ggtitle('')+
      theme(plot.title = element_text(hjust = 0.5),legend.position="none")

##############################################################################################
#Retrospectivo relativo
##############################################################################################
Rtrel <- ggplot(Rt_retroRel) + lims(y=c(-1,1)) +
```

```
    geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
   annotate("text", x=2004, y=0.75,label=paste("Rho =",round(ave.mohn.r,2))) +
    labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
    scale_colour_manual("",values=c("green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=8) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BDrel <- ggplot(BD_retroRel) + lims(y=c(-1,1)) +
     geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
   annotate("text", x=2004, y=0.75,label=paste("Rho =",round(ave.mohn.ssb,2))) +
    labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
    scale_colour_manual("",values=c("green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=8) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Ftrel <- ggplot(Ft_retroRel) + lims(y=c(-1,1)) +
    geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
   annotate("text", x=2004, y=0.75,label=paste("Rho =",round(ave.mohn.f,2))) +
    labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 2)) +
    scale_colour_manual("",values=c("green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=8) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Rt/BD/Ft |Rtrel/BDrel/Ftrel
```


2018
2019
2020
2021
IC asintótico
Reclutamientos
Diferencia porcentual del último año
Rho = −0.11
Biomasa desovante (t)
Rho = −0.06
Mortalidad por pesca (F)
Rho = 0.08

3.7. Perfil de verosimilitud

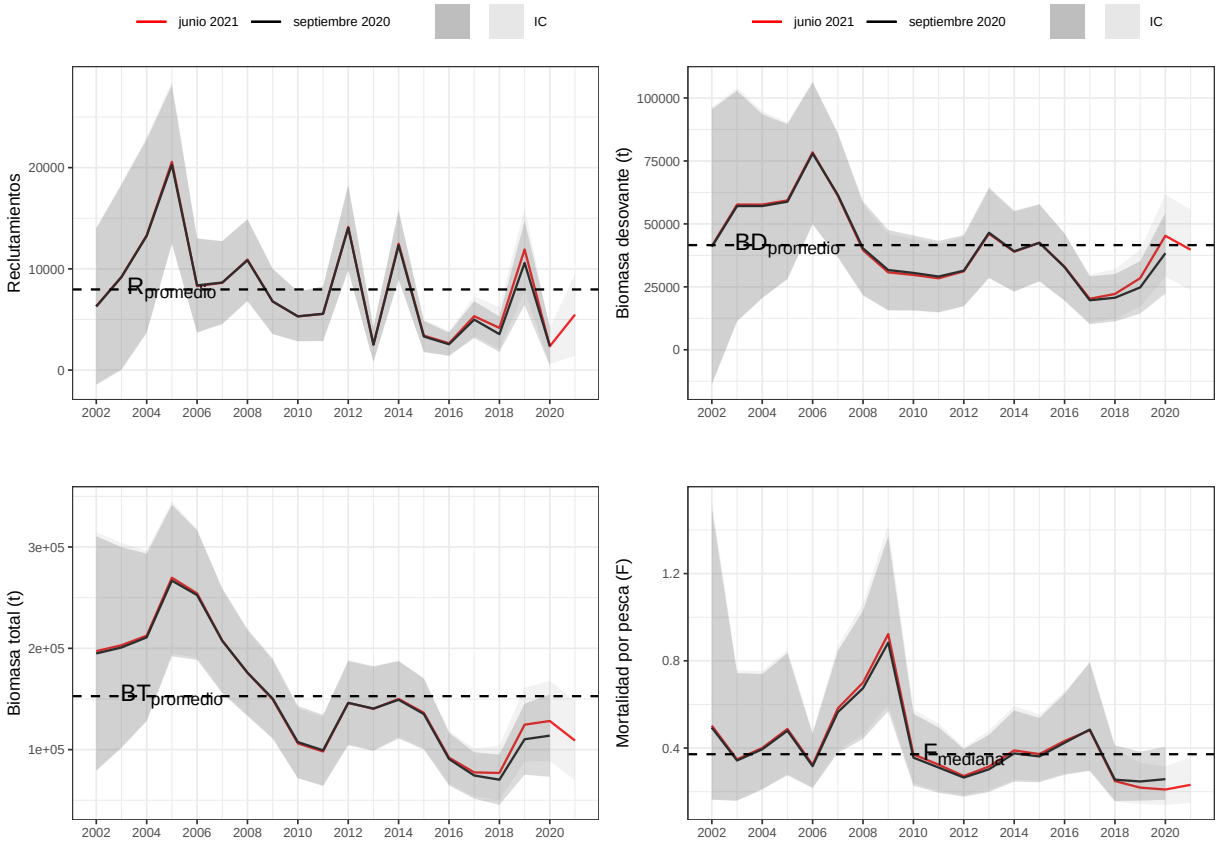
```
#########################################################################################
# AREGLOS DE DATOS
#########################################################################################
admb<-"MTT0621"
dir<-paste(dir.0,"/VerosimilitudbaseJun",sep="")
setwd(dir)
#########################################################################################
  casos <-35
  logRo    <- rep(0,casos)
  likeval  <- matrix(ncol=9,nrow=casos)
  slikeval <- matrix(ncol=10,nrow=casos)

  for(i in 1:casos){
    rep         <- reptoRlist(paste(admb,"s",i,".rep",sep=""))
    data        <- readLines(paste(admb,"s",i,".dat", sep=''),encoding="UTF-8")
    logRo[i]    <- as.numeric(data[161])
    likeval[i,] <- rep$Likeval}
  #=======================================================================================
  # SEXTO PASO: ESTANDARIZAR VEROSIMILITUD
  #=======================================================================================
  like    <- data.frame(round(likeval,3),Total=apply(likeval,1,sum))
  minLik  <- apply(like,2,min)                          # busca el minimo
  for(i in 1:10){slikeval[,i]<-like[,i]-minLik[i]}    # Estandarizacin
  #=======================================================================================
  # ULTIMO PASO: GUARDAR TABLAS Y FIGURA
  #=======================================================================================
  names<-c("Ro","cpue", "cru","mph",    "desemb",   "proflo",   "procru",
           "desvRo",    "desNo",    "Lo", "Total")
  # Tabla verosimilitud
  TLk1 <- data.frame(exp(logRo),like);
  colnames(TLk1)<-names
  # Tabla estandarizada
  TLk2 <- data.frame(exp(logRo),slikeval);
  colnames(TLk2)<-names

#########################################################################################
# GRAFICAS
#########################################################################################
  par(mar=c(4,4,1,1)+0.5)
  plot(TLk2$Ro,TLk2$Total,type="l",lwd=3,ylim=c(0,4),xlim=c(2500,8000),
       xaxs= "i",yaxs= "i", ylab="L-min(L)",xlab="Ro", las=1,
       main="Modelo base",cex.main=0.7,cex.axis=0.7,cex.lab=0.7)
  abline(h=2,col=1,lty=2)
   for(i in 2:7){
  lines(TLk2$Ro,TLk2[,i],col=i,lty=2,lwd=2)}
  legend(6000,4,names[c(11,2:7)],col=1:8,lty=c(1,rep(2,7)),
          lwd=2,bty="n",cex=0.8)
```


Modelo base
L−min(L)
Ro
Total
cpue
cru
mph
desemb
proflo
procru
0
1
2
3
4
3000
4000
5000
6000
7000
8000

3.8. Sensibilidad a la actualización de datos

4. RESULTADOS OBJETIVO 2

4.1. Indicadores del stock


junio 2021
septiembre 2020
IC
Reclutamientos
$R_{promedio}$
Biomasa desovante (t)
$BD_{promedio}$
Biomasa total (t)
$BT_{promedio}$
Mortalidad por pesca (F)
$F_{mediana}$

```r
par(mfrow=c(1,2),mar=c(4,4,1,1)+0.5)

# ASESORÍA JUNIO 2021
plot(rep1$Tallas,rep1$Selflo_talla[1,],type="l",las=1,col=4,ylim=c(0,1.1),
     ylab="Selectividad",xlab="Tallas (cm)",main="Flota")
lines(rep1$Tallas,rep1$Selflo_talla[9,],type="l",col=3)
lines(rep1$Tallas,rep1$Selflo_talla[nyears1,],type="l",col=2)
legend(13,0.3,c("sel_2002-2009","sel_2010-2012","sel_2013-2021"),
       col=c(4,3,2),lwd=c(1,1,1),cex=0.8,bty="n")

# ASESORÍA JUNIO 2021
plot(rep1$Tallas,rep1$Selcru_talla[1,],type="l",las=1,col=4,ylim=c(0,1.1),
     ylab="Selectividad",xlab="Tallas (cm)",main="Crucero")
lines(rep1$Tallas,rep1$Selcru_talla[nyears1,],type="l",col=2)
legend(13,0.3,c("sel_2002-2012","sel_2013-2021"),
       col=c(4,2),lwd=c(1,1),cex=0.8,bty="n")
```

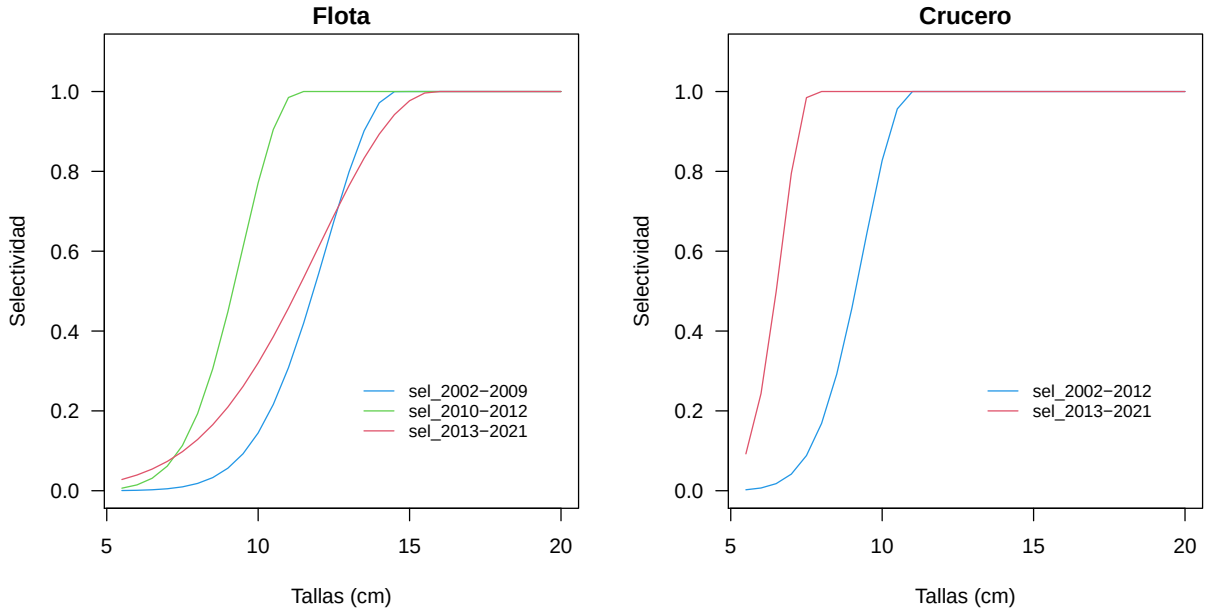


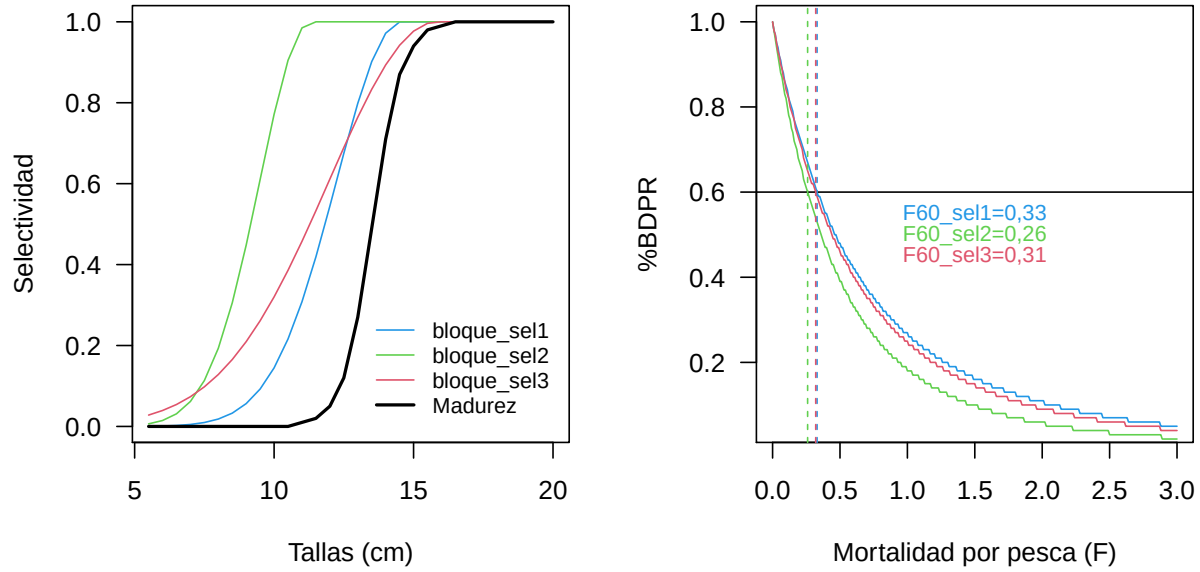
Tabla 13.
Indicadores poblacionales de sardina austral en aguas interiores de Chiloé. Tabla comparativa entre los resultados de la evaluación de septiembre (primer hito) y junio (segundo hito).

```
VarPobl1<- cbind(anos=rep1$Years,
                 "BD_sep"=c(BD0),
                 "BD_jun"=c(BD1),
                 "BT_sep"=c(BT0),
                 "BT_jun"=c(BT1),
                  "R_sep"=c(round(Rt0,0)),
                 "R_jun"=c(round(Rt1,0)),
                 "F_sep"=c(round(exp(Ft0),2)),
                 "F_jun"=c(round(exp(Ft1),2))
                 )
kable(VarPobl1)
```

anos	BD_sep	BD_jun	BT_sep	BT_jun	R_sep	R_jun	F_sep	F_jun
2002	40951	41213	194920	197200	6280	6315	0.49	0.50
2003	57096	57682	200800	203060	9191	9222	0.34	0.35
2004	57102	57678	210790	212490	13264	13307	0.39	0.40
2005	58821	59315	266800	269680	20282	20573	0.48	0.49
2006	77957	78422	252550	254240	8370	8305	0.32	0.32
2007	61494	61186	207380	207580	8651	8624	0.56	0.58
2008	40283	39547	176060	175740	10848	10919	0.67	0.70
2009	31677	30768	150360	149630	6789	6773	0.88	0.92
2010	30535	29728	107450	106140	5312	5301	0.36	0.37
2011	29097	28405	99342	98159	5564	5544	0.31	0.32
2012	31432	31171	146180	146100	14058	14146	0.26	0.27
2013	46501	46065	140570	140240	2521	2501	0.30	0.32
2014	39131	38953	149190	150040	12319	12489	0.38	0.39
2015	42501	42512	135130	136350	3317	3406	0.36	0.37
2016	32793	32993	90698	92081	2550	2649	0.42	0.43
2017	19677	20264	74464	77529	4984	5324	0.48	0.48
2018	20680	22170	70331	76962	3551	4166	0.25	0.25
2019	24776	28464	110240	124640	10586	11918	0.25	0.22
2020	38349	45275	113800	128280	2378	2356	0.26	0.21
2021	NA	39749	NA	108910	NA	5475	NA	0.23

```
write.csv(VarPobl1, file="TablaVarpob.csv")
```

4.2. Estados de explotación




```
yrs     <- rep1$Years
nyrs    <- length(yrs)
tallas  <- seq(5,19.5,0.5)
ntallas <- length(tallas)
age     <- seq(0,4,1)
nage    <- length(age)

x1  <-c(yrs,rev(yrs))
x0_1 <-c(yrs[1],yrs[nyrs]+1,nyrs+1/2) #xaxp
x0_2 <-c(yrs[1]-1,yrs[nyrs]+1) #xlim
years.0    <-rep0$Years
x0  <-c(years.0,rev(years.0))
years.1    <-rep1$Years
################################################
# Asesoría de septiembre
################################################
Rpr0     <-subset(std0,name=="RPR")$value
Rpr0std  <-subset(std0,name=="RPR")$std
Frpr0    <-subset(std0,name=="Frpr")$value
Frpr0std <-subset(std0,name=="Frpr")$std

rpr0     <-c((Rpr0-1.96*Rpr0std),
         rev((Rpr0+1.96*Rpr0std)));
frpr0    <-c((Frpr0-1.96*Frpr0std),
         rev((Frpr0+1.96*Frpr0std)))

################################################
# Asesoría de junio
################################################
Rpr1     <-subset(std1,name=="RPR")$value
Rpr1std  <-subset(std1,name=="RPR")$std
Frpr1    <-subset(std1,name=="Frpr")$value
Frpr1std <-subset(std1,name=="Frpr")$std

rpr1     <-c((Rpr1 -1.96*Rpr1std),
```

```
          rev((Rpr1 +1.96*Rpr1std)));
frpr1    <-c((Frpr1 -1.96*Frpr1std),
          rev((Frpr1 +1.96*Frpr1std)))

#########################################################################
#########################################################################################
### *MODELO BASE Asesoría septiembre 2020*
#########################################################################################
# biomasa desovante vs BDrms
#########################################################################################
xbs1 <-rnorm(1000, mean = Rpr0[length(years.0)],
                    sd = Rpr0std[length(years.0)])

xbs  <-seq(min(xbs1),max(xbs1),0.005)

ybs  <-dnorm(xbs, mean = Rpr0[length(years.0)],
                  sd = Rpr0std[length(years.0)])

icbs <-qnorm(c(0.05,0.95,0.5),
             Rpr0[length(years.0)],
             Rpr0std[length(years.0)])

xxbs <-c(xbs[xbs>=icbs[1]&xbs<=icbs[2]],
     rev(xbs[xbs>=icbs[1]&xbs<=icbs[2]]))

yybs <-c(ybs[xbs>=icbs[1]&xbs<=icbs[2]],
     rep(0,length(ybs[xbs>=icbs[1]&xbs<=icbs[2]])))

#########################################################################################
# mortalidad por pesca vs Frms
#########################################################################################
xfs1 <- rnorm(1000, mean = Frpr0[length(years.0)],
                    sd = Frpr0std[length(years.0)])

xfs  <-seq(min(xfs1),
           max(xfs1),0.005)

yfs  <-dnorm(xfs, mean = Frpr0[length(years.0)],
                  sd = Frpr0std[length(years.0)])

icfs <-qnorm(c(0.05,0.95,0.5),
             Frpr0[length(years.0)],
             Frpr0std[length(years.0)])

xxfs <-c(xfs[xfs>=icfs[1]&xfs<=icfs[2]],
     rev(xfs[xfs>=icfs[1]&xfs<=icfs[2]]))

yyfs <-c(yfs[xfs>=icfs[1]&xfs<=icfs[2]],
     rep(0,length(yfs[xfs>=icfs[1]&xfs<=icfs[2]])))

#########################################################################################
### *MODELO BASE Asesoría junio 2020*
#########################################################################################
# biomasa desovante vs BDrms
#########################################################################################
xbm1 <- rnorm(1000, mean = Rpr1[length(years.1)],
                    sd = Rpr1std[length(years.1)])
```

```
xbm  <- seq(min(xbm1),
            max(xbm1),0.005)

ybm  <- dnorm(xbm, mean = Rpr1[length(years.1)],
                     sd = Rpr1std[length(years.1)])

icbm <- qnorm(c(0.05,0.95,0.5),
              Rpr1[length(years.1)],
              Rpr1std[length(years.1)])

xxbm <- c(xbm[xbm>=icbm[1]&xbm<=icbm[2]],
      rev(xbm[xbm>=icbm[1]&xbm<=icbm[2]]))

yybm <- c(ybm[xbm>=icbm[1]&xbm<=icbm[2]],
      rep(0,length(ybm[xbm>=icbm[1]&xbm<=icbm[2]])))

##############################################################################################
# mortalidad por pesca vs Frms
##############################################################################################
xfm1 <-rnorm(1000, mean = Frpr1[length(years.0)],
                     sd = Frpr1std[length(years.0)])

xfm  <-seq(min(xfm1),
           max(xfm1),0.005)

yfm  <-dnorm(xfm, mean = Frpr1[length(years.0)],
                   sd = Frpr1std[length(years.0)])

icfm <-qnorm(c(0.05,0.95,0.5),
             Frpr1[length(years.0)],
             Frpr1std[length(years.0)])

xxfm <-c(xfm[xfm>=icfm[1]&xfm<=icfm[2]],
     rev(xfm[xfm>=icfm[1]&xfm<=icfm[2]]))

yyfm <-c(yfm[xfm>=icfm[1]&xfm<=icfm[2]],
     rep(0,length(yfm[xfm>=icfm[1]&xfm<=icfm[2]])))
```

```
### *Probabilidad de estar bajo BRMS*
pa1<-pnorm(1,Rpr0[length(years.0)],
           Rpr0std[length(years.0)],
           lower.tail = TRUE,log.p = F)

pa2<-pnorm(1,Rpr1[length(years.1)],
           Rpr1std[length(years.1)],
           lower.tail = TRUE,log.p = F)
### *Probabilidad de estar bajo FRMS*
pb1<-1-pnorm(1,Frpr0[length(years.0)],
             Frpr0std[length(years.0)],
             lower.tail = TRUE,log.p = F)

pb2<-1-pnorm(1,Frpr1[length(years.1)],
             Frpr1std[length(years.1)],
             lower.tail = TRUE,log.p = F)

### *Probabilidad de estar en zona de sobreexplotacion*
pc1<-pnorm(0.9,Rpr0[length(years.0)],
           Rpr0std[length(years.0)],
```

```
           lower.tail = TRUE,log.p = F)

pc2<-pnorm(0.9,Rpr1[length(years.1)],
           Rpr1std[length(years.1)],
           lower.tail = TRUE,log.p = F)

### *Probabilidad de estar en zona de colapso*
pd1<-pnorm(0.5,Rpr0[length(years.0)],
           Rpr0std[length(years.0)],
           lower.tail = TRUE,log.p = F)

pd2<-pnorm(0.5,Rpr1[length(years.1)],
           Rpr1std[length(years.1)],
           lower.tail = TRUE,log.p = F)

### *Probailidad de sobrepesca*
pe1<-1-pnorm(1.1,Frpr0[length(years.0)],
             Frpr0std[length(years.0)],
             lower.tail = TRUE,log.p = F)

pe2<-1-pnorm(1.1,Frpr1[length(years.1)],
             Frpr1std[length(years.1)],
             lower.tail = TRUE,log.p = F)
```

```
PBRs<-round(rbind("BD~0~"=c(BDo0,BDo1)/1000,
                  "BD~RMS~"=c(BRMS0,BRMS1)/1000,
                  "BD~LIM~"=c(BDlim0,BDlim1)/1000,
                  "F~RMS~"=c(FRMS0,FRMS1),
                  "p(BD~last~<BD~RMS)~"=round(c(pa1,pa2),2),
                  "p(F~last~>F~RMS~)"=round(c(pb1,pb2),2),
                  "p(BD~last~<0.9BD~RMS~)"=round(c(pc1,pc2),2),
                  "p(BD~last~<0.5BD~RMS~)"=round(c(pd1,pd2),2),
                  "p(F~last~>1.1F~RMS~)"=round(c(pe1,pe2),2)),3)

colnames(PBRs)<-c("sept","junio")
kable(PBRs)
```

	sept	junio
BD_0	53.725	54.592
BD_{RMS}	29.549	30.026
BD_{LIM}	14.774	15.013
F_{RMS}	0.310	0.320
$p(BD_{last}<BD_{RMS)}$	0.080	0.050
$p(F_{last}>F_{RMS})$	0.190	0.040
$p(BD_{last}<0.9BD_{RMS})$	0.030	0.020
$p(BD_{last}<0.5BD_{RMS})$	0.000	0.000
$p(F_{last}>1.1F_{RMS})$	0.080	0.010

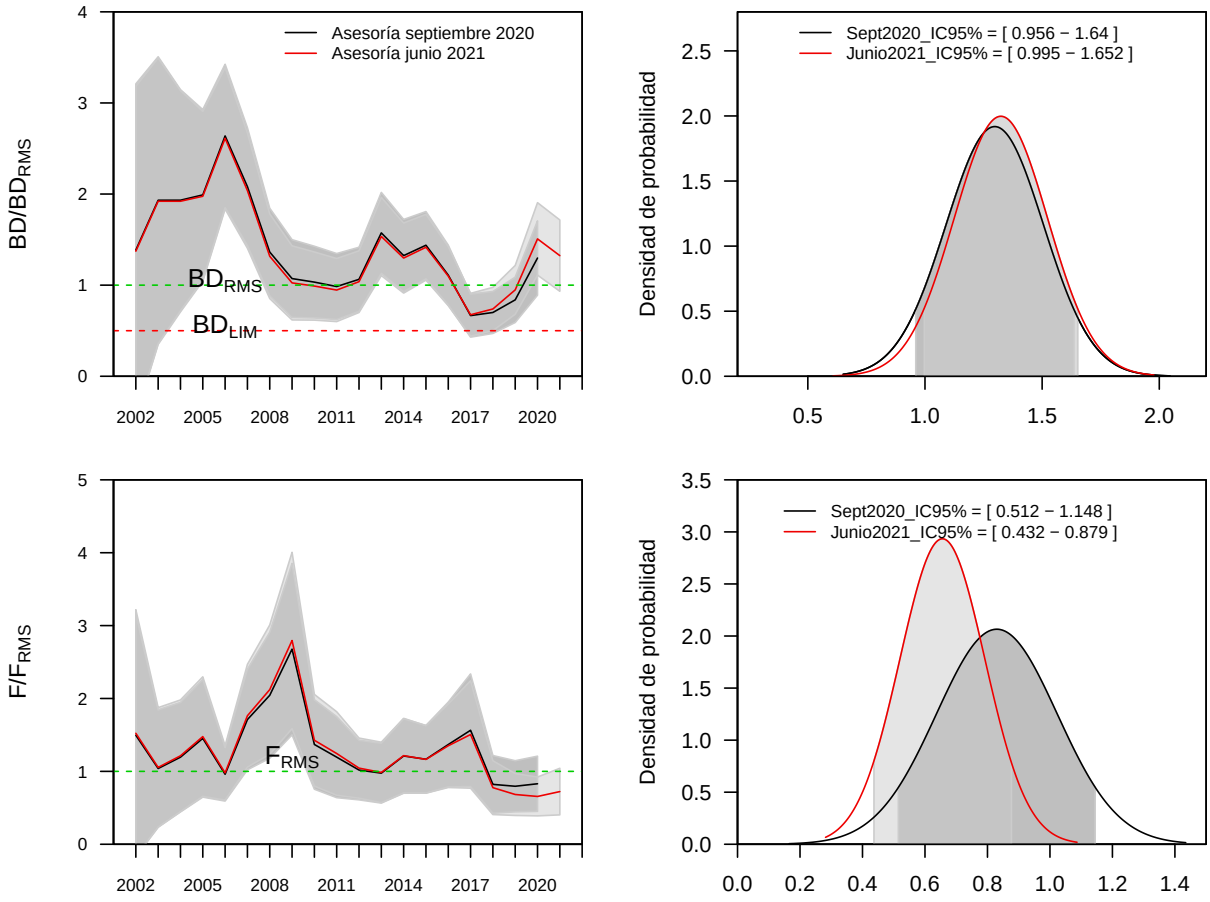


Tabla 15.
Variación interanual de F respecto de FRMS (F/F RMS), BD respecto de BDRMS (BD/BD RMS), y de las tasas de explotación referidos a la biomasa total (Y/BT) en la pesquería de sardina austral. Comparación entre las Estimaciones de la evaluación de stock actual (sept 2018) y anterior (jun 2018).

```
VarPobl2<- cbind(anos=rep1$Years,
                 "F/F~RMS~**S**"=c(round(exp(Ft0)/FRMS0,3)),
                 "F/F~RMS~**J**"=round(exp(Ft1)/FRMS1,3),
                 "BD/BD~RMS~**S**"=c(round(BD0/BRMS0,3)),
                 "BD/BD~RMS~**J**"=round(BD1/BRMS1,3),
                 "Y/BT_**S**"=c(round(rep0$Desemb_pred/BT0,3)),
                 "Y/BT_**J**"=round(rep1$Desemb_pred/BT1,3))
kable(VarPobl2)
```

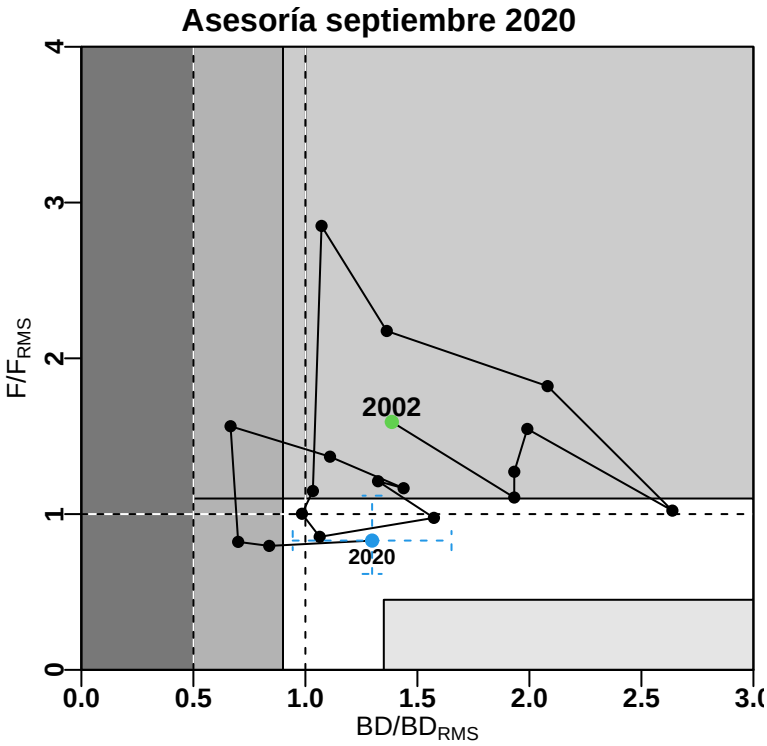
anos	F/F_{RMS}**S**	F/F_{RMS}**J**	BD/BD_{RMS}**S**	BD/BD_{RMS}**J**	Y/BT_**S**	Y/BT_**J**
2002	1.592	1.570	1.386	1.373	0.187	0.189
2003	1.106	1.087	1.932	1.921	0.157	0.158
2004	1.272	1.252	1.932	1.921	0.166	0.169
2005	1.547	1.523	1.991	1.975	0.182	0.184
2006	1.022	1.010	2.638	2.612	0.154	0.156
2007	1.822	1.818	2.081	2.038	0.249	0.255
2008	2.176	2.188	1.363	1.317	0.258	0.265
2009	2.850	2.883	1.072	1.025	0.335	0.344
2010	1.148	1.159	1.033	0.990	0.191	0.198
2011	1.002	1.012	0.985	0.946	0.168	0.174
2012	0.854	0.849	1.064	1.038	0.135	0.138

anos	F/F_{RMS}**S**	F/F_{RMS}**J**	BD/BD_{RMS}**S**	BD/BD_{RMS}**J**	Y/BT_**S**	Y/BT_**J**
2013	0.976	0.986	1.574	1.534	0.156	0.160
2014	1.211	1.216	1.324	1.297	0.159	0.162
2015	1.166	1.164	1.438	1.416	0.179	0.182
2016	1.369	1.351	1.110	1.099	0.213	0.215
2017	1.564	1.506	0.666	0.675	0.207	0.203
2018	0.822	0.776	0.700	0.738	0.121	0.116
2019	0.796	0.683	0.838	0.948	0.101	0.089
2020	0.830	0.656	1.298	1.508	0.134	0.111
2021	NA	0.723	NA	1.324	NA	0.116

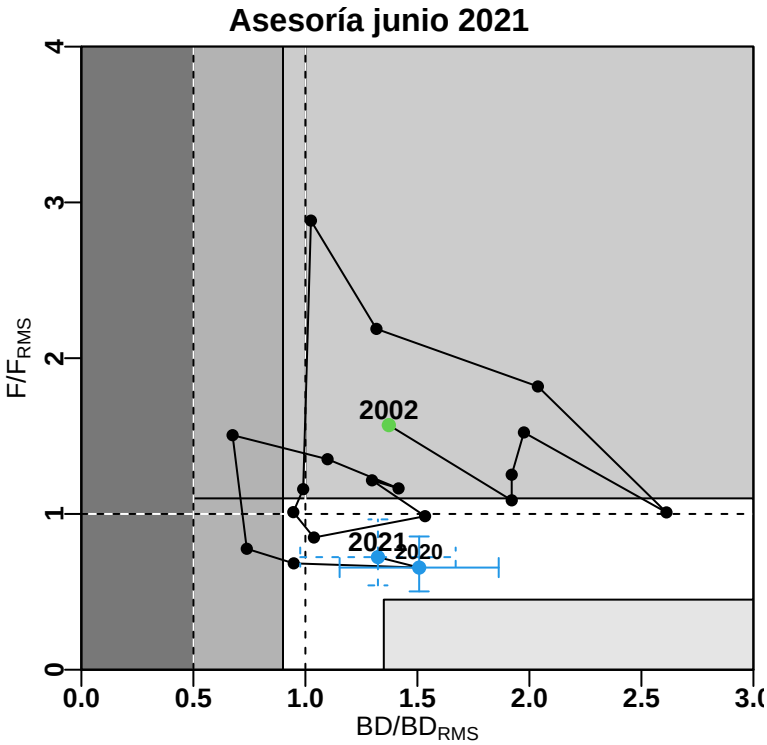
```
write.csv(VarPobl2, file="TablaEstatus.csv")
```

Diagramas de Fase

```
source(paste(dir.fun,"Fn_DiagramaFase.R",sep="")) # funciones para leer .dat y .rep

name<-"Asesoría septiembre 2020"
DiagramaFase(name,FRMS0,BRMS0,BD0,BD0std,Ft0,Ft0std,years0)
#cruz del año previo
lastB1    <- BD0[nyears0-1]/BRMS0
lastB     <- BD0[nyears0-1]
lastF     <- exp(Ft0[nyears0-1])/FRMS0
# Calculate confidence intervals
Qmult     <- -qnorm((1-(80/100))/2.0)
sbSE      <- BD0std[nyears0-1]
sb95      <- c(lastB-Qmult*sbSE,lastB+Qmult*sbSE)
B95       <- sb95/BRMS0
FvSE      <- Ft0std[nyears0-1]
F95       <- c(lastF*exp(-Qmult*FvSE),lastF*exp(Qmult*FvSE))

arrows(x0=B95[1],
       y0=lastF,
       x1=B95[2],
       y1=lastF,
       length=0.05,angle=90,col=4,lwd=1,code=3,lty=2)

arrows(x0=lastB1,
       y0=F95[1],
       x1=lastB1,
       y1=F95[2],
       length=0.05,angle=90,col=4,lwd=1,code=3,lty=2)

points(lastB1,lastF,pch=19,col=4)
text(lastB1,lastF-0.1,years0[nyears0-1],cex=0.8)
```



```
name<-"Asesoría junio 2021"
DiagramaFase(name,FRMS1,BRMS1,BD1,BD1std,Ft1,Ft1std,years1)

#cruz del año previo
lastB1    <- BD1[nyears1-1]/BRMS1
lastB     <- BD1[nyears1-1]
lastF     <- exp(Ft1[nyears1-1])/FRMS1
# Calculate confidence intervals
Qmult     <- -qnorm((1-(80/100))/2.0)
sbSE      <- BD1std[nyears1-1]
sb95      <- c(lastB-Qmult*sbSE,lastB+Qmult*sbSE)
B95       <- sb95/BRMS1
FvSE      <- Ft1std[nyears1-1]
F95       <- c(lastF*exp(-Qmult*FvSE),lastF*exp(Qmult*FvSE))

arrows(x0=B95[1],
       y0=lastF,
       x1=B95[2],
       y1=lastF,
       length=0.05,angle=90,col=4,lwd=1,code=3)

arrows(x0=lastB1,
       y0=F95[1],
       x1=lastB1,
       y1=F95[2],
       length=0.05,angle=90,col=4,lwd=1,code=3)

points(lastB1,lastF,pch=19,col=4)
text(lastB1,lastF+0.1,years1[nyears1-1],cex=0.8)
```



\textbf{Figura 26}. Diagrama de fases de explotación de sardina austral en aguas interiores de la Región de Los

Lagos, basado en mortalidad por pesca (F) y Biomasa desovante (BD/BDo)

5. RESULTADOS OBJETIVO 3

Cálculo de CBA inicial (Septiembre - Hito 1)

```
carpeta<-"/cba_septiembre2020_base/"

reps1b     <- reptoRlist(paste(dir.0,carpeta,"MTT0920s1.rep", sep='/'))
reps2b     <- reptoRlist(paste(dir.0,carpeta,"MTT0920s2.rep", sep='/'))
reps3b     <- reptoRlist(paste(dir.0,carpeta,"MTT0920s3.rep", sep='/'))

stds1     <- read.table(paste(dir.0,carpeta,"MTT0920s1.std", sep='/'),header=T,sep="",na="NA",fill=T)
stds2     <- read.table(paste(dir.0,carpeta,"MTT0920s2.std", sep='/'),header=T,sep="",na="NA",fill=T)
stds3     <- read.table(paste(dir.0,carpeta,"MTT0920s3.std", sep='/'),header=T,sep="",na="NA",fill=T)

cbas1     <- subset(stds1,name=="Yp")$value[3] ;
cbas1std  <- subset(stds1,name=="Yp")$std[3] #reclutamiento medios

cbas2     <- subset(stds2,name=="Yp")$value[3] ;
cbas2std  <- subset(stds2,name=="Yp")$std[3] #reclutamiento 2018

cbas3     <- subset(stds3,name=="Yp")$value[3] ;
cbas3std  <- subset(stds3,name=="Yp")$std[3] #reclutamiento 2012

q       <- seq(0.1,0.5,0.1)  # niveles de riesgo (cuantiles)
nq      <- length(q)
CBAs1     <- rep(0,nq)
CBAs2     <- rep(0,nq)
CBAs3     <- rep(0,nq)

buffer1   <- rep(0,nq)
buffer2   <- rep(0,nq)
buffer3   <- rep(0,nq)

for(j in 1:nq){CBAs1[j]  <-qnorm(q[j],cbas1,cbas1std)}
for(j in 1:nq){CBAs2[j]<-qnorm(q[j],cbas2,cbas2std)}
for(j in 1:nq){CBAs3[j]<-qnorm(q[j],cbas3,cbas3std)}

for(j in 1:nq){buffer1[j] <-round(1-CBAs1[j]/CBAs1[5],2)}
for(j in 1:nq){buffer2[j] <-round(1-CBAs2[j]/CBAs2[5],2)}
for(j in 1:nq){buffer3[j] <-round(1-CBAs3[j]/CBAs3[5],2)}

tCBA<-cbind(CBAs3,CBAs1,CBAs2)
rownames(tCBA)<-c(seq(10,50,10))
colnames(tCBA)<-c("R_bajo(2018)","R_Med","R_alto(2012))")
kable(t(round(tCBA,0)))
```

	10	20	30	40	50
R_bajo(2018)	10005	11300	12234	13032	13778
R_Med	10899	12213	13161	13971	14728
R_alto(2012))	14253	15766	16857	17789	18660

```
tbuffer<-cbind(buffer1,buffer2,buffer3)
rownames(tbuffer)<-c(seq(10,50,10))
```

```r
colnames(tbuffer)<-c("R_bajo(2018)","R_Med","R_alto(2012))")
kable(t(round(tbuffer,2)))
```

	10	20	30	40	50
R_bajo(2018)	0.26	0.17	0.11	0.05	0
R_Med	0.24	0.16	0.10	0.05	0
R_alto(2012))	0.27	0.18	0.11	0.05	0

Cálculo de CBA actualizada (Junio- Hito 2)

```r
cbas0     <- subset(std1,name=="Yact")$value[3] ;
cbas0std  <- subset(std1,name=="Yact")$std[3] #reclutamiento medios

q       <- seq(0.1,0.5,0.1)  # niveles de riesgo (cuantiles)
nq      <- length(q)
CBAs0     <- rep(0,nq)
buffer0   <- rep(0,nq)
for(j in 1:nq){CBAs0[j]<-qnorm(q[j],cbas0,cbas0std)}
for(j in 1:nq){buffer0[j] <-round(1-CBAs0[j]/CBAs0[5],2)}

tCBA<-cbind(percentil=c(seq(10,50,10)),CBA_final=round(CBAs0,0),CBA_finaldesc=round(CBAs0*0.977,0),Resgu
kable((tCBA))
```

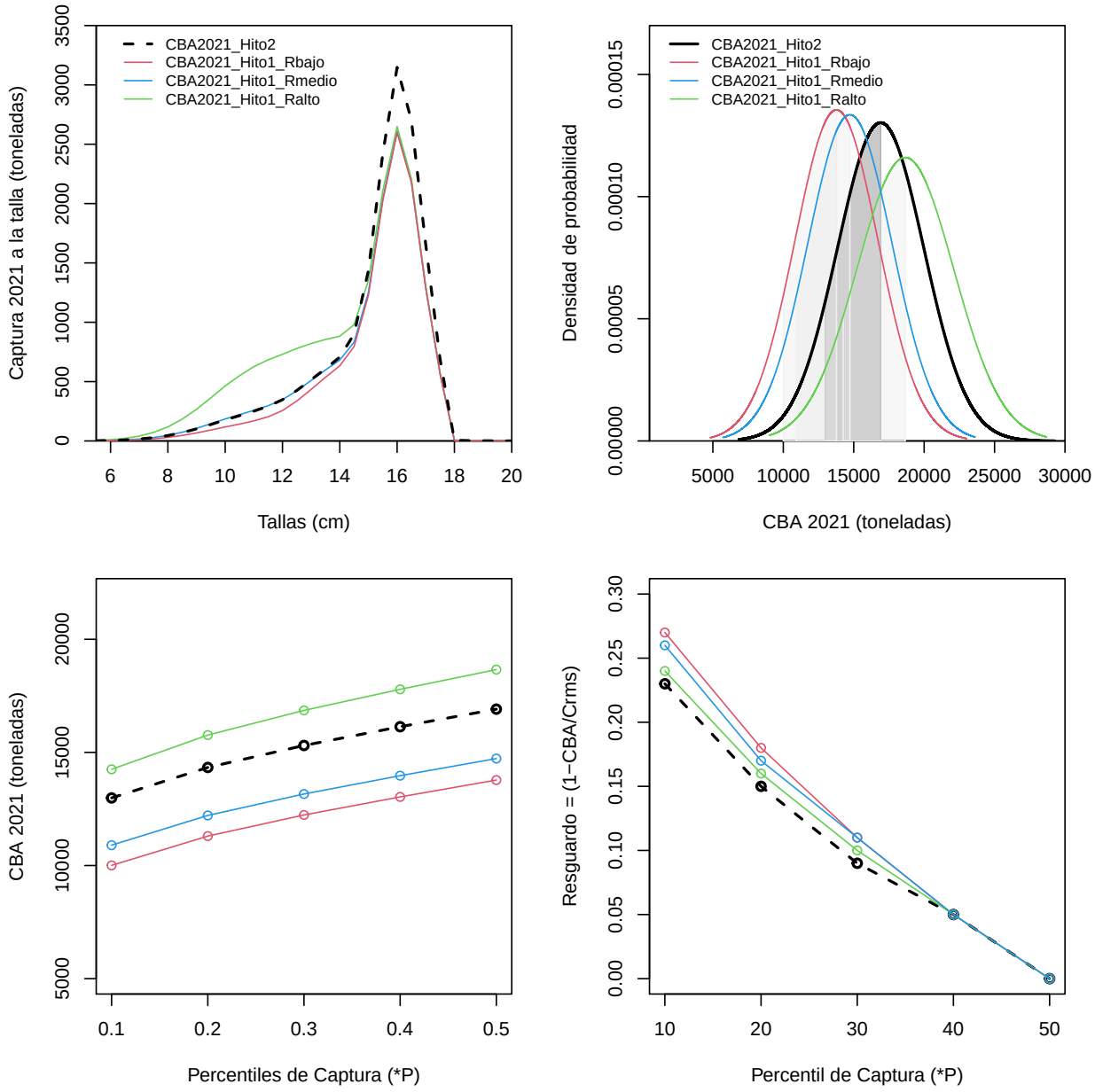
percentil	CBA_final	CBA_finaldesc	Resguardo
10	12987	12688	0.23
20	14334	14005	0.15
30	15306	14954	0.09
40	16136	15765	0.05
50	16912	16523	0.00

```r
#####################################################
# Asesoría junio
#####################################################
#  densidad de probabilidad
xbm1 <-rnorm(1000, mean = cbas0, sd = cbas0std)
xbm  <-seq(min(xbm1),max(xbm1),0.5)
ybm  <-dnorm(xbm, mean = cbas0, sd =cbas0std)
icbm <-qnorm(c(0.10,0.50,0.5),cbas0,cbas0std)

#distribución probabilidad
xxbm      <- c(xbm[xbm>=icbm[1]&xbm<=icbm[2]],
               rev(xbm[xbm>=icbm[1]&xbm<=icbm[2]]))
yybm      <- c(ybm[xbm>=icbm[1]&xbm<=icbm[2]],
               rep(0,length(ybm[xbm>=icbm[1]&xbm<=icbm[2]])))

densb_bm  <- data.frame(x=xxbm, y=yybm , t=rep('a', length(xxbm)), r=seq(1,length(xxbm),1))

#####################################################
# Asesoría septiembre #reclutamiento medios
#####################################################
#  densidad de probabilidad
```

```r
xbs1a <-rnorm(1000, mean = cbas1, sd = cbas1std)
xbsa  <-seq(min(xbs1a),max(xbs1a),0.5)
ybsa  <-dnorm(xbsa, mean = cbas1, sd =cbas1std)
icbsa <-qnorm(c(0.10,0.50,0.5),cbas1,cbas1std)

#distribución probabilidad
xxbsa      <- c(xbsa[xbsa>=icbsa[1]&xbsa<=icbsa[2]],
                rev(xbsa[xbsa>=icbsa[1]&xbsa<=icbsa[2]]))
yybsa      <- c(ybsa[xbsa>=icbsa[1]&xbsa<=icbsa[2]],
                rep(0,length(ybsa[xbsa>=icbsa[1]&xbsa<=icbsa[2]])))

densb_bsa  <- data.frame(x=xxbsa, y=yybsa , t=rep('a', length(xxbsa)), r=seq(1,length(xxbsa),1))

#######################################################
# Asesoría septiembre #reclutamiento 2018
#######################################################
#  densidad de probabilidad
xbs1b <-rnorm(1000, mean = cbas2, sd = cbas2std)
xbsb  <-seq(min(xbs1b),max(xbs1b),0.5)
ybsb  <-dnorm(xbsb, mean = cbas2, sd =cbas2std)
icbsb <-qnorm(c(0.10,0.50,0.5),cbas2,cbas2std)

#distribución probabilidad
xxbsb      <- c(xbsb[xbsb>=icbsb[1]&xbsb<=icbsb[2]],
                rev(xbsb[xbsb>=icbsb[1]&xbsb<=icbsb[2]]))
yybsb      <- c(ybsb[xbsb>=icbsb[1]&xbsb<=icbsb[2]],
                rep(0,length(ybsb[xbsb>=icbsb[1]&xbsb<=icbsb[2]])))

densb_bsb  <- data.frame(x=xxbsb, y=yybsb , t=rep('a', length(xxbsb)), r=seq(1,length(xxbsb),1))

#######################################################
# Asesoría septiembre #reclutamiento 2012
#######################################################
#  densidad de probabilidad
xbs1c <-rnorm(1000, mean = cbas3, sd = cbas3std)
xbsc  <-seq(min(xbs1c),max(xbs1c),0.5)
ybsc  <-dnorm(xbsc, mean = cbas3, sd =cbas3std)
icbsc <-qnorm(c(0.10,0.50,0.5),cbas3,cbas3std)

#distribución probabilidad
xxbsc      <- c(xbsc[xbsc>=icbsc[1]&xbsc<=icbsc[2]],
                rev(xbsc[xbsc>=icbsc[1]&xbsc<=icbsc[2]]))
yybsc      <- c(ybsc[xbsc>=icbsc[1]&xbsc<=icbsc[2]],
                rep(0,length(ybsc[xbsc>=icbsc[1]&xbsc<=icbsc[2]])))

densb_bsc  <- data.frame(x=xxbsc, y=yybsc , t=rep('a', length(xxbsc)), r=seq(1,length(xxbsc),1))
```

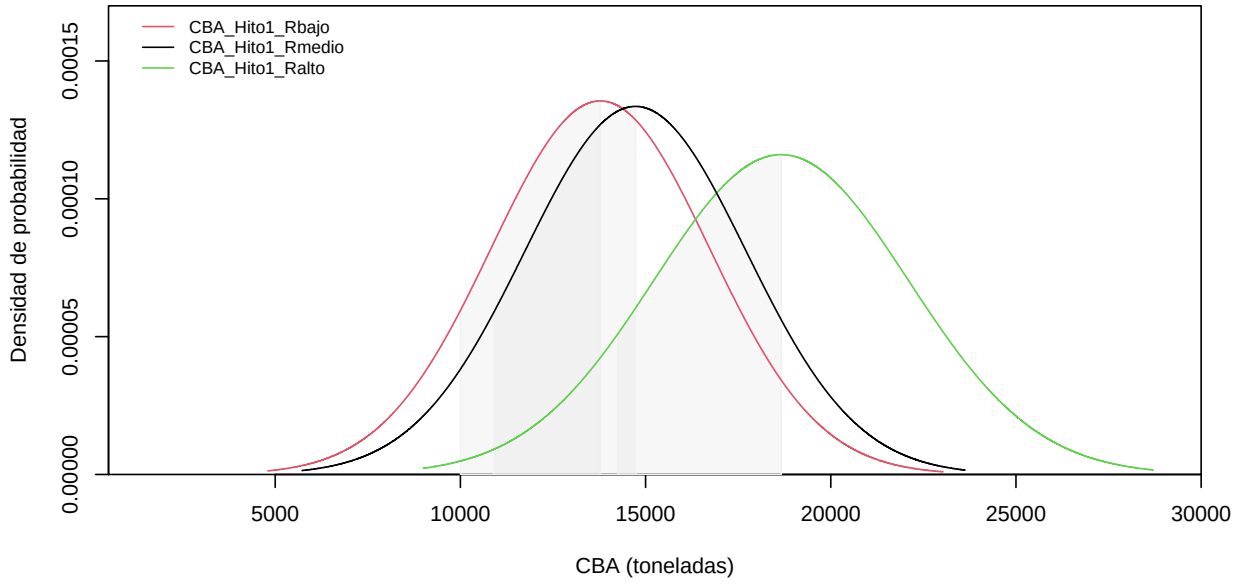
```r
#par(layout( matrix(c(1,1,2,3), nrow=2, byrow=TRUE) ),mar=c(4,4,1,1)+0.5)

par(mfrow=c(2,2),mar=c(4,4,1,1)+0.5)
tallas<-seq(5.5,20,0.5)
plot(tallas,reps1b$CTPp,type="l",ylim=c(0,3500),main="",xaxs="i",yaxs= "i",
     ylab="Captura 2021 a la talla (toneladas)",xlab="Tallas (cm)",col=4)
lines(tallas,reps2b$CTPp,col=3)
```

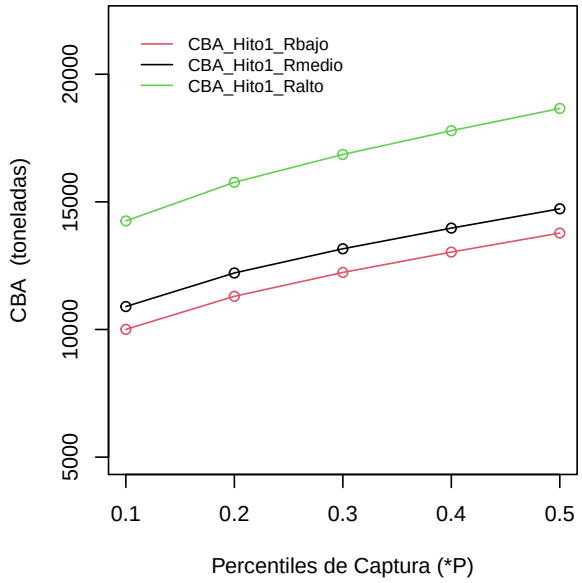
```
lines(tallas,reps3b$CTPp,col=2)
lines(tallas,rep1$CTP,col=1,lwd=2,lty=2)

legend(6,3500,c("CBA2021_Hito2","CBA2021_Hito1_Rbajo","CBA2021_Hito1_Rmedio","CBA2021_Hito1_Ralto"),lwd=
text(904.3,0.0022,"Crms")


plot(xbm,ybm ,type="n",ylab="Densidad de probabilidad",xaxs="i",yaxs= "i",xlab="CBA 2021 (toneladas)", m
polygon(xxbm,yybm,col=gray(0.7,0.7),border="gray70")
polygon(xxbsc,yybsc,col=gray(0.9,0.3),border="gray95")
polygon(xxbsb,yybsb,col=gray(0.9,0.3),border="gray95")
polygon(xxbsa,yybsa,col=gray(0.9,0.3),border="gray95")
lines(xbm,ybm,lwd=2,lty=1,col=1)
lines(xbsc,ybsc,lwd=1,lty=1,col=2)
lines(xbsb,ybsb,lwd=1,lty=1,col=3)
lines(xbsa,ybsa,lwd=1,lty=1,col=4)
legend(1000,0.00017,c("CBA2021_Hito2","CBA2021_Hito1_Rbajo","CBA2021_Hito1_Rmedio","CBA2021_Hito1_Ralto
text(904.3,0.0022,"Crms")


plot(seq(0.1,0.5,0.1),CBAs3,type="o",col=2,ylim=c(5000,22000),ylab="CBA 2021 (toneladas)",xlab="Percenti
lines(seq(0.1,0.5,0.1),CBAs2,type="o",col=3)
lines(seq(0.1,0.5,0.1),CBAs1,type="o",col=4)
lines(seq(0.1,0.5,0.1),CBAs0,type="o",col=1,lwd=2,lty=2)


plot(seq(10,50,10),buffer0,type="o",ylim=c(0,0.3), ylab="Resguardo = (1-CBA/Crms)",xlab="Percentil de Ca
lines(seq(10,50,10),buffer3,type="o",col=2)
lines(seq(10,50,10),buffer2,type="o",col=3)
lines(seq(10,50,10),buffer1,type="o",col=4)
```

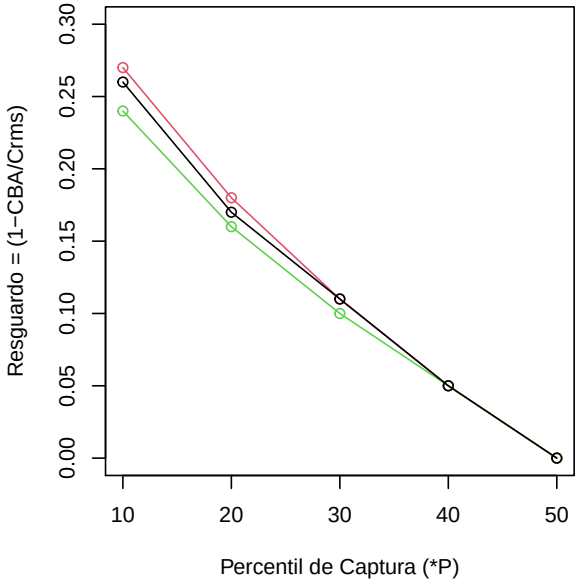



```r
par(layout( matrix(c(1,1,2,3), nrow=2, byrow=TRUE) ),mar=c(4,4,1,1)+0.5)

#par(mfrow=c(2,2),mar=c(4,4,1,1)+0.5)


plot(xbm,ybm ,type="n",ylab="Densidad de probabilidad",xaxs="i",yaxs= "i",xlab="CBA (toneladas)", main=
#polygon(xxbm,yybm,col=gray(0.7,0.7),border="gray70")
polygon(xxbsc,yybsc,col=gray(0.9,0.3),border="gray95")
polygon(xxbsb,yybsb,col=gray(0.9,0.3),border="gray95")
polygon(xxbsa,yybsa,col=gray(0.9,0.3),border="gray95")
#lines(xbm,ybm,lwd=2,lty=1,col=1)
lines(xbsc,ybsc,lwd=1,lty=1,col=2)
lines(xbsb,ybsb,lwd=1,lty=1,col=3)
lines(xbsa,ybsa,lwd=1,lty=1,col=1)
```

```
legend(1000,0.00017,c("CBA_Hito1_Rbajo","CBA_Hito1_Rmedio","CBA_Hito1_Ralto"),lwd=c(1,1,1),col=c(2,1,3)
text(904.3,0.0022,"Crms")


plot(seq(0.1,0.5,0.1),CBAs3,type="o",col=2,ylim=c(5000,22000),ylab="CBA  (toneladas)",xlab="Percentiles
lines(seq(0.1,0.5,0.1),CBAs2,type="o",col=3)
lines(seq(0.1,0.5,0.1),CBAs1,type="o",col=1)
#lines(seq(0.1,0.5,0.1),CBAs0,type="o",col=1,lwd=2,lty=1)
legend(0.1,22000,c("CBA_Hito1_Rbajo","CBA_Hito1_Rmedio","CBA_Hito1_Ralto"),lwd=c(1,1,1),col=c(2,1,3),lty

plot(seq(10,50,10),buffer0,type="n",ylim=c(0,0.3), ylab="Resguardo = (1-CBA/Crms)",xlab="Percentil de Ca
lines(seq(10,50,10),buffer3,type="o",col=2)
lines(seq(10,50,10),buffer2,type="o",col=3)
lines(seq(10,50,10),buffer1,type="o",col=1)
```

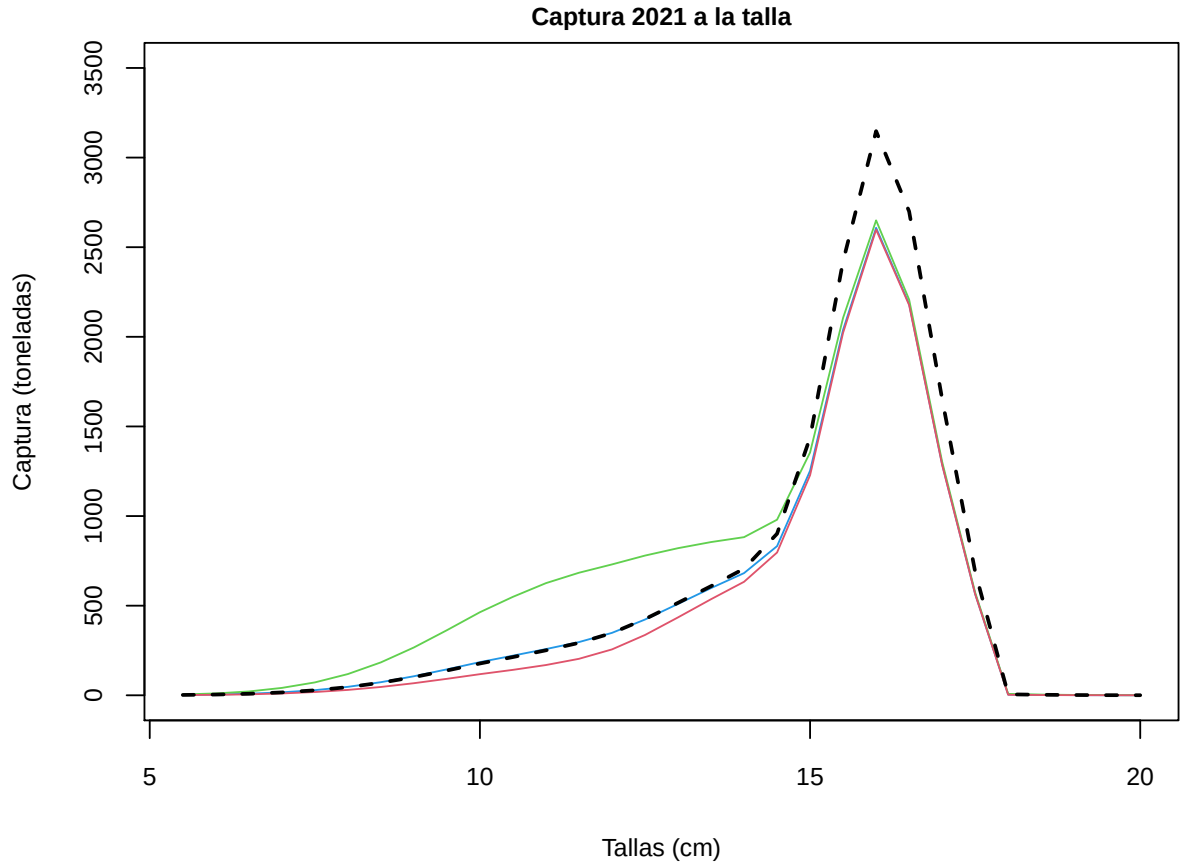







```
dirb<-paste(dir.0,"/cba_septiembre2020_base",sep="")
setwd(dirb)
reps1b     <- reptoRlist("MTT0920s1.rep")
reps2b     <- reptoRlist("MTT0920s2.rep")
reps3b     <- reptoRlist("MTT0920s3.rep")



par(mfcol=c(1,1),mar=c(4,4,1,1)+0.5)

plot(tallas,reps1b$CTPp,type="l",ylim=c(0,3500),main="Captura 2021 a la talla",
     ylab="Captura (toneladas)",xlab="Tallas (cm)",cex.axis=0.8,cex.main=0.8,cex.lab=0.8,col=4)
lines(tallas,reps2b$CTPp,col=3)
lines(tallas,reps3b$CTPp,col=2)
```

```
lines(tallas,rep1$CTP,col=1,lwd=2,lty=2)
```

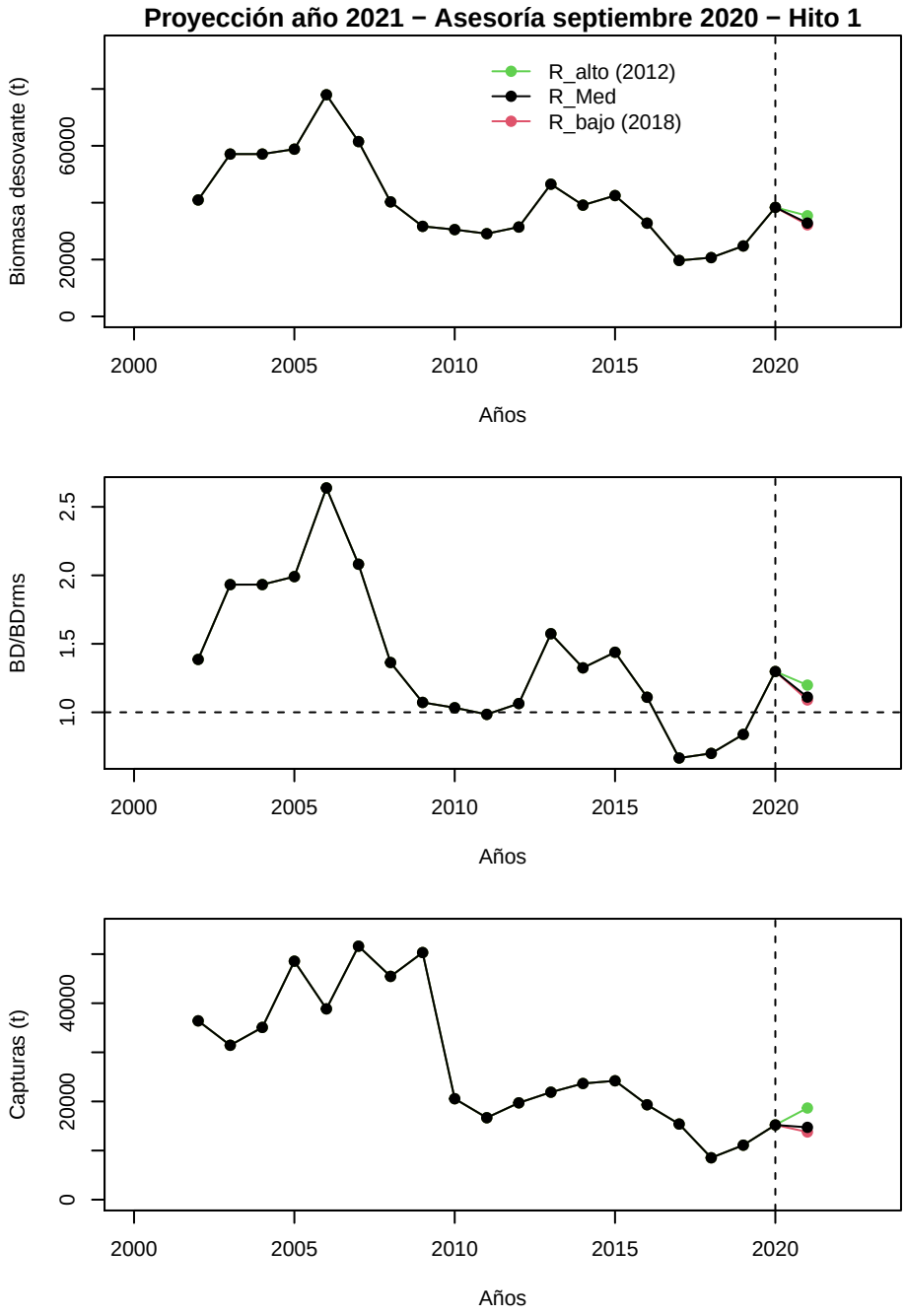


Proyección del stock

La **Figura 28** muestra la proyección de la biomasa desovante, la reducción del stock (BD/BD_{MRS}) y capturas en cinco años bajo tres escenarios de reclutamiento proyectado

```
carpeta<-"/cba_septiembre2020_base/"

stds1     <- read.table(paste(dir.0,carpeta,"MTT0920s1.std", sep=''),header=T,sep="",na="NA",fill=T)
stds2     <- read.table(paste(dir.0,carpeta,"MTT0920s2.std", sep=''),header=T,sep="",na="NA",fill=T)
stds3     <- read.table(paste(dir.0,carpeta,"MTT0920s3.std", sep=''),header=T,sep="",na="NA",fill=T)

bds1     <- subset(stds1,name=="Bp")$value[3] ; bds1std  <- subset(stds1,name=="Bp")$std[3] #reclutamie
bds2     <- subset(stds2,name=="Bp")$value[3] ; bds2std  <- subset(stds2,name=="Bp")$std[3] #reclutamie
bds3     <- subset(stds3,name=="Bp")$value[3] ; bds3std  <- subset(stds3,name=="Bp")$std[3] #reclutamie

cs1     <- subset(stds1,name=="Yp")$value[3] ; cs1std  <- subset(stds1,name=="Yp")$std[3] #reclutamient
cs2     <- subset(stds2,name=="Yp")$value[3] ; cs2std  <- subset(stds2,name=="Yp")$std[3] #reclutamient
cs3     <- subset(stds3,name=="Yp")$value[3] ; cs3std  <- subset(stds3,name=="Yp")$std[3] #reclutamient
```

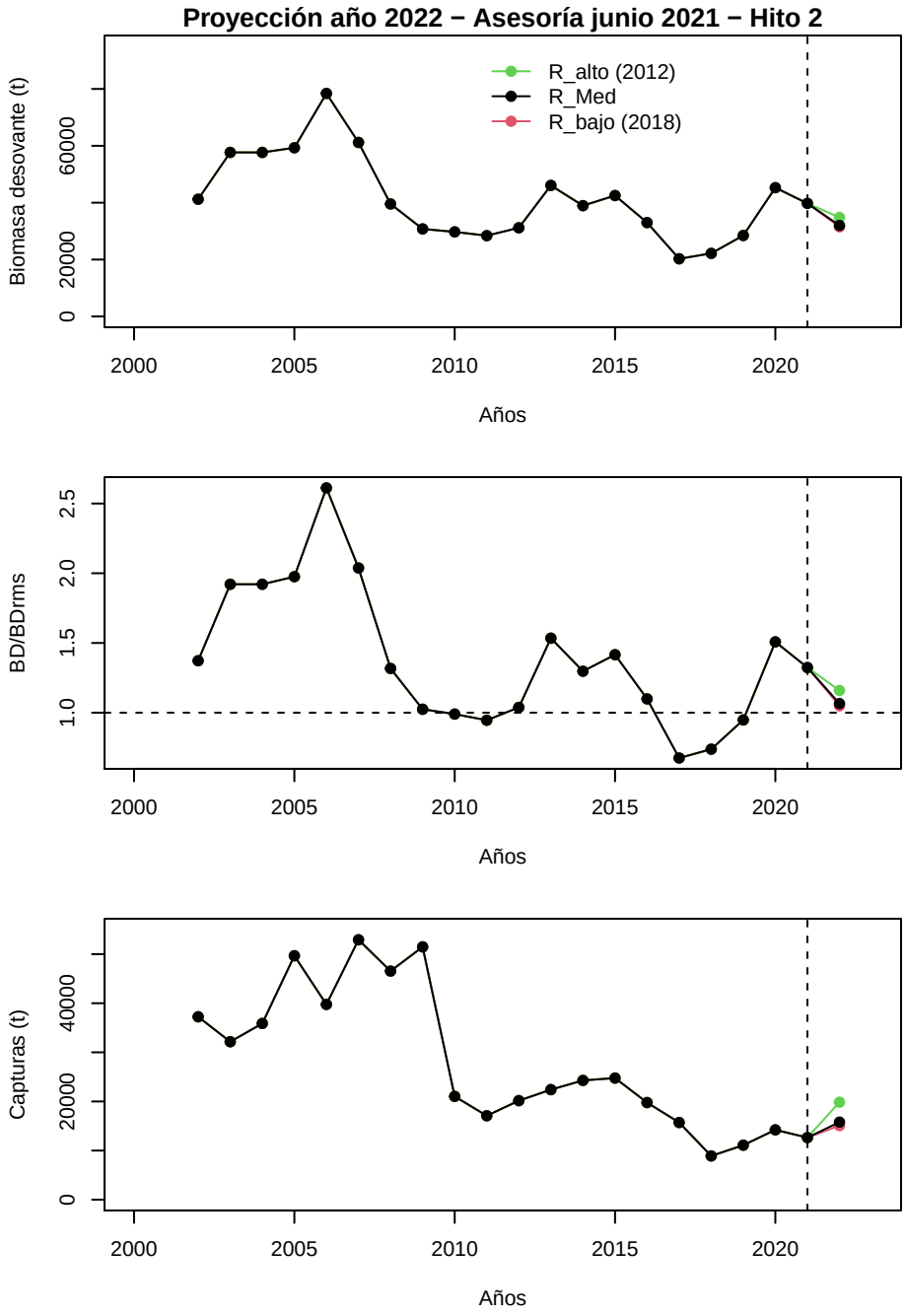
```
par(mfcol=c(3,1),mar=c(4,4,1,1)+0.5)
yearProy<-2021

plot(c(rep0$Years,seq(yearProy,yearProy,1)),
     c(rep0$Biomasa_desovante,bds3),
     type="o",ylab="Biomasa desovante (t)",xlab="Años",col=2,
     ylim=c(0,95000),xlim=c(2000,2023),pch=19,main="Proyección año 2021 - Asesoría septiembre 2020 - Hi
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Biomasa_desovante,bds2),
      type="o",col=3,pch=19)
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Biomasa_desovante,bds1),type="o",col=1,pch=19)
abline(v=yearProy-1,lty=2)
legend(2011,95000,c("R_alto (2012)","R_Med","R_bajo (2018)"),pch=19,lwd=1,col=c(3,1,2),bty="n")

plot(c(rep0$Years,seq(yearProy,yearProy,1)),
     c(rep0$Biomasa_desovante,bds3)/BRMS0,
     type="o",ylab="BD/BDrms",col=2,xlab="Años",pch=19,xlim=c(2000,2023),)
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Biomasa_desovante,bds2)/BRMS0,
      type="o",col=3,pch=19)
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Biomasa_desovante,bds1)/BRMS0,
      type="o",col=1,pch=19)
abline(v=yearProy-1,h=1,lty=2)

plot(c(rep0$Years,seq(yearProy,yearProy,1)),
     c(rep0$Desemb_pred,cs3),type="o",
     ylab="Capturas (t)",col=2,ylim=c(0,55000),xlab="Años",pch=19,xlim=c(2000,2023),)
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Desemb_pred,cs2),
      type="o",col=3,pch=19)
lines(c(rep0$Years,seq(yearProy,yearProy,1)),
      c(rep0$Desemb_pred,cs1),
      type="o",col=1,pch=19)
abline(v=yearProy-1,lty=2)
```




```
carpeta<-"/cba_junio2021_base/"

stds1     <- read.table(paste(dir.0,carpeta,"MTT0621s1.std", sep=''),header=T,sep="",na="NA",fill=T)
stds2     <- read.table(paste(dir.0,carpeta,"MTT0621s2.std", sep=''),header=T,sep="",na="NA",fill=T)
stds3     <- read.table(paste(dir.0,carpeta,"MTT0621s3.std", sep=''),header=T,sep="",na="NA",fill=T)

bds1     <- subset(stds1,name=="Bp")$value[3] ; bds1std  <- subset(stds1,name=="Bp")$std[3] #reclutamie
bds2     <- subset(stds2,name=="Bp")$value[3] ; bds2std  <- subset(stds2,name=="Bp")$std[3] #reclutamie
bds3     <- subset(stds3,name=="Bp")$value[3] ; bds3std  <- subset(stds3,name=="Bp")$std[3] #reclutamie

cs1     <- subset(stds1,name=="Yp")$value[3] ; cs1std  <- subset(stds1,name=="Yp")$std[3] #reclutamient
```

```r
cs2     <- subset(stds2,name=="Yp")$value[3] ; cs2std  <- subset(stds2,name=="Yp")$std[3] #reclutamient
cs3     <- subset(stds3,name=="Yp")$value[3] ; cs3std  <- subset(stds3,name=="Yp")$std[3] #reclutamient
```

```r
par(mfcol=c(3,1),mar=c(4,4,1,1)+0.5)

plot(c(rep1$Years,seq(2022,2022,1)),
     c(rep1$Biomasa_desovante,bds3),
     type="o",ylab="Biomasa desovante (t)",xlab="Años",col=2,
     ylim=c(0,95000),xlim=c(2000,2023),pch=19,main="Proyección año 2022 - Asesoría junio 2021 - Hito 2")

lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Biomasa_desovante,bds2),
      type="o",col=3,pch=19)
lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Biomasa_desovante,bds1),type="o",col=1,pch=19)
abline(v=2021,lty=2)
legend(2011,95000,c("R_alto (2012)","R_Med","R_bajo (2018)"),pch=19,lwd=1,col=c(3,1,2),bty="n")

plot(c(rep1$Years,seq(2022,2022,1)),
     c(rep1$Biomasa_desovante,bds3)/BRMS1,
     type="o",ylab="BD/BDrms",col=2,xlab="Años",xlim=c(2000,2023),pch=19)
lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Biomasa_desovante,bds2)/BRMS1,
      type="o",col=3,pch=19)
lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Biomasa_desovante,bds1)/BRMS1,
      type="o",col=1,pch=19)
abline(v=2021,h=1,lty=2)

plot(c(rep1$Years,seq(2022,2022,1)),
     c(rep1$Desemb_pred,cs3),type="o",
     ylab="Capturas (t)",col=2,ylim=c(0,55000),xlim=c(2000,2023),xlab="Años",pch=19)
lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Desemb_pred,cs2),
      type="o",col=3,pch=19)
lines(c(rep1$Years,seq(2022,2022,1)),
      c(rep1$Desemb_pred,cs1),
      type="o",col=1,pch=19)
abline(v=2021,lty=2)
```


Proyección año 2022 − Asesoría junio 2021 − Hito 2
R_alto (2012)
R_Med
R_bajo (2018)
Biomasa desovante (t)
0
20000
60000
2000
2005
2010
2015
2020
Años
BD/BDrms
1.0
1.5
2.0
2.5
2000
2005
2010
2015
2020
Años
Capturas (t)
0
20000
40000
2000
2005
2010
2015
2020
Años