FIGURAS Y TABLAS PRIMER INFORME ESTATUS Y CBA 2022 SARDINA AUSTRAL LOS LAGOS

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 2021 MODELO BASE NUEVO
data.0    <- lisread(paste(dir.1,"MAT0921.dat", sep='/'));
names(data.0)<-str_trim(names(data.0), side="right")
rep0      <- reptoRlist("MAT0921.rep")
std0      <- read.table("MAT0921.std",header=T,sep="",na="NA",fill=T)
```

FUNCIÓN DE RETROSPECTIVO

FUNCIÓN DE VEROSIMILITUD

FUNCIÓN DE CBA

CÁLCULO DE TAMAÑO DE MUESTRA

```
#============================================================#
# II. COMPOSICI?N EDAD DE LAS CAPTURAS                       #
#============================================================#
years  <- data.1$Ind[,1]
nyears <- data.1$nanos
```

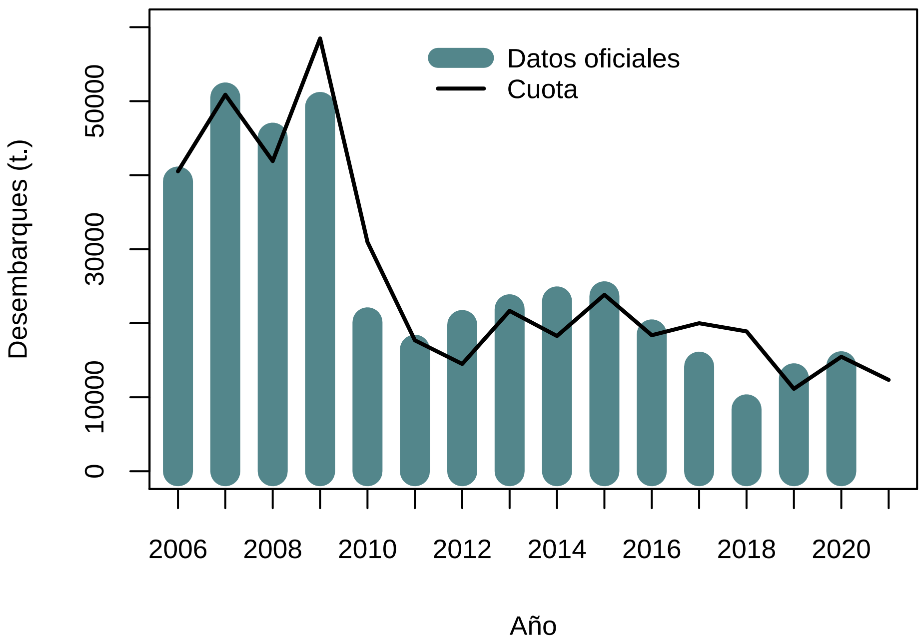
```r
age  <-seq(5.5,20,0.5)
nage<-length(age)
#Proporci?n observada
pobsF<-rep1$Propfl_obs
pobsR<-rep1$Propcru_obs

#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
```

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

SEGUNDA PARTE: GENERA GRÁFICAS Y TABLAS

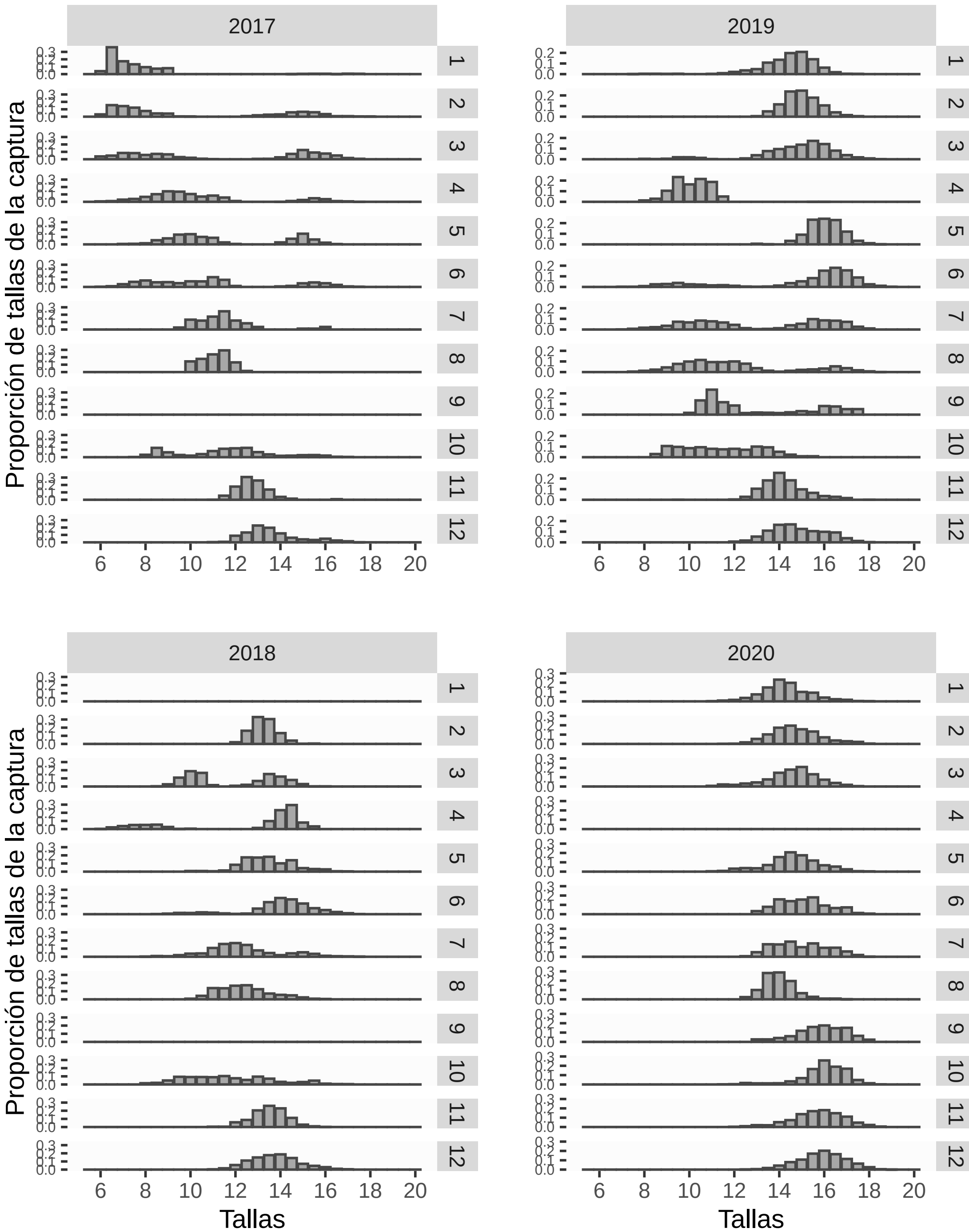
1. Antecedentes

```
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","Cuota"),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','mes'))%>%
  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, s
          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, s
          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, s
          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, s
          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
```

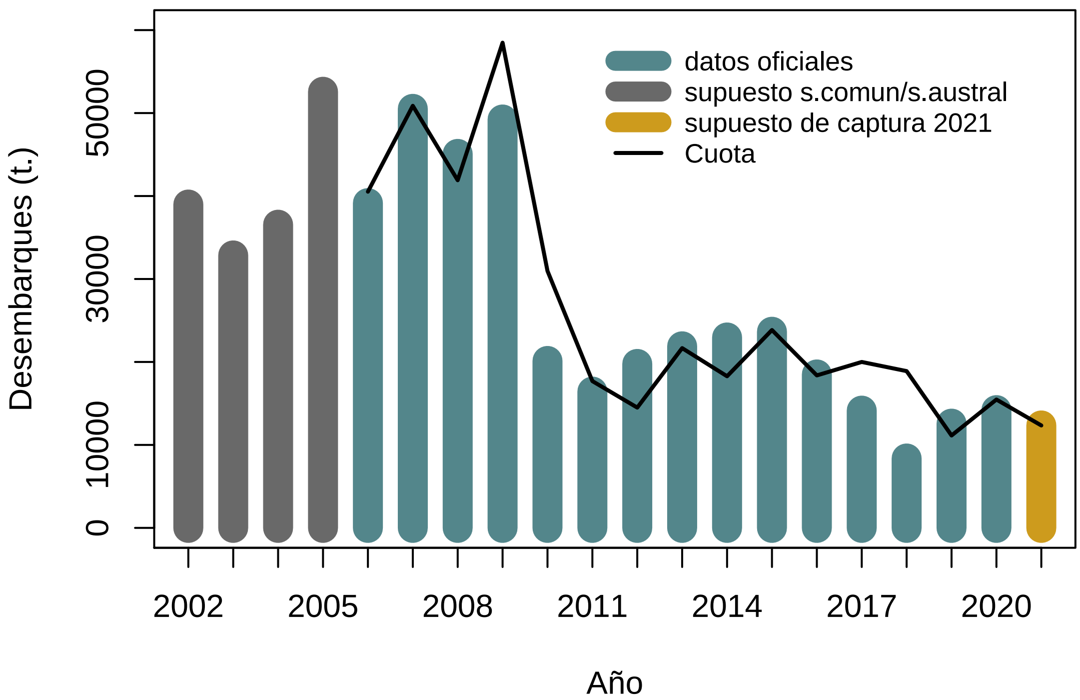

2017
2019
2018
2020
Proporción de tallas de la captura
Tallas
1
2
3
4
5
6
7
8
9
10
11
12
0.0
0.1
0.2
0.3
6
8
10
12
14
16
18
20

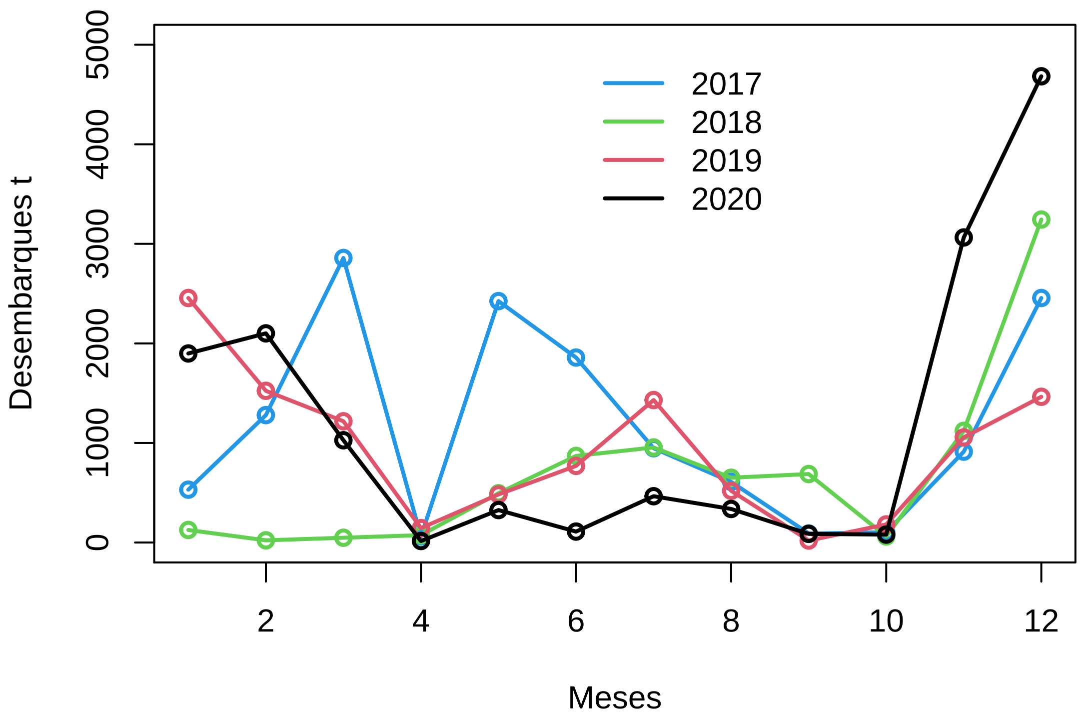
2. Metodología

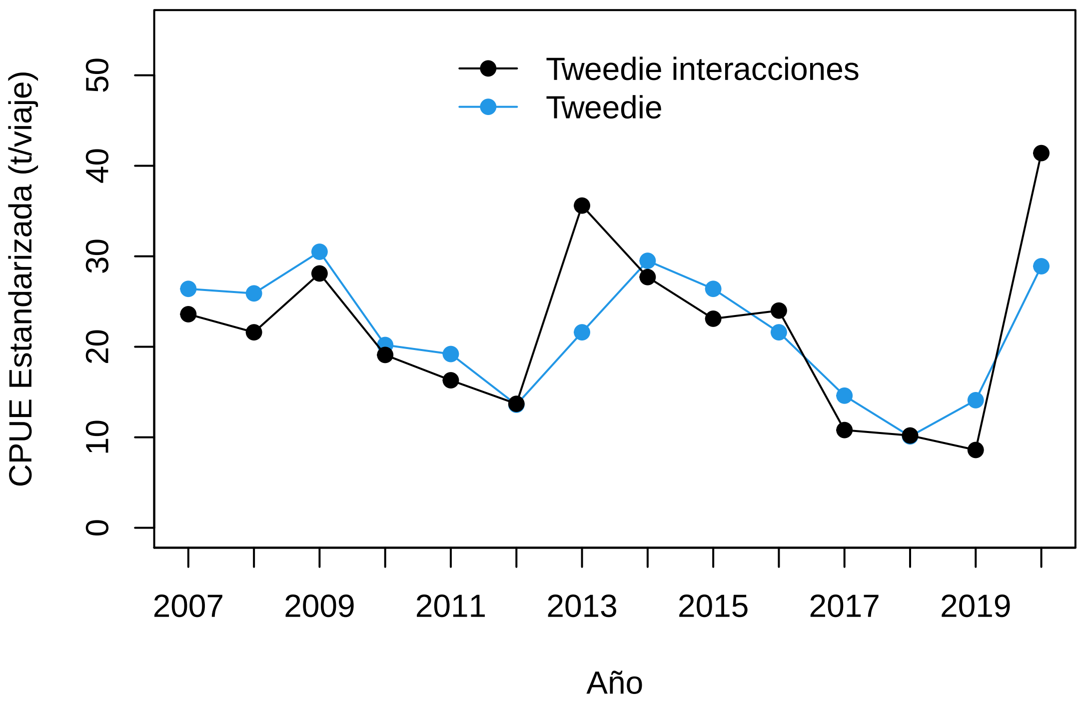
```r
dirb<-paste(dir.0,"/cba_septiembre2021",sep="")
setwd(dirb)
reps1b     <- reptoRlist("MAT0921s1.rep")
reps2b     <- reptoRlist("MAT0921s2.rep")
reps3b     <- reptoRlist("MAT0921s3.rep")



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 (Asesoría Septiembre 2020)",
     cex.axis=0.6,cex.main=0.7,cex.lab=0.7)
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(8.6053e+000),
                    reps2b$Reclutamiento[11],
                    reps3b$Reclutamiento[17]),0),cex=0.7)
```

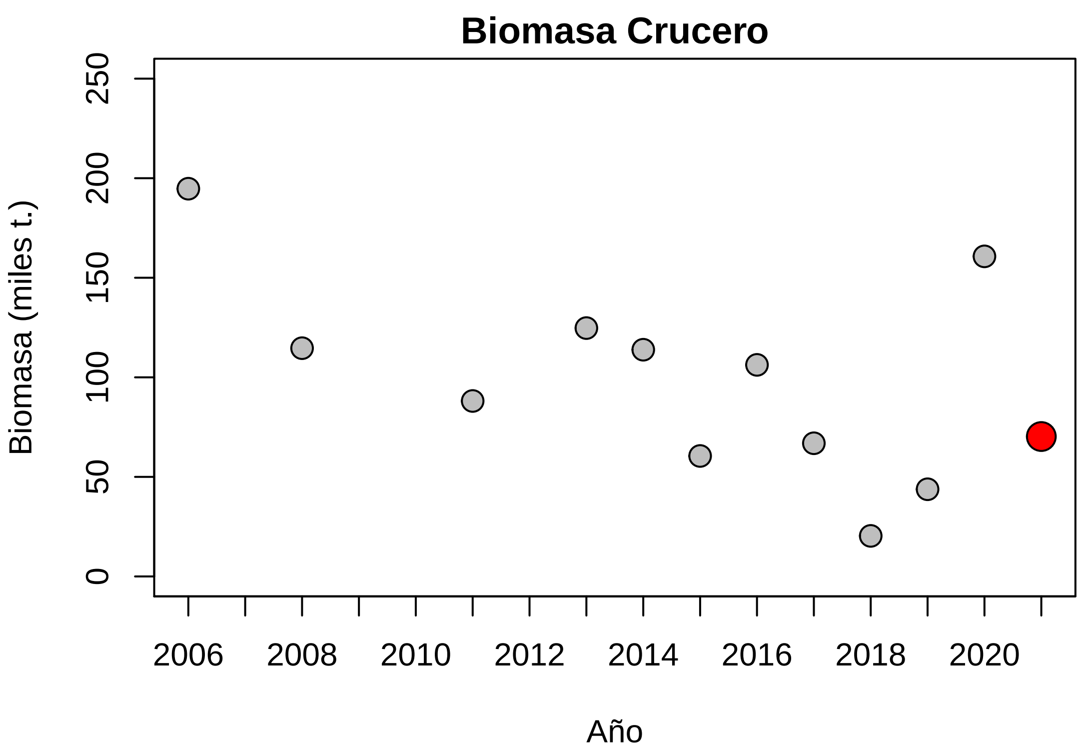
3. RESULTADOS OBJETIVO 1

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





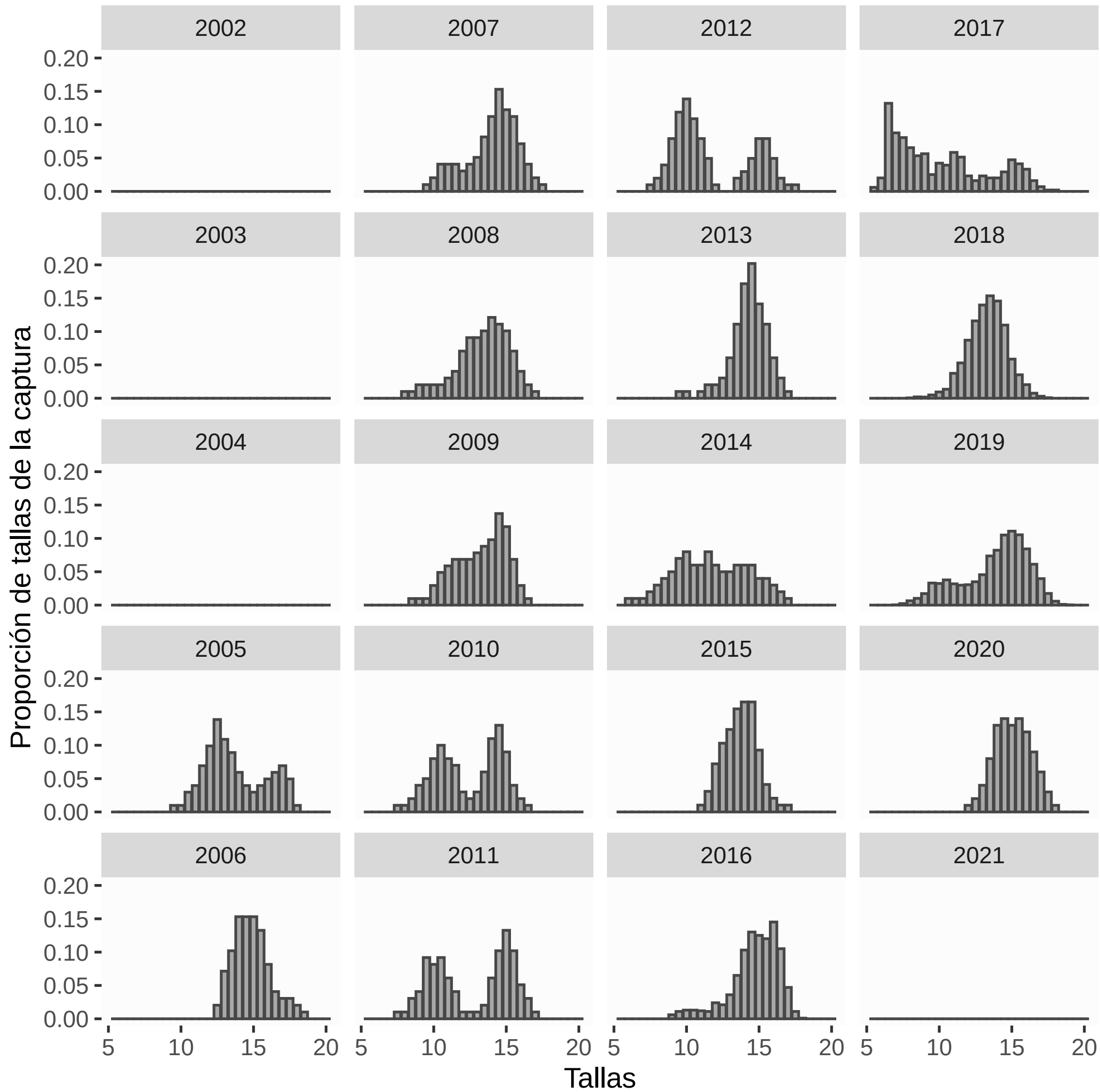




ESTRUCTURA DE TALLAS DE LA FLOTA

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

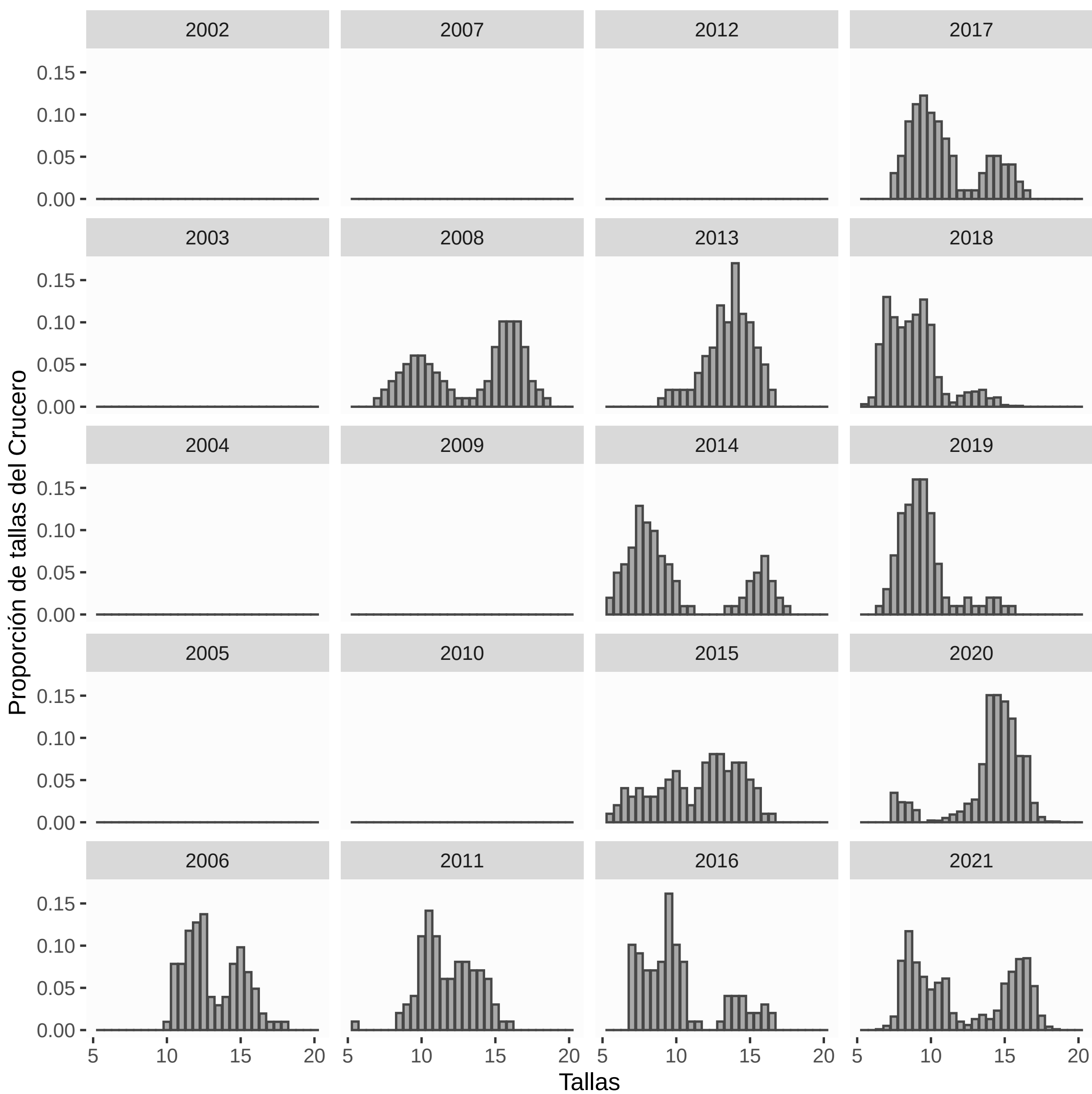
```r
#################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)
etf_obs_sept <- data.frame(rep0$pf_obs)


yearf   <- rep0$YRS
nyearf  <- length(yearf)

 obs       <- as.data.frame(etf_obs_sept) %>%
                            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(rep0$pobs_RECLAN)
yearc       <- rep0$YRS
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)
```

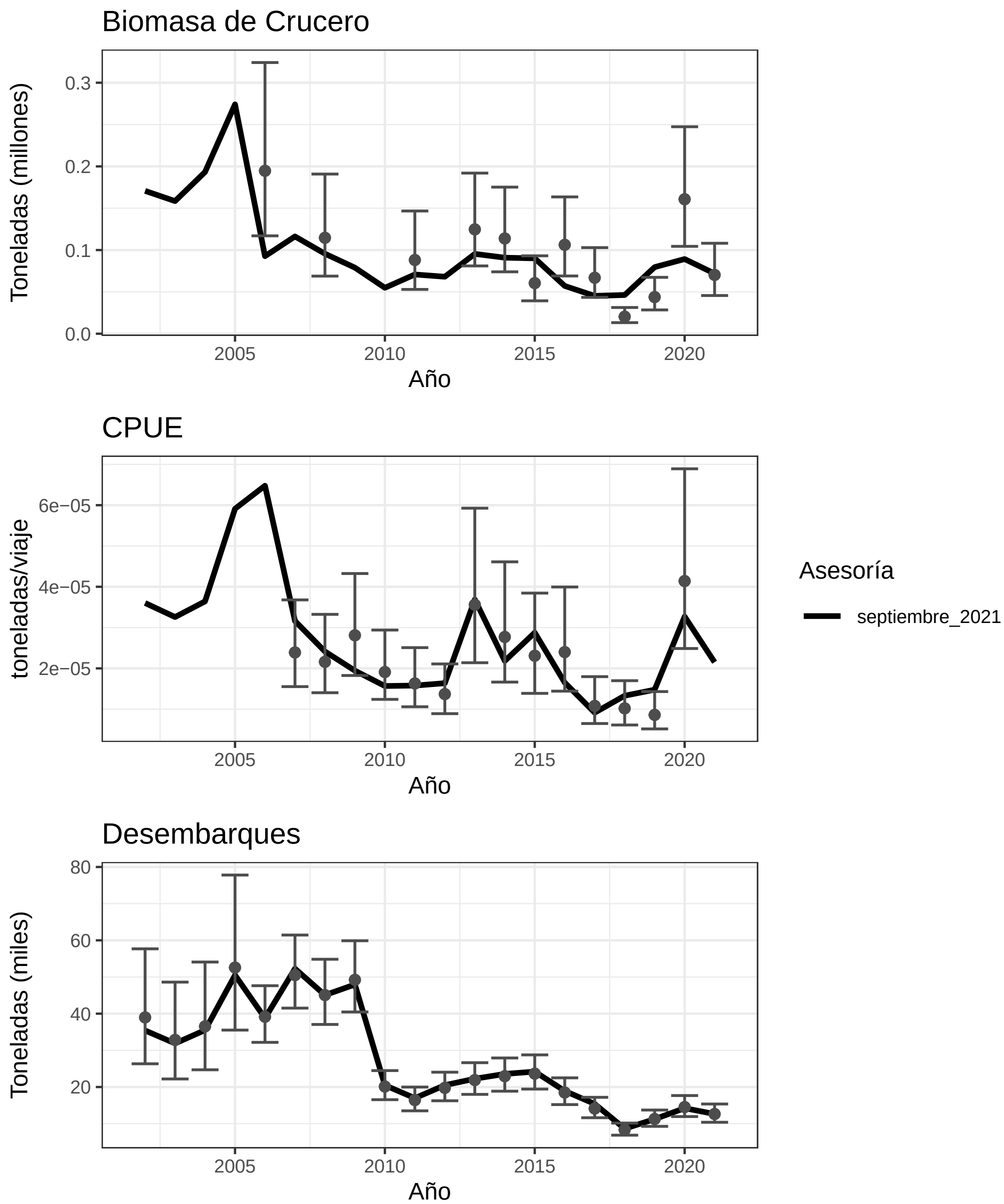
```r
##########################################################################################
# GRAFICAS
##########################################################################################
fig1 <- ggplot(filter(mat, type=='obs')) +
        geom_bar(aes(x = edad, y = value),
                 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

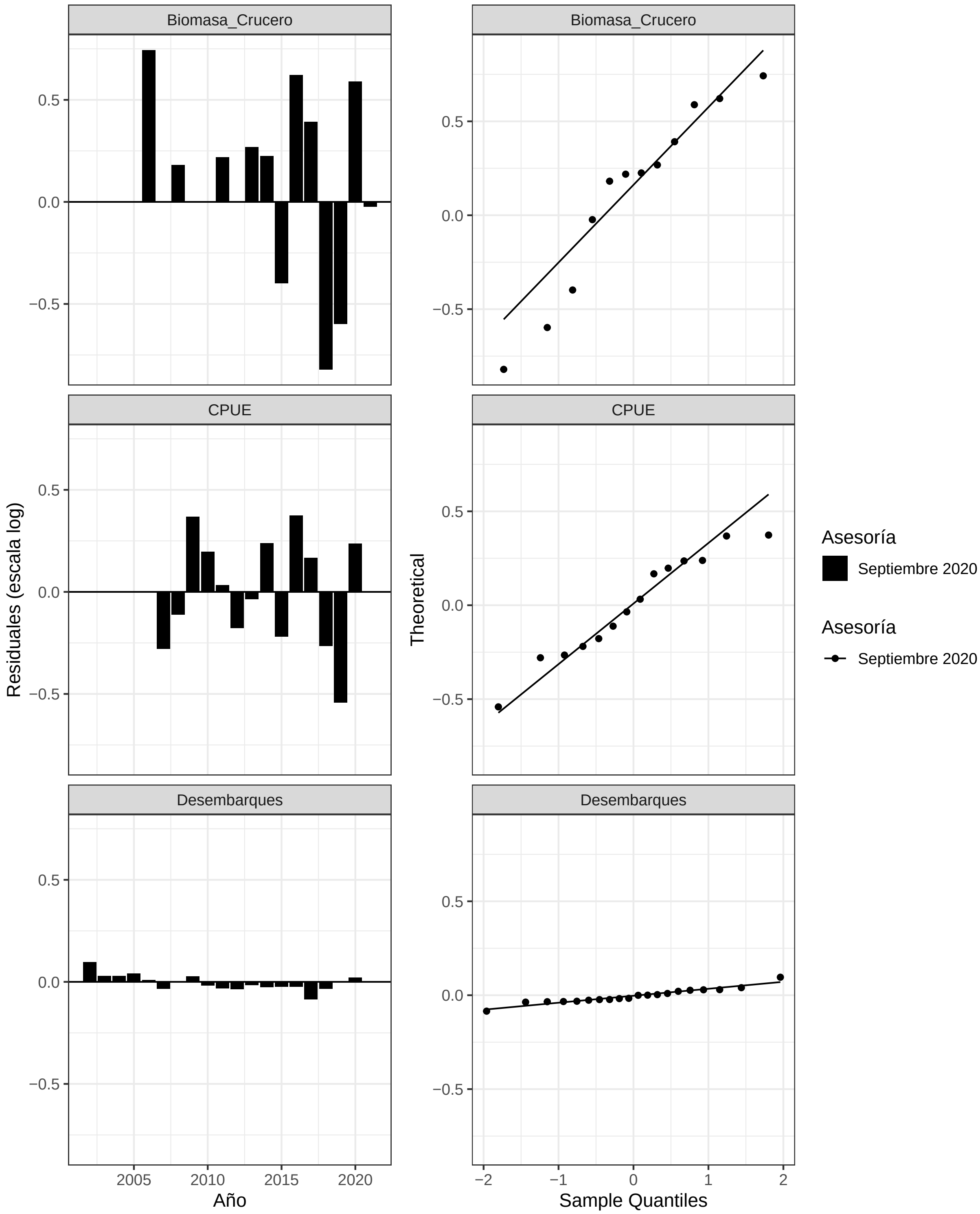
```r
######################################################################################
# AREGLOS DE DATOS
######################################################################################

library(patchwork)

yrs   <- rep0$YRS
nyrs  <- length(yrs)
lasty <- yrs[nyrs]
cvCB   <-data.0$Ind[,8]
cvcpue <-data.0$Ind[,7]
cvdes  <-data.0$Ind[,6]

ind_obs  <- cbind(rep0$reclan,
                  rep0$cpue,
                  rep0$desemb);
ind_obs[ind_obs==0] <- NA
colnames(ind_obs) <- c('Biomasa_Crucero',
                       'CPUE',
                       'Desembarques')

ind_sept <- cbind(c(rep0$reclan_pred),
                  c(rep0$cpue_pred),
                  c(rep0$desemb_pred))

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'))

sept    <- data.frame(ind_sept) %>%
           mutate (Asesoría='septiembre_2021') %>%
           mutate (yrs= yrs)  %>%
           melt(id.var=c('yrs', 'Asesoría'))

base1 <- data.frame(rbind(ind, 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('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 = 2021, 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('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 = 2021, 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('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 = 2021, 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
2e−05
4e−05
6e−05
2005
2010
2015
2020
Año
Asesoría
septiembre_2021
Desembarques
Toneladas (miles)
20
40
60
80
2005
2010
2015
2020
Año

3.2. Análisis de Residuales de los índices

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

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

Res      <- rbind(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("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("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("black")) +
      facet_wrap(. ~ variable, ncol = 1) +
      labs(x= 'Sample Quantiles', y ='Theoretical') +
      theme_bw(base_size=12)

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

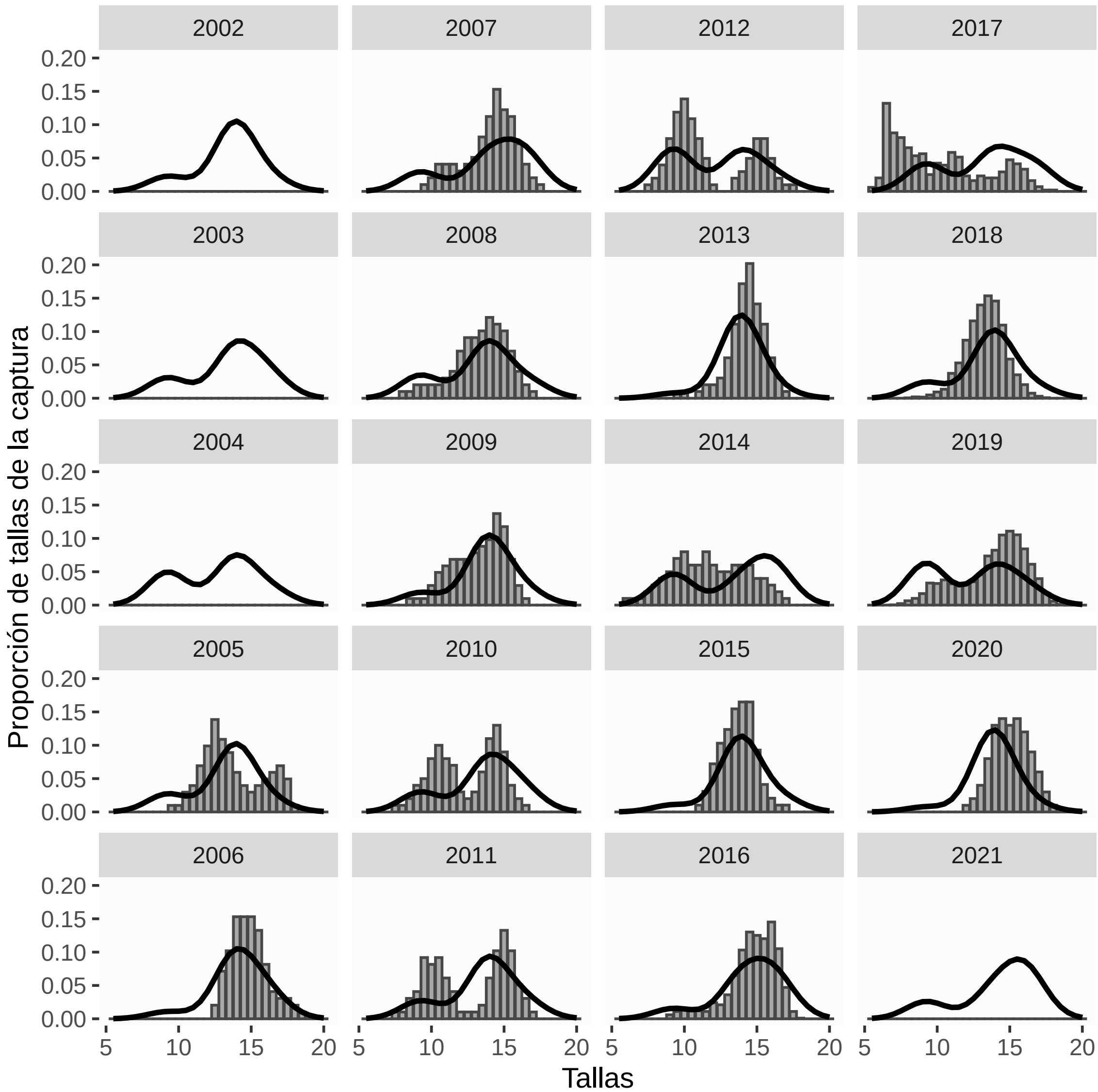


Biomasa_Crucero
CPUE
Desembarques
Residuales (escala log)
Año
Theoretical
Sample Quantiles
Asesoría
Septiembre 2020
Asesoría
Septiembre 2020

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

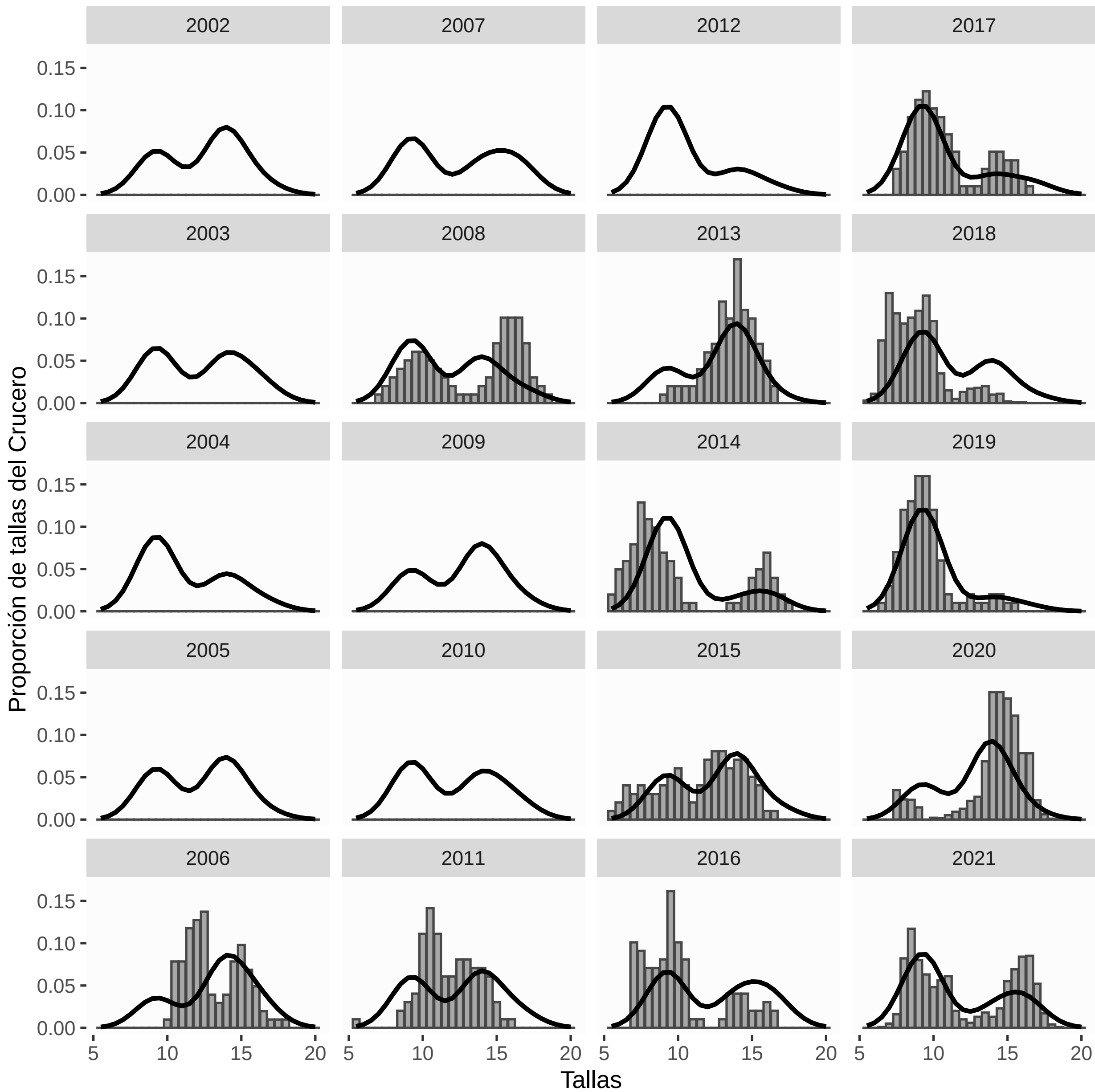
FLOTA

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

etf_obs_sept <- data.frame(rbind(rep0$pf_obs))
etf_pre_sept <- data.frame(rbind(rep0$pf_pred))

yearf   <- rep0$YRS
nyearf  <- length(yearf)

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


 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_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) +
        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
0.20
0.15
0.10
0.05
0.00
5
10
15
20
Proporción de tallas de la captura
Tallas

CRUCERO

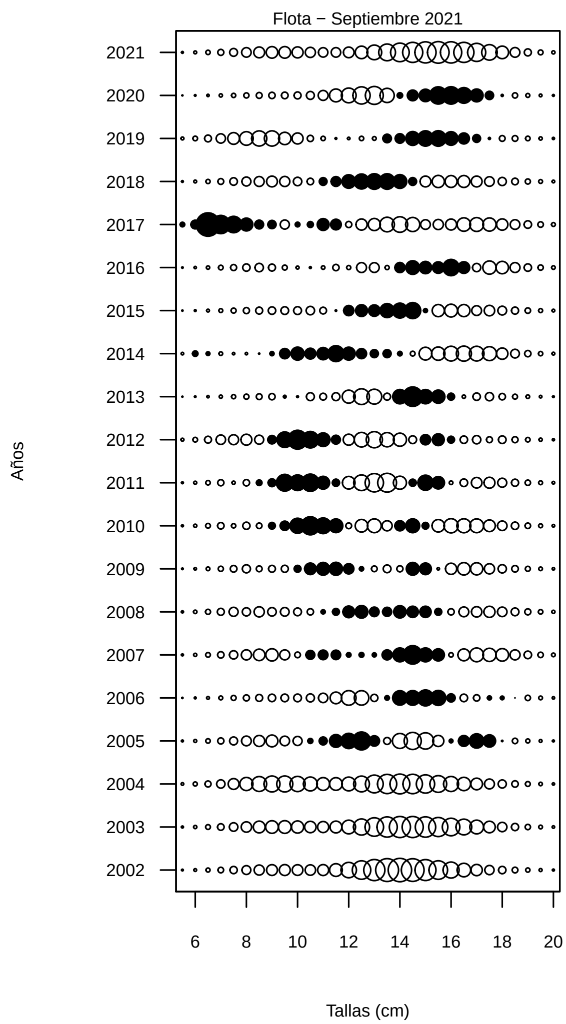
```r
###########################################################################################
# AREGLOS DE DATOS
###########################################################################################
age     <-seq(5.5,20,0.5)
nage    <-length(age)

etc_obs_sept <- data.frame(rbind(rep0$pobs_RECLAN))
etc_pre_sept <- data.frame(rbind(rep0$ppred_RECLAN))

yearc   <- rep0$YRS
nyearc  <-length(yearc)

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

 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_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) +
        theme(panel.background = element_rect(fill ="gray99")) +
        theme(panel.grid=element_line(color=NA))
 fig1
```

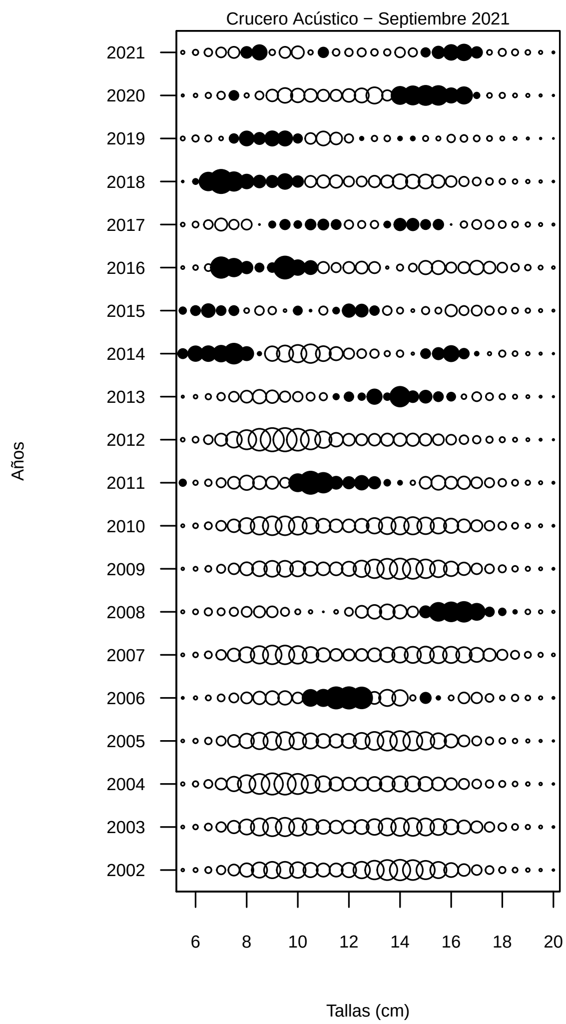

2002
2007
2012
2017
2003
2008
2013
2018
2004
2009
2014
2019
2005
2010
2015
2020
2006
2011
2016
2021
0.15
0.10
0.05
0.00
5
10
15
20
Proporción de tallas del Crucero
Tallas

3.4. Análisis de Residuales de Composiciones de tallas

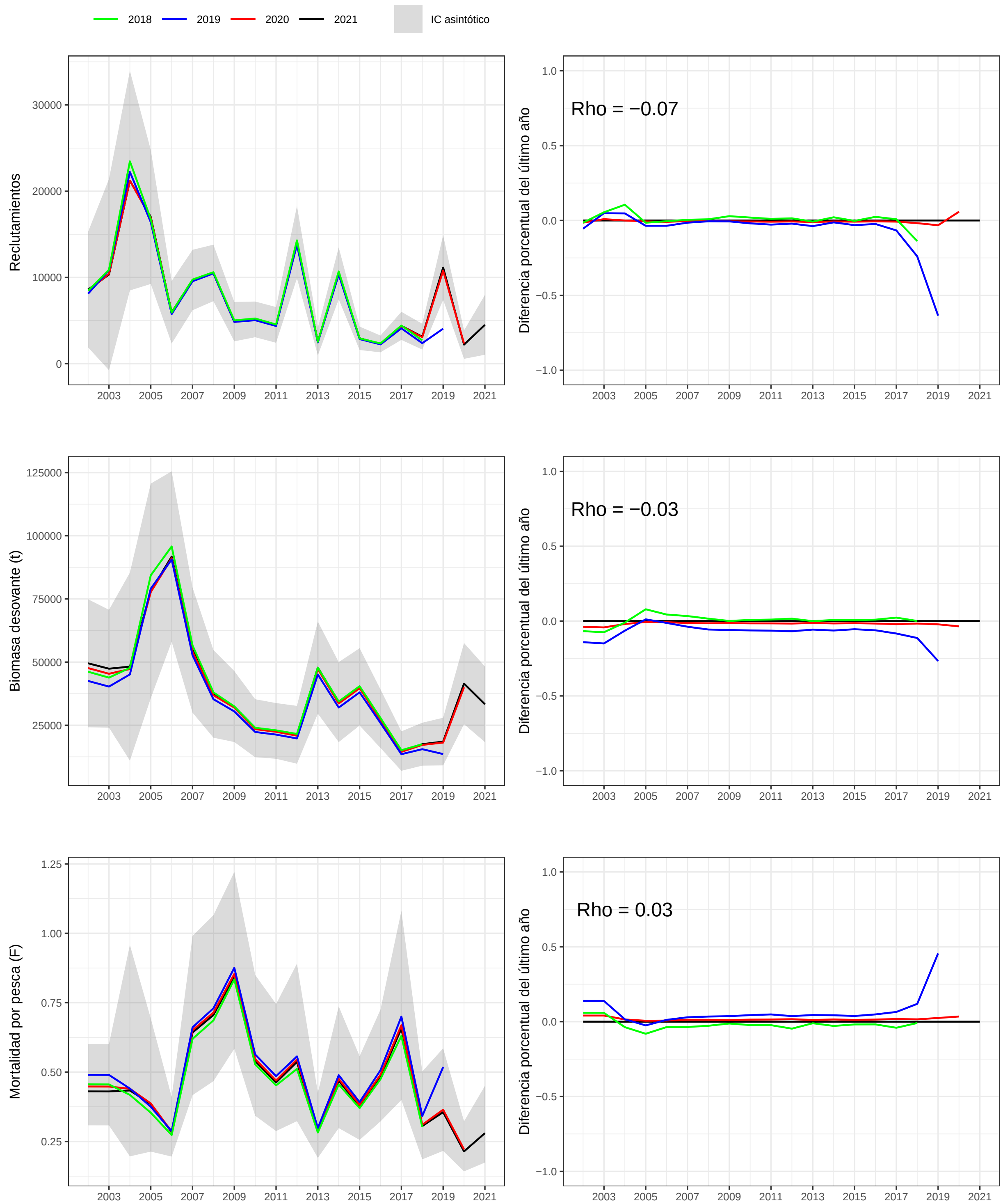
```r
par(mfcol=c(1,2))
#Flota
cx<-0.7
#####################################################################################
# Residuales Flota
#####################################################################################
anos        <-rep0$YRS
obsF_alt    <-rep0$pf_obs
preF_alt    <-rep0$pf_pred
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 - Septiembre 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 <-rep0$pobs_RECLAN
preB_alt <-rep0$ppred_RECLAN
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){
```

```r
    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 - Septiembre 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()
```



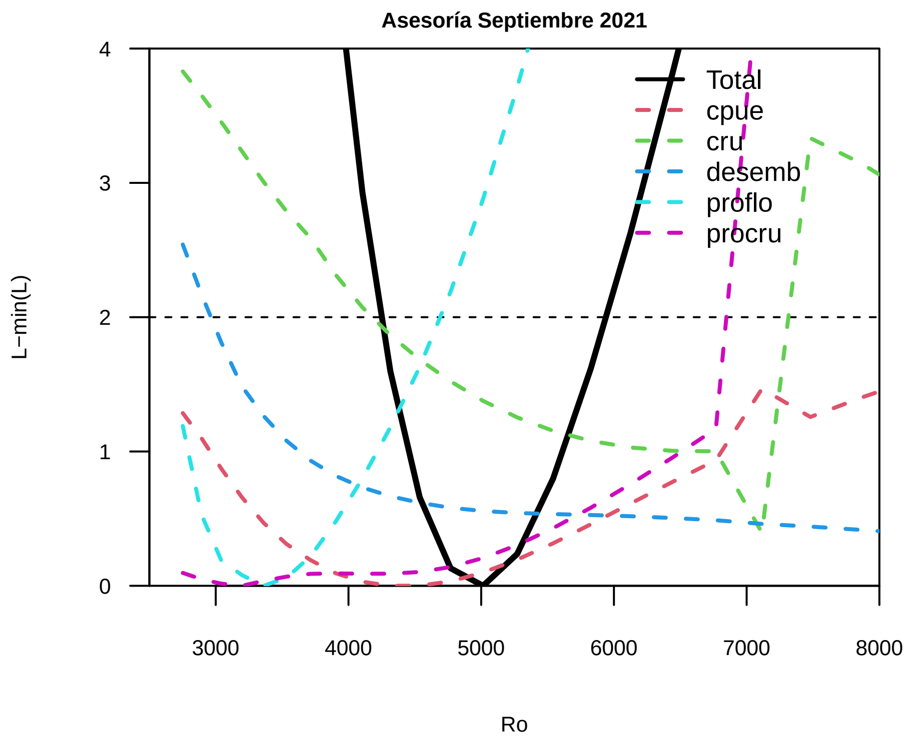


6.5. Análisis retrospectivo modelo alternativo



3.7. Perfil de verosimilitud

```
#######################################################################################
# AREGLOS DE DATOS
#######################################################################################
admb<-"MAT0921"
dir<-paste(dir.0,"/VerosimilitudBaseN_sept",sep="")
setwd(dir)
#######################################################################################
  casos <-36
  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[154])
    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", "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="Asesoría Septiembre 2021",cex.main=0.7,cex.axis=0.7,cex.lab=0.7)
  abline(h=2,col=1,lty=2)
   for(i in 2:6){
  lines(TLk2$Ro,TLk2[,i],col=i,lty=2,lwd=2)}
  legend(6000,4,names[c(11,2:6)],col=1:7,lty=c(1,rep(2,6)),
          lwd=2,bty="n",cex=0.8)
```

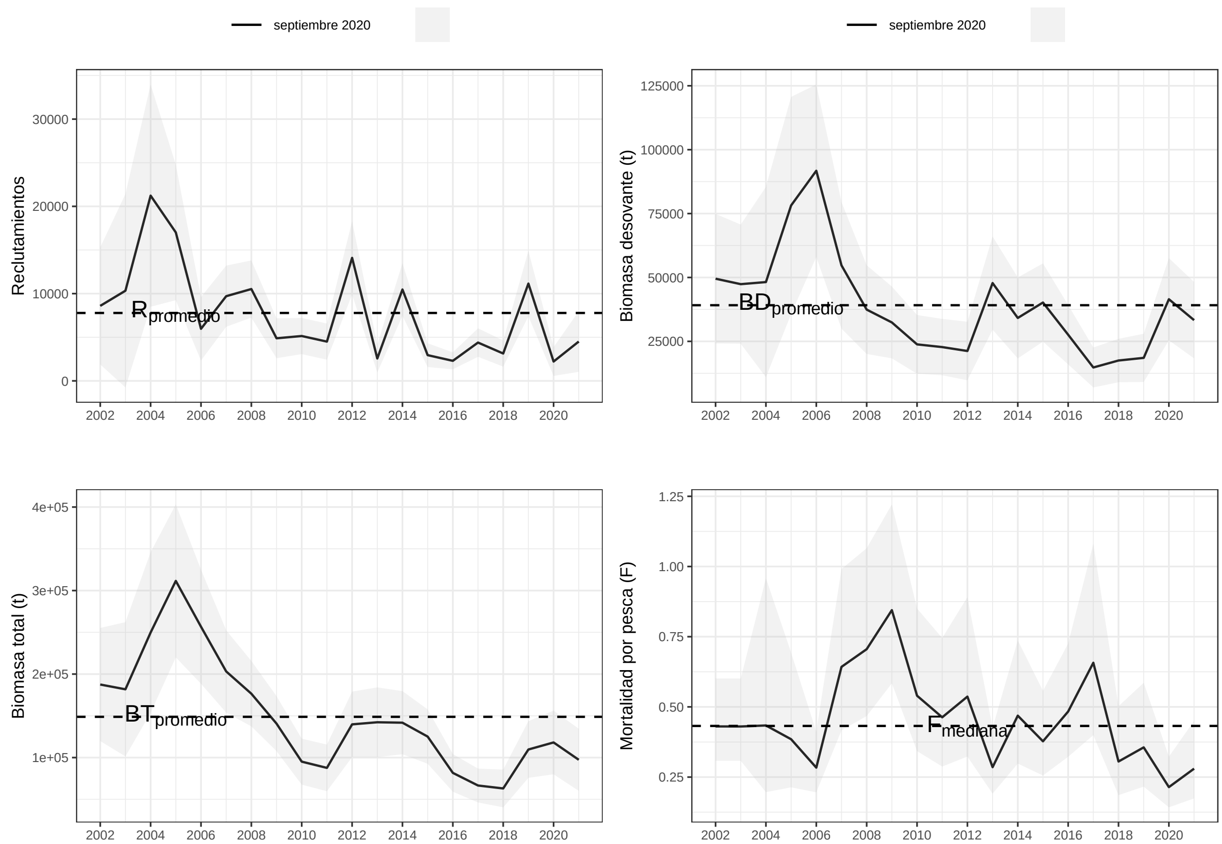


Asesoría Septiembre 2021
L−min(L)
Ro
0
1
2
3
4
3000
4000
5000
6000
7000
8000
Total
cpue
cru
desemb
proflo
procru

3.8. Sensibilidad a la actualización de datos

4. RESULTADOS OBJETIVO 2

4.1. Indicadores del stock




```r
Rt0_mean<-mean(VarPobSep$Rt0)
BT0_mean<-mean(VarPobSep$BT0)
BD0_mean<-mean(VarPobSep$BD0)

R15_18 <-mean(VarPobSep$Rt0[14:17])
BT16_18 <-mean(VarPobSep$BT0[15:17])
BT19_20 <-mean(VarPobSep$BT0[18:19])

rbind(Rt0_mean,BT0_mean,BD0_mean,R15_18,BT16_18,BT19_20)
```

```
##                 [,1]
## Rt0_mean    7783.045
## BT0_mean  148793.050
## BD0_mean   39140.600
## R15_18      3192.400
## BT16_18    70423.000
## BT19_20   113895.000
```

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

plot(data.0$Edades,rep0$Sflo_age[1,],type="l",las=1,col=4,ylim=c(0,1.1),
     ylab="Selectividad Flota",xlab="Edades",main="FLOTA")
lines(data.0$Edades,rep0$Sflo_age[9,],type="l",col=3)
lines(data.0$Edades,rep0$Sflo_age[nyears0,],type="l",col=2)
legend(4,0.3,c("sel_2002-2009","sel_2010-2012","sel_2013-2020"),
       col=c(4,3,2),lwd=c(1,1,1),cex=0.8,bty="n")


plot(data.0$Edades,rep0$Scru_age[1,],type="l",las=1,col=4,ylim=c(0,1.1),
     ylab="Selectividad Crucero",xlab="Edades",main="CRUCEROS")
lines(data.0$Edades,rep0$Scru_age[nyears0,],type="l",col=2)
legend(4,0.3,c("sel_2002-2012","sel_2013-2020"),
       col=c(4,2),lwd=c(1,1),cex=0.8,bty="n")
```

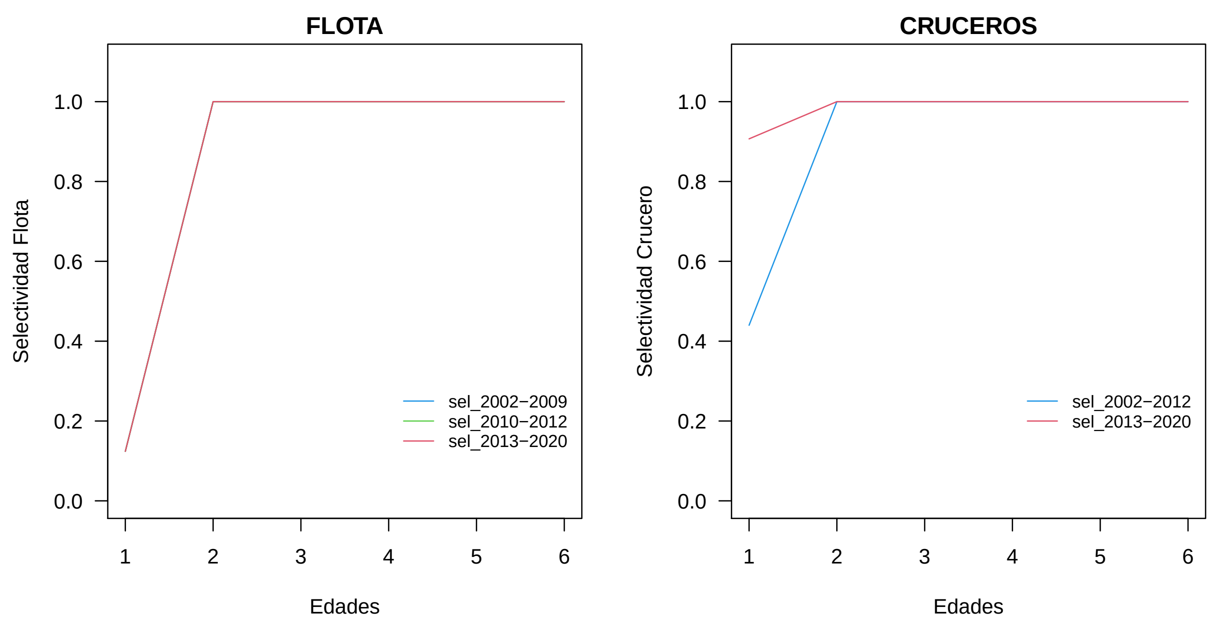


Tabla 13.
Indicadores poblacionales de sardina austral en aguas interiores de Chiloé. Tabla comparativa entre los resultados de la evaluación de septiembre (primer hito) y junio (segundo hito).

```
VarPobl0<- cbind(anos=rep0$YRS,
                 "BD_sep"=c(BD0),
                 "BT_sep"=c(BT0),
                 "R_sep"=c(round(Rt0,0)),
                 "F_sep"=c(round(exp(Ft0),2))
                 )
kable(VarPobl0)
```

anos	BD_sep	BT_sep	R_sep	F_sep
2002	49521	187500	8594	0.43
2003	47382	181770	10332	0.43
2004	48200	249770	21228	0.43
2005	78180	311580	17012	0.38
2006	91755	256720	5967	0.28
2007	54739	203150	9704	0.64
2008	37425	176500	10526	0.71
2009	32407	140660	4880	0.84
2010	23822	95121	5141	0.54
2011	22760	87651	4500	0.46
2012	21224	139790	14099	0.54
2013	47818	142290	2564	0.29
2014	34159	141790	10472	0.47
2015	40200	125150	2948	0.38
2016	27601	81693	2296	0.48
2017	14781	66542	4391	0.66
2018	17506	63034	3134	0.31
2019	18543	109670	11150	0.36
2020	41489	118120	2214	0.21
2021	33300	97360	4508	0.28

```
write.csv(VarPobl0, file="Tablas/TablaVarpob.csv")
```

4.2. Estados de explotación

```
#PBRs Modelo alternativo
BDo0    <- rep0$Bo
BRMS0   <- BDo0*0.55
BDlim0  <- BDo0*0.275
FRMS0   <- exp(subset(std0,name=="log_Fref")$value[3])
```

```
par(mfcol=c(1,2),mar=c(4,4,1,1)+0.5)
plot(rep0$Tallas,rep0$Selflo_talla[1,],type="l",las=1,col=4,
     ylab="Selectividad",xlab="Tallas (cm)")
lines(rep0$Tallas,rep0$Selflo_talla[9,],type="l",col=3)
lines(rep0$Tallas,rep0$Selflo_talla[nyears1,],type="l",col=2)
lines(rep0$Tallas,data.0$Madurez,lwd=2)
legend(13,0.3,c("bloque_sel1","bloque_sel2","bloque_sel3","Madurez"),
       col=c(4,3,2,1),lwd=c(1,1,1,2),cex=0.8,bty="n")

plot(PBRsb1[,1],PBRsb1[,4],type="l",ylab="%BDPR",xlab="Mortalidad por pesca (F)",lwd=1,las=1,col=4)
lines(PBRsb2[,1],PBRsb2[,4],col=3,lwd=1)
lines(PBRsb3[,1],PBRsb3[,4],col=2,lwd=1)
abline(h=0.6,col=1,lty=1)
abline(v=c(FRMSb1,FRMSb2,FRMSb3),col=c(4,3,2),lty=2)
    text(1.5,c(0.55,0.50,0.45),c("F60_sel1=0,33", "F60_sel2=0,26","F60_sel3=0,31"),cex=0.8,col=c(4,3,2))
```

```
yrs     <- rep0$YRS
nyrs    <- length(yrs)
tallas  <- seq(5,19.5,0.5)
ntallas <- length(tallas)
age     <- seq(0,4,1)
nage    <- length(age)

x  <-c(yrs,rev(yrs))
x1 <-c(yrs[1],yrs[nyrs]+1,nyrs+1/2) #xaxp
x2 <-c(yrs[1]-1,yrs[nyrs]+1) #xlim
years0    <-rep0$YRS


################################################
#modelo alternativo
################################################
Rpr0     <-subset(std0,name=="RPRrms")$value
Rpr0std  <-subset(std0,name=="RPRrms")$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)))


#####################################################################################
### *MODELO BASE*
#####################################################################################
# biomasa desovante vs BDrms
#####################################################################################
xbs1 <- rnorm(1000, mean = Rpr0[length(years0)],
                    sd = Rpr0std[length(years0)])
```

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

ybs  <- dnorm(xbs, mean = Rpr0[length(years0)],
                     sd = Rpr0std[length(years0)])

icbs <- qnorm(c(0.05,0.95,0.5),
             Rpr0[length(years0)],
             Rpr0std[length(years0)])

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(years0)],
                     sd = Frpr0std[length(years0)])

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

yfs  <-dnorm(xfs, mean = Frpr0[length(years0)],
                    sd = Frpr0std[length(years0)])

icfs <-qnorm(c(0.05,0.95,0.5),
             Frpr0[length(years0)],
             Frpr0std[length(years0)])

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]])))

#####################################################################################
### *Probabilidad de estar bajo BRMS*
#####################################################################################
# MALTERNATIVO
pa0<-pnorm(1,Rpr0[length(years0)],
             Rpr0std[length(years0)],
             lower.tail = TRUE,log.p = F)

#####################################################################################
### *Probabilidad de estar bajo FRMS*
#####################################################################################
# MALTERNATIVO
pb0<-1-pnorm(1,Frpr0[length(years0)],
               Frpr0std[length(years0)],
               lower.tail = TRUE,log.p = F)

#####################################################################################
### *Probabilidad de estar en zona de sobreexplotacion*
#####################################################################################
# MALTERNATIVO
```

```r
pc0<-pnorm(0.9,Rpr0[length(years0)],
               Rpr0std[length(years0)],
               lower.tail = TRUE,log.p = F)

#######################################################################################
### *Probabilidad de estar en zona de colapso*
#######################################################################################
# MALTERNATIVO
pd0<-pnorm(0.5,Rpr0[length(years0)],
               Rpr0std[length(years0)],
               lower.tail = TRUE,log.p = F)

#######################################################################################
### *Probailidad de sobrepesca*
#######################################################################################
# MALTERNATIVO
pe0<-1-pnorm(1.1,Frpr0[length(years0)],
                 Frpr0std[length(years0)],
                 lower.tail = TRUE,log.p = F)
```

```r
PBRs<-round(rbind("BD~0~"=c(BDo0)/1000,
                  "BD~RMS~"=c(BRMS0)/1000,
                  "BD~LIM~"=c(BDlim0)/1000,
                  "F~RMS~"=c(FRMS0),
                  "p(BD~2021~<BD~RMS)~"=round(c(pa0),2),
                  "p(F~2021~>F~RMS~)"=round(c(pb0),2),
                  "*p(sobreexplotación)*"=round(c(pc0),2),
                  "*p(agotado/colapsado)*"=round(c(pd0),2),
                  "*p(sobrepesca)*"=round(c(pe0),2)),3)

colnames(PBRs)<-c("Septiembre")
kable(PBRs)
```

	Septiembre
BD_0	59.815
$\mathrm{BD}_{\mathrm{RMS}}$	32.898
$\mathrm{BD}_{\mathrm{LIM}}$	16.449
$\mathrm{F}_{\mathrm{RMS}}$	0.299
$\mathrm{p(BD}_{2021}\mathrm{<BD}_{\mathrm{RMS)}}$	0.470
$\mathrm{p(F}_{2021}\mathrm{>F}_{\mathrm{RMS}}\mathrm{)}$	0.390
p(sobreexplotación)	0.260
p(agotado/colapsado)	0.000
p(sobrepesca)	0.240

```r
write.csv(PBRs, file="Tablas/PBRs.csv")
```

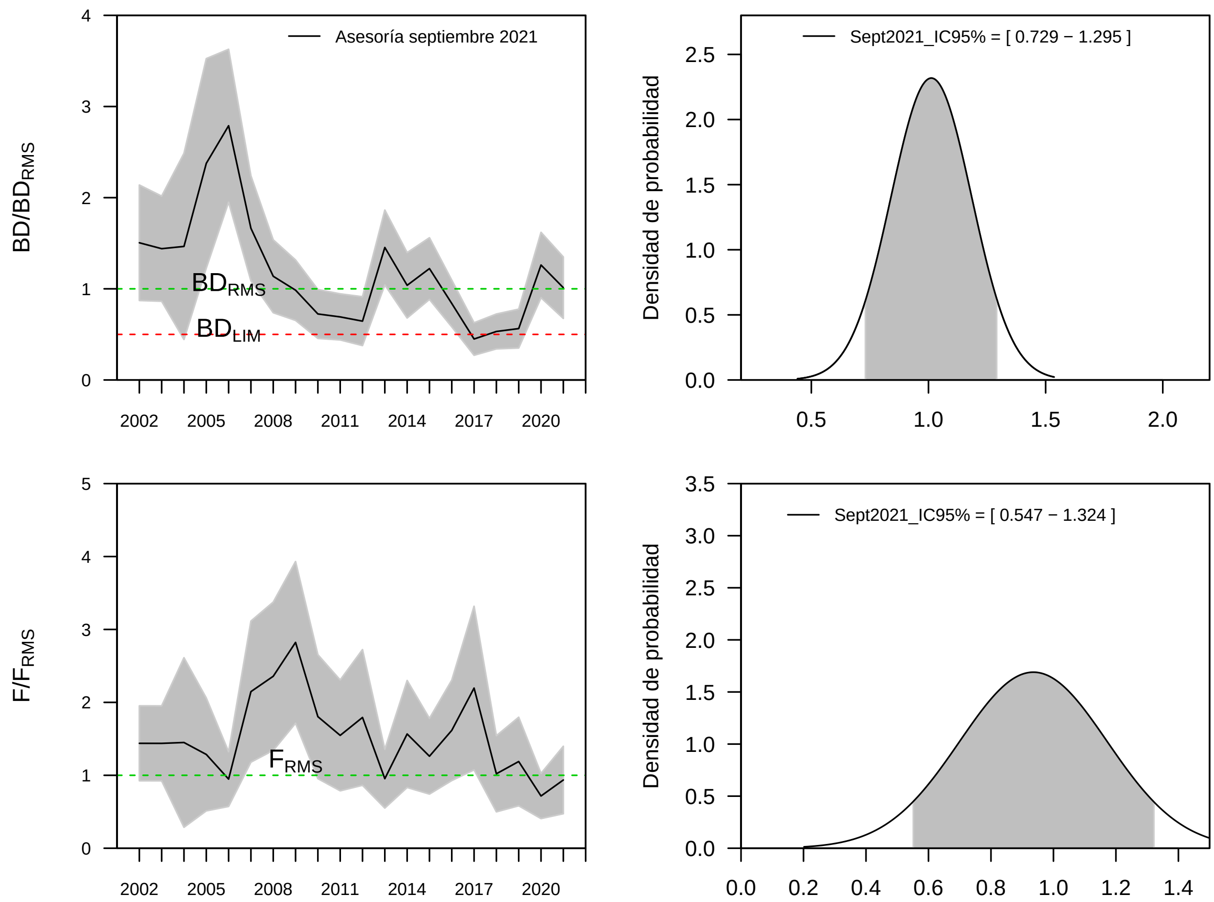


Tabla 15.

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).

```
VarPobl0<- cbind(anos=rep0$YRS,
                 "F/F~RMS~**S**"=c(round(exp(Ft0)/FRMS0,3)),
                 "BD/BD~RMS~**S**"=c(round(BD0/BRMS0,3)),
                 "Y/BT_**S**"=c(round(rep0$desemb_pred/BT0,3)))
kable(VarPobl0)
```

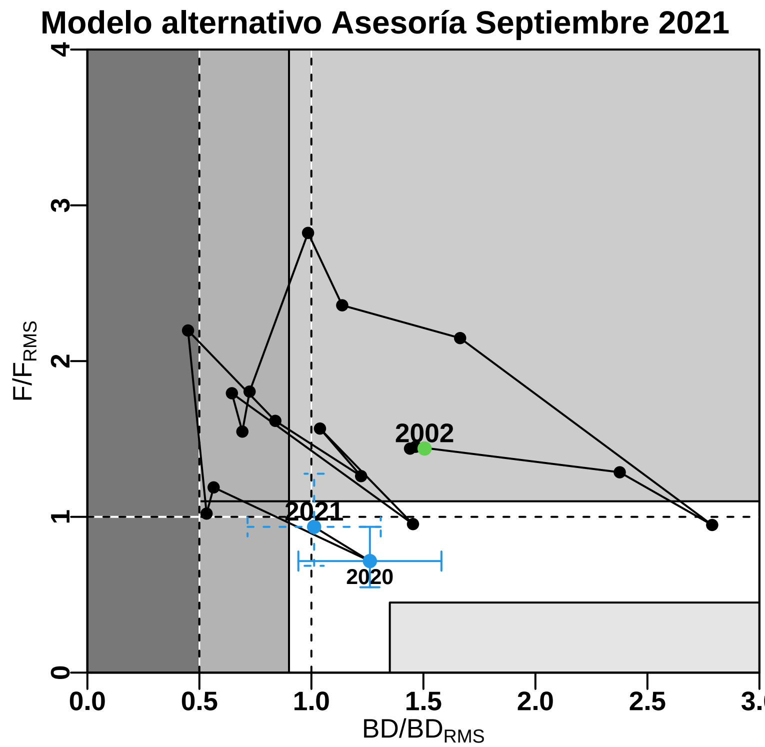
anos	F/F_{RMS}**S**	BD/BD_{RMS}**S**	Y/BT_**S**
2002	1.439	1.505	0.189
2003	1.438	1.440	0.175
2004	1.450	1.465	0.142
2005	1.286	2.376	0.162
2006	0.948	2.789	0.151
2007	2.148	1.664	0.257
2008	2.358	1.138	0.255
2009	2.823	0.985	0.341
2010	1.804	0.724	0.215
2011	1.547	0.692	0.194
2012	1.794	0.645	0.147
2013	0.954	1.454	0.156
2014	1.567	1.038	0.166
2015	1.262	1.222	0.193

anos	F/F_{RMS}**S**	BD/BD_{RMS}**S**	Y/BT_**S**
2016	1.616	0.839	0.232
2017	2.196	0.449	0.231
2018	1.021	0.532	0.137
2019	1.189	0.564	0.103
2020	0.716	1.261	0.120
2021	0.936	1.012	0.130

```
write.csv(VarPobl0, file="Tablas/Estatus.csv")
```

Diagramas de Fase

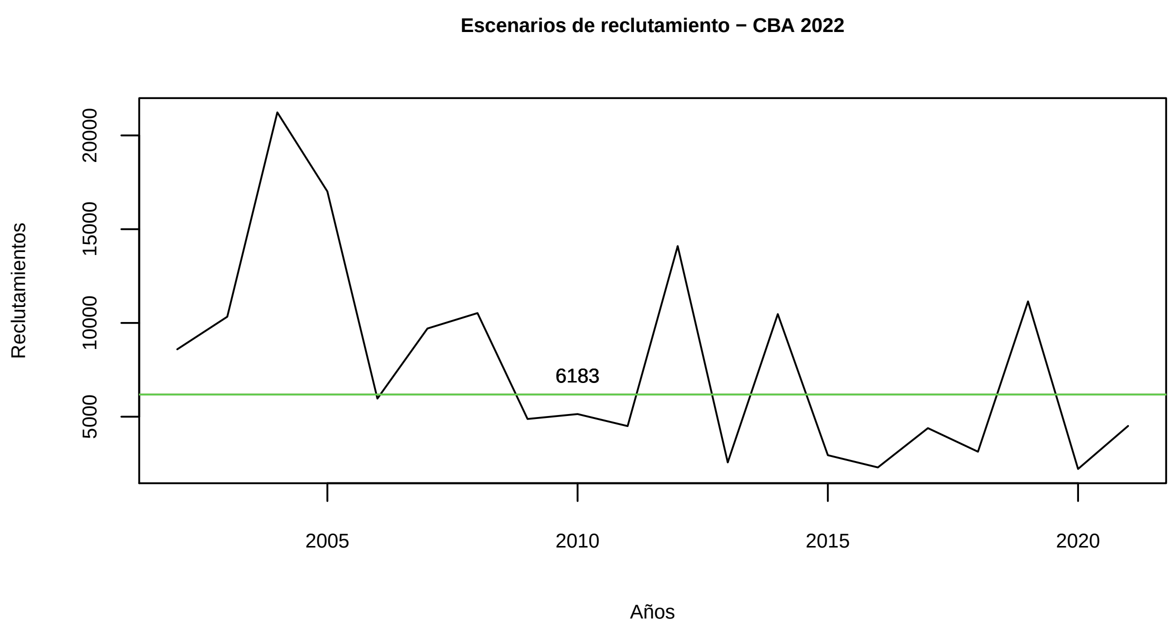
```
source(paste(getwd(),"/funciones/Fn_DiagramaFase.R",sep=""))
name0<-"Modelo alternativo Asesoría Septiembre 2021"

years0<-rep0$YRS
SSBt0         <- subset(std0,name=="BD")$value
SSBt0std      <- subset(std0,name=="BD")$std
Ft0           <- subset(std0,name=="log_F")$value
Ft0std        <- subset(std0,name=="log_F")$std
BDo0    <- rep0$Bo
BRMS0   <- BDo0*0.55
FRMS0   <- exp(subset(std0,name=="log_Fref")$value[3])

DiagramaFase(name0,FRMS0,BRMS0,SSBt0,SSBt0std,Ft0,Ft0std,years0)
#cruz del año previo
lastB0    <- SSBt0[nyears0-1]/BRMS0
lastB    <- SSBt0[nyears0-1]
lastF    <- exp(Ft0[nyears0-1])/FRMS0
# Calculate confidence intervals
Qmult    <- -qnorm((1-(80/100))/2.0)
sbSE     <- SSBt0std[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)
arrows(x0=lastB0,
       y0=F95[1],
       x1=lastB0,
       y1=F95[2],
       length=0.05,angle=90,col=4,lwd=1,code=3)

points(lastB0,lastF,pch=19,col=4)
text(lastB0,lastF-0.1,years0[nyears0-1],cex=0.8)
```



Modelo alternativo Asesoría Septiembre 2021
F/F_RMS
BD/BD_RMS
0
1
2
3
4
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2002
2021
2020

5. RESULTADOS OBJETIVO 3

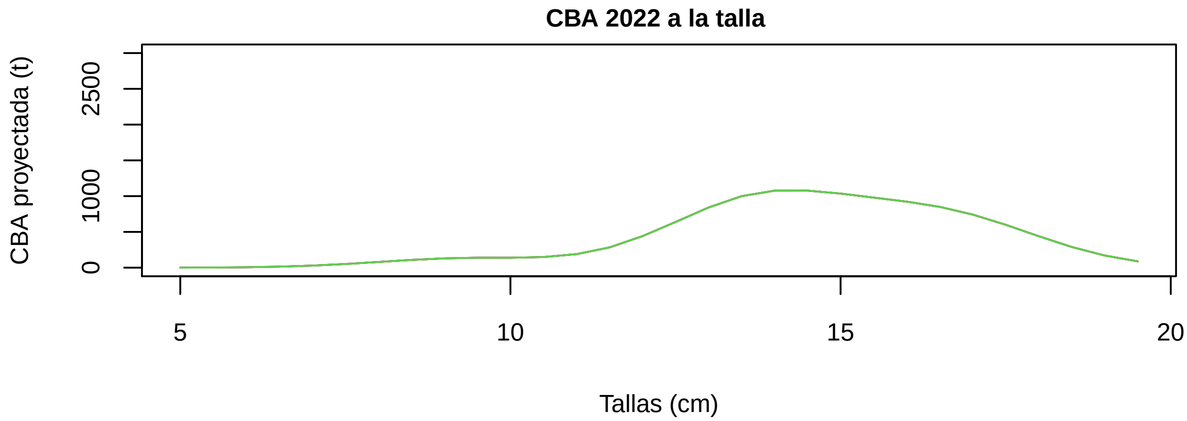
```
##########################################################
dira<-paste(dir.0,"/cba_septiembre2021",sep="")
setwd(dira)
reps1a     <- reptoRlist("MAT0921s1.rep")
reps2a     <- reptoRlist("MAT0921s2.rep")
reps3a     <- reptoRlist("MAT0921s3.rep")

# modelo alternativo
plot(reps1a$YRS,reps1a$Reclutas,type="l",ylab="Reclutamientos",xlab="Años",main="Escenarios de reclutamiento - CBA
abline(h=c(reps1a$Rproy,reps2a$Rproy,reps3a$Rproy),col=c(1,2,3))
text(2010,c(reps1a$Rproy,reps2a$Rproy,reps3a$Rproy)+1000,round(c(reps1a$Rproy,reps2a$Rproy,reps3a$Rproy),0),cex=0.7
```

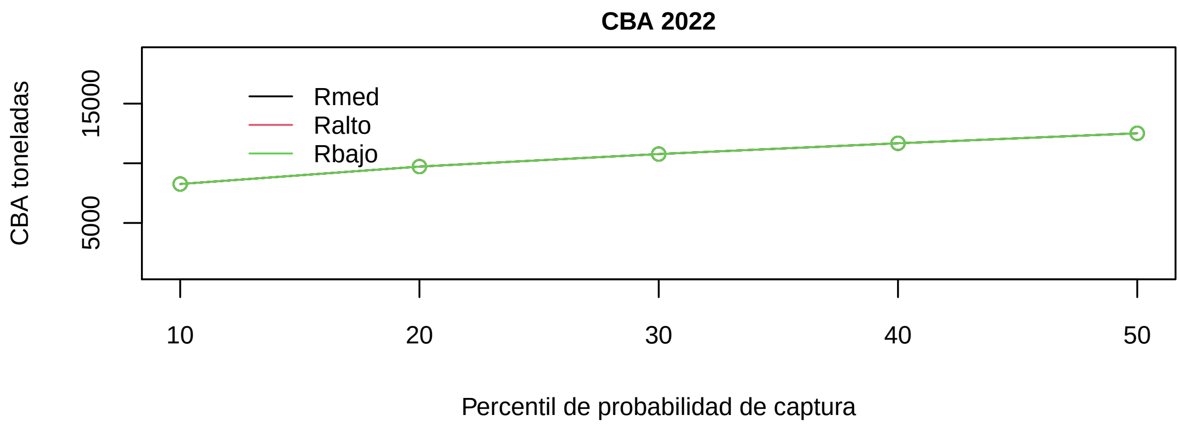



```
dir<-paste(dir.0,"/cba_septiembre2021",sep="")
admb<-"/MAT0921"

stds1a     <- read.table(paste(dir,admb,"s1.std", sep=''),header=T,sep="",na="NA",fill=T)
stds2a     <- read.table(paste(dir,admb,"s2.std", sep=''),header=T,sep="",na="NA",fill=T)
stds3a     <- read.table(paste(dir,admb,"s3.std", sep=''),header=T,sep="",na="NA",fill=T)

cbas1a     <- subset(stds1a ,name=="CBAp")$value[3]
cbas1astd  <- subset(stds1a ,name=="CBAp")$std[3] #reclutamiento medios
cbas2a     <- subset(stds2a ,name=="CBAp")$value[3]
cbas2astd  <- subset(stds2a ,name=="CBAp")$std[3] #reclutamiento medios
cbas3a     <- subset(stds3a ,name=="CBAp")$value[3]
cbas3astd  <- subset(stds3a ,name=="CBAp")$std[3] #reclutamiento medios

q       <- seq(0.1,0.5,0.1)  # niveles de riesgo (cuantiles)
nq      <- length(q)
CBAs1a     <- rep(0,nq)
CBAs2a     <- rep(0,nq)
CBAs3a   <- rep(0,nq)
```

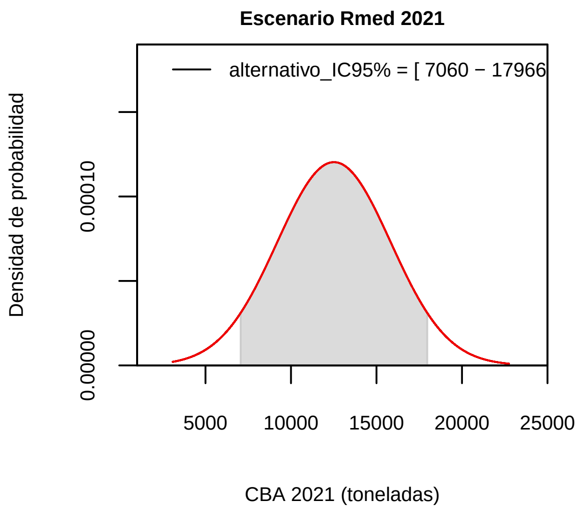
```r
buffer1a   <- rep(0,nq)
buffer2a   <- rep(0,nq)
buffer3a   <- rep(0,nq)

for(j in 1:nq){
  CBAs1a[j]<-qnorm(q[j],cbas1a,cbas1astd )
  CBAs2a[j]<-qnorm(q[j],cbas2a,cbas2astd )
  CBAs3a[j]<-qnorm(q[j],cbas3a,cbas3astd )
  }
for(j in 1:nq){
    buffer1a[j] <-round(1-CBAs1a[j]/CBAs1a[5],2)
    buffer2a[j] <-round(1-CBAs2a[j]/CBAs2a[5],2)
    buffer3a[j] <-round(1-CBAs3a[j]/CBAs3a[5],2)
  }

tCBA1<-cbind(percentil=c(seq(10,50,10)),CBA_Rmed=round(CBAs1a,0),CBA_Ralto=round(CBAs2a,0),CBA_Rbajo=round(CBAs3a,0
#kable((tCBA1))
tCBA2<-cbind(percentil=c(seq(10,50,10)),CBA_Ralto=round(CBAs2a,0),Resguardo=buffer2a)
#kable((tCBA2))
tCBA3<-cbind(percentil=c(seq(10,50,10)),CBA_Rbajo=round(CBAs3a,0),Resguardo=buffer3a)
#kable((tCBA3))
```

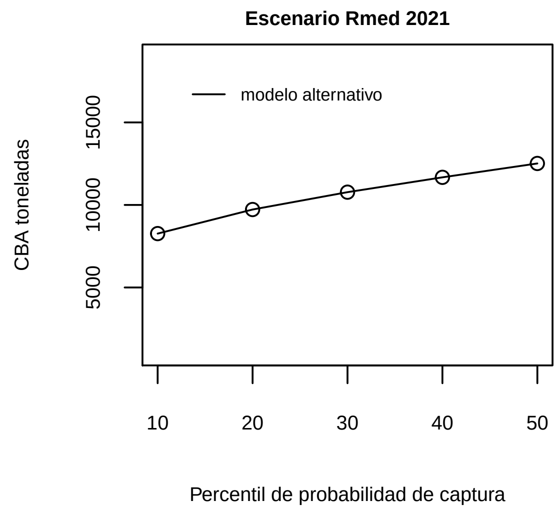
```r
dira<-paste(dir.0,"/cba_septiembre2021",sep="")
setwd(dira)
reps1a     <- reptoRlist("MAT0921s1.rep")
reps2a     <- reptoRlist("MAT0921s2.rep")
reps3a     <- reptoRlist("MAT0921s3.rep")


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

plot(tallas,reps1a$CTPp,type="l",ylim=c(0,3000),main="CBA 2022 a la talla ",
     ylab="CBA proyectada (t)",xlab="Tallas (cm)",cex.axis=0.8,cex.main=0.8,cex.lab=0.8)
lines(tallas,reps2a$CTPp,col=2)
lines(tallas,reps3a$CTPp,col=3)

plot(seq(10,50,10),CBAs1a,type="o", ylab="CBA toneladas",xlab="Percentil de probabilidad de captura",main="CBA 2022
lines(seq(10,50,10),CBAs1a,type="o",col=1)
lines(seq(10,50,10),CBAs2a,type="o",col=2)
lines(seq(10,50,10),CBAs3a,type="o",col=3)
legend(12,18000,c("Rmed","Ralto","Rbajo"),col=c(1,2,3),lwd=1,bty="n",cex=0.8)
```






```r
### *modelo altarnativo*
xca1 <-rnorm(1000, mean = cbas1a, sd = cbas1astd)
xca  <-seq(min(xca1),max(xca1),0.5)
yca  <-dnorm(xca, mean = cbas1a, sd =cbas1astd)
icca <-qnorm(c(0.05,0.95,0.5),cbas1a,cbas1astd)
xxca <-c(xca[xca>=icca[1]&xca<=icca[2]],rev(xca[xca>=icca[1]&xca<=icca[2]]))
yyca <-c(yca[xca>=icca[1]&xca<=icca[2]],rep(0,length(yca[xca>=icca[1]&xca<=icca[2]])))

par(mfcol=c(1,2),mar=c(4,4,1,1)+0.5)
plot(xca,yca,type="l",ylab="Densidad de probabilidad",xaxs="i",yaxs= "i",ylim=c(0,0.00019),xlim=c(1000,25000),xlab=
polygon(xxca,yyca,col=gray(0.8,0.7),border="gray80")
lines(xca,yca,lwd=1,col="red2",lty=1)
legend(2000,0.00019,c(paste("alternativo_IC95% = [",round(icca[1],0),"-",round(icca[2],0),"]",sep=" ")), lty=c(1,1)
box()

plot(seq(10,50,10),CBAs1a,type="o", ylab="CBA toneladas",xlab="Percentil de probabilidad de captura",main="Escenari
legend(12,18000,c("modelo alternativo"),col=c(1,2),lwd=1,bty="n",cex=0.6)
```


Escenario Rmed 2021
alternativo_IC95% = [7060 − 17966
Densidad de probabilidad
0.00000
0.00010
5000
10000
15000
20000
25000
CBA 2021 (toneladas)


Escenario Rmed 2021
modelo alternativo
CBA toneladas
5000
10000
15000
10
20
30
40
50
Percentil de probabilidad de captura