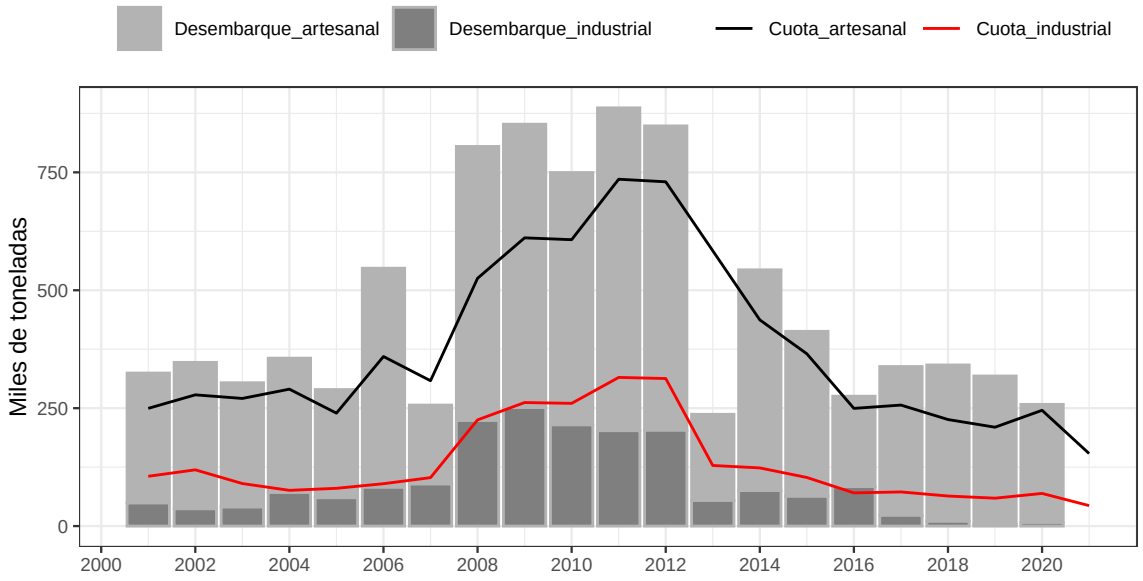
Figuras y Tablas para Tercer Informe de sardina común Centro sur

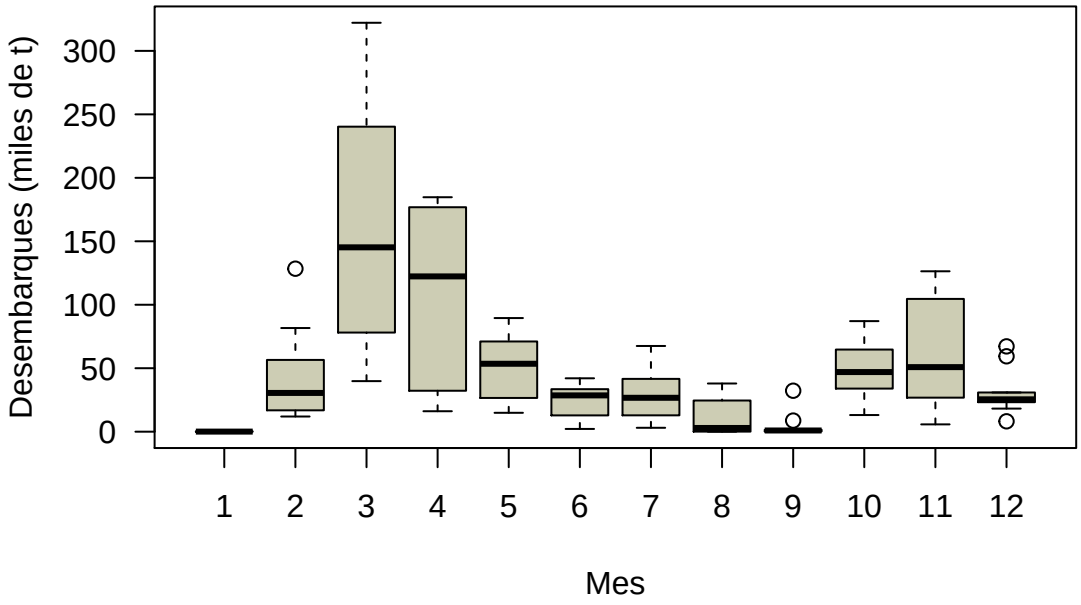
# 1. ANTECEDENTES

```
years<-seq(1990,2020,1)
dataDesem  <- ant$des_oficialesvscorregidos
Tdesem  <- data.frame(years,dataDesem[,1:2],rep(median(dataDesem[,2]),length(dataDesem[,2])))
colnames(Tdesem) <- c("Years",
                      "Desembarques_oficiales",
                      "Desembarques_oficales_corregidos",
                      "Mediana_desembarques_corregidos")

des_Of_corr <- data.frame(Tdesem) %>% mutate(Registros="desembarques") %>% melt(id.var=c("Years","Registros"))

ggplot(des_Of_corr)+
  geom_line(aes(Years,value/1000,colour=variable))+
  annotate("text", x=2011, y=(round(median(Tdesem[,3]),0)/1000)+30,
  label=paste(round(median(Tdesem[,3]/1000),0),"mil toneladas"))+
  scale_colour_manual(values=c('blue',"black","red")) +
  labs(x = '', y = 'Desembarques (miles de toneladas)',colour="") +
  scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 2)) +
  theme_bw(base_size=9) +
  theme(plot.title = element_text(hjust = 0.5),legend.position="top")
```

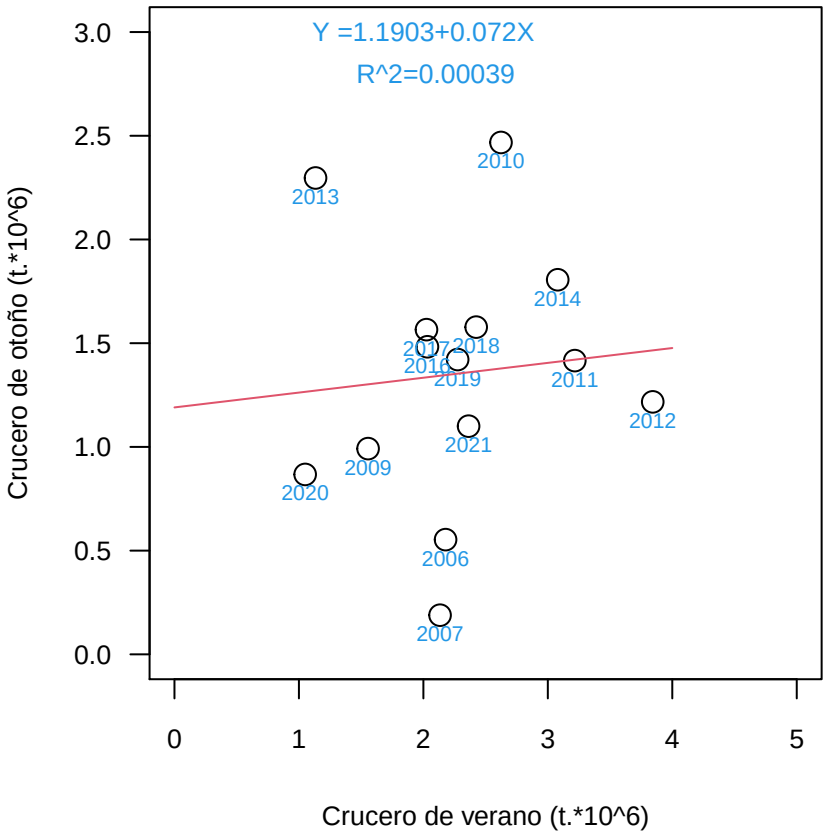
```r
dataDesem2  <- data.frame(ant$year_cuota,ant$des_art,ant$des_ind)
colnames(dataDesem2) <- c("Years",
                          "Desembarque_artesanal",
                          "Desembarque_industrial")

dataDesem3  <- data.frame(ant$year_cuota,
                          ant$cuot_art,
                          ant$cuot_ind)

colnames(dataDesem3) <- c("Years",
                          "Cuota_artesanal",
                          "Cuota_industrial")

des_art_ind   <- data.frame(dataDesem2) %>%
                          mutate(Registros="desembarques") %>%
                          melt(id.var=c("Years","Registros"))

cuota_art_ind <- data.frame(dataDesem3) %>%
                           mutate(Registros=c("cuotas")) %>%
                           melt(id.var=c("Years","Registros"))

ggplot(des_art_ind)+
  geom_bar(aes(x=Years, y =value/1000,fill=variable), stat="identity",color = 'gray70') +
  geom_line(data = cuota_art_ind, aes(x = Years, y = value/1000, colour=variable)) +
  scale_fill_manual(values=c('gray70',"gray50")) +
  scale_color_manual(values=c('black',"red")) +
  labs(x = '', y = 'Miles de toneladas',fill="",color="") +
  scale_x_continuous(breaks = seq(from = 2000, to = 2020, by = 2)) +
  theme_bw(base_size=8.9) +
  theme(plot.title = element_text(hjust = 0.5),legend.position="top")
```



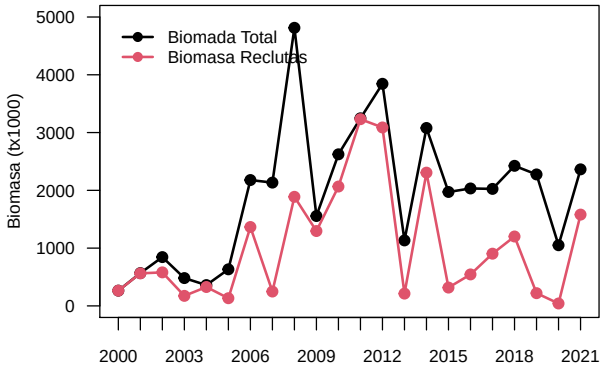
```r
ano<-ant$desembarques_sernapesca[,1]
des_mes<-data.frame(mes=rep(seq(1,12,1),27),ano=gl(27,12,labels=ano),desem=c(t(ant$desembarques_sernapesca[,2:13])))

par(mfcol=c(1,1),mar=c(4,4,1,1))
boxplot(des_mes$desem[145:264]/10^3~des_mes$mes[145:264],las=1,xlab="Mes",
    ylab="Desembarques (miles de t)",col="lightyellow3")
```

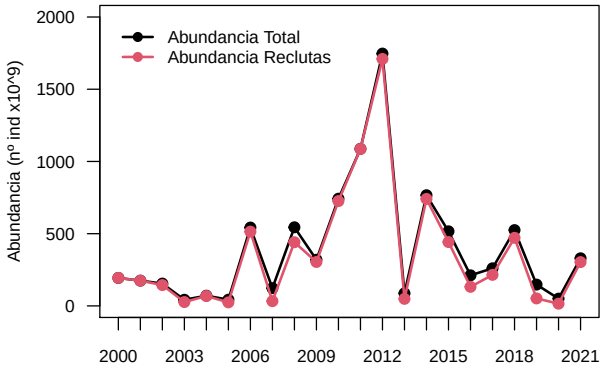


```
x<-rep3$reclasobs[rep3$reclasobs>0&rep3$pelacesobs>0]/10^6
y<-rep3$pelacesobs[rep3$reclasobs>0&rep3$pelacesobs>0]/10^6
years<-rep3$years

par(mar=c(4,4,1,1))
plot(x,y,las=1,cex=1.5,xlab="Crucero de verano (t.*10^6)",ylab="Crucero de otoño (t.*10^6)",xlim=c(0,5),ylim=c(0,3),cex.lab=0.8,
text(x,y-0.09,years[rep3$reclasobs>0&rep3$pelacesobs>0],cex=0.7,col=4)

model0<-lm(y~x)
y0<-predict(model0,data.frame(x=seq(0,4,0.1)),interval="prediction",level = 0.98)
lines(seq(0,4,0.1),y0[,1],col=2)
#summary(model0)
text(2,3,paste("Y =",round(model0$coefficients[1],4),"+",round(model0$coefficients[2],3),"X",sep=""),col=4,cex=0.8)
text(2.1,2.8, "R^2=0.00039",col=4,cex=0.8)
```



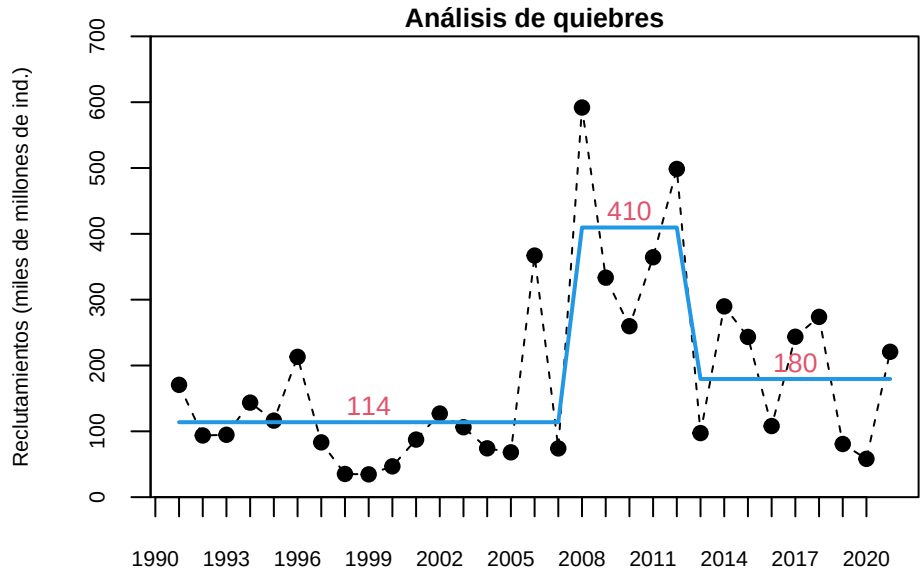
```
anorecl<-ant$reclas_BT_BR_AT_AR[,1]
BTreclas<-ant$reclas_BT_BR_AT_AR[,2]
BRreclas<-ant$reclas_BT_BR_AT_AR[,3]
ATreclas<-ant$reclas_BT_BR_AT_AR[,4]
ARreclas<-ant$reclas_BT_BR_AT_AR[,5]
anopela<-ant$pelaces_BT_AT[,1]
BTpela<-ant$pelaces_BT_AT[,2]
ATpela<-ant$pelaces_BT_AT[,3]

par(mfcol=c(1,2),mar=c(4,4,1,1))
plot(anorecl,BTreclas/1000,ylim=c(0,5000),xaxp=c(2000,2021,21),las=1,ylab="Biomasa (tx1000)",xlab="",type="o",pch=19,col=1,lwd=2
lines(anorecl,BRreclas/1000,type="o",pch=19,col=2,lwd=2)
legend(2000, 5000,c("Biomada Total","Biomasa Reclutas"),pch=19,lwd=2,col=c(1,2),bty="n",cex=0.8)

plot(anorecl,ATreclas/1000,ylim=c(0,2000),xaxp=c(2000,2021,21),las=1,ylab="Abundancia (nº ind x10^9)",xlab="",type="o",pch=19,co
lines(anorecl,ARreclas/1000,type="o",pch=19,col=2,lwd=2)
legend(2000, 2000,c("Abundancia Total","Abundancia Reclutas"),pch=19,lwd=2,col=c(1,2),bty="n",cex=0.8)
```



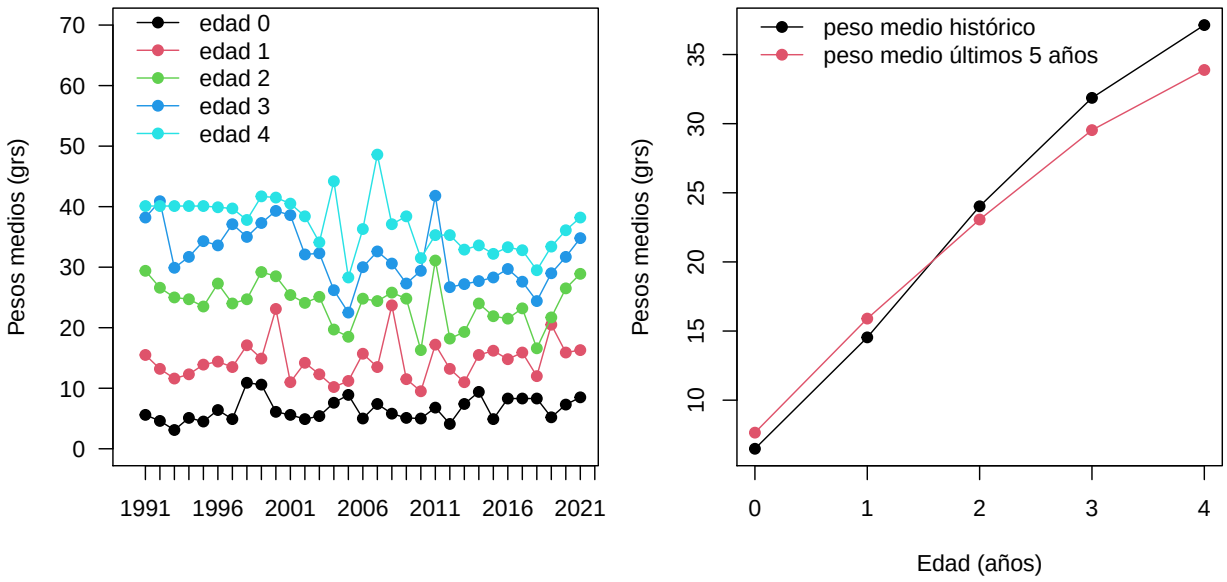



# 2. METODOLOGÍA

```
library(strucchange)
years     <- rep3$years
nyears    <- length(years)
bp.nile   <- breakpoints(rep3$Reclutas/1000 ~ 1)
fm0       <- lm(rep3$Reclutas/1000 ~ 1)
fm1       <- lm(rep3$Reclutas/1000 ~ breakfactor(bp.nile, breaks = 2))
quiebres3 <- fitted(fm1)

par(mfrow=c(1,1),mar=c(2,4,1,1))
plot(years,rep3$Reclutas/1000,type="l",lty=2,pch=19,ylim=c(0,700),
     xaxp=c(1990,2020,30),yaxs="i",xlab="",ylab="Reclutamientos (miles de millones de ind.)",main="Análisis de quiebres",cex.mai
points(years,rep3$Reclutas/1000,col=1,pch=19)
lines(years,quiebres3,lwd=2,col=4)
text(c(1999,2010,2017),c(fitted(fm1)[1],fitted(fm1)[18],fitted(fm1)[23])+25,round(c(fitted(fm1)[1],fitted(fm1)[18],fitted(fm1)[2
```



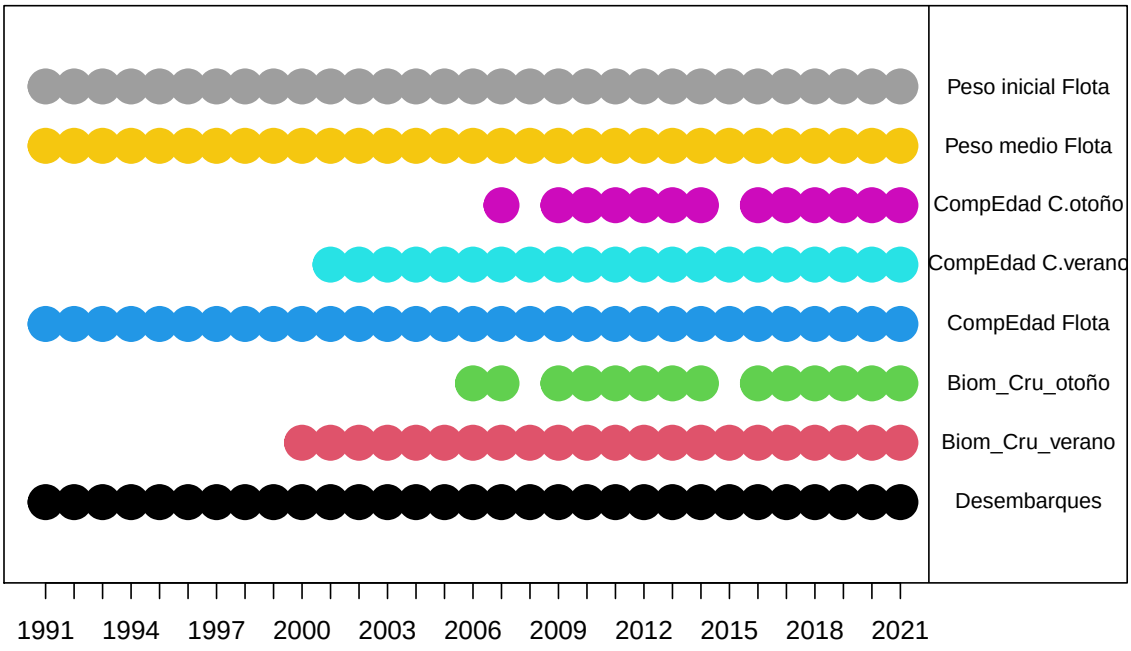
```r
years3  <-rep3$years
nyears3 <-length(years3)
age     <-seq(0,4,1)
nage    <-length(age)
pobsF   <-rep3$pf_obs

#Proporcion observada
WmedF <-dat3$Wmed
WiniF <-dat3$Wini
#Proporciones
Wm    <-c(WmedF); Wm[Wm==0]  <-NA
Wi    <-c(WiniF); Wi[Wi==0]  <-NA

x1 <-c(years3[1],years3[nyears3]+1,nyears3+1/2)
#Proporci?n de edad
par(mar=c(4,4,2,1),mfrow=c(1,2))
# pesos medios
plot(years3,WmedF[,1],type="n",las=1,ylim=c(0,70),xlim=c(1990,years3[nyears3]),ylab="Pesos medios (grs)",xlab="",xaxp=x1,main="
for(i in 1:5){
lines(years3,WmedF[,i],col=i,type="o", pch=19)}
legend(1990,75,c("edad 0","edad 1","edad 2","edad 3","edad 4"),pch=19,lwd=1,col=1:5,bty="n")


plot(age,colMeans(WmedF),type="o",pch=19,ylab="Pesos medios (grs)",xlab="Edad (años)")
lines(age,colMeans(WmedF[(nyears3-5):nyears3,]),col=2,type="o",pch=19)
legend(0,39,c("peso medio histórico","peso medio últimos 5 años"),pch=19,lwd=1,col=c(1,2),bty="n")
```



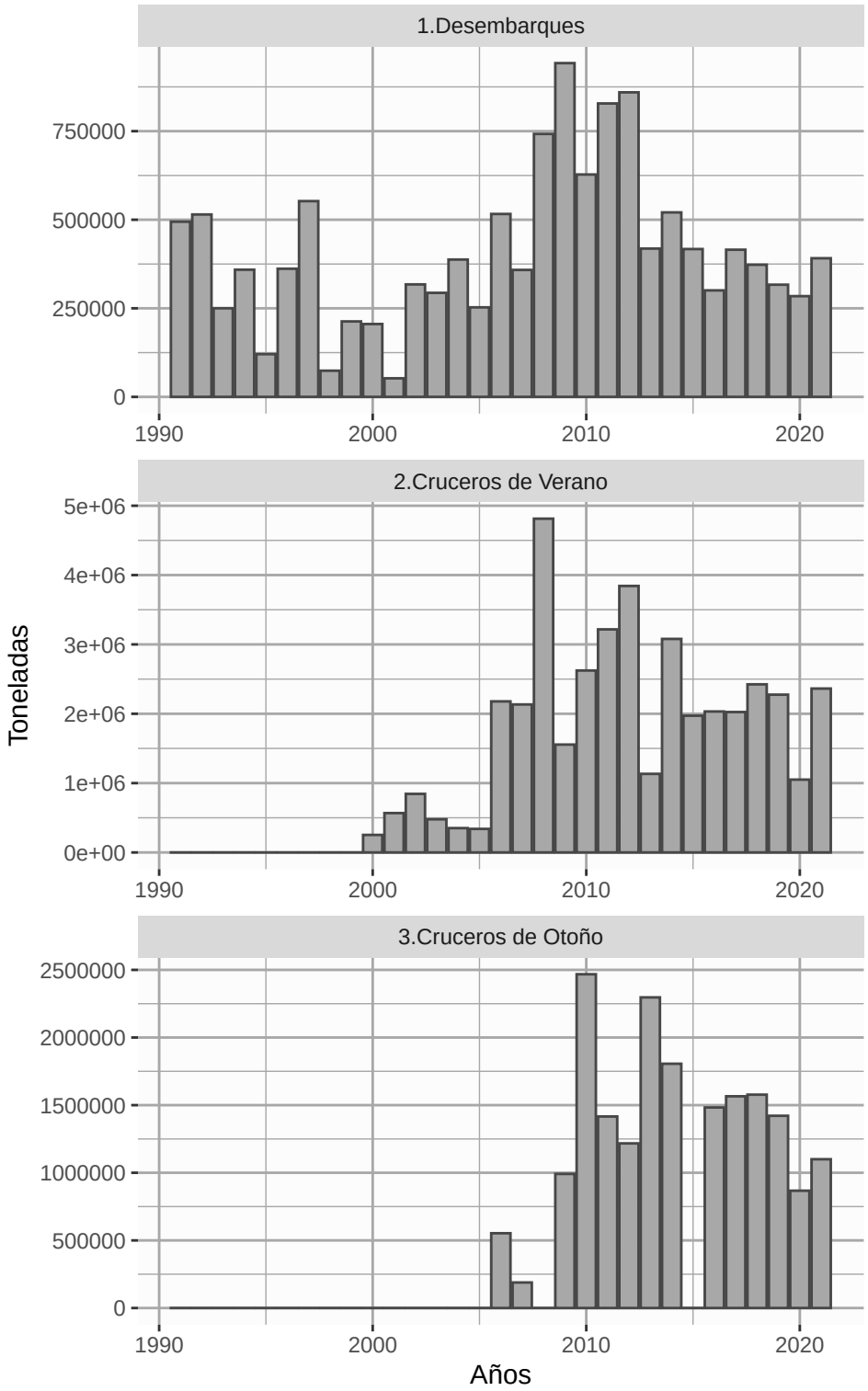
| Año.biológico | Desembarques.t. | Porcentaje.descarte | Captura.descartada.t. | Captura.total.t. |
|---|---|---|---|---|
| 1990-91 | 494567 | 0% | 0 | 494567 |
| 1991-92 | 514787 | 0% | 0 | 514787 |
| 1992-93 | 250237 | 0% | 0 | 250237 |
| 1993-94 | 358949 | 0% | 0 | 358949 |
| 1994-95 | 120608 | 0% | 0 | 120608 |
| 1995-96 | 361735 | 0% | 0 | 361735 |
| 1996-97 | 552515 | 0% | 0 | 552515 |
| 1997-98 | 73892 | 0% | 0 | 73892 |
| 1998-99 | 212993 | 0% | 0 | 212993 |
| 1999-00 | 205616 | 0% | 0 | 205616 |
| 2000-01 | 50451 | 4% | 2018 | 52469 |
| 2001-02 | 305257 | 4% | 12210 | 317467 |
| 2002-03 | 282360 | 4% | 11294 | 293654 |
| 2003-04 | 372689 | 4% | 14908 | 387597 |
| 2004-05 | 242976 | 4% | 9719 | 252695 |
| 2005-06 | 496438 | 4% | 19858 | 516296 |
| 2006-07 | 344596 | 4% | 13784 | 358380 |
| 2007-08 | 713623 | 4% | 28545 | 742168 |
| 2008-09 | 905818 | 4% | 36233 | 942051 |
| 2009-10 | 603450 | 4% | 24138 | 627588 |
| 2010-11 | 796319 | 4% | 31853 | 828172 |
| 2011-12 | 826505 | 4% | 33060 | 859565 |
| 2012,13 | 402507 | 4% | 16100 | 418607 |
| 2013-14 | 500641 | 4% | 20026 | 520667 |
| 2014-15 | 401201 | 4% | 16048 | 417249 |
| 2015-16 | 289013 | 4% | 11561 | 300574 |
| 2016-17 | 399415 | 4% | 15977 | 415391 |
| 2017-18 | 348574 | 7% | 24400 | 372974 |
| 2018-19 | 301557 | 5% | 15078 | 316634 |
| 2019-20 | 273376 | 4% | 10935 | 284311 |
| 2020-21 | 376245 | 4% | 15050 | 391294 |

# 3. RESULTADOS

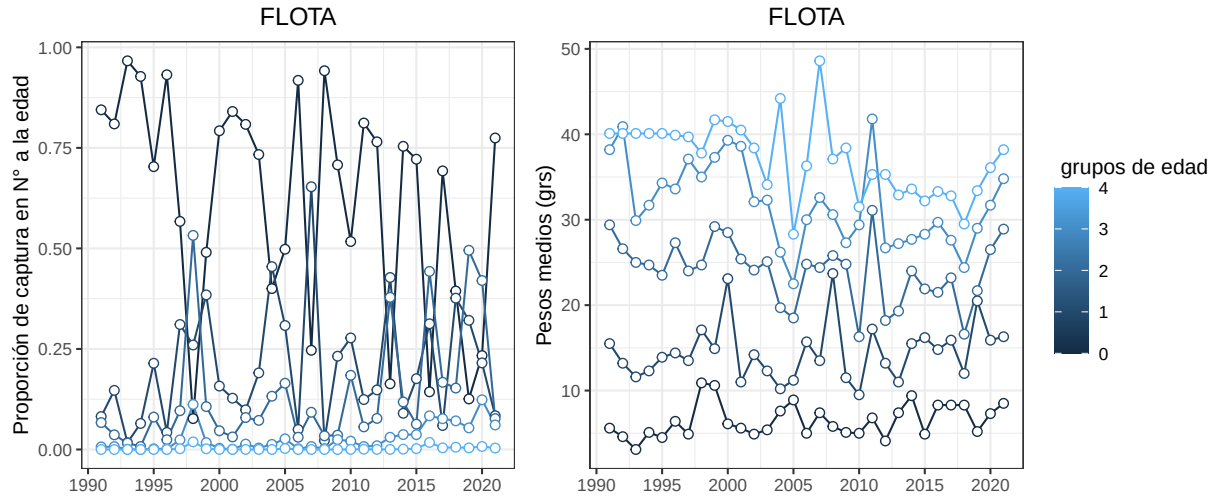
```
setwd(dir.1)
years  <- rep3$years
nyears <- dat3$nanos
x2      <-c(years,rev(years))
x1_2    <-c(years[1],years[nyears]+1,nyears+1/2) #xaxp
x2_2    <-c(years[1]-1,years[nyears]+1) #xlim

ydesembarques<-rep3$years[rep3$desembarqueobs>0]
yreclas      <-rep3$years[rep3$reclasobs>0]
ypelaces     <-rep3$years[rep3$pelacesobs>0]
ycompflota   <-rep3$years[rowSums(rep3$pf_obs)>0]
ycompreclas  <-rep3$years[rowSums(rep3$pobs_RECLAS)>0]
ycomppelaces <-rep3$years[rowSums(rep3$pobs_PELACES)>0]
ypesomedio   <-rep3$years[rowSums(dat3$Wmed)>0]
ypesoinicial <-rep3$years[rowSums(dat3$Wini)>0]

par(mfrow=c(1,1),mar=c(2,2,1,1)+0.5)
plot(years,rep(0,length(years)),type="n",ylim=c(0,9),ylab="",xlab="",xaxp=x1_2,axes=F,xlim=c(1991,2027.5))
abline(v=2022)
points(ydesembarques,rep(1,length(ydesembarques)),lwd=15,col=1)
points(yreclas,rep(2,length(yreclas)),lwd=15,col=2)
points(ypelaces,rep(3,length(ypelaces)),lwd=15,col=3)
points(ycompflota,rep(4,length(ycompflota)),lwd=15,col=4)
points(ycompreclas,rep(5,length(ycompreclas)),lwd=15,col=5)
points(ycomppelaces,rep(6,length(ycomppelaces)),lwd=15,col=6)
points(ypesomedio,rep(7,length(ypesomedio)),lwd=15,col=7)
points(ypesoinicial,rep(8,length(ypesoinicial)),lwd=15,col=8)

ejey<-c("Desembarques","Biom_Cru_verano","Biom_Cru_otoño","CompEdad Flota","CompEdad C.verano","CompEdad C.otoño","Peso medio Fl

#legend()
axis(1,years,xaxp=x1_2)
text(rep(2025.5,8),1:8,ejey,cex=0.8)

box()
```



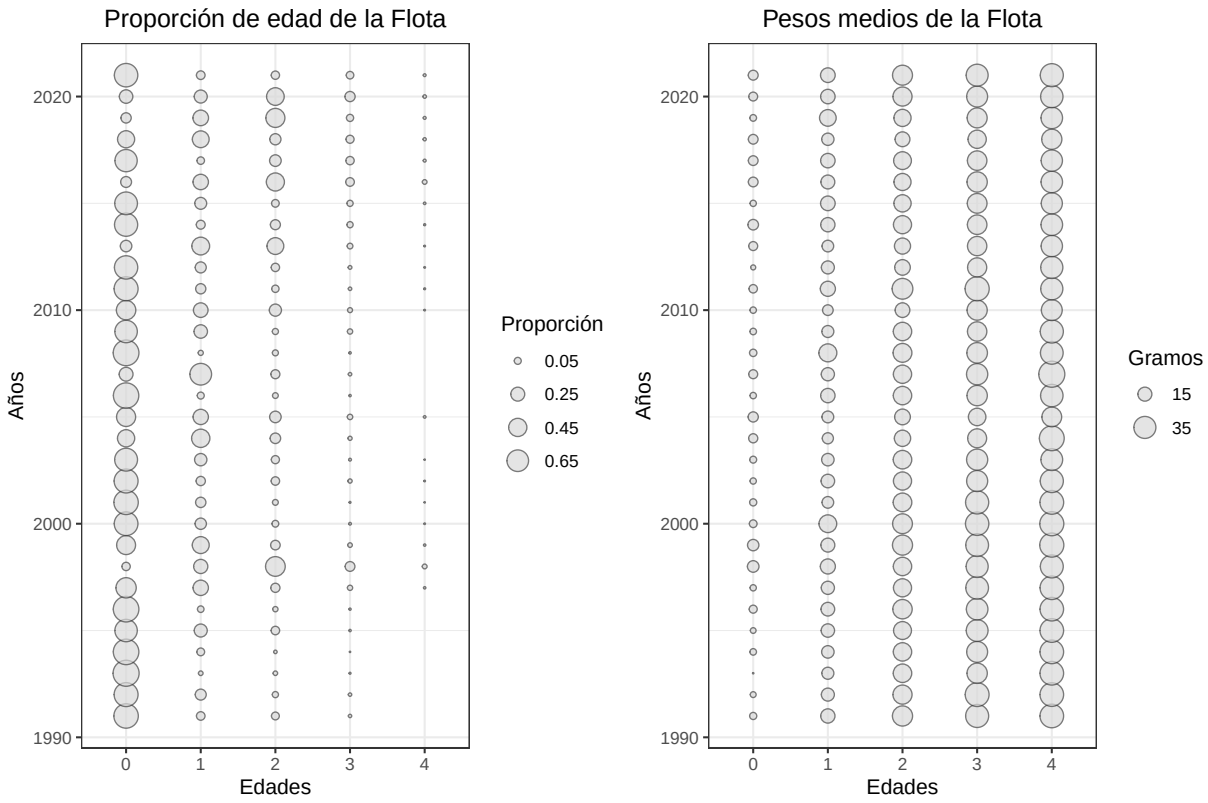
```
des_obs <- data.frame(rep3$desembarqueobs)
bc_obs  <- data.frame(rep3$reclasobs)
bp_obs  <- data.frame(rep3$pelacesobs)
yearc   <- rep3$years
nyearc  <-length(yearc)

 obsC  <- as.data.frame(bc_obs) %>% mutate(year=yearc) %>% melt(id.vars='year') %>% mutate(type='2.Cruceros de Verano')
 obsP  <- as.data.frame(bp_obs) %>% mutate(year=yearc) %>% melt(id.vars='year') %>% mutate(type='3.Cruceros de Otoño')
 obsD  <- as.data.frame(des_obs) %>% mutate(year=yearc) %>% melt(id.vars='year') %>% mutate(type='1.Desembarques')
 Bcru  <-rbind(obsC,obsP,obsD)

p <- ggplot()  +
  geom_bar(data=Bcru, aes(x=year, y =value), stat="identity", fill='gray66',
                   color = 'gray28') +
    facet_wrap(~type,scale="free",dir = 'v', as.table = TRUE) + labs(x="Años", y="Toneladas")
p +  theme(panel.background = element_rect(fill ="gray99")) + theme(panel.grid=element_line(color="gray66"))
```


1.Desembarques
750000
500000
250000
0
1990
2000
2010
2020
2.Cruceros de Verano
5e+06
4e+06
3e+06
2e+06
1e+06
0e+00
Toneladas
3.Cruceros de Otoño
2500000
2000000
1500000
1000000
500000
Años

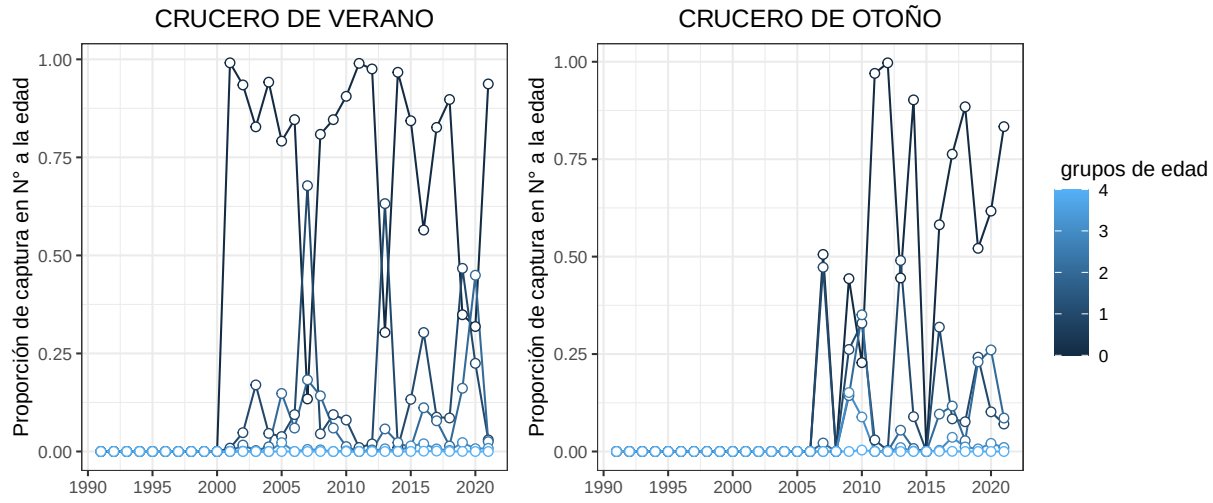
```r
years    <- rep3$years
nyears   <- length(years)
age      <- seq(0,4,1)
nage     <- length(age)
WmedF    <- dat3$Wmed
WiniF    <- dat3$Wini
pobsF    <- rep3$pf_obs

WmedF <- as.data.frame(WmedF) %>%
                       mutate(years=years) %>%
                       melt(id.vars='years') %>%
                       mutate(edad = rep(age, each=nyears)) %>%
                       mutate(type='WmedF')

pobsF <- as.data.frame(pobsF) %>%
                       mutate(years=years) %>%
                       melt(id.vars='years') %>%
                       mutate(edad = rep(age, each=nyears)) %>%
                       mutate(type='pobsF')


f1<-ggplot(pobsF, aes(x = years, y = value, group=edad,colour=edad))+
  geom_line() +
  geom_point( size=2, shape=21, fill="white") +
  labs(x = '', y = 'Proporción de captura en N° a la edad',fill="",color=" grupos de edad") +
  scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
  ggtitle("FLOTA")+
  theme_bw(base_size=11) +
  theme(plot.title = element_text(hjust = 0.5),legend.position="none")

f2<-ggplot(WmedF, aes(x = years, y = value, group=edad,colour=edad))+
  geom_line() +
  geom_point( size=2, shape=21, fill="white") +
  labs(x = '', y = 'Pesos medios (grs)',fill="",color=" grupos de edad") +
  scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
   ggtitle("FLOTA")+
  theme_bw(base_size=11) +
  theme(plot.title = element_text(hjust = 0.5))

f1 + f2
```



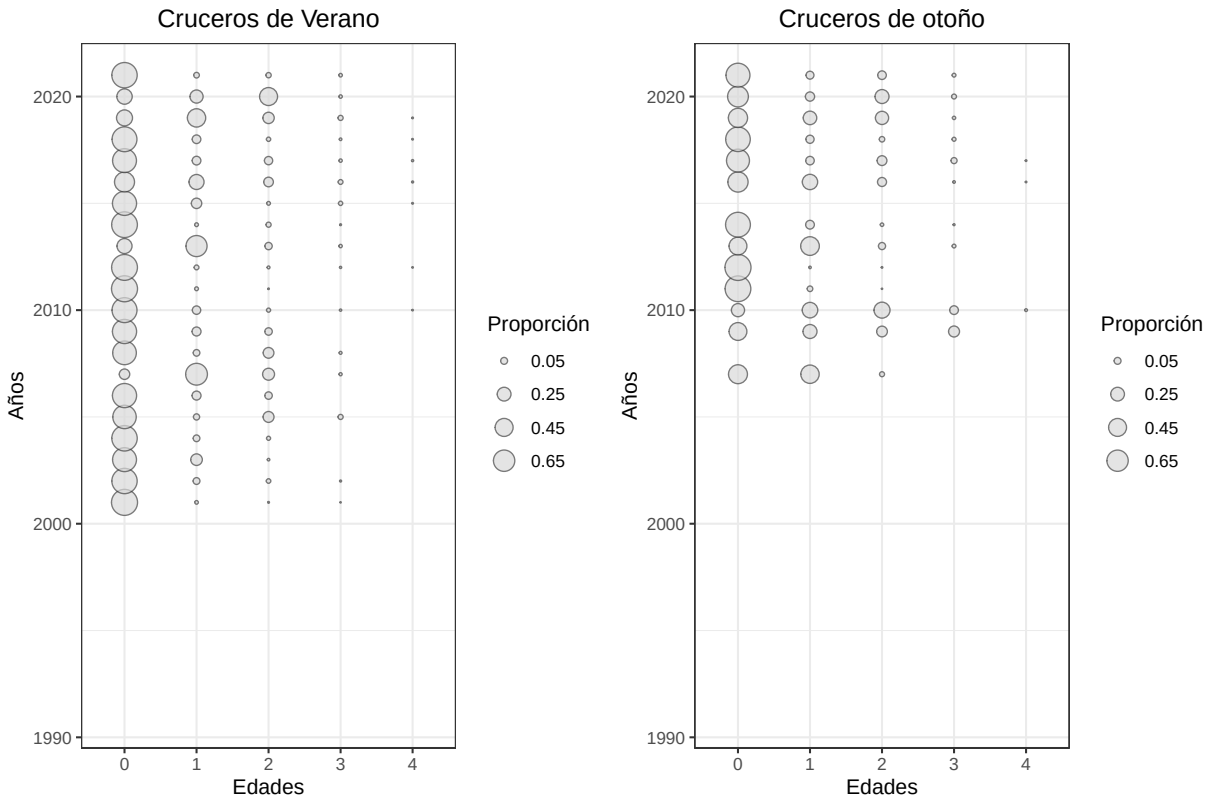
```r
pobsF    <- rep3$pf_obs
pF       <- c(pobsF); pF[pF==0]  <-NA
WmedF    <- dat3$Wmed
Wm       <- c(WmedF); Wm[Wm==0]  <-NA

years    <- rep3$years
nyears   <- dat3$nanos
age      <- seq(0,4,1)
nage     <- length(age)

anos <- rep(years,length(age))
edad <- gl((length(age)),length(years),label=age)

datosProp=data.frame(x=edad,y=anos,tamanio=pF)
datosWmed=data.frame(x=edad,y=anos,tamanio=Wm )

g1 <- ggplot (datosProp,aes(x,y)) +
     geom_point(aes(size=tamanio),color = 'gray25',shape=21, fill="gray85",alpha = 0.7) +
     scale_size_continuous(breaks = seq(0.05,0.65,0.2),range=c(0,6))+
     labs(x = 'Edades', y = 'Años',size="Proporción") +
     ggtitle("Proporción de edad de la Flota")+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5))

g2 <- ggplot (datosWmed,aes(x,y)) +
      geom_point(aes(size=tamanio),color = 'gray25',shape=21, fill="gray85",alpha=0.7) +
      scale_size_continuous(breaks = seq(15,75,20),range=c(0,6))+
      labs(x = 'Edades', y = 'Años',size="Gramos") +
      ggtitle("Pesos medios de la Flota")+
      theme_bw(base_size=11) +
      theme(plot.title = element_text(hjust = 0.5))

g1 + g2
```


Proporción de edad de la Flota
Años
2020
2010
2000
1990
0
1
2
3
4
Edades
Proporción
0.05
0.25
0.45
0.65
Pesos medios de la Flota
Años
2020
2010
2000
1990
0
1
2
3
4
Edades
Gramos
15
35

```
years    <- rep3$years
nyears   <- dat3$nanos
age      <- seq(0,4,1)
nage     <- length(age)
pobsR1    <- rep3$pobs_RECLAS
pobsP1    <- rep3$pobs_PELACES


pobsR <- as.data.frame(pobsR1) %>%
                        mutate(years=years) %>%
                        melt(id.vars='years') %>%
                        mutate(edad = rep(age, each=nyears)) %>%
                        mutate(type='pobsR')

pobsP <- as.data.frame(pobsP1) %>%
                        mutate(years=years) %>%
                        melt(id.vars='years') %>%
                        mutate(edad = rep(age, each=nyears)) %>%
                        mutate(type='pobsP')


f1<-ggplot(pobsR, aes(x = years, y = value, group=edad,colour=edad))+
  geom_line() +
  geom_point( size=2, shape=21, fill="white") +
  labs(x = '', y = 'Proporción de captura en N° a la edad',fill="",color=" grupos de edad") +
  scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
  ggtitle("CRUCERO DE VERANO")+
  theme_bw(base_size=11) +
  theme(plot.title = element_text(hjust = 0.5),legend.position="none")

f2<-ggplot(pobsP, aes(x = years, y = value, group=edad,colour=edad))+
  geom_line() +
  geom_point( size=2, shape=21, fill="white") +
  labs(x = '', y = 'Proporción de captura en N° a la edad',fill="",color=" grupos de edad") +
  scale_x_continuous(breaks = seq(from = 1990, to = 2020, by = 5)) +
  ggtitle("CRUCERO DE OTOÑO")+
  theme_bw(base_size=11) +
  theme(plot.title = element_text(hjust = 0.5))

f1 + f2
```



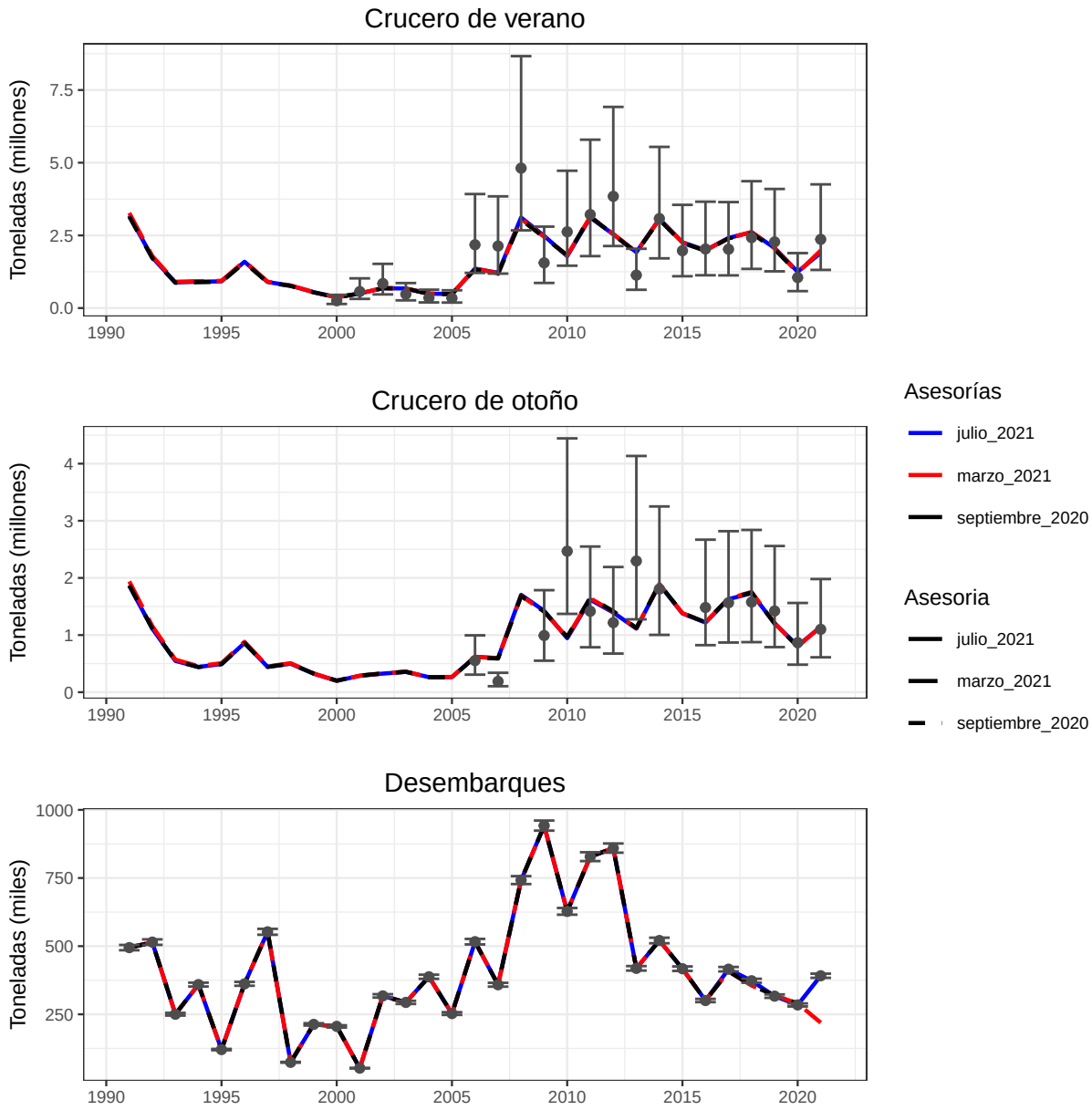
```
pobsR    <- rep3$pobs_RECLAS
pR       <- c(pobsR); pR[pR==0]  <-NA
pobsP    <- rep3$pobs_PELACES
pP       <- c(pobsP); pP[pP==0]  <-NA

years    <- rep3$years
nyears   <- dat3$nanos
age      <- seq(0,4,1)
nage     <- length(age)

anos <- rep(years,length(age))
edad <- gl((length(age)),length(years),label=age)

datosPropR=data.frame(x=edad,y=anos,tamanio=pR)
datosPropP=data.frame(x=edad,y=anos,tamanio=pP )

g1 <- ggplot (datosPropR,aes(x,y)) +
     geom_point(aes(size=tamanio),color = 'gray25',shape=21, fill="gray85",alpha = 0.7) +
     scale_size_continuous(breaks = seq(0.05,0.65,0.2),range=c(0,6))+
     labs(x = 'Edades', y = 'Años',size="Proporción") +
     ggtitle("Cruceros de Verano")+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5))

g2 <- ggplot (datosPropP,aes(x,y)) +
      geom_point(aes(size=tamanio),color = 'gray25',shape=21, fill="gray85",alpha=0.7) +
      scale_size_continuous(breaks = seq(0.05,0.65,0.2),range=c(0,6))+
      labs(x = 'Edades', y = 'Años',size="Proporción") +
      ggtitle("Cruceros de otoño")+
      theme_bw(base_size=11) +
      theme(plot.title = element_text(hjust = 0.5))

g1 + g2
```


Cruceros de Verano
Años
2020
2010
2000
1990
0
1
2
3
4
Edades
Proporción
0.05
0.25
0.45
0.65
Cruceros de otoño
Años
2020
2010
2000
1990
0
1
2
3
4
Edades
Proporción
0.05
0.25
0.45
0.65

## 3.1. Ajuste del modelo a los datos

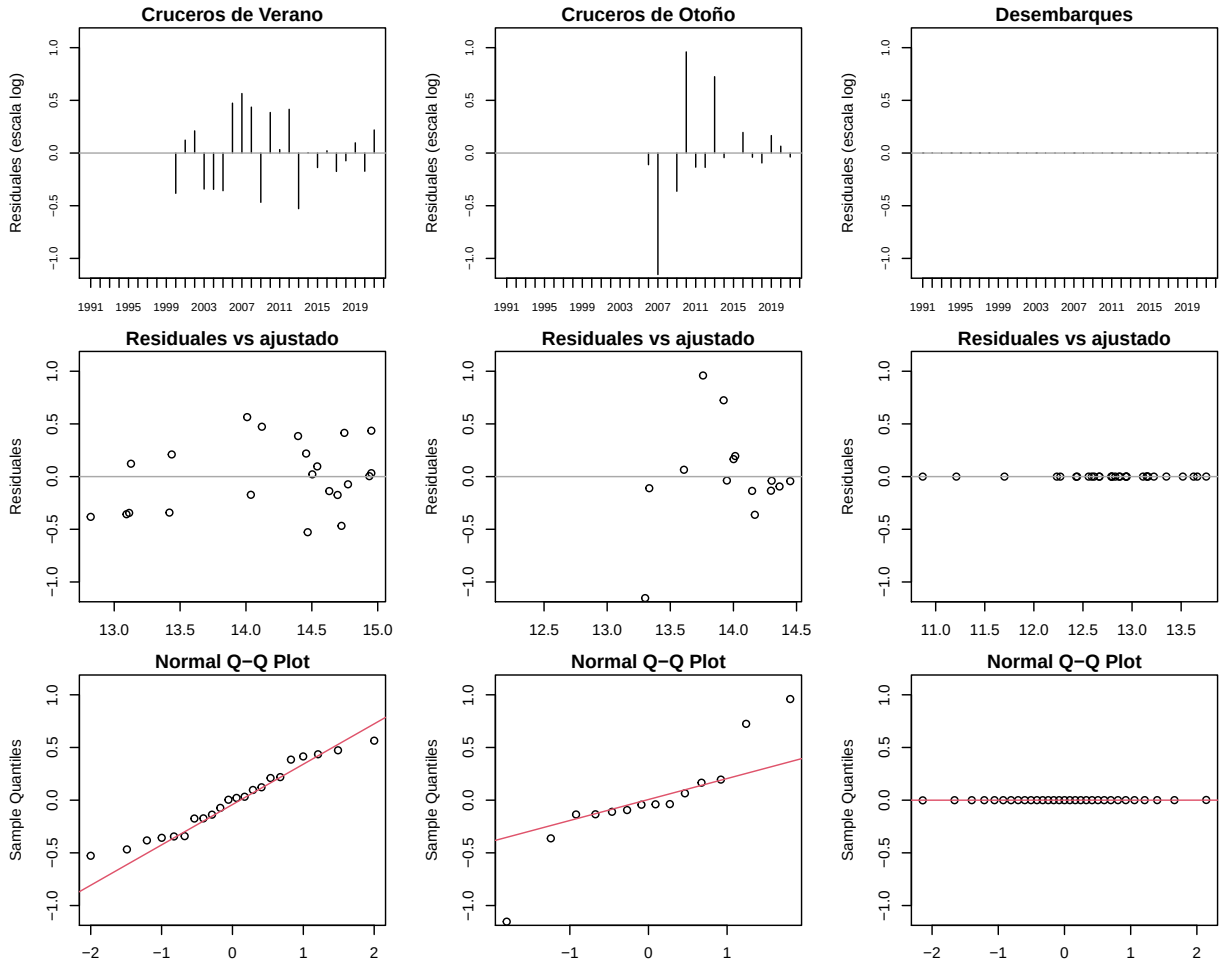
```
yrs   <- rep3$years
nyrs  <- length(yrs)
lasty <- yrs[nyrs]
cvBcV   <-0.30
cvBcO   <-0.30
cvdes   <-0.01
#=============================================================================
ind_obs           <- cbind(c(rep3$reclasobs),
                           c(rep3$pelacesobs),
                           c(rep3$desembarqueobs))
ind_obs[ind_obs==0] <- NA
colnames(ind_obs) <- c('Crucero_verano',
                       'Crucero_otoño',
                       'Desembarques')
#-----------------------------------------------------
ind_sept           <- cbind(c(rep1$reclaspred,NA),
                            c(rep1$pelacespred,NA),
                            c(rep1$desembarquepred,NA))
colnames(ind_sept) <- c('Crucero_verano',
                        'Crucero_otoño',
                        'Desembarques')
#-----------------------------------------------------
ind_marzo           <- cbind(c(rep2$reclaspred),
                             c(rep2$pelacespred),
                             c(rep2$desembarquepred))
colnames(ind_marzo) <- c('Crucero_verano',
                         'Crucero_otoño',
                         'Desembarques')
#-----------------------------------------------------
ind_julio           <- cbind(c(rep3$reclaspred),
                             c(rep3$pelacespred),
                             c(rep3$desembarquepred))
colnames(ind_julio) <- c('Crucero_verano',
                         'Crucero_otoño',
                         'Desembarques')

#=============================================================================
ind               <- data.frame(ind_obs) %>%
                              mutate(Asesoria='observado') %>%
                              mutate (yrs= yrs) %>%
                              melt(id.var=c('yrs', 'Asesoria'))

sept               <- data.frame(ind_sept) %>%
                               mutate (Asesoria='septiembre_2020') %>%
                               mutate (yrs= yrs)  %>%
                               melt(id.var=c('yrs', 'Asesoria'))

marzo              <- data.frame(ind_marzo) %>%
                               mutate (Asesoria='marzo_2021') %>%
                               mutate (yrs= yrs)  %>%
                               melt(id.var=c('yrs', 'Asesoria'))

julio              <- data.frame(ind_julio) %>%
                               mutate (Asesoria='julio_2021') %>%
                               mutate (yrs= yrs)  %>%
                               melt(id.var=c('yrs', 'Asesoria'))

#=============================================================================
base1 <- data.frame(rbind(ind, sept,marzo,julio))
#=============================================================================

#GRÁFICOS

#=============================================================================

BcV <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Crucero_verano'),
```

```
       aes(yrs,value/1000000)) +
       geom_line(aes(colour=Asesoria,linetype = Asesoria), size=0.8) +
       scale_colour_manual(values=c('blue','red','black')) +
       scale_linetype_manual(values=c("solid", "longdash","dashed"))+
       geom_point(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_verano'),
       aes(yrs,value/1000000), shape = 19, colour = 'gray30') +
       geom_errorbar(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_verano'),
       aes(ymin = value*exp(-1.96*cvBcO)*10^-6, ymax = value*exp(1.96*cvBcO)*10^-6), color = 'gray30') +
       scale_x_continuous(breaks = seq(from = 1985, to = 2021, by = 5)) +
       labs(x = '', y = 'Toneladas (millones)') +
       theme_bw(base_size=9) +
       ggtitle('Crucero de verano')+
       theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BcP <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Crucero_otoño'),
       aes(yrs,value/1000000)) +
       geom_line(aes(colour=Asesoria,linetype = Asesoria), size=0.8) +
       scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
       scale_linetype_manual(values=c("solid", "longdash","dashed"))+
       geom_point(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_otoño'),
       aes(yrs,value/1000000), shape = 19, colour = 'gray30') +
       geom_errorbar(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_otoño'),
       aes(ymin = value*exp(-1.96*cvBcV)*10^-6, ymax = value*exp(1.96*cvBcV)*10^-6), color = 'gray30') +
       scale_x_continuous(breaks = seq(from = 1985, to = 2021, by = 5)) +
       labs(x = '', y = 'Toneladas (millones)') +
       theme_bw(base_size=9) +
       ggtitle('Crucero de otoño')+
       theme(plot.title = element_text(hjust = 0.5))

d   <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Desembarques'),
       aes(yrs,value/1000)) +
       geom_line(aes(colour=Asesoria,linetype = Asesoria), size=0.8) +
       scale_colour_manual(values=c('blue','red','black')) +
       scale_linetype_manual(values=c("solid", "longdash","dashed"))+
       geom_point(data = base1 %>% filter(Asesoria=='observado', variable=='Desembarques'),
       aes(yrs,value/1000), shape = 19, colour = 'gray30') +
       geom_errorbar(data = base1 %>% filter(Asesoria=='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(x = '', y = 'Toneladas (miles)') +
       theme_bw(base_size=9) +
       ggtitle('Desembarques') +
       theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BcV/BcP/d + plot_layout(guides="collect")
```

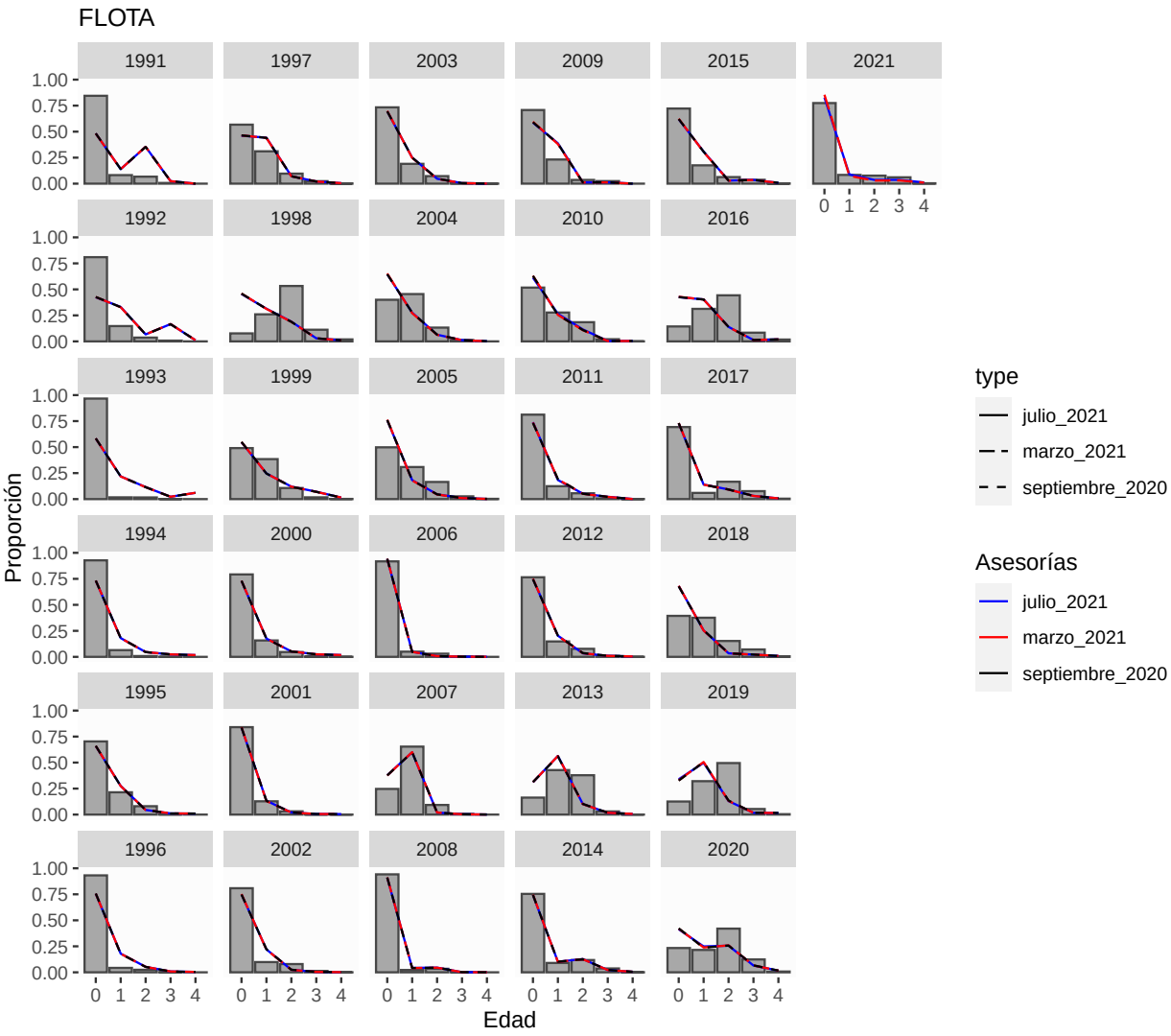

Crucero de verano
Toneladas (millones)
0.0
2.5
5.0
7.5
1990
1995
2000
2005
2010
2015
2020
Crucero de otoño
Toneladas (millones)
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Desembarques
Toneladas (miles)
250
500
750
1000
1990
1995
2000
2005
2010
2015
2020
Asesorías
julio_2021
marzo_2021
septiembre_2020
Asesoria
julio_2021
marzo_2021
septiembre_2020

```r
# I. INDICES DE ABUNDANCIA                                                    #
years  <- dat3$Ind[,1]
nyears <- dat3$nanos
age    <- seq(0,4,1)
nage   <- dat3$nedades
Amax   <- dat3$nedades
Age    <- seq(0,4,1)
#Observado
obsR <- rep3$reclasobs       ;obsR[obsR<=1] <-NA
obsP <- rep3$pelacesobs      ;obsP[obsP<=1] <-NA
obsM <- rep3$mphobs          ;obsM[obsM<=1] <-NA
obsD <- rep3$desembarqueobs
#predicho                   #stdpredicho
predR <- rep3$reclaspred
predP <- rep3$pelacespred
predM <- rep3$mphpred
predD <- rep3$desembarquepred
#Residuos
Res_reclas   <- log(obsR)-log(predR)
Res_Pelaces  <- log(obsP)-log(predP)
Res_MPH      <- log(obsM)-log(predM)
Res_Desemb   <- log(obsD)-log(predD)

x  <- c(years,rev(years))
x1 <- c(years[1],years[nyears]+1,nyears+1/2) #xaxp
x2 <- c(years[1]-1,years[nyears]+1) #xlim

cvreclas <- rep(0.30,nyears)
cvpela   <- rep(0.30,nyears)
cvdes    <- rep(0.01,nyears)

obsR95i <- obsR*exp(-1.96*cvreclas)
obsR95s <- obsR*exp(1.96*cvreclas)
obsP95i <- obsP*exp(-1.96*cvpela)
obsP95s <- obsP*exp(1.96*cvpela)
obsD95i <- obsD*exp(-1.96*cvdes)
obsD95s <- obsD*exp(1.96*cvdes)
```

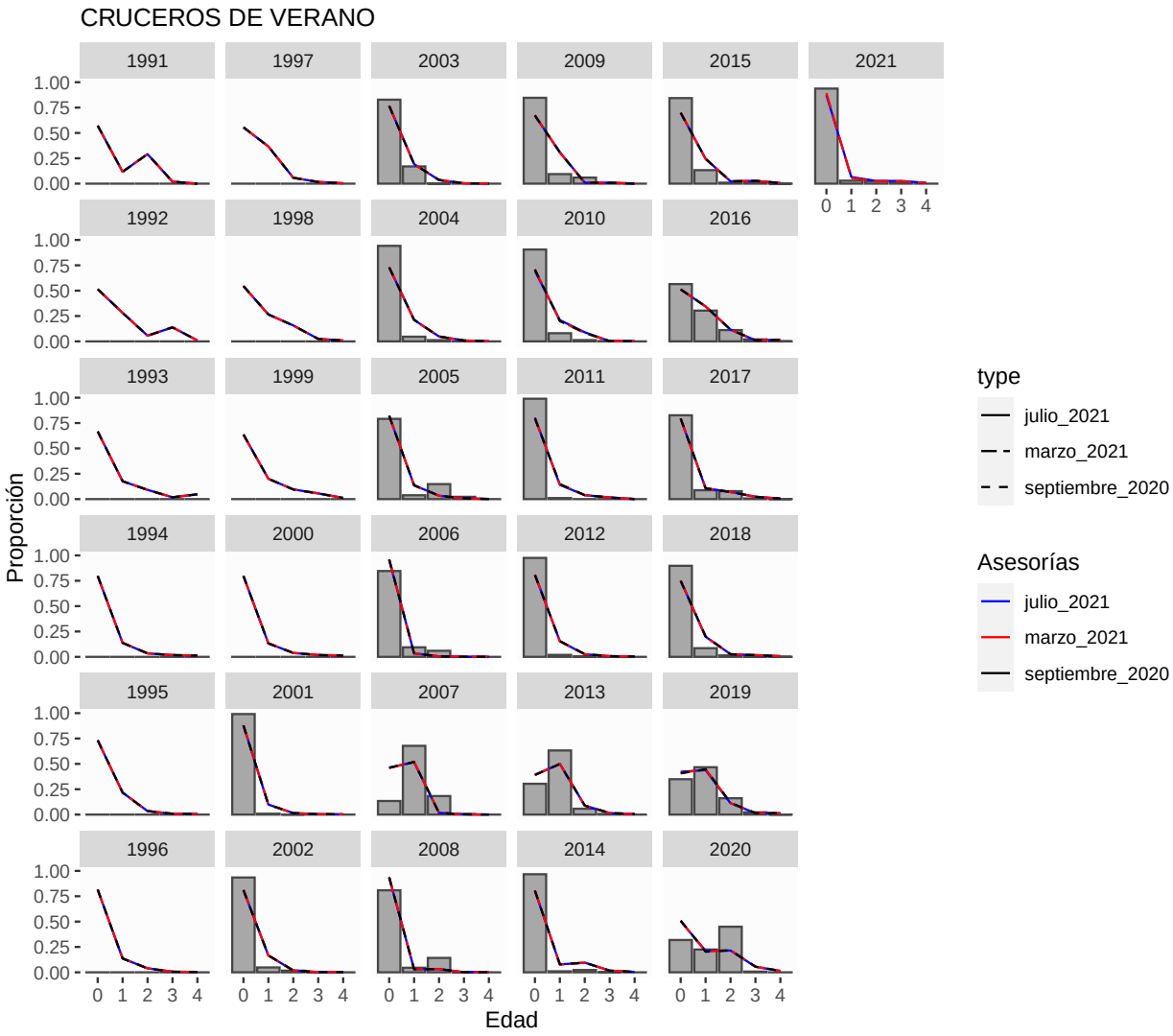
```r
par(mfcol=c(3,3),mar=c(2,4,1,1)+0.5)

 plot(years,Res_reclas,xaxp=x1,cex.axis=0.8,ylim=c(-1.1,1.1),type="h",main="Cruceros de Verano",ylab="Residuales (escala log)",x
    #mtext("b)",side=3,line=0.25,adj=-0.15,cex=1.5)
    abline(h=0,col="darkgray")
    plot(log(predR),Res_reclas, ylim=c(-1.1,1.1),main="Residuales vs ajustado",ylab="Residuales",xlab="Valor ajustado")
    abline(h=0,col="darkgray")
    #hist(Res_reclas,xlab="Residuales",ylab="Frecuencia",main="Histograma de Residuos")
    qqnorm(Res_reclas,ylim=c(-1.1,1.1)); qqline(Res_reclas, col = 2)

    plot(years,Res_Pelaces,xaxp=x1,ylim=c(-1.1,1.1),cex.axis=0.8,type="h",main="Cruceros de Otoño",ylab="Residuales (escala log)
    #mtext("b)",side=3,line=0.25,adj=-0.15,cex=1.5)
    abline(h=0,col="darkgray")
    plot(log(predP),Res_Pelaces,ylim=c(-1.1,1.1), main="Residuales vs ajustado",ylab="Residuales",xlab="Valor ajustado")
    abline(h=0,col="darkgray")
    #hist(Res_Pelaces,xlab="Residuales",ylab="Frecuencia",main="Histograma de Residuos")
    qqnorm(Res_Pelaces,ylim=c(-1.1,1.1)); qqline(Res_Pelaces, col = 2)

  plot(years,Res_Desemb,xaxp=x1,cex.axis=0.8,ylim=c(-1.1,1.1),type="h",main="Desembarques",ylab="Residuales (escala log)",xlab="
#    mtext("b)",side=3,line=0.25,adj=-0.15,cex=1.5)
    abline(h=0,col="darkgray")
    plot(log(predD),Res_Desemb, ylim=c(-1.1,1.1),main="Residuales vs ajustado",ylab="Residuales",xlab="Valor ajustado")
    abline(h=0,col="darkgray")
    #hist(Res_Desemb,xlab="Residuales",ylab="Frecuencia",main="Histograma de Residuos")
    qqnorm(Res_Desemb,ylim=c(-1.1,1.1)); qqline(Res_Desemb, col = 2)
```



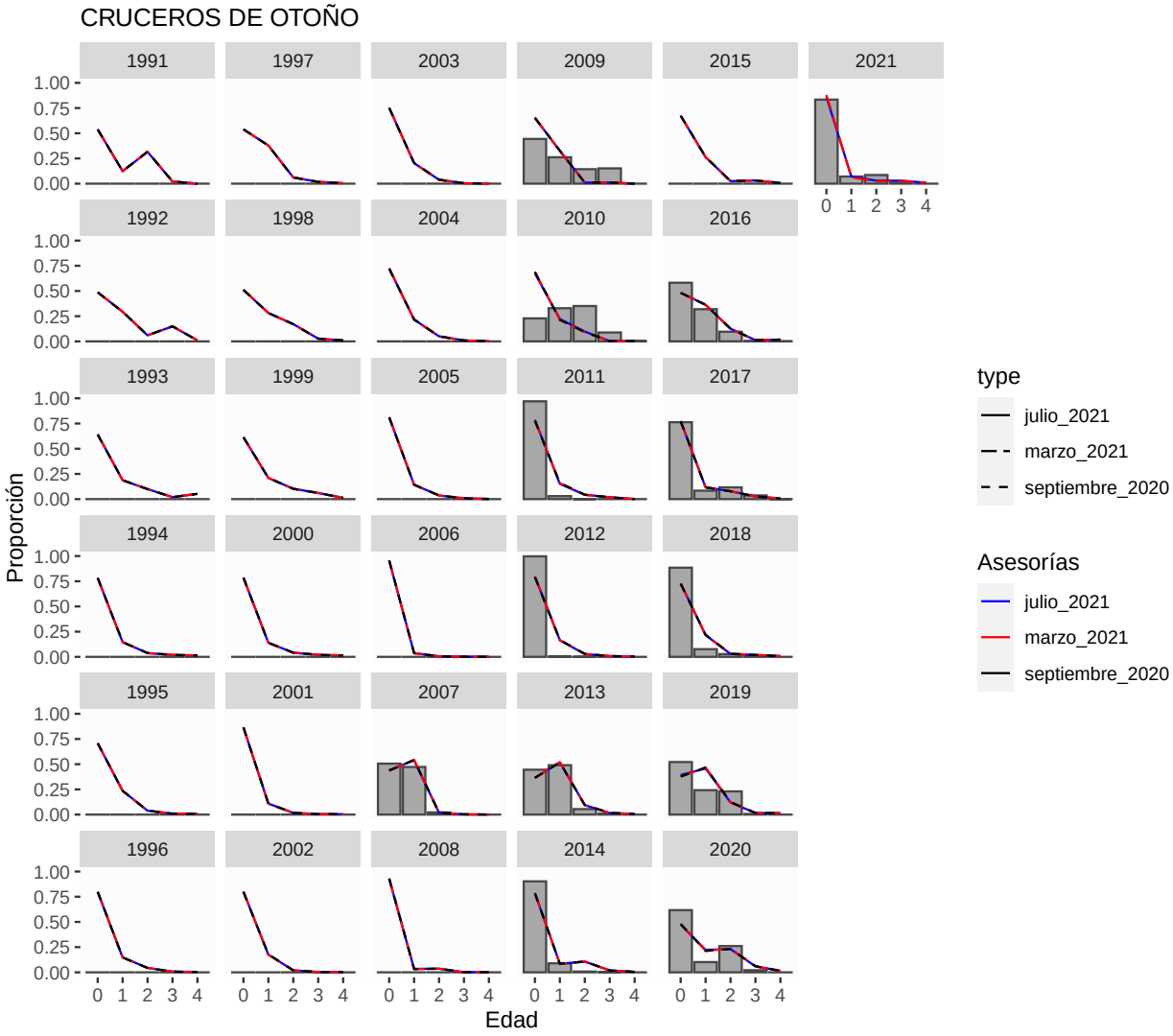
```r
years   <- dat3$Ind[,1]
nyears  <- length(years)
age     <- seq(0,4,1)
nage    <- length(age)

etcf1_obs <- data.frame(rep3$pf_obs)
etcf1_pre <- rbind(rep1$pf_pred,rep(NA,nage))
etcf2_pre <- rep2$pf_pred
etcf3_pre <- rep3$pf_pred

 obs  <- as.data.frame(etcf1_obs) %>%
                      mutate(year=years) %>%
                      melt(id.vars='year') %>%
                      mutate(edad = rep(age, each=nyears)) %>%
                      mutate(type='obs')

 pred_sep <- as.data.frame(etcf1_pre) %>%
                           mutate(year=years) %>%
                           melt(id.vars='year') %>%
                           mutate(edad = rep(age, each=nyears)) %>%
                           mutate(type='septiembre_2020')

 pred_marzo <- as.data.frame(etcf2_pre) %>%
                             mutate(year=years) %>%
                             melt(id.vars='year') %>%
                             mutate(edad = rep(age, each=nyears)) %>%
                             mutate(type='marzo_2021')

  pred_julio <- as.data.frame(etcf3_pre) %>%
                             mutate(year=years) %>%
                             melt(id.vars='year') %>%
                             mutate(edad = rep(age, each=nyears)) %>%
                             mutate(type='julio_2021')


  mat  <- rbind(obs,pred_sep,pred_marzo,pred_julio)

  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 = 'Edad', y = 'Proporción') +
          geom_line(data = mat %>% filter(type != 'obs'), aes(x = edad, y = value, colour=type,linetype =type)) +
          scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
          scale_linetype_manual(values=c("solid", "longdash","dashed"))+
          theme(panel.background = element_rect(fill ="gray99")) +
          theme(panel.grid=element_line(color=NA)) +
          ggtitle("FLOTA") + theme(plot.title = element_text(size = 12))
  fig1
```


FLOTA
1991
1997
2003
2009
2015
2021
1992
1998
2004
2010
2016
1993
1999
2005
2011
2017
1994
2000
2006
2012
2018
1995
2001
2007
2013
2019
1996
2002
2008
2014
2020
1.00
0.75
0.50
0.25
0.00
0 1 2 3 4
Proporción
Edad
type
julio_2021
marzo_2021
septiembre_2020
Asesorías
julio_2021
marzo_2021
septiembre_2020

```r
years   <- dat3$Ind[,1]
nyears  <- length(years)
age     <- seq(0,4,1)
nage    <- length(age)

etcf1_obs <- data.frame(rep3$pobs_RECLAS)
etcf1_pre <- rbind(rep1$ppred_RECLAS,rep(NA,nage))
etcf2_pre <- rep2$ppred_RECLAS
etcf3_pre <- rep3$ppred_RECLAS

 obs  <- as.data.frame(etcf1_obs) %>%
                       mutate(year=years) %>%
                       melt(id.vars='year') %>%
                       mutate(edad = rep(age, each=nyears)) %>%
                       mutate(type='obs')

 pred_sep <- as.data.frame(etcf1_pre) %>%
                           mutate(year=years) %>%
                           melt(id.vars='year') %>%
                           mutate(edad = rep(age, each=nyears)) %>%
                           mutate(type='septiembre_2020')

 pred_marzo <- as.data.frame(etcf2_pre) %>%
                           mutate(year=years) %>%
                           melt(id.vars='year') %>%
                           mutate(edad = rep(age, each=nyears)) %>%
                           mutate(type='marzo_2021')

 pred_julio <- as.data.frame(etcf3_pre) %>%
                           mutate(year=years) %>%
                           melt(id.vars='year') %>%
                           mutate(edad = rep(age, each=nyears)) %>%
                           mutate(type='julio_2021')


  mat  <- rbind(obs,pred_sep,pred_marzo,pred_julio)

  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 = 'Edad', y = 'Proporción') +
          geom_line(data = mat %>% filter(type != 'obs'), aes(x = edad, y = value, colour=type,linetype =type)) +
          scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
          scale_linetype_manual(values=c("solid", "longdash","dashed"))+
          theme(panel.background = element_rect(fill ="gray99")) + theme(panel.grid=element_line(color=NA)) +
          ggtitle("CRUCEROS DE VERANO") + theme(plot.title = element_text(size = 12))
  fig1
```

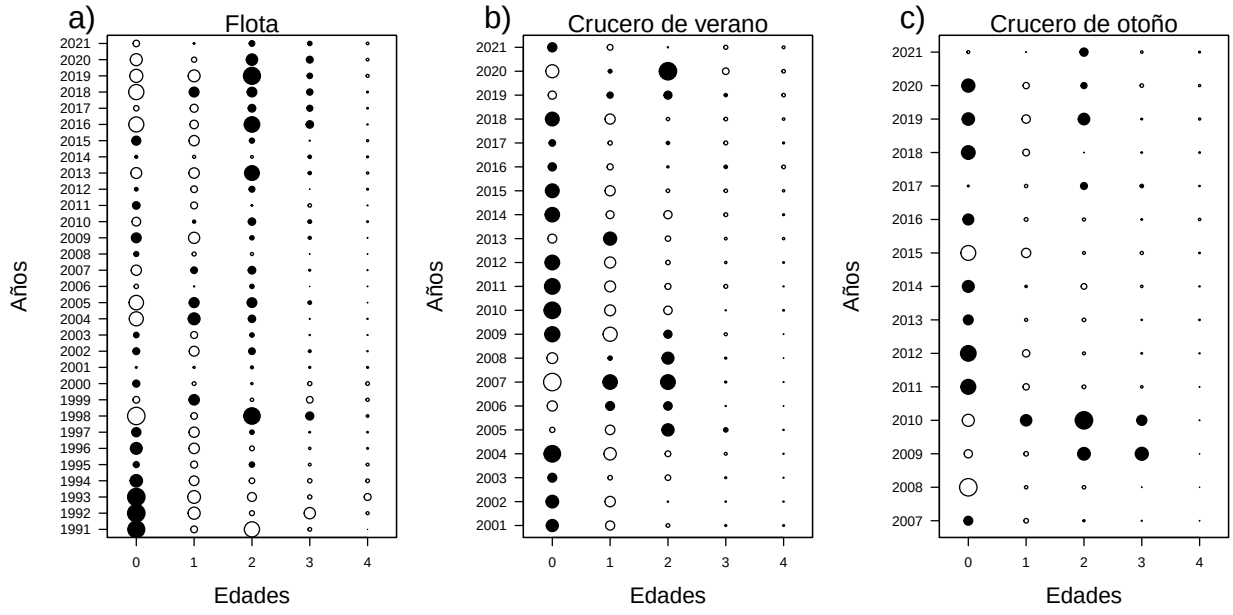

CRUCEROS DE VERANO
1991
1997
2003
2009
2015
2021
1992
1998
2004
2010
2016
1993
1999
2005
2011
2017
1994
2000
2006
2012
2018
1995
2001
2007
2013
2019
1996
2002
2008
2014
2020
Proporción
1.00
0.75
0.50
0.25
0.00
0 1 2 3 4
Edad
type
julio_2021
marzo_2021
septiembre_2020
Asesorías
julio_2021
marzo_2021
septiembre_2020

```r
years   <- dat3$Ind[,1]
nyears  <- length(years)
age     <- seq(0,4,1)
nage    <- length(age)

etcf1_obs <- data.frame(rep3$pobs_PELACES)
etcf1_pre <- rbind(rep1$ppred_PELACES,rep(NA,nage))
etcf2_pre <- rep2$ppred_PELACES
etcf3_pre <- rep3$ppred_PELACES

 obs  <- as.data.frame(etcf1_obs) %>%
                       mutate(year=years) %>%
                       melt(id.vars='year') %>%
                       mutate(edad = rep(age, each=nyears)) %>%
                       mutate(type='obs')

 pred_sep <- as.data.frame(etcf1_pre) %>%
                       mutate(year=years) %>%
                       melt(id.vars='year') %>%
                       mutate(edad = rep(age, each=nyears)) %>%
                       mutate(type='septiembre_2020')

 pred_marzo <- as.data.frame(etcf2_pre) %>%
                         mutate(year=years) %>%
                         melt(id.vars='year') %>%
                         mutate(edad = rep(age, each=nyears)) %>%
                         mutate(type='marzo_2021')

  pred_julio <- as.data.frame(etcf3_pre) %>%
                         mutate(year=years) %>%
                         melt(id.vars='year') %>%
                         mutate(edad = rep(age, each=nyears)) %>%
                         mutate(type='julio_2021')

  mat  <- rbind(obs,pred_sep,pred_marzo,pred_julio)

  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 = 'Edad', y = 'Proporción') +
          geom_line(data = mat %>% filter(type != 'obs'), aes(x = edad, y = value, colour=type,linetype =type)) +
          scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
          scale_linetype_manual(values=c("solid", "longdash","dashed"))+
          theme(panel.background = element_rect(fill ="gray99")) + theme(panel.grid=element_line(color=NA)) +
          ggtitle("CRUCEROS DE OTOÑO") + theme(plot.title = element_text(size = 12))
  fig1
```


CRUCEROS DE OTOÑO
1991
1997
2003
2009
2015
2021
1992
1998
2004
2010
2016
1993
1999
2005
2011
2017
1994
2000
2006
2012
2018
1995
2001
2007
2013
2019
1996
2002
2008
2014
2020
Proporción
1.00
0.75
0.50
0.25
0.00
0 1 2 3 4
Edad
type
julio_2021
marzo_2021
septiembre_2020
Asesorías
julio_2021
marzo_2021
septiembre_2020

```
ppredF<-rep3$pf_pred
ppredR<-rep3$ppred_RECLAS
ppredP<-rep3$ppred_PELACES

#DESEMBARQUES
anos <-dat3$Ind[,1]
obsF <-pobsF
preF <-ppredF
resF <-obsF-preF

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

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

par(mfrow=c(1,3),mar=c(5.4,6.7,2,1),cex.axis=1,cex.lab=1.1)
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=2.82*sqrt(vol),col=1)}
    if(vol<0){points(age[m],anos[n],pch=1,cex=2.82*sqrt(vol*-1),col=1)}
}}}

mtext("Flota",side=3,cex=1.2)
mtext("Edades",side=1,line=3.2,cex=1.1);posi<-seq(1,57,by=4)
axis(2,at=anos,labels=anos,las=2)
mtext("Años",side=2,line=4.7,cex=1.1)
    mtext("a)",side=3,line=0.25,adj=-0.15,cex=1.5)
box()

# RECLAS
anos<-years[11:nyears]
obsR <-pobsR[11:nyears,]
preR <-ppredR[11:nyears,]
resR <-obsR-preR

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

for(j in 1:dd[1]){for(k in 1:dd[2]){val<-resR[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=1,cex.lab=1.1)
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=2.82*sqrt(vol),col=1)}
    if(vol<0){points(age[m],anos[n],pch=1,cex=2.82*sqrt(vol*-1),col=1)}
}}}
mtext("Crucero de verano",side=3,cex=1.2)
mtext("Edades",side=1,line=3.2,cex=1.1);posi<-seq(1,57,by=4)
axis(2,at=anos,labels=anos,las=2)
mtext("Años",side=2,line=4.7,cex=1.1)
mtext("b)",side=3,line=0.25,adj=-0.15,cex=1.5)
box()

# PELACES
anos<-years[17:nyears]
obsP <-pobsP[17:nyears,]
preP <-ppredP[17:nyears,]
```

```
resP <-obsP-preP

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

for(j in 1:dd[1]){for(k in 1:dd[2]){val<-resP[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=1,cex.lab=1.1)
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=2.82*sqrt(vol),col=1)}
    if(vol<0){points(age[m],anos[n],pch=1,cex=2.82*sqrt(vol*-1),col=1)}
}}}
mtext("Crucero de otoño",side=3,cex=1.2)
mtext("Edades",side=1,line=3.2,cex=1.1);posi<-seq(1,57,by=4)
axis(2,at=anos,labels=anos,las=2)
mtext("Años",side=2,line=4.7,cex=1.1)
mtext("c)",side=3,line=0.25,adj=-0.15,cex=1.5)
box()
```

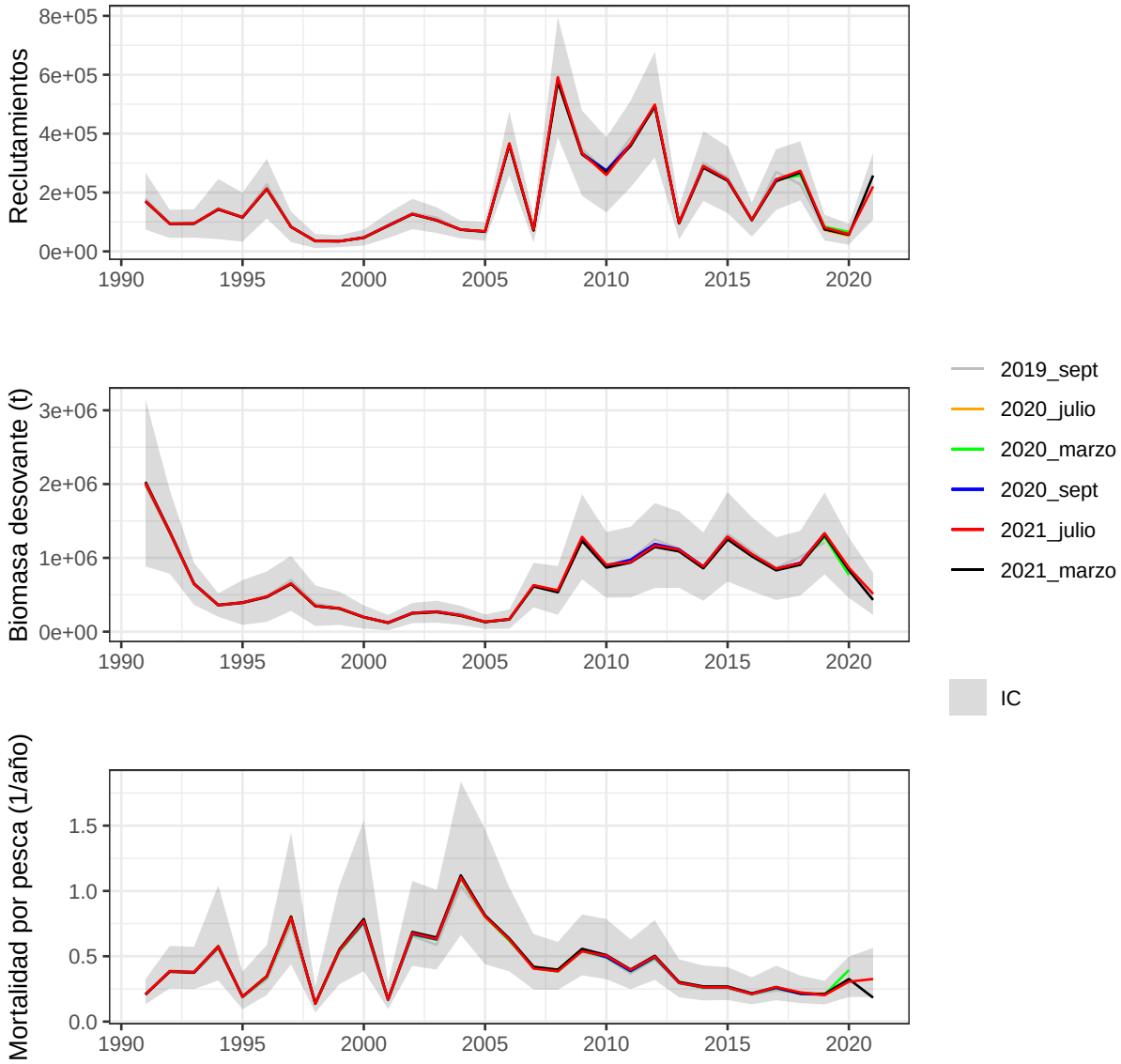


## 3.2. Comparación con asesorías previas

```
years<-rep3$years
nyears<-length(years)

Rt3      <- subset(std3,name=="Reclutas")$value
Rt3std   <- subset(std3,name=="Reclutas")$std
BT3      <- subset(std3,name=="BT")$value
BT3std   <- subset(std3,name=="BT")$std
BD3      <- subset(std3,name=="SSB")$value
BD3std   <- subset(std3,name=="SSB")$std
Ft3      <- subset(std3,name=="log_Ft")$value
Ft3std   <- subset(std3,name=="log_Ft")$std

VarPob<- data.frame(x=years,
                    Rt3=Rt3,
                    BT3=BT3,
                    BD3=BD3,
                    Ft3=exp(Ft3),
         lowerRt3 = (Rt3 -1.96*Rt3std),
         upperRt3 = (Rt3 +1.96*Rt3std),
         lowerBT3 = (BT3 -1.96*BT3std),
         upperBT3 = (BT3 +1.96*BT3std),
         lowerBD3 = (BD3 -1.96*BD3std),
         upperBD3 = (BD3 +1.96*BD3std),
         lowerFt3 = exp(Ft3 -1.96*Ft3std),
         upperFt3 = exp(Ft3 +1.96*Ft3std))
```

```
dir<-paste(dir.0,"/rep_AsesoriasPrevias",sep="")
setwd(dir)

sept18 <-paste(dir,"/MAE0918.rep",sep="")
mar19  <-paste(dir,"/MAE0319.rep",sep="")
jul19  <-paste(dir,"/MAE0719.rep",sep="")
sept19 <-paste(dir,"/MAE0919.rep",sep="")
mar20  <-paste(dir,"/MAE0320.rep",sep="")
jul20  <-paste(dir,"/MAE0720.rep",sep="")
sept20 <-paste(dir,"/MAE0920.rep",sep="")
mar21  <-paste(dir.1,"/MAE0321.rep",sep="")
jul21  <-paste(dir.1,"/MAE0721.rep",sep="")

#================================================================================#
rep_sept18 <- reptoRlist(sept18)
rep_mar19  <- reptoRlist(mar19)
rep_jul19  <- reptoRlist(jul19)
rep_sept19 <- reptoRlist(sept19)
rep_mar20 <- reptoRlist(mar20)
rep_jul20 <- reptoRlist(jul20)
rep_sept20 <- reptoRlist(sept20)
rep_mar21  <- reptoRlist(mar21)
rep_jul21  <- reptoRlist(jul21)
#================================================================================#
years  <- rep_jul21$years
nyears <- length(years)
x  <-c(years,rev(years))
x1 <-c(years[1],years[nyears]+1,nyears+1/2) #xaxp
x2 <-c(years[1]-1,years[nyears]+1) #xlim

 Rtcomp <- data.frame(x=years,
                          Rt_sept18=c(rep_sept18$Reclutas,NA,NA,NA),
                          Rt_mar19=c(rep_mar19$Reclutas,NA,NA),
                          Rt_jul19=c(rep_jul19$Reclutas,NA,NA),
                          Rt_sept19=c(rep_sept19$Reclutas,NA,NA),
                          Rt_mar20=c(rep_mar20$Reclutas,NA),
                          Rt_jul20=c(rep_jul20$Reclutas,NA),
                          Rt_sept20=c(rep_sept20$Reclutas,NA),
                          Rt_mar21=c(rep_mar21$Reclutas),
                          Rt_jul21=c(rep_jul21$Reclutas))

 SSBtcomp <- data.frame(x=years,
                          SSBt_sept18=c(rep_sept18$SSB,NA,NA,NA),
                          SSBt_mar19=c(rep_mar19$SSB,NA,NA),
                          SSBt_jul19=c(rep_jul19$SSB,NA,NA),
                          SSBt_sept19=c(rep_sept19$SSB,NA,NA),
                          SSBt_mar20=c(rep_mar20$SSB,NA),
                          SSBt_jul20=c(rep_jul20$SSB,NA),
                          SSBt_sept20=c(rep_sept20$SSB,NA),
                          SSBt_mar21=c(rep_mar21$SSB),
                          SSBt_jul21=c(rep_jul21$SSB))

 Ftcomp <- data.frame(x=years,
                          Ft_sept18=c(rep_sept18$Ftot,NA,NA,NA),
                          Ft_mar19=c(rep_mar19$Ftot,NA,NA),
                          Ft_jul19=c(rep_jul19$Ftot,NA,NA),
                          Ft_sept19=c(rep_sept19$Ftot,NA,NA),
                          Ft_mar20=c(rep_mar20$Ftot,NA),
                          Ft_jul20=c(rep_jul20$Ftot,NA),
                          Ft_sept20=c(rep_sept20$Ftot,NA),
                          Ft_mar21=c(rep_mar21$Ftot),
                          Ft_jul21=c(rep_jul21$Ftot))
```

```r
year_retros <- c("2021_julio","2021_marzo","2020_sept","2020_julio","2020_marzo","2019_sept")
nretros <-6


#Retrospectivo tradicional
Rt <- ggplot(Rtcomp) +
    geom_ribbon(data=VarPob,aes(ymin=lowerRt3, ymax=upperRt3, x=x, fill = "IC"), alpha = 0.2)+
    geom_line(aes(y=Rt_sept19, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=Rt_mar20, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=Rt_jul20, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=Rt_sept20, x=x, colour = year_retros[nretros-3]), size=0.5)+
    geom_line(aes(y=Rt_mar21, x=x, colour = year_retros[nretros-4]), size=0.5)+
    geom_line(aes(y=Rt_jul21, x=x, colour = year_retros[nretros-5]), size=0.5)+
    labs(x = '', y = 'Reclutamientos ',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1990, to = 2021, by = 5)) +
    scale_colour_manual("",values=c("gray","orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=11) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BD <- ggplot(SSBtcomp) +
     geom_ribbon(data=VarPob,aes(ymin=lowerBD3, ymax=upperBD3, x=x, fill = "IC"), alpha = 0.2)+
     geom_line(aes(y=SSBt_sept19, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=SSBt_mar20, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=SSBt_jul20, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=SSBt_sept20, x=x, colour = year_retros[nretros-3]), size=0.5)+
    geom_line(aes(y=SSBt_mar21, x=x, colour = year_retros[nretros-4]), size=0.5)+
    geom_line(aes(y=SSBt_jul21, x=x, colour = year_retros[nretros-5]), size=0.5)+
    labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1990, to = 2021, by = 5)) +
    scale_colour_manual("",values=c("gray","orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=11) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5))

Ft <- ggplot(Ftcomp) +
    geom_ribbon(data=VarPob,aes(ymin=lowerFt3, ymax=upperFt3, x=x, fill = "IC"), alpha = 0.2)+
    geom_line(aes(y=Ft_sept19, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=Ft_mar20, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=Ft_jul20, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=Ft_sept20, x=x, colour = year_retros[nretros-3]), size=0.5)+
    geom_line(aes(y=Ft_mar21, x=x, colour = year_retros[nretros-4]), size=0.5)+
    geom_line(aes(y=Ft_jul21, x=x, colour = year_retros[nretros-5]), size=0.5)+
    labs(x = '', y = 'Mortalidad por pesca (1/año)',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1990, to = 2021, by = 5)) +
    scale_colour_manual("",values=c("gray","orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=11) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Rt/BD/Ft
```


Reclutamientos
8e+05
6e+05
4e+05
2e+05
0e+00
1990
1995
2000
2005
2010
2015
2020
Biomasa desovante (t)
3e+06
2e+06
1e+06
0e+00
Mortalidad por pesca (1/año)
1.5
1.0
0.5
0.0
2019_sept
2020_julio
2020_marzo
2020_sept
2021_julio
2021_marzo
IC

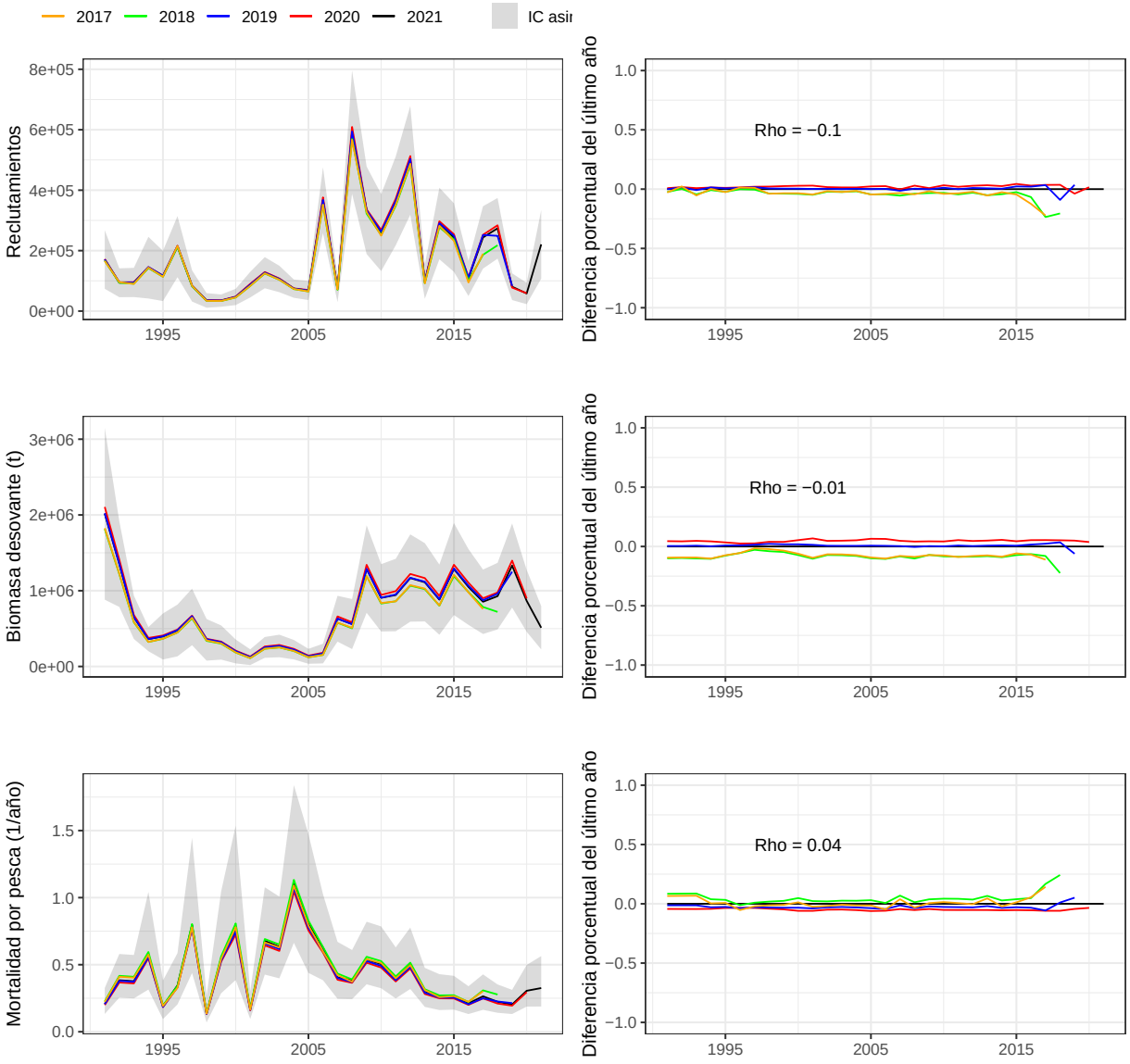
## 3.3. Análisis retrospectivo

```
dir<-paste(dir.0,"/Retrospectivo_jul",sep="")
setwd(dir)
admb<-"MAE0721"

years<-rep3$years
nyears<-length(years)
retros<-seq(1,5)
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$Reclutas,rep(NA,i-1))
  retroBD[,i+1] <- c(rep$SSB,rep(NA,i-1))
  retroF[,i+1]  <- c(rep$Ftot,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)

 # Arreglo datos

#Para retrospectivo tradicional
Rt_retro<- data.frame(x=years,
                      y1=retroR[,2],
                      y2=retroR[,3],
                      y3=retroR[,4],
                      y4=retroR[,5],
                      y5=retroR[,6],
                      lower = (Rt3 -1.96*Rt3std),
                      upper = (Rt3 +1.96*Rt3std))
BD_retro<- data.frame(x=years,
                      y1=retroBD[,2],
                      y2=retroBD[,3],
                      y3=retroBD[,4],
                      y4=retroBD[,5],
                      y5=retroBD[,6],
                      lower = (BD3 -1.96*BD3std),
                      upper = (BD3 +1.96*BD3std))
Ft_retro<- data.frame(x=years,
                      y1=retroF[,2],
                      y2=retroF[,3],
                      y3=retroF[,4],
                      y4=retroF[,5],
                      y5=retroF[,6],
```

```
                    lower = exp(Ft3 -1.96*Ft3std),
                    upper = exp(Ft3 +1.96*Ft3std))

#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],
                         y5=rel.diff.r[,5])
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],
                         y5=rel.diff.ssb[,5])
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],
                         y5=rel.diff.f[,5])
```

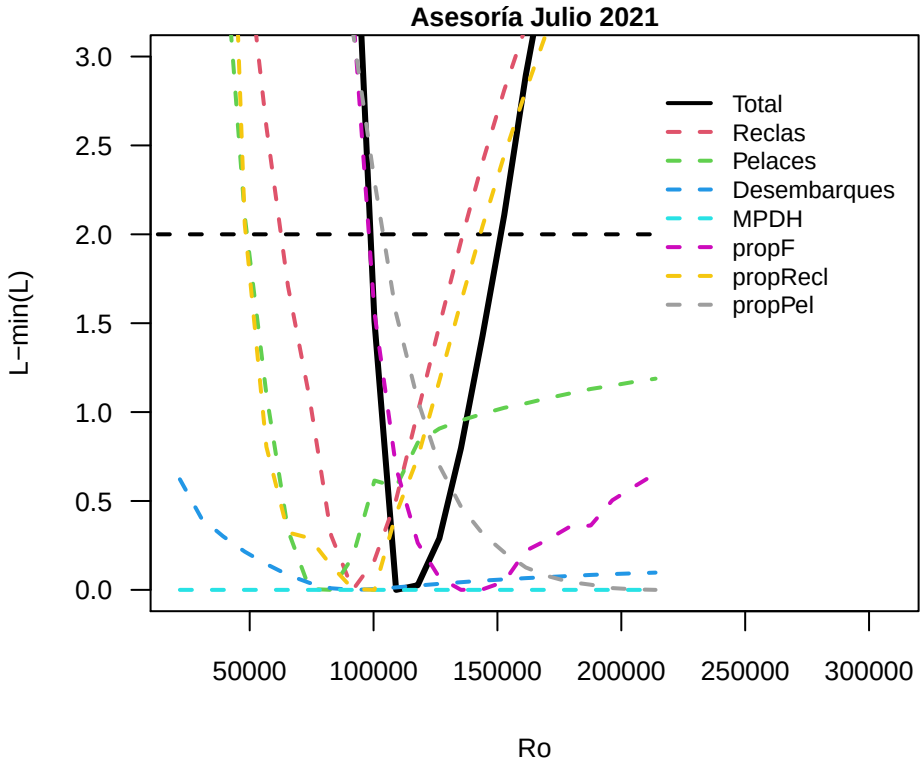
```
#Retrospectivo tradicional
Rt <- ggplot(Rt_retro) +
    geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = "IC asintótico"), alpha = 0.2)+
    geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, 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)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
    labs(x = '', y = 'Reclutamientos ',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
     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)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
    labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
     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)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
    labs(x = '', y = 'Mortalidad por pesca (1/año)',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
    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)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
   annotate("text", x=2000, y=0.5,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 = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
     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)+
```

```
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
   annotate("text", x=2000, y=0.5,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 = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
     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)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
   annotate("text", x=2000, y=0.5,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 = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

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


2017
2018
2019
2020
2021
IC asi
Reclutamientos
8e+05
6e+05
4e+05
2e+05
0e+00
1995
2005
2015
Diferencia porcentual del último año
1.0
0.5
0.0
−0.5
−1.0
Rho = −0.1
Biomasa desovante (t)
3e+06
2e+06
1e+06
0e+00
Rho = −0.01
Mortalidad por pesca (1/año)
1.5
1.0
0.5
0.0
Rho = 0.04

## 3.4. Perfil de verosimilitud

```
dir<-paste(dir.0,"/Verosimilitud_jul",sep="")
setwd(dir)

casos <-23
logRo    <- rep(0,casos)
likeval  <- matrix(ncol=15,nrow=casos)
slikeval <- matrix(ncol=16,nrow=casos)

for(i in 1:casos){
report      <- reptoRlist(paste(dir,"/MAE0721s",i,".rep",sep=""))
logRo[i]    <- report$log_Ro
likeval[i,] <- report$likeval}

like    <- data.frame(round(likeval,3),Total=apply(likeval,1,sum))
minLik  <- apply(like,2,min)                          # busca el mínimo
for(i in 1:16){slikeval[,i]<-like[,i]-minLik[i]}    # Estandarización

names<-c("Ro","Reclas","Pelaces","Desembarques","MPDH","propF",
    "propRecl","propPel","prepPelTall","DesvRt","qreclas","qpela","PenFt",
    "PenFspr","NA","NA","Total")
# Tabla verosimilitud
TLk1 <- data.frame(exp(logRo),like);colnames(TLk1)<-names
# Tabla estandarizada
TLk2 <- data.frame(exp(logRo),slikeval);colnames(TLk2)<-names

par(mar=c(4,4,1,1))
plot(TLk2$Ro,TLk2$Total,type="l",lwd=3,ylim=c(0,3),xlim=c(10^4,32*10^4),
    xaxs= "i",  ylab="L-min(L)",xlab="Ro",las=1,main='Asesoría Julio 2021',cex.main=0.8,cex.axis=0.8,cex.lab=0.8)
lines(c(0,TLk2$Ro),rep(2,casos+1),lty=2,lwd=2)
for(i in 2:8){lines(TLk2$Ro,TLk2[,i],col=i,lty=2,lwd=2)}
#for(i in 9:14){lines(TLk2$Ro,TLk2[,i],col=i,lty=3,lwd=2)}
legend(210000,2.9,names[c(17,2:8)],col=1:8,lty=c(1,rep(2,7)),lwd=2,bty="n",cex=0.75)
```



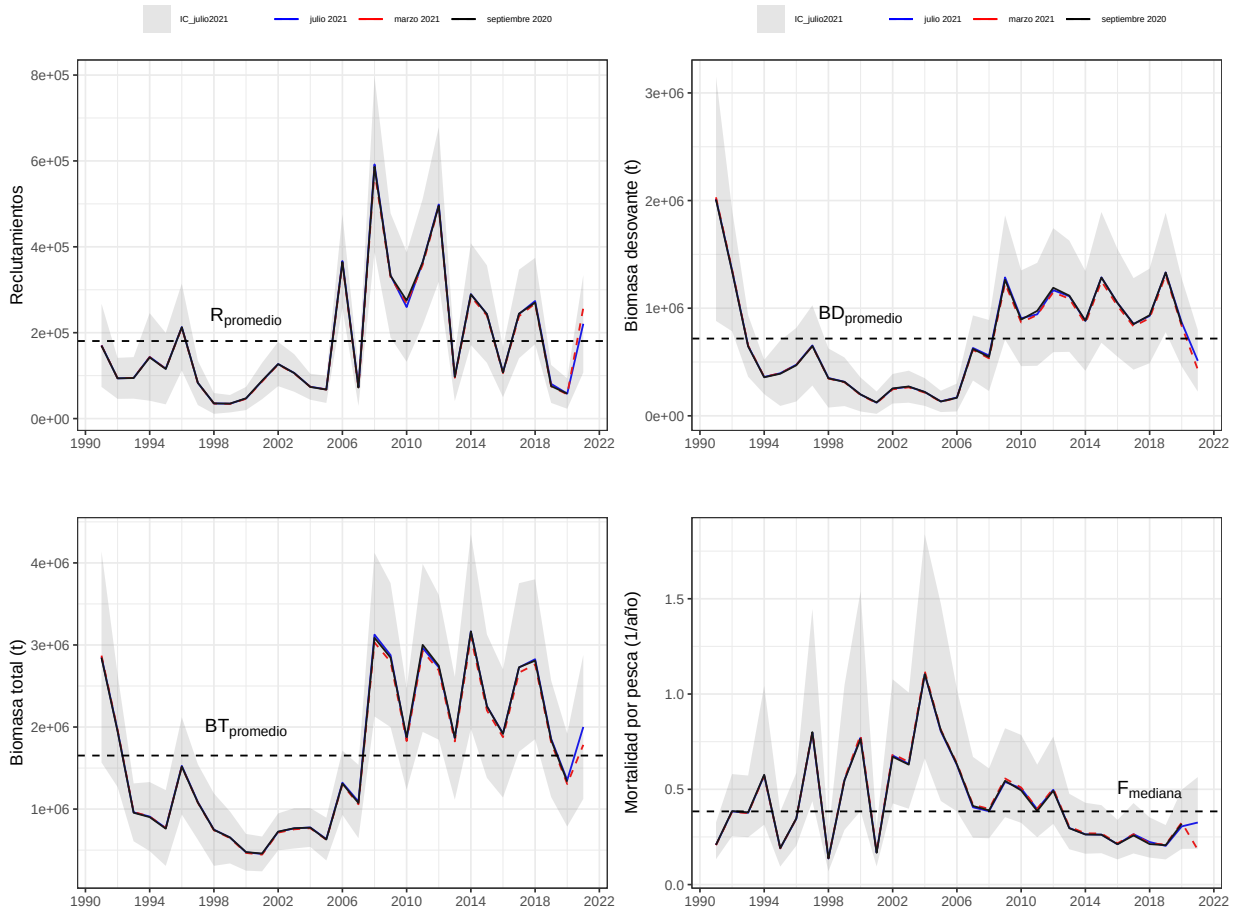

```
#legend(230000,1.5,names[9:14],col=9:14,lty=3,lwd=2,bty="n",cex=0.8)
```

## 3.5. Variables poblacionales

```
years1<-rep3$years
nyears1<-length(years1)

Rt1      <- c(subset(std1,name=="Reclutas")$value,NA)
Rt1std   <- c(subset(std1,name=="Reclutas")$std,NA)
BT1      <- c(subset(std1,name=="BT")$value,NA)
BT1std   <- c(subset(std1,name=="BT")$std,NA)
BD1      <- c(subset(std1,name=="SSB")$value,NA)
BD1std   <- c(subset(std1,name=="SSB")$std,NA)
Ft1      <- c(subset(std1,name=="log_Ft")$value,NA)
Ft1std   <- c(subset(std1,name=="log_Ft")$std,NA)

VarPobSep<- data.frame(x=years1,
                       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))
```

```
years2<-rep2$years
nyears2<-length(years2)

Rt2      <- subset(std2,name=="Reclutas")$value
Rt2std   <- subset(std2,name=="Reclutas")$std
BT2      <- subset(std2,name=="BT")$value
BT2std   <- subset(std2,name=="BT")$std
BD2      <- subset(std2,name=="SSB")$value
BD2std   <- subset(std2,name=="SSB")$std
Ft2      <- subset(std2,name=="log_Ft")$value
Ft2std   <- subset(std2,name=="log_Ft")$std

VarPobMar<- data.frame(x=years2,
                       Rt2=Rt2,
                       BT2=BT2,
                       BD2=BD2,
                       Ft2=exp(Ft2),
         lowerRt2 = (Rt2 -1.96*Rt2std),
         upperRt2 = (Rt2+1.96*Rt2std),
         lowerBT2 = (BT2 -1.96*BT2std),
         upperBT2 = (BT2+1.96*BT2std),
         lowerBD2 = (BD2 -1.96*BD2std),
         upperBD2 = (BD2+1.96*BD2std),
         lowerFt2 = exp(Ft2 -1.96*Ft2std),
         upperFt2 = exp(Ft2+1.96*Ft2std))
```

```
years3   <- rep3$years
nyears3  <- length(years3)

Rt3      <- subset(std3,name=="Reclutas")$value
Rt3std   <- subset(std3,name=="Reclutas")$std
BT3      <- subset(std3,name=="BT")$value
BT3std   <- subset(std3,name=="BT")$std
BD3      <- subset(std3,name=="SSB")$value
BD3std   <- subset(std3,name=="SSB")$std
Ft3      <- subset(std3,name=="log_Ft")$value
Ft3std   <- subset(std3,name=="log_Ft")$std

VarPobJul<- data.frame(x=years3,
                       Rt3=Rt3,
                       BT3=BT3,
                       BD3=BD3,
                       Ft3=exp(Ft3),
         lowerRt3 = (Rt3 -1.96*Rt3std),
         upperRt3 = (Rt3 +1.96*Rt3std),
         lowerBT3 = (BT3 -1.96*BT3std),
         upperBT3 = (BT3 +1.96*BT3std),
         lowerBD3 = (BD3 -1.96*BD3std),
         upperBD3 = (BD3 +1.96*BD3std),
         lowerFt3 = exp(Ft3 -1.96*Ft3std),
         upperFt3 = exp(Ft3 +1.96*Ft3std))
```


IC_julio2021
julio 2021
marzo 2021
septiembre 2020
Reclutamientos
$R_{promedio}$
Biomasa desovante (t)
$BD_{promedio}$
Biomasa total (t)
$BT_{promedio}$
Mortalidad por pesca (1/año)
$F_{mediana}$

```r
yearsb<-c("1990/91","1991/92","1992/93","1993/94","1994/95","1995/96","1996/97","1997/98","1998/99","1999/00","2000/01","2001/02

Rt1      <- c(subset(std1,name=="Reclutas")$value,NA)
Rt1std   <- c(subset(std1,name=="Reclutas")$std,NA)
BT1      <- c(subset(std1,name=="BT")$value,NA)
BT1std   <- c(subset(std1,name=="BT")$std,NA)
BD1      <- c(subset(std1,name=="SSB")$value,NA)
BD1std   <- c(subset(std1,name=="SSB")$std,NA)
Ft1      <- c(subset(std1,name=="log_Ft")$value,NA)
Ft1std   <- c(subset(std1,name=="log_Ft")$std,NA)


Rt2      <- subset(std2,name=="Reclutas")$value
Rt2std   <- subset(std2,name=="Reclutas")$std
BT2      <- subset(std2,name=="BT")$value
BT2std   <- subset(std2,name=="BT")$std
BD2      <- subset(std2,name=="SSB")$value
BD2std   <- subset(std2,name=="SSB")$std
Ft2      <- subset(std2,name=="log_Ft")$value
Ft2std   <- subset(std2,name=="log_Ft")$std


Rt3      <- rep3$Reclutas
Rt3std   <- subset(std3,name=="Reclutas")$std
BT3      <- rep3$BT
BT3std   <- subset(std3,name=="BT")$std
BD3      <- rep3$SSB
BD3std   <- subset(std3,name=="SSB")$std
Ft3      <- log(rep3$Ftot)
Ft3std   <- subset(std3,name=="log_Ft")$std


VarPobl1<- cbind('Año'=yearsb,
                 "$BD_{sept}$"=c(BD1),
                 "$BD_{marzo}$"=c(BD2),
                 "$BD_{julio}$"=c(BD3),
                 "$BT_{sept}$"=c(BT1),
                 "$BT_{marzo}$"=c(BT2),
                 "$BT_{julio}$"=c(BT3),
                 "$R_{sept}$"=c(Rt1),
                 "$R_{marzo}$"=c(Rt2),
                 "$R_{julio}$"=c(Rt3),
                 "$F_{sept}$"=c(round(exp(Ft1),3)),
                 "$F_{marzo}$"=c(round(exp(Ft2),3)),
                 "$F_{julio}$"=c(round(exp(Ft3),3)))
kable(VarPobl1)
```

| Año | $BD_{sept}$ | $BD_{marzo}$ | $BD_{julio}$ | $BT_{sept}$ | $BT_{marzo}$ | $BT_{julio}$ | $R_{sept}$ | $R_{marzo}$ | $R_{julio}$ | $F_{sept}$ | $F_{marzo}$ | $F_{julio}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990/91 | 2008700 | 2030000 | 2015480 | 2844200 | 2870400 | 2854570 | 169670 | 170120 | 170639 | 0.209 | 0.207 | 0.208 |
| 1991/92 | 1344500 | 1358500 | 1351070 | 1949500 | 1966700 | 1957010 | 93768 | 94041 | 93684.9 | 0.386 | 0.382 | 0.384 |
| 1992/93 | 645250 | 652550 | 648897 | 955290 | 964360 | 960132 | 94409 | 94707 | 94732.2 | 0.379 | 0.375 | 0.377 |
| 1993/94 | 358150 | 362070 | 360662 | 902180 | 909000 | 908707 | 142470 | 143180 | 143611 | 0.576 | 0.57 | 0.573 |
| 1994/95 | 390940 | 395090 | 395593 | 761620 | 767170 | 769117 | 115500 | 115760 | 116301 | 0.192 | 0.19 | 0.19 |
| 1995/96 | 469770 | 473120 | 475138 | 1518000 | 1517100 | 1526620 | 212650 | 211490 | 213115 | 0.347 | 0.347 | 0.346 |
| 1996/97 | 648700 | 647450 | 653825 | 1080200 | 1077600 | 1086140 | 83311 | 82828 | 83214 | 0.8 | 0.803 | 0.796 |
| 1997/98 | 348370 | 346010 | 351479 | 746840 | 741130 | 749454 | 35378 | 35062 | 35261.1 | 0.137 | 0.138 | 0.137 |
| 1998/99 | 314830 | 311640 | 316169 | 653870 | 646260 | 654159 | 34847 | 34292 | 34642.9 | 0.547 | 0.555 | 0.548 |
| 1999/00 | 198580 | 194090 | 198246 | 475590 | 465230 | 473346 | 47251 | 46073 | 46792.4 | 0.764 | 0.786 | 0.77 |
| 2000/01 | 123590 | 118470 | 122362 | 457800 | 444970 | 453525 | 88252 | 86319 | 87439.7 | 0.167 | 0.172 | 0.169 |
| 2001/02 | 254560 | 246340 | 251598 | 725490 | 713020 | 722233 | 126940 | 126130 | 127032 | 0.671 | 0.686 | 0.678 |
| 2002/03 | 272510 | 264590 | 270551 | 766550 | 753550 | 765101 | 105990 | 105110 | 106224 | 0.63 | 0.643 | 0.633 |
| 2003/04 | 221470 | 215090 | 221022 | 773620 | 767100 | 775923 | 73689 | 73955 | 74159.6 | 1.104 | 1.12 | 1.104 |
| 2004/05 | 132870 | 130190 | 133954 | 629360 | 626840 | 634685 | 67496 | 67638 | 68097.8 | 0.809 | 0.813 | 0.804 |
| 2005/06 | 167690 | 166450 | 170388 | 1310300 | 1299600 | 1321650 | 364340 | 361230 | 366988 | 0.631 | 0.636 | 0.628 |
| 2006/07 | 621470 | 612730 | 630224 | 1074400 | 1058400 | 1091760 | 72290 | 70839 | 74055.3 | 0.412 | 0.419 | 0.406 |
| 2007/08 | 546580 | 533910 | 560080 | 3087000 | 3029800 | 3125370 | 586530 | 576230 | 591892 | 0.389 | 0.397 | 0.385 |

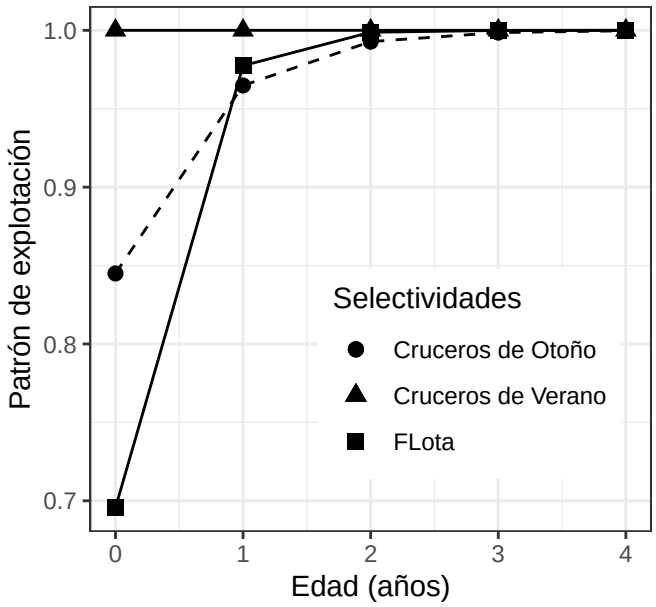
| Año | $BD_{sept}$ | $BD_{marzo}$ | $BD_{julio}$ | $BT_{sept}$ | $BT_{marzo}$ | $BT_{julio}$ | $R_{sept}$ | $R_{marzo}$ | $R_{julio}$ | $F_{sept}$ | $F_{marzo}$ | $F_{julio}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008/09 | 1263800 | 1230300 | 1285730 | 2846100 | 2794700 | 2875880 | 332590 | 329460 | 333486 | 0.545 | 0.557 | 0.539 |
| 2009/10 | 894040 | 867720 | 906147 | 1877000 | 1828600 | 1852850 | 275020 | 268470 | 259700 | 0.494 | 0.509 | 0.505 |
| 2010/11 | 974810 | 936800 | 942980 | 3000800 | 2926400 | 2963710 | 364240 | 358290 | 364438 | 0.386 | 0.398 | 0.395 |
| 2011/12 | 1189500 | 1147700 | 1167280 | 2747600 | 2690600 | 2728000 | 495590 | 492960 | 498579 | 0.493 | 0.504 | 0.498 |
| 2012/13 | 1116600 | 1088100 | 1111240 | 1869900 | 1824500 | 1862960 | 97434 | 95115 | 97325.9 | 0.296 | 0.303 | 0.297 |
| 2013/14 | 883910 | 857790 | 881823 | 3164100 | 3096700 | 3165820 | 289240 | 284180 | 289821 | 0.263 | 0.269 | 0.264 |
| 2014/15 | 1284500 | 1250400 | 1286070 | 2252000 | 2202700 | 2254280 | 243240 | 240020 | 243378 | 0.262 | 0.268 | 0.262 |
| 2015/16 | 1047700 | 1021300 | 1049280 | 1916400 | 1876300 | 1921390 | 107500 | 106000 | 108023 | 0.212 | 0.217 | 0.212 |
| 2016/17 | 851980 | 831090 | 853911 | 2728000 | 2663200 | 2726220 | 244410 | 238570 | 243660 | 0.258 | 0.264 | 0.264 |
| 2017/18 | 934650 | 907150 | 928190 | 2809100 | 2763000 | 2826010 | 270150 | 267990 | 273830 | 0.213 | 0.216 | 0.223 |
| 2018/19 | 1331300 | 1307200 | 1331900 | 1841000 | 1811000 | 1855990 | 75649 | 75099 | 80726.6 | 0.207 | 0.21 | 0.203 |
| 2019/20 | 849310 | 832960 | 866506 | 1333000 | 1305400 | 1352630 | 58067 | 56309 | 58187.9 | 0.319 | 0.326 | 0.306 |
| 2020/21 | NA | 430060 | 511108 | NA | 1782600 | 2000590 | NA | 257750 | 220797 | NA | 0.183 | 0.326 |

```
#setwd(dir.basedatos)
write.csv(VarPobl1, file="Tabla_20_indicadorespoblacionales.csv")
#setwd(dir.1)
```

```
# Reclutimientos asesoría marzo 2021
Rprom_1991_2007<-mean(Rt3[1:17])
Rprom_2008_2012<-mean(Rt3[18:22])
Rprom_2013_2021<-mean(Rt3[23:31])
Rprom_2013_2020<-mean(Rt3[23:30])
Rprom_historico<-mean(Rt3)

Rprom<-rbind(Rprom_1991_2007,
      Rprom_2008_2012,
      Rprom_2013_2021,
      Rprom_2013_2020,
      Rprom_historico)

#diferencia del Rúltimo año y los promedios de los tres períodos principales
Rlast_1991_2007<-1-(Rt3[31]/Rprom_1991_2007)
Rlast_2008_2012<-1-(Rt3[31]/Rprom_2008_2012)
Rlast_2013_2021<-1-(Rt3[31]/Rprom_2013_2021)
Rlast_2013_2020<-1-(Rt3[31]/Rprom_2013_2020)
Rlast_historico<-1-(Rt3[31]/Rprom_historico)

difR<-rbind(Rlast_1991_2007,
      Rlast_2008_2012,
      Rlast_2013_2021,
      Rlast_2013_2020,
      Rlast_historico)

# Biomasa total (BT) asesoría marzo 2021
BTprom_1991_2007<-mean(BT3[1:17])
BTprom_2008_2012<-mean(BT3[18:22])
BTprom_2013_2021<-mean(BT3[23:31])
BTprom_2013_2020<-mean(BT3[23:30])
BTprom_historico<-mean(BT3)

BTprom<-rbind(BTprom_1991_2007,
      BTprom_2008_2012,
      BTprom_2013_2021,
      BTprom_2013_2020,
      BTprom_historico)

#diferencia del BT último año y los promedios de los tres períodos principales
BTlast_1991_2007<-1-(BT3[31]/BTprom_1991_2007)
BTlast_2008_2012<-1-(BT3[31]/BTprom_2008_2012)
BTlast_2013_2021<-1-(BT3[31]/BTprom_2013_2021)
BTlast_2013_2020<-1-(BT3[31]/BTprom_2013_2020)
BTlast_historico<-1-(BT3[31]/BTprom_historico)

difBT<- rbind(BTlast_1991_2007,
      BTlast_2008_2012,
      BTlast_2013_2021,
      BTlast_2013_2020,
      BTlast_historico)


# Biomasa desovante (BD) asesoría marzo 2021

BDprom_1991_2007<-mean(BD3[1:17])
BDprom_2008_2012<-mean(BD3[18:22])
BDprom_2013_2021<-mean(BD3[23:31])
BDprom_2013_2020<-mean(BD3[23:30])
BDprom_historico<-mean(BD3)

BDprom<-rbind(BDprom_1991_2007,
      BDprom_2008_2012,
      BDprom_2013_2021,
      BDprom_2013_2020,
      BDprom_historico)
```

```r
#diferencia del BD último año y los promedios de los tres períodos principales
BDlast_1991_2007<-1-(BD3[31]/BDprom_1991_2007)
BDlast_2008_2012<-1-(BD3[31]/BDprom_2008_2012)
BDlast_2013_2021<-1-(BD3[31]/BDprom_2013_2021)
BDlast_2013_2020<-1-(BD3[31]/BDprom_2013_2020)
BDlast_historico<-1-(BD3[31]/BDprom_historico)

difBD<-rbind(BDlast_1991_2007,
      BDlast_2008_2012,
      BDlast_2013_2021,
      BDlast_2013_2020,
      BDlast_historico)


diferencias<-cbind(difR,difBT,difBD,Rprom,BTprom,BDprom)
colnames(diferencias)<-c("difRt","difBT","difBD","Rprom","BTprom","BDprom")
diferencias

write.csv(diferencias, file="Tabla_20_diferencias.csv")
```

```
sel_Flota<-rep3$Sel_flota[1,]
sel_CruV <-rep3$Sel_reclas[1,]
sel_CruO <-rep3$Sel_pelaces[1,]

g1 <- ggplot () +
     #lineas
     geom_line(aes(x=age,y=sel_Flota))+
     geom_line(aes(x=age,y=sel_CruV))+
     geom_line(aes(x=age,y=sel_CruO),linetype="dashed")+
     #puntos
     geom_point(aes(x=age,y=sel_Flota,shape="FLota"),size=2.5) +
     geom_point(aes(x=age,y=sel_CruV,shape="Cruceros de Verano"),size=2.5) +
     geom_point(aes(x=age,y=sel_CruO,shape="Cruceros de Otoño"),size=2.5) +
     #parámetros
     labs(x = 'Edad (años)', y = 'Patrón de explotación',shape="Selectividades") +
     ggtitle("")+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5),legend.justification=c(1.1,0), legend.position=c(1,0.1))
g1
```



## 3.6. Puntos biológicos de referencia

```
#PBR año biologico
Amax        <- dat1$nedades
Fmort       <- seq(0,3.5,0.02)
nf          <- length(Fmort)
R0            <- 1
#datos de entrada
Dat<-list()
Dat$M           <- dat1$par[5]
Dat$Tspw      <- dat1$Dt[3]
Dat$Mad     <- dat1$madurezsexual
Dat$Wmed      <- colMeans(dat1$Wmed)
Dat$Wini      <- colMeans(dat1$Wini)
Dat$Sel     <- rep1$Sel_flota[1,]

Rmed1        <- mean(Rt1,na.rm = T)
Bmed1        <- mean(BD1,na.rm = T)
Fmedian1     <- exp(median(Ft1,na.rm = T))

Bobj        <-c(.85,.80,.60,.55,.52,.50,.45,.40,.30,.325,0.425)
Fobj        <- optim(par=rep(0.,11),fn=SPRFpbr,method='BFGS')

SPR1            <- SPRFmort(Rmed1,c(0,Fobj$par,Fmedian1,rep1$Ftot[25]),Amax,Dat)
pSPR_Fmh1    <- as.numeric(SPR1[13,4])                    # Paso 2: Cálculo de la curva SPR
pB_Fmh1      <- pSPR_Fmh1-0.05                            # Paso 3: Aproximación obtención de %BD(Fmh)
SPRcurv1        <- SPRFmort(R0,Fmort,Amax,Dat)
```

```r
#PBR año biologico
Amax        <- dat2$nedades
Fmort       <- seq(0,3.5,0.02)
nf          <- length(Fmort)
R0            <- 1
#datos de entrada
Dat<-list()
Dat$M           <- dat2$par[5]
Dat$Tspw      <- dat2$Dt[3]
Dat$Mad     <- dat2$madurezsexual
Dat$Wmed      <- colMeans(dat2$Wmed)
Dat$Wini      <- colMeans(dat2$Wini)
Dat$Sel     <- rep2$Sel_flota[1,]

Rmed2        <- mean(Rt2)
Bmed2        <- mean(BD2)
Fmedian2     <- exp(median(Ft2))

Bobj        <-c(.85,.80,.60,.55,.52,.50,.45,.40,.30,.325,0.425)
Fobj        <- optim(par=rep(0.,11),fn=SPRFpbr,method='BFGS')

SPR2            <- SPRFmort(Rmed2,c(0,Fobj$par,Fmedian2,rep2$Ftot[25]),Amax,Dat)
pSPR_Fmh2    <- as.numeric(SPR2[13,4])                    # Paso 2: Cálculo de la curva SPR
pB_Fmh2      <- pSPR_Fmh2-0.05                            # Paso 3: Aproximación obtención de %BD(Fmh)
SPRcurv2        <- SPRFmort(R0,Fmort,Amax,Dat)
```

```r
#PBR año biologico
Amax        <- dat3$nedades
Fmort       <- seq(0,3.5,0.02)
nf          <- length(Fmort)
R0            <- 1
#datos de entrada
Dat<-list()
Dat$M           <- dat3$par[5]
Dat$Tspw      <- dat3$Dt[3]
Dat$Mad     <- dat3$madurezsexual
Dat$Wmed      <- colMeans(dat3$Wmed)
Dat$Wini      <- colMeans(dat3$Wini)
Dat$Sel     <- rep3$Sel_flota[1,]

Rmed3        <- mean(Rt3)
Bmed3        <- mean(BD3)
Fmedian3     <- exp(median(Ft3))

Bobj        <-c(.85,.80,.60,.55,.52,.50,.45,.40,.30,.325,0.425)
Fobj        <- optim(par=rep(0.,11),fn=SPRFpbr,method='BFGS')

SPR3            <- SPRFmort(Rmed3,c(0,Fobj$par,Fmedian3,rep3$Ftot[25]),Amax,Dat)
pSPR_Fmh3    <- as.numeric(SPR3[13,4])                    # Paso 2: Cálculo de la curva SPR
pB_Fmh3      <- pSPR_Fmh3-0.05                            # Paso 3: Aproximación obtención de %BD(Fmh)
SPRcurv3        <- SPRFmort(R0,Fmort,Amax,Dat)
```

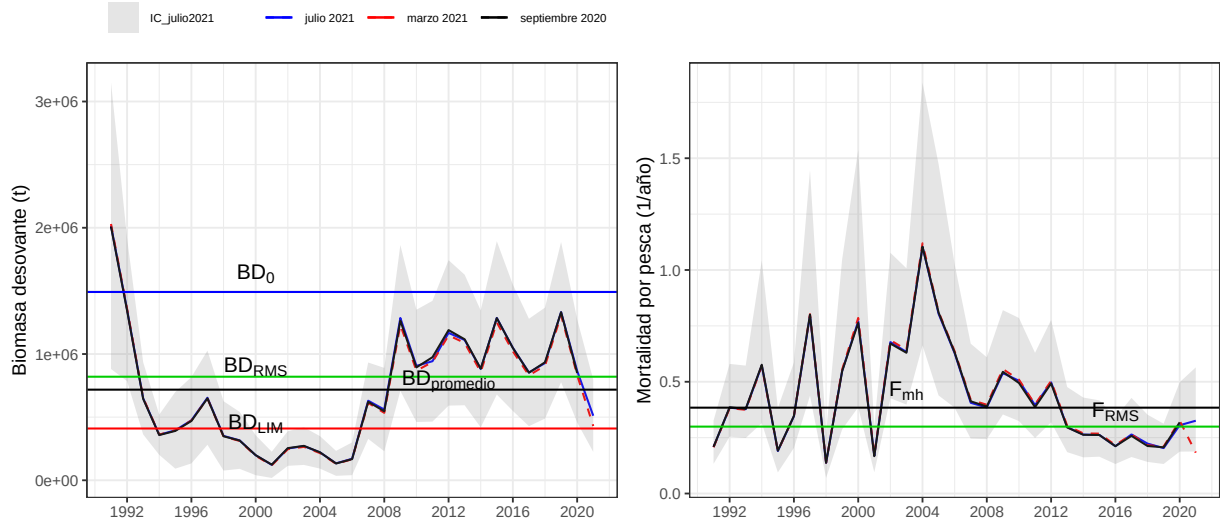
```r
# ASESORÍA DE SEPTIEMBRE
Bo1           <- rep1$SSBpbr[1]                        # Paso 4: Obtenci?n de Bo
BRMS1         <- rep1$SSBpbr[3]                        # Paso 5: Obtenci?n de Brms = 60%SPRo = 55%Bo
FRMS1         <- rep1$Fs[2]
BLIM1         <- Bo1*0.275                             # Paso 6: Obtenci?n de Blim = 20%Bo
FLIM1         <- rep1$Fs[3]                            # Paso 6: Obtenci?n de Flim = 30%SPRo
SpB1          <- BD1                                 # BD serie hist?rica de evaluaci?n de stock
SpBSE1        <- BD1std                              # desviaci?n estandar BD
ln_Fyr1       <- Ft1                                   # logaritmo de Ft
ln_FSE1       <- Ft1std                                # logaritmo de la desviaci?n standar de Ft
```

```
# ASESORÍA DE SEPTIEMBRE
Bo2           <- rep2$SSBpbr[1]                    # Paso 4: Obtenci?n de Bo
BRMS2         <- rep2$SSBpbr[3]                    # Paso 5: Obtenci?n de Brms = 60%SPRo = 55%Bo
FRMS2         <- rep2$Fs[2]
BLIM2         <- Bo2*0.275                         # Paso 6: Obtenci?n de Blim = 20%Bo
FLIM2         <- rep2$Fs[3]                        # Paso 6: Obtenci?n de Flim = 30%SPRo
SpB2          <- BD2                              # BD serie hist?rica de evaluaci?n de stock
SpBSE2        <- BD2std                           # desviaci?n estandar BD
ln_Fyr2       <- Ft2                               # logaritmo de Ft
ln_FSE2       <- Ft2std                            # logaritmo de la desviaci?n standar de Ft
```

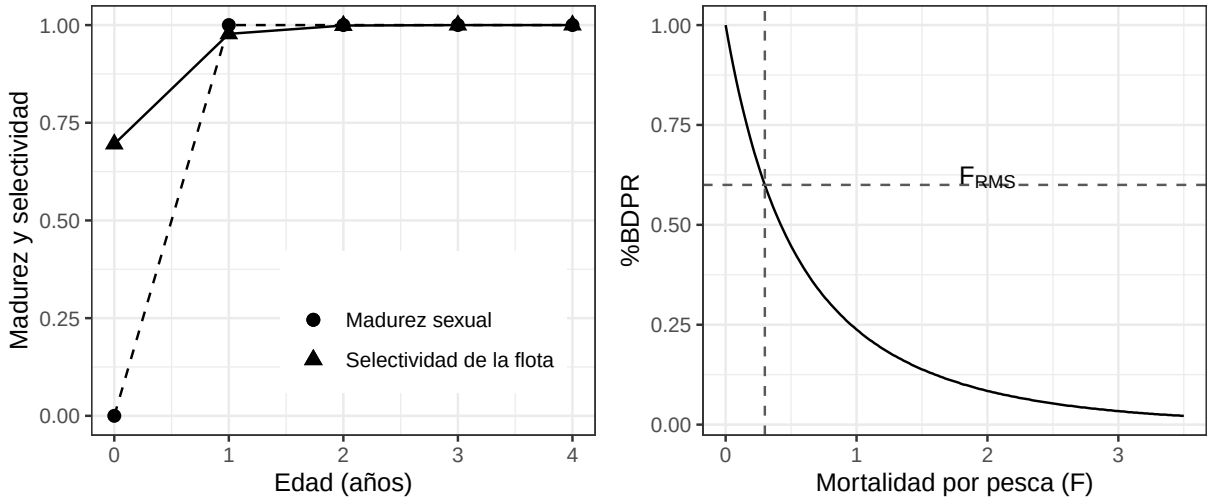
```
# ASESORÍA DE SEPTIEMBRE
Bo3           <- rep3$SSBpbr[1]                    # Paso 4: Obtenci?n de Bo
BRMS3         <- rep3$SSBpbr[3]                    # Paso 5: Obtenci?n de Brms = 60%SPRo = 55%Bo
FRMS3         <- rep3$Fs[2]
BLIM3         <- Bo3*0.275                         # Paso 6: Obtenci?n de Blim = 20%Bo
FLIM3         <- rep3$Fs[3]                        # Paso 6: Obtenci?n de Flim = 30%SPRo
SpB3          <- BD3                              # BD serie hist?rica de evaluaci?n de stock
SpBSE3        <- BD3std                           # desviaci?n estandar BD
ln_Fyr3       <- Ft3                               # logaritmo de Ft
ln_FSE3       <- Ft3std                            # logaritmo de la desviaci?n standar de Ft
```

```
Tabla3.1<-rbind( "BDpromedio"=c(round(Bmed1/10^3,0),
                                round(Bmed2/10^3,0),
                                round(Bmed3/10^3,0)),
                 "Fmh"=c(round(Fmedian1,2),
                         round(Fmedian2,2),
                         round(Fmedian3,2)),
                 "%BDPR_Fmh"=c(pSPR_Fmh1*100,
                               pSPR_Fmh2*100,
                               pSPR_Fmh3*100),
                 "%BDPR_F~RMS~"=c(60,
                                  60,
                                  60),
                 "%BD_Fmh"=c(pB_Fmh1*100,
                             pB_Fmh2*100,
                             pB_Fmh3*100),
                 "%BD_F~RMS~"=c(55,
                                55,
                                55),
                 "BDo"=c(round(Bo1/10^3,0),
                         round(Bo2/10^3,0),
                         round(Bo3/10^3,0)),
                 "BD55%"=c(round(BRMS1/10^3,0),
                           round(BRMS2/10^3,0),
                           round(BRMS3/10^3,0)),
                 "BD27.5%"=c(round(BLIM1/10^3,0),
                             round(BLIM2/10^3,0),
                             round(BLIM3/10^3,0)))

colnames(Tabla3.1)<-c("Septiembre","Marzo","Julio")
kable(Tabla3.1, align = 'c')

write.csv(Tabla3.1, file="Tabla21_PBRsporasesoria.csv")
```

```
BD <- ggplot() +
     geom_line(data=VarPobJul,aes(y=BD3, x=x, colour = "julio 2021"), linetype="solid",size=0.5)+
     geom_line(data=VarPobMar,aes(y=BD2, x=x, colour = "marzo 2021"), linetype="dashed",size=0.5)+
     geom_line(data=VarPobSep,aes(y=BD1, x=x, colour = "septiembre 2020"), linetype="solid",size=0.5)+
     geom_ribbon(data=VarPobJul,aes(ymin=lowerBD3, ymax=upperBD3, x=x, fill = "IC_julio2021"), alpha = 0.2)+
     #geom_ribbon(data=VarPobMar,aes(ymin=lowerBD2, ymax=upperBD2, x=x, fill = ""), alpha = 0.2)+
     #geom_ribbon(data=VarPobSep,aes(ymin=lowerBD1, ymax=upperBD1, x=x, fill = ""), alpha = 0.2)+
     geom_hline(yintercept = c(BRMS3,BLIM3,Bo3,Bmed3),colour=c('green3','red','blue','black'))+
     annotate("text", x=c(rep(2000,3),2012), y=c(BRMS3*1.1,BLIM3*1.1,Bo3*1.1,Bmed3*1.1),
              label=c(expression("BD"[RMS]),expression("BD"[LIM]),expression("BD"[0]),expression("BD"[promedio]))) +
     labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías')  +
     scale_x_continuous(breaks = seq(from = 1960, to = 2022, by = 4)) +
     scale_colour_manual("",values=c('blue','red',"black"))+
     scale_linetype_manual(values=c("solid", "dashed","solid"))+
     scale_fill_manual("",values=c("grey50","grey60",'gray35'))+
     theme_bw(base_size=10) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="top",legend.text = element_text(size=6))

Ft <- ggplot() +
    geom_line(data=VarPobJul,aes(y=Ft3, x=x, colour = "julio 2021"),linetype="solid", size=0.5)+
    geom_line(data=VarPobMar,aes(y=Ft2, x=x, colour = "marzo 2021"), linetype="dashed",size=0.5)+
    geom_line(data=VarPobSep,aes(y=Ft1, x=x, colour = "septiembre 2020"), linetype="solid",size=0.5)+
    geom_ribbon(data=VarPobJul,aes(ymin=lowerFt3, ymax=upperFt3, x=x, fill = "IC_julio2021"), alpha = 0.2)+
    #geom_ribbon(data=VarPobMar,aes(ymin=lowerFt2, ymax=upperFt2, x=x, fill = ""), alpha = 0.2)+
    #geom_ribbon(data=VarPobSep,aes(ymin=lowerFt1, ymax=upperFt1, x=x, fill = ""), alpha = 0.2)+
     geom_hline(yintercept = c(FRMS3,median(VarPobJul$Ft3)),colour=c('green3','black')) +
     annotate("text", x=c(2016,2003), y=c(FRMS3*1.02, median(exp(ln_Fyr3)))*1.2, label=c(expression("F"[RMS]), expression("F"[mh
    labs(x = '', y = 'Mortalidad por pesca (1/año)',colour='Asesorías')  +
    scale_x_continuous(breaks = seq(from = 1960, to = 2022, by = 4)) +
    scale_colour_manual("",values=c('blue','red',"black"))+
    scale_linetype_manual(values=c("solid", "dashed","solid"))+
     scale_fill_manual("",values=c("grey50","grey60",'gray35'))+
     theme_bw(base_size=10) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BD + Ft
```



```
sel_Flota <- rep3$Sel_flota[1,]
madurez   <- dat3$madurezsexual
Fspr      <- SPRcurv3[,1]
BDspr     <- SPRcurv3[,4]

g1 <- ggplot () +
     #lineas
     geom_line(aes(x=age,y=sel_Flota))+
     geom_line(aes(x=age,y=madurez),linetype="dashed")+
     #puntos
     geom_point(aes(x=age,y=sel_Flota,shape="Selectividad de la flota"),size=2.5) +
     geom_point(aes(x=age,y=madurez,shape="Madurez sexual"),size=2.5) +
     #parámetros
     labs(x = 'Edad (años)', y = 'Madurez y selectividad',shape="") +
     ggtitle("")+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5),legend.justification=c(1.1,0), legend.position=c(1,0.1))


g2 <- ggplot () +
     geom_line(aes(x=Fspr,y=BDspr))+
     geom_hline(yintercept = 0.6,colour=c('gray35'),linetype="dashed") +
     geom_vline(xintercept = FRMS3,colour=c('gray35'),linetype="dashed") +
     annotate("text", x=2, y=0.6+0.02,label=c(expression("F"[RMS]))) +
     labs(x = 'Mortalidad por pesca (F)', y = '%BDPR',shape="") +
     ggtitle("")+
     theme_bw(base_size=11) +
     theme(plot.title = element_text(hjust = 0.5),legend.justification=c(1.1,0), legend.position=c(1,0.1))
g1 + g2
```



```
years1<-rep2$years
nyears1<-length(years1)
#para serie histórica
Rpr1     <- c(subset(std1,name=="RPRequ3")$value,NA);
Rpr1std  <- c(subset(std1,name=="RPRequ3")$std,NA)
Frpr1    <- c(subset(std1,name=="Frpr")$value,NA);
Frpr1std <- c(subset(std1,name=="Frpr")$std,NA)

EstatusSep<- data.frame(x=years1,
                        Rpr1=Rpr1,
                        Frpr1=Frpr1,
                        lowerRpr1  = (Rpr1 - 1.96*Rpr1std ),
                        upperRpr1  = (Rpr1 +1.96*Rpr1std ),
                        lowerFrpr1 = (Frpr1 -1.96*Frpr1std),
                        upperFrpr1 = (Frpr1 +1.96*Frpr1std))

#Para densidad de probabilidad
rprSEPT     <-subset(std1,name=="RPRequ3")$value[nyears1-1]
rprSEPTstd  <-subset(std1,name=="RPRequ3")$std[nyears1-1]
FrprSEPT    <-subset(std1,name=="Frpr")$value[nyears1-1]
FrprSEPTstd <-subset(std1,name=="Frpr")$std[nyears1-1]

# biomasa desovante vs BDrms
xbs1 <-rnorm(1000, mean = rprSEPT, sd = rprSEPTstd)
xbs  <-seq(min(xbs1),max(xbs1),0.005)
ybs  <-dnorm(xbs, mean = rprSEPT, sd =rprSEPTstd)
icbs <-qnorm(c(0.05,0.95,0.5),rprSEPT,rprSEPTstd)

# mortalidad por pesca vs Frms
xfs1 <- rnorm(1000, mean = FrprSEPT, sd = FrprSEPTstd)
xfs  <-seq(min(xfs1),max(xfs1),0.005)
yfs  <-dnorm(xfs, mean = FrprSEPT, sd =FrprSEPTstd)
icfs <-qnorm(c(0.05,0.95,0.5),FrprSEPT,FrprSEPTstd)

#distribución probabilidad
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]])))

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]])))

densb_bs  <- data.frame(x=xxbs, y=yybs , t=rep('a', length(xxbs)), r=seq(1,length(xxbs),1))
densb_fs  <- data.frame(x=xxfs, y=yyfs , t=rep('a', length(xxfs)), r=seq(1,length(xxfs),1))

### *Probabilidad de estar bajo BRMS*
#Asesoría Septiembre #P(BD<BDrms)
pa_sept<-pnorm(1,rprSEPT,rprSEPTstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar bajo FRMS*
#Asesoría Septiembre #P(F>Frms)
pb_sept<-1-pnorm(1,FrprSEPT,FrprSEPTstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de sobreexplotacion*
#Asesoría Septiembre #P(BD<BDrms)
pc_sept<-pnorm(0.9,rprSEPT,rprSEPTstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de colapso*
#Asesoría Septiembre #P(BD<BDrms)
pd_sept<-pnorm(0.5,rprSEPT,rprSEPTstd,lower.tail = TRUE,log.p = F)
### *Probailidad de sobrepesca*
#Asesoría Septiembre #P(F>Frms)
pe_sept<-1-pnorm(1.1,FrprSEPT,FrprSEPTstd,lower.tail = TRUE,log.p = F)
```

## 3.7. Estatus

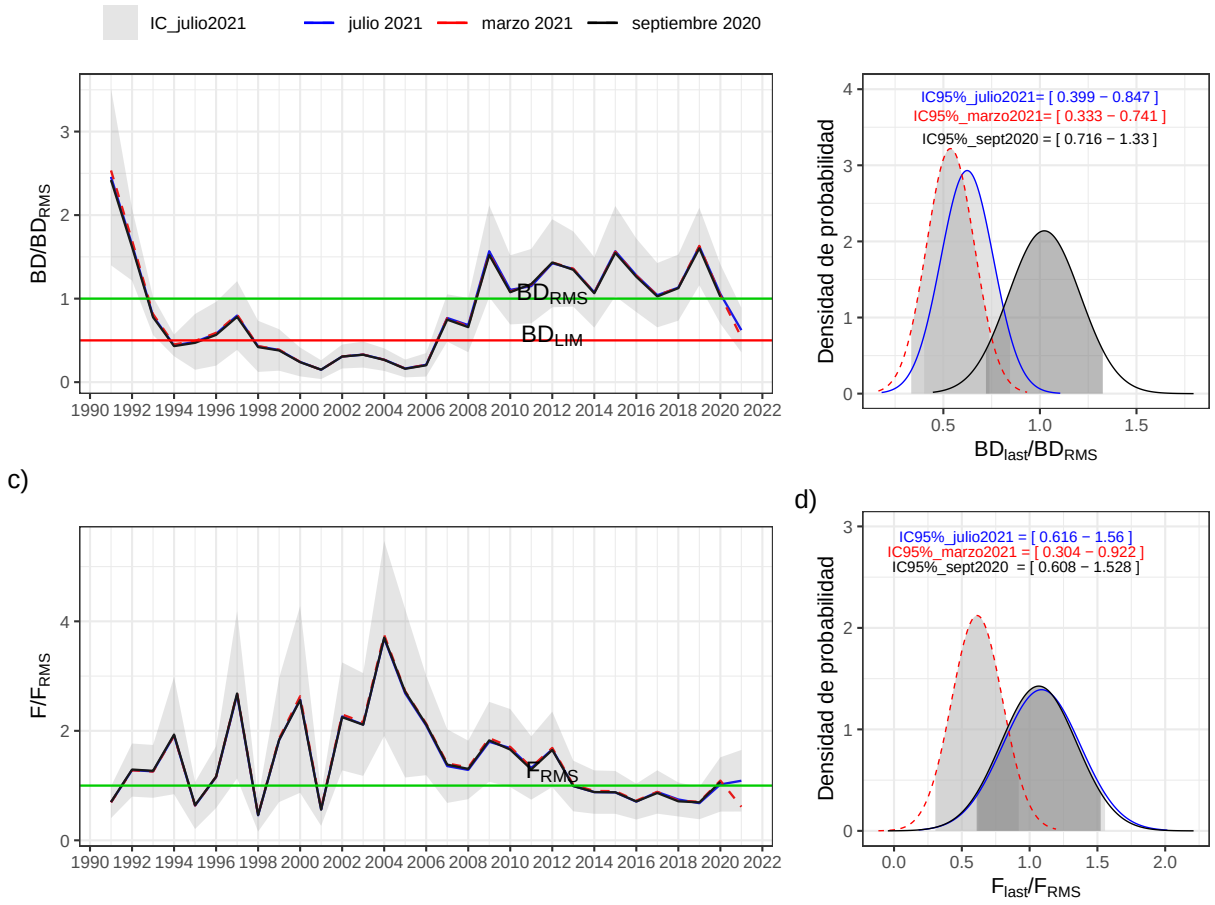
```
years2<-rep2$years
nyears2<-length(years2)

#para serie histórica indicadores del estatus
Rpr2     <- subset(std2,name=="RPRequ3")$value;
Rpr2std  <- subset(std2,name=="RPRequ3")$std
Frpr2    <- subset(std2,name=="Frpr")$value;
Frpr2std <- subset(std2,name=="Frpr")$std

EstatusMar<- data.frame(x=years2,
                        Rpr2=Rpr2,
                        Frpr2=Frpr2,
         lowerRpr2  = (Rpr2 - 1.96*Rpr2std ),
         upperRpr2   = (Rpr2 +1.96*Rpr2std ),
         lowerFrpr2 = (Frpr2 -1.96*Frpr2std),
         upperFrpr2 = (Frpr2+1.96*Frpr2std))

#Para densidad de probabilidad
rprMARZO     <-subset(std2,name=="RPRequ3")$value[nyears2]
rprMARZOstd  <-subset(std2,name=="RPRequ3")$std[nyears2]
FrprMARZO    <-subset(std2,name=="Frpr")$value[nyears2]
FrprMARZOstd <-subset(std2,name=="Frpr")$std[nyears2]
# biomasa desovante vs BDrms - densidad de probabilidad
xbm1 <-rnorm(1000, mean = rprMARZO, sd = rprMARZOstd)
xbm  <-seq(min(xbm1),max(xbm1),0.005)
ybm  <-dnorm(xbm, mean = rprMARZO, sd =rprMARZOstd)
icbm <-qnorm(c(0.05,0.95,0.5),rprMARZO,rprMARZOstd)
# mortalidad por pesca vs Frms - densidad de probabilidad
xfm1 <- rnorm(1000, mean = FrprMARZO, sd = FrprMARZOstd)
xfm  <-seq(min(xfm1),max(xfm1),0.005)
yfm  <-dnorm(xfm, mean = FrprMARZO, sd =FrprMARZOstd)
icfm <-qnorm(c(0.05,0.95,0.5),FrprMARZO,FrprMARZOstd)
#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]])))

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]])))

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

### *Probabilidad de estar bajo BRMS*
#Asesoría marzo #P(BD<BDrms)
pa_mar<-pnorm(1,rprMARZO,rprMARZOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar bajo FRMS*
#Asesoría marzo #P(F>Frms)
pb_mar<-1-pnorm(1,FrprMARZO,FrprMARZOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de sobreexplotacion*
#Asesoría marzo #P(BD<BDrms)
pc_mar<-pnorm(0.9,rprMARZO,rprMARZOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de colapso*
#Asesoría marzo #P(BD<BDrms)
pd_mar<-pnorm(0.5,rprMARZO,rprMARZOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de sobrepesca*
#Asesoría marzo #P(F>Frms)
pe_mar<-1-pnorm(1.1,FrprMARZO,FrprMARZOstd,lower.tail = TRUE,log.p = F)
```

```
years3  <-rep3$years
nyears3 <-length(years3)
```

```r
#para serie histórica indicadores del estatus
Rpr3     <- subset(std3,name=="RPRequ3")$value;
Rpr3std  <- subset(std3,name=="RPRequ3")$std
Frpr3    <- subset(std3,name=="Frpr")$value;
Frpr3std <- subset(std3,name=="Frpr")$std

EstatusJul<- data.frame(x=years3,
                        Rpr3=Rpr3,
                        Frpr3=Frpr3,
        lowerRpr3   = (Rpr3  -1.96*Rpr3std ),
        upperRpr3   = (Rpr3 +1.96*Rpr3std ),
        lowerFrpr3  = (Frpr3 -1.96*Frpr3std),
        upperFrpr3  = (Frpr3 +1.96*Frpr3std))

#Para densidad de probabilidad
rprJULIO     <-subset(std3,name=="RPRequ3")$value[nyears3]
rprJULIOstd  <-subset(std3,name=="RPRequ3")$std[nyears3]
FrprJULIO    <-subset(std3,name=="Frpr")$value[nyears3]
FrprJULIOstd <-subset(std3,name=="Frpr")$std[nyears3]
# biomasa desovante vs BDrms - densidad de probabilidad
xbj1 <-rnorm(1000, mean = rprJULIO, sd = rprJULIOstd)
xbj  <-seq(min(xbj1),max(xbj1),0.005)
ybj  <-dnorm(xbj, mean = rprJULIO, sd =rprJULIOstd)
icbj <-qnorm(c(0.05,0.95,0.5),rprJULIO,rprJULIOstd)
# mortalidad por pesca vs Frms - densidad de probabilidad
xfj1 <- rnorm(1000, mean = FrprJULIO, sd = FrprJULIOstd)
xfj  <-seq(min(xfj1),max(xfj1),0.005)
yfj  <-dnorm(xfj, mean = FrprJULIO, sd =FrprJULIOstd)
icfj <-qnorm(c(0.05,0.95,0.5),FrprJULIO,FrprJULIOstd)
#distribución probabilidad
xxbj      <- c(xbj[xbj>=icbj[1]&xbj<=icbj[2]],rev(xbj[xbj>=icbj[1]&xbj<=icbj[2]]))
yybj      <- c(ybj[xbj>=icbj[1]&xbj<=icbj[2]],rep(0,length(ybj[xbj>=icbj[1]&xbj<=icbj[2]])))
xxfj      <- c(xfj[xfj>=icfj[1]&xfj<=icfj[2]],rev(xfj[xfj>=icfj[1]&xfj<=icfj[2]]))
yyfj      <- c(yfj[xfj>=icfj[1]&xfj<=icfj[2]],rep(0,length(yfj[xfj>=icfj[1]&xfj<=icfj[2]])))

densb_bj  <- data.frame(x=xxbj, y=yybj , t=rep('a', length(xxbj)), r=seq(1,length(xxbj),1))
densb_fj  <- data.frame(x=xxfj, y=yyfj , t=rep('a', length(xxfj)), r=seq(1,length(xxfj),1))

### *Probabilidad de estar bajo BRMS*
#Asesoría julio #P(BD<BDrms)
pa_jul<-pnorm(1,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar bajo FRMS*
#Asesoría julio#P(F>Frms)
pb_jul<-1-pnorm(1,FrprJULIO,FrprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de sobreexplotacion*
#Asesoría julio #P(BD<BDrms)
pc_jul<-pnorm(0.9,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de colapso*
#Asesoría julio #P(BD<BDrms)
pd_jul<-pnorm(0.5,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de sobrepesca*
#Asesoría julio #P(F>Frms)
pe_jul<-1-pnorm(1.1,FrprJULIO,FrprJULIOstd,lower.tail = TRUE,log.p = F)
```

```
BD_BDrms <- ggplot() +
     geom_line(data=EstatusJul,aes(y=Rpr3, x=x, colour = "julio 2021"), linetype="solid", size=0.5)+
     geom_line(data=EstatusMar,aes(y=Rpr2, x=x, colour = "marzo 2021"), linetype="dashed",size=0.5)+
     geom_line(data=EstatusSep,aes(y=Rpr1, x=x, colour = "septiembre 2020"), linetype="solid",size=0.5)+
     geom_ribbon(data=EstatusJul,aes(ymin=lowerRpr3, ymax=upperRpr3, x=x, fill = "IC_julio2021"), alpha = 0.2)+
    # geom_ribbon(data=EstatusMar,aes(ymin=lowerRpr2, ymax=upperRpr2, x=x, fill = ""), alpha = 0.2)+
     #geom_ribbon(data=EstatusSep,aes(ymin=lowerRpr1, ymax=upperRpr1, x=x, fill = ""), alpha = 0.2)+
     geom_hline(yintercept = c(1,0.5),colour=c('green3','red'))+
     annotate("text", x=c(2012,2012), y=c(1,0.5)+0.06,
              label=c(expression("BD"[RMS]),expression("BD"[LIM]))) +
     labs(x = '', y = expression("BD/BD"[RMS]),colour='Asesorías',tag="a)")  +
     scale_x_continuous(breaks = seq(from = 1960, to = 2062, by = 2)) +
     scale_colour_manual("",values=c('blue','red',"black"))+
     scale_linetype_manual(values=c("solid", "dashed","solid"))+
     scale_fill_manual("",values=c("grey50","grey50",'gray35'))+
     theme_bw(base_size=10) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="top")

F_Frms <- ggplot() +
    geom_line(data=EstatusJul,aes(y=Frpr3, x=x, colour = "julio 2021"), linetype="solid",size=0.5)+
    geom_line(data=EstatusMar,aes(y=Frpr2, x=x, colour = "marzo 2021"), linetype="dashed",size=0.5)+
    geom_line(data=EstatusSep,aes(y=Frpr1, x=x, colour = "septiembre 2020"), linetype="solid",size=0.5)+
    geom_ribbon(data=EstatusJul,aes(ymin=lowerFrpr3, ymax=upperFrpr3, x=x, fill = "IC_julio2021"), alpha = 0.2)+
    #geom_ribbon(data=EstatusMar,aes(ymin=lowerFrpr2, ymax=upperFrpr2, x=x, fill = ""), alpha = 0.2)+
    #geom_ribbon(data=EstatusSep,aes(ymin=lowerFrpr1, ymax=upperFrpr1, x=x, fill = ""), alpha = 0.2)+
     geom_hline(yintercept = 1,colour=c('green3')) +
     annotate("text", x=2012, y=1+0.25,label=c(expression("F"[RMS]))) +
    labs(x = '', y = expression("F/F"[RMS]),colour='Asesorías',tag="c)")  +
    scale_x_continuous(breaks = seq(from = 1960, to = 2062, by = 2)) +
    scale_colour_manual("",values=c('blue','red',"black"))+
     scale_linetype_manual(values=c("solid", "dashed","solid"))+
     scale_fill_manual("",values=c("grey50","grey50",'gray35'))+
     theme_bw(base_size=10) +
     ggtitle('')+
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

fig_desnb<- ggplot() + lims(y=c(0,4)) +
     geom_polygon(data=densb_bj,aes(x=x, y=y, group=t,alpha=0.9),fill="gray80")+
     geom_polygon(data=densb_bm,aes(x=x, y=y, group=t,alpha=0.9),fill="gray70")+
     geom_polygon(data=densb_bs,aes(x=x, y=y, group=t,alpha=0.9),fill="gray50")+
     geom_line(aes(xbj,ybj), size=0.3,color="blue",linetype="solid")+
     geom_line(aes(xbm,ybm), size=0.3,color="red",linetype="dashed")+
     geom_line(aes(xbs,ybs), size=0.3,color="black",linetype="solid")+
     annotate("text", x=c(1,1,1), y=c(3.9,3.65,3.35), colour = c('blue',"red","black"), size = 2.5,
              label=c(paste("IC95%_julio2021= [",round(icbj[1],3),"-",round(icbj[2],3),"]",sep=" "),
                      paste("IC95%_marzo2021= [",round(icbm[1],3),"-",round(icbm[2],3),"]",sep=" "),
                      paste("IC95%_sept2020 = [",round(icbs[1],3),"-",round(icbs[2],3),"]",sep=" "))) +
     labs(x = expression("BD"[last]*"/BD"[RMS]), y = 'Densidad de probabilidad',tag="b)")  +
     theme_bw(base_size=10) +
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")

fig_desnf<- ggplot() + lims(y=c(0,3))+
     geom_polygon(data=densb_fj,aes(x=x, y=y, group=t,alpha=0.9),fill="gray80")+
     geom_polygon(data=densb_fm,aes(x=x, y=y, group=t,alpha=0.9),fill="gray70")+
     geom_polygon(data=densb_fs,aes(x=x, y=y, group=t,alpha=0.9),fill="gray50")+
     geom_line(aes(xfj,yfj), size=0.3,color="blue",linetype="solid")+
     geom_line(aes(xfm,yfm), size=0.3,color="red",linetype="dashed")+
     geom_line(aes(xfs,yfs), size=0.3,color="black",linetype="solid")+
     annotate("text", x=c(0.9,0.9,0.9), y=c(2.9,2.75,2.6), colour = c('blue',"red","black"), size = 2.5,
              label=c(paste("IC95%_julio2021 = [",round(icfj[1],3),"-",round(icfj[2],3),"]",sep=" "),
                      paste("IC95%_marzo2021 = [",round(icfm[1],3),"-",round(icfm[2],3),"]",sep=" "),
                      paste("IC95%_sept2020  = [",round(icfs[1],3),"-",round(icfs[2],3),"]",sep=" "))) +
     labs(x = expression("F"[last]*"/F"[RMS]), y = 'Densidad de probabilidad',tag="d)")  +
     theme_bw(base_size=10) +
     theme(plot.title = element_text(hjust = 0.5),legend.position="none")
```

```
{(BD_BDrms / F_Frms)   | (fig_desnb/fig_desnf)} +  plot_layout(ncol=2,widths=c(2,1))
```



```r
yearsb<-c("1990/91","1991/92","1992/93","1993/94","1994/95","1995/96","1996/97","1997/98","1998/99","1999/00","2000/01","2001/02

VarPobl2<- cbind('Años'=yearsb,
                 "$F/F_{RMS_{sept}}$"=c(round(exp(Ft1)/FRMS1,3)),
                 "$F/F_{RMS_{marzo}}$"=c(round(exp(Ft2)/FRMS2,3)),
                 "$F/F_{RMS_{julio}}$"=c(round(exp(Ft3)/FRMS3,3)),
                 "$BD/BD_{RMS_{sept}}$"=c(round(BD1/BRMS1,3)),
                 "$BD/BD_{RMS_{marzo}}$"=c(round(BD2/BRMS2,3)),
                 "$BD/BD_{RMS_{julio}}$"=c(round(BD3/BRMS3,3)))
kable(VarPobl2, align = 'c')
```

| Años | $F/F_{RMS_{sept}}$ | $F/F_{RMS_{marzo}}$ | $F/F_{RMS_{julio}}$ | $BD/BD_{RMS_{sept}}$ | $BD/BD_{RMS_{marzo}}$ | $BD/BD_{RMS_{julio}}$ |
|---|---|---|---|---|---|---|
| 1990/91 | 0.7 | 0.693 | 0.696 | 2.419 | 2.534 | 2.457 |
| 1991/92 | 1.293 | 1.279 | 1.283 | 1.619 | 1.696 | 1.647 |
| 1992/93 | 1.27 | 1.256 | 1.259 | 0.777 | 0.815 | 0.791 |
| 1993/94 | 1.931 | 1.911 | 1.913 | 0.431 | 0.452 | 0.44 |
| 1994/95 | 0.643 | 0.637 | 0.635 | 0.471 | 0.493 | 0.482 |
| 1995/96 | 1.164 | 1.161 | 1.155 | 0.566 | 0.591 | 0.579 |
| 1996/97 | 2.682 | 2.689 | 2.658 | 0.781 | 0.808 | 0.797 |
| 1997/98 | 0.461 | 0.464 | 0.458 | 0.42 | 0.432 | 0.429 |
| 1998/99 | 1.835 | 1.859 | 1.831 | 0.379 | 0.389 | 0.385 |
| 1999/00 | 2.561 | 2.632 | 2.573 | 0.239 | 0.242 | 0.242 |
| 2000/01 | 0.56 | 0.576 | 0.566 | 0.149 | 0.148 | 0.149 |
| 2001/02 | 2.249 | 2.299 | 2.263 | 0.307 | 0.308 | 0.307 |
| 2002/03 | 2.111 | 2.155 | 2.116 | 0.328 | 0.33 | 0.33 |
| 2003/04 | 3.701 | 3.751 | 3.687 | 0.267 | 0.269 | 0.269 |
| 2004/05 | 2.713 | 2.724 | 2.685 | 0.16 | 0.163 | 0.163 |
| 2005/06 | 2.116 | 2.131 | 2.096 | 0.202 | 0.208 | 0.208 |
| 2006/07 | 1.383 | 1.405 | 1.355 | 0.748 | 0.765 | 0.768 |
| 2007/08 | 1.305 | 1.331 | 1.286 | 0.658 | 0.667 | 0.683 |
| 2008/09 | 1.825 | 1.865 | 1.799 | 1.522 | 1.536 | 1.568 |
| 2009/10 | 1.657 | 1.707 | 1.685 | 1.077 | 1.083 | 1.105 |
| 2010/11 | 1.295 | 1.335 | 1.321 | 1.174 | 1.17 | 1.15 |
| 2011/12 | 1.651 | 1.688 | 1.662 | 1.433 | 1.433 | 1.423 |
| 2012/13 | 0.991 | 1.016 | 0.992 | 1.345 | 1.358 | 1.355 |
| 2013/14 | 0.881 | 0.901 | 0.881 | 1.065 | 1.071 | 1.075 |
| 2014/15 | 0.878 | 0.898 | 0.875 | 1.547 | 1.561 | 1.568 |
| 2015/16 | 0.71 | 0.726 | 0.707 | 1.262 | 1.275 | 1.279 |
| 2016/17 | 0.865 | 0.886 | 0.883 | 1.026 | 1.038 | 1.041 |
| 2017/18 | 0.713 | 0.725 | 0.746 | 1.126 | 1.133 | 1.132 |
| 2018/19 | 0.693 | 0.705 | 0.679 | 1.603 | 1.632 | 1.624 |
| 2019/20 | 1.068 | 1.091 | 1.021 | 1.023 | 1.04 | 1.056 |
| 2020/21 | NA | 0.613 | 1.088 | NA | 0.537 | 0.623 |

```r
#setwd(dir.basedatos)
write.csv(VarPobl2, file="Tabla_22_indicesReduccion.csv")
#setwd(dir.1)
```

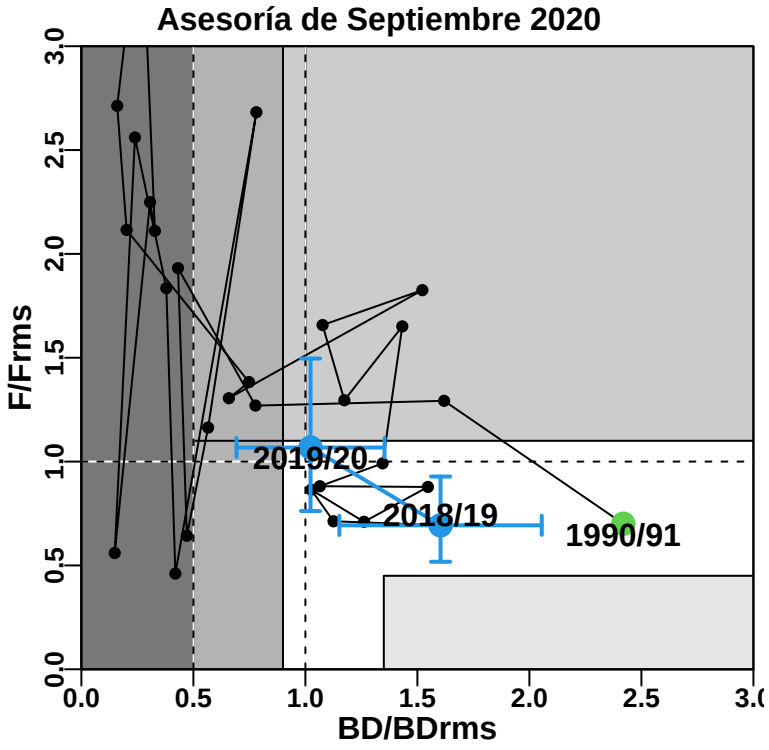
```r
yearsb<-c("1990/91","1991/92","1992/93","1993/94","1994/95","1995/96","1996/97","1997/98","1998/99","1999/00","2000/01","2001/02

VarPobl2b<- cbind('Años'=yearsb,
                 "$Y/BT_{sept}$"=c(round(rep1$desembarquepred/BT1,3)),
                  "$Y/BT_{marzo}$"=c(round(rep2$desembarquepred/BT2,3)),
                 "$Y/BT_{julio}$"=c(round(rep3$desembarquepred/BT3,3)),
                 "$C/N_{sept}$"=c(round(c(rowSums(rep1$pred_Ctot)/rowSums(rep1$N),NA),3)),
                  "$C/N_{marzo}$"=c(round(rowSums(rep2$pred_Ctot)/rowSums(rep2$N),3)),
                 "$C/N_{julio}$"=c(round(rowSums(rep3$pred_Ctot)/rowSums(rep3$N),3)))
kable(VarPobl2b, align = 'c')
```

| Años | $Y/BT_{sept}$ | $Y/BT_{marzo}$ | $Y/BT_{julio}$ | $C/N_{sept}$ | $C/N_{marzo}$ | $C/N_{julio}$ |
|---|---|---|---|---|---|---|
| 1990/91 | 0.174 | 0.172 | 0.173 | 0.102 | 0.101 | 0.101 |
| 1991/92 | 0.264 | 0.261 | 0.263 | 0.179 | 0.178 | 0.179 |
| 1992/93 | 0.262 | 0.26 | 0.261 | 0.169 | 0.167 | 0.167 |
| 1993/94 | 0.398 | 0.395 | 0.395 | 0.232 | 0.23 | 0.23 |

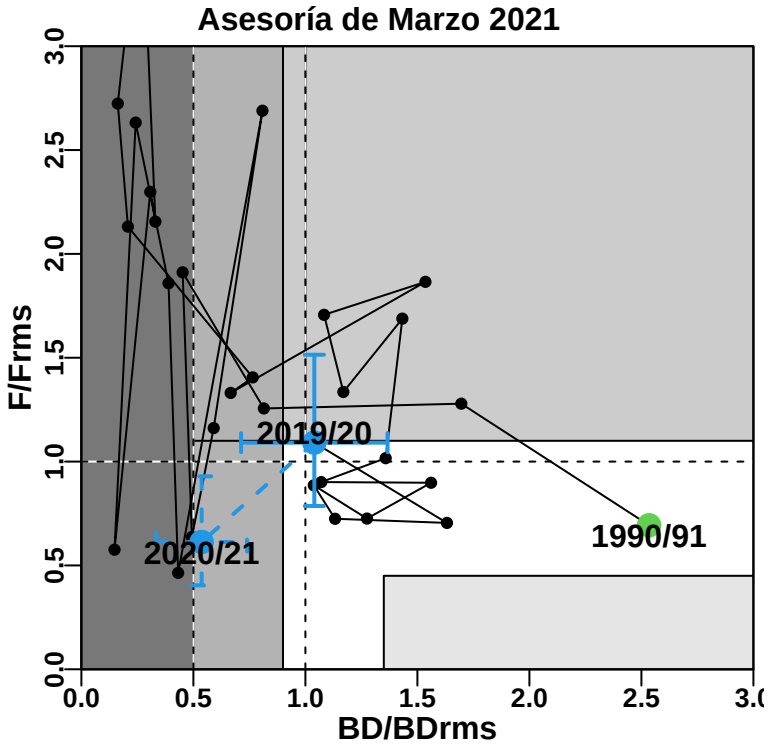
| Años | $Y/BT_{sept}$ | $Y/BT_{marzo}$ | $Y/BT_{julio}$ | $C/N_{sept}$ | $C/N_{marzo}$ | $C/N_{julio}$ |
|---|---|---|---|---|---|---|
| 1994/95 | 0.158 | 0.157 | 0.157 | 0.088 | 0.088 | 0.087 |
| 1995/96 | 0.238 | 0.238 | 0.237 | 0.148 | 0.149 | 0.147 |
| 1996/97 | 0.512 | 0.513 | 0.509 | 0.323 | 0.324 | 0.321 |
| 1997/98 | 0.099 | 0.1 | 0.099 | 0.069 | 0.069 | 0.069 |
| 1998/99 | 0.326 | 0.33 | 0.326 | 0.233 | 0.236 | 0.233 |
| 1999/00 | 0.432 | 0.442 | 0.435 | 0.291 | 0.298 | 0.292 |
| 2000/01 | 0.115 | 0.118 | 0.116 | 0.074 | 0.076 | 0.074 |
| 2001/02 | 0.438 | 0.445 | 0.44 | 0.261 | 0.266 | 0.262 |
| 2002/03 | 0.383 | 0.39 | 0.384 | 0.252 | 0.256 | 0.252 |
| 2003/04 | 0.501 | 0.505 | 0.499 | 0.39 | 0.394 | 0.389 |
| 2004/05 | 0.401 | 0.403 | 0.398 | 0.302 | 0.304 | 0.3 |
| 2005/06 | 0.394 | 0.397 | 0.391 | 0.237 | 0.239 | 0.235 |
| 2006/07 | 0.334 | 0.339 | 0.328 | 0.193 | 0.196 | 0.189 |
| 2007/08 | 0.24 | 0.245 | 0.237 | 0.158 | 0.161 | 0.155 |
| 2008/09 | 0.331 | 0.337 | 0.327 | 0.229 | 0.234 | 0.227 |
| 2009/10 | 0.334 | 0.343 | 0.339 | 0.209 | 0.215 | 0.213 |
| 2010/11 | 0.276 | 0.283 | 0.279 | 0.164 | 0.169 | 0.167 |
| 2011/12 | 0.313 | 0.319 | 0.315 | 0.202 | 0.206 | 0.203 |
| 2012/13 | 0.224 | 0.229 | 0.225 | 0.147 | 0.15 | 0.147 |
| 2013/14 | 0.165 | 0.168 | 0.164 | 0.116 | 0.119 | 0.116 |
| 2014/15 | 0.185 | 0.189 | 0.185 | 0.119 | 0.122 | 0.119 |
| 2015/16 | 0.157 | 0.16 | 0.156 | 0.104 | 0.107 | 0.104 |
| 2016/17 | 0.149 | 0.153 | 0.152 | 0.114 | 0.117 | 0.116 |
| 2017/18 | 0.127 | 0.129 | 0.132 | 0.097 | 0.098 | 0.101 |
| 2018/19 | 0.174 | 0.176 | 0.171 | 0.105 | 0.107 | 0.103 |
| 2019/20 | 0.217 | 0.222 | 0.21 | 0.152 | 0.155 | 0.146 |
| 2020/21 | NA | 0.123 | 0.196 | NA | 0.08 | 0.137 |

```
#setwd(dir.basedatos)
write.csv(VarPobl2b, file="Tabla_23_tasasExplotacion.csv")
#setwd(dir.1)
```

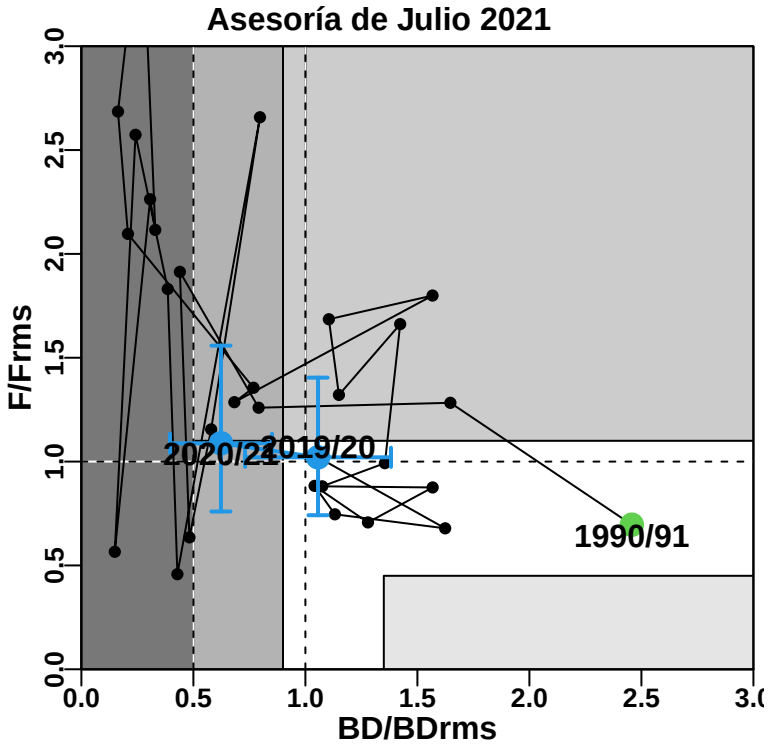
```
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name1<-"Asesoría de Septiembre 2020"
years1<-rep1$years
nyears1<-length(years1)

DiagramaFase2(name1,
              years1[1:nyears1-1],
              SpB1[1:nyears1-1],
              SpBSE1[1:nyears1-1],
              ln_Fyr1[1:nyears1-1],
              ln_FSE1[1:nyears1-1],
              SpB1[nyears1],
              SpBSE1[nyears1],
              ln_Fyr1[nyears1],
              ln_FSE1[nyears1],
              FRMS1,
              BRMS1,
              BLIM1,
              FLIM1,
              color=F,
              dir.1,
              etiqueta=F,
              preliminar=F,
              completo=T)

text(c(SpB1[1]/BRMS1,SpB1[nyears1]/BRMS1,SpB1[nyears1-1]/BRMS1),
     c(exp(ln_Fyr1[1])/FRMS1-0.05,exp(ln_Fyr1[nyears1])/FRMS1-0.05,exp(ln_Fyr1[nyears1-1])/FRMS1+0.05), c("1990/91","2019/20","2
```



```r
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name2<-"Asesoría de Marzo 2021"
years2<-rep2$years
nyears2<-length(years2)

DiagramaFase2(name2,
              years2[1:nyears2-1],
              SpB2[1:nyears2-1],
              SpBSE2[1:nyears2-1],
              ln_Fyr2[1:nyears2-1],
              ln_FSE2[1:nyears2-1],
              SpB2[nyears2],
              SpBSE2[nyears2],
              ln_Fyr2[nyears2],
              ln_FSE2[nyears2],
              FRMS2,
              BRMS2,
              BLIM2,
              FLIM2,
              color=F,
              dir.1,
              etiqueta=F,
              preliminar=T,
              completo=F)

text(c(SpB2[1]/BRMS2,SpB2[nyears2]/BRMS2,SpB2[nyears2-1]/BRMS2),
     c(exp(ln_Fyr2[1])/FRMS2-0.05,exp(ln_Fyr2[nyears2])/FRMS2-0.05,exp(ln_Fyr2[nyears2-1])/FRMS2+0.05), c("1990/91","2020/21","2
```



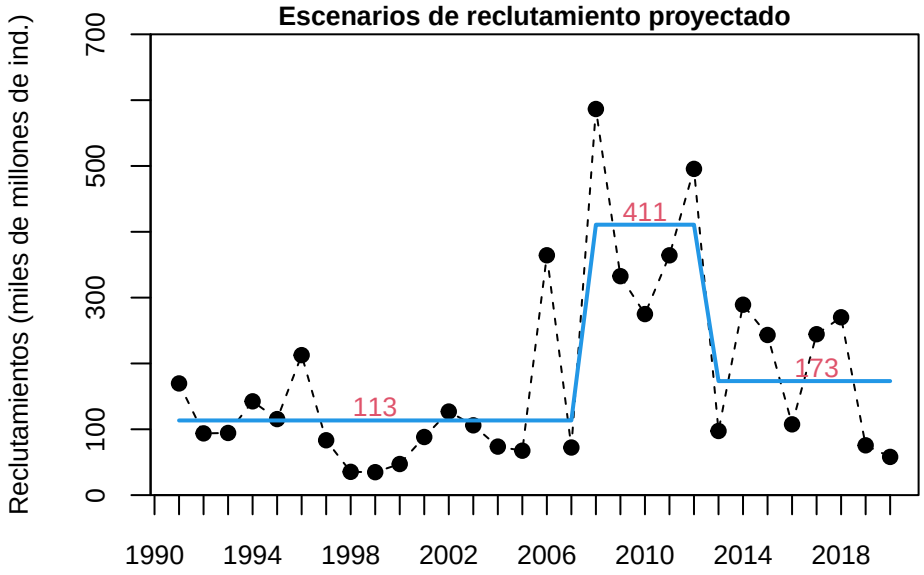
```
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name3<-"Asesoría de Julio 2021"
years3<-rep3$years
nyears3<-length(years3)

DiagramaFase2(name3,
              years3[1:nyears3-1],
              SpB3[1:nyears3-1],
              SpBSE3[1:nyears3-1],
              ln_Fyr3[1:nyears3-1],
              ln_FSE3[1:nyears3-1],
              SpB3[nyears3],
              SpBSE3[nyears3],
              ln_Fyr3[nyears3],
              ln_FSE3[nyears3],
              FRMS3,
              BRMS3,
              BLIM3,
              FLIM3,
              color=F,
              dir.1,
              etiqueta=F,
              preliminar=F,
              completo=T)

text(c(SpB3[1]/BRMS3,SpB3[nyears3]/BRMS3,SpB3[nyears3-1]/BRMS3),
     c(exp(ln_Fyr3[1])/FRMS3-0.05,exp(ln_Fyr3[nyears3])/FRMS3-0.05,exp(ln_Fyr3[nyears3-1])/FRMS3+0.05), c("1990/91","2020/21","2
```



```
Tabla4.1<-rbind("Año biológico"=c("2019/20",
                                  "2020/21",
                                  "2020/21"),
                "$F_{RMS}$"=c(round(FRMS1,2),
                              round(FRMS2,2),
                              round(FRMS3,2)),
                "$BD_{RMS}$"=c(round(BRMS1/10^3,0),
                               round(BRMS2/10^3,0),
                               round(BRMS3/10^3,0)),
                "$BD_{LIM}$"=c(round(BLIM1/10^3,0),
                               round(BLIM2/10^3,0),
                               round(BLIM3/10^3,0)),
                "$p(BD_{last}<BD_{RMS})$"=round(c(pa_sept,
                                                  pa_mar,
                                                  pa_jul),2),
                "$p(F_{last}>F_{RMS})$"=round(c(pb_sept,
                                                pb_mar,
                                                pb_jul),2),
                "$p(sobre-explotación)$"=round(c(pc_sept,
                                                 pc_mar,
                                                 pc_jul),2),
                "$p(agotado/colapsado)$"=round(c(pd_sept,
                                                 pd_mar,
                                                 pd_jul),2),
                "$p(sobrepesca)$"=round(c(pe_sept,
                                          pe_mar,
                                          pe_jul),2))
colnames(Tabla4.1)<-c("Septiembre 2020","Marzo 2021","Julio 2021")
kable(Tabla4.1,align='c')
```

| | Septiembre 2020 | Marzo 2021 | Julio 2021 |
|---|---|---|---|
| Año biológico | 2019/20 | 2020/21 | 2020/21 |
| $F_{RMS}$ | 0.3 | 0.3 | 0.3 |
| $BD_{RMS}$ | 830 | 801 | 820 |
| $BD_{LIM}$ | 415 | 401 | 410 |
| $p(BD_{last} < BD_{RMS})$ | 0.45 | 1 | 1 |
| $p(F_{last} > F_{RMS})$ | 0.6 | 0.02 | 0.62 |
| $p(sobre - explotación)$ | 0.26 | 1 | 0.98 |
| $p(agotado/colapsado)$ | 0 | 0.38 | 0.18 |
| $p(sobrepesca)$ | 0.45 | 0 | 0.48 |

### 3.8. CBA 2021 Inicial (Asesoría de septiembre 2020)



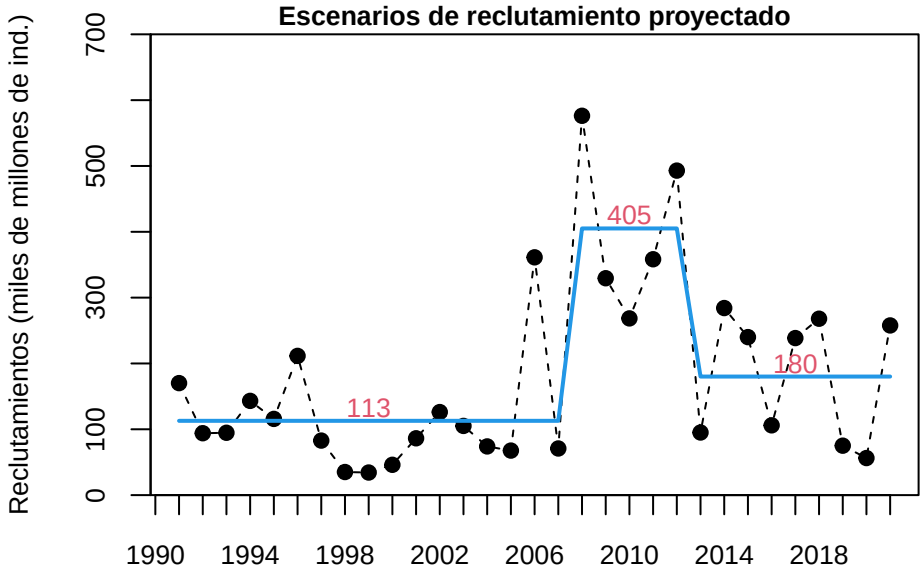

| | 1991-2007 | 2008-2012 | 2013-2020 |
|---|---|---|---|
| mean | 250260 | 447840 | 300810 |
| std | 42769 | 73667 | 60397 |
| 10% | 195449 | 353432 | 223408 |
| 20% | 214265 | 385840 | 249979 |
| 30% | 227832 | 409209 | 269138 |
| 40% | 239425 | 429177 | 285509 |
| 50% | 250260 | 447840 | 300810 |

| | 1991-2007 | 2008-2012 | 2013-2020 |
|---|---|---|---|
| 10% | 0.22 | 0.21 | 0.26 |
| 20% | 0.14 | 0.14 | 0.17 |
| 30% | 0.09 | 0.09 | 0.11 |
| 40% | 0.04 | 0.04 | 0.05 |
| 50% | 0.00 | 0.00 | 0.00 |

| | 1991-2007 | 2008-2012 | 2013-2020 |
|---|---|---|---|
| 10% | 191540 | 346363 | 218940 |
| 20% | 209979 | 378123 | 244979 |
| 30% | 223275 | 401025 | 263755 |
| 40% | 234636 | 420593 | 279798 |
| 50% | 245255 | 438883 | 294794 |

| | 1991-2007 | 2008-2012 | 2013-2020 |
|---|---|---|---|
| 10% | 183722 | 332226 | 210004 |
| 20% | 201409 | 362690 | 234980 |
| 30% | 214162 | 384656 | 252990 |
| 40% | 225059 | 403426 | 268378 |
| 50% | 235244 | 420970 | 282761 |

## 3.9. Primera revisión CBA 2021 (Asesoría de marzo 2021)



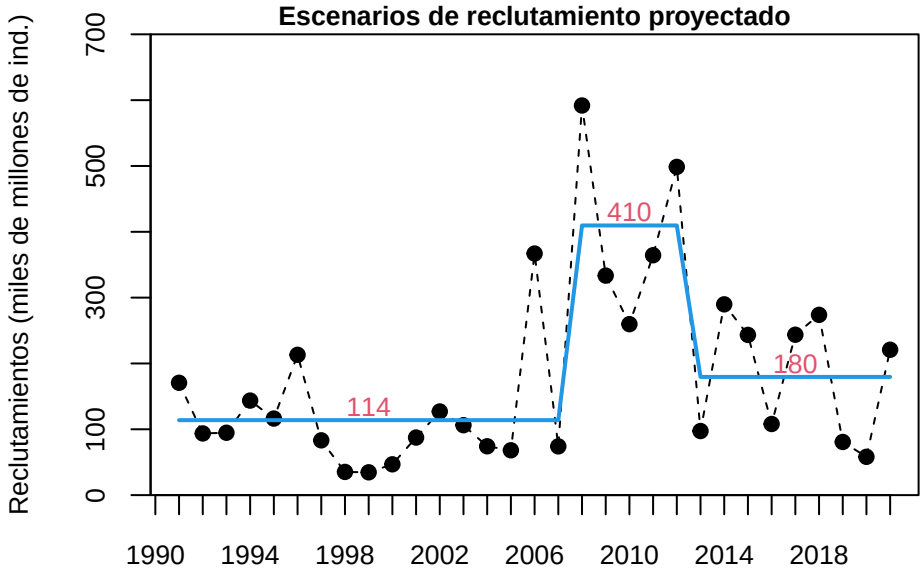

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| mean | 271720 | 313030 | 279570 |
| std | 29384 | 34291 | 33911 |
| 10% | 234063 | 269084 | 236111 |
| 20% | 246990 | 284170 | 251030 |
| 30% | 256311 | 295048 | 261787 |
| 40% | 264276 | 304342 | 270979 |
| 50% | 271720 | 313030 | 279570 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 0.14 | 0.14 | 0.16 |
| 20% | 0.09 | 0.09 | 0.10 |
| 30% | 0.06 | 0.06 | 0.06 |
| 40% | 0.03 | 0.03 | 0.03 |
| 50% | 0.00 | 0.00 | 0.00 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 224700 | 258321 | 226667 |
| 20% | 237110 | 272803 | 240989 |
| 30% | 246059 | 283246 | 251316 |
| 40% | 253705 | 292169 | 260140 |
| 50% | 260851 | 300509 | 268387 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 22 | -22 | 8 |
| 20% | 18 | -25 | 3 |
| 30% | 15 | -26 | -1 |
| 40% | 13 | -28 | -3 |
| 50% | 11 | -29 | -5 |

## 4.0. Segunda revisión CBA 2021 (Asesoría de julio 2021)




```
library(strucchange)
library(tidyverse)
```

```
## -- Attaching packages ------------------------------ tidyverse 1.3.0 --
```

```
## v tibble  3.0.3     v purrr   0.3.4
## v tidyr   1.1.2     v forcats 0.5.0
## v readr   1.3.1
```

```
## -- Conflicts --------------------------------- tidyverse_conflicts() --
## x strucchange::boundary() masks stringr::boundary()
## x tidyr::expand()         masks reshape::expand()
## x dplyr::filter()         masks stats::filter()
## x dplyr::lag()            masks stats::lag()
## x dplyr::rename()         masks reshape::rename()
```

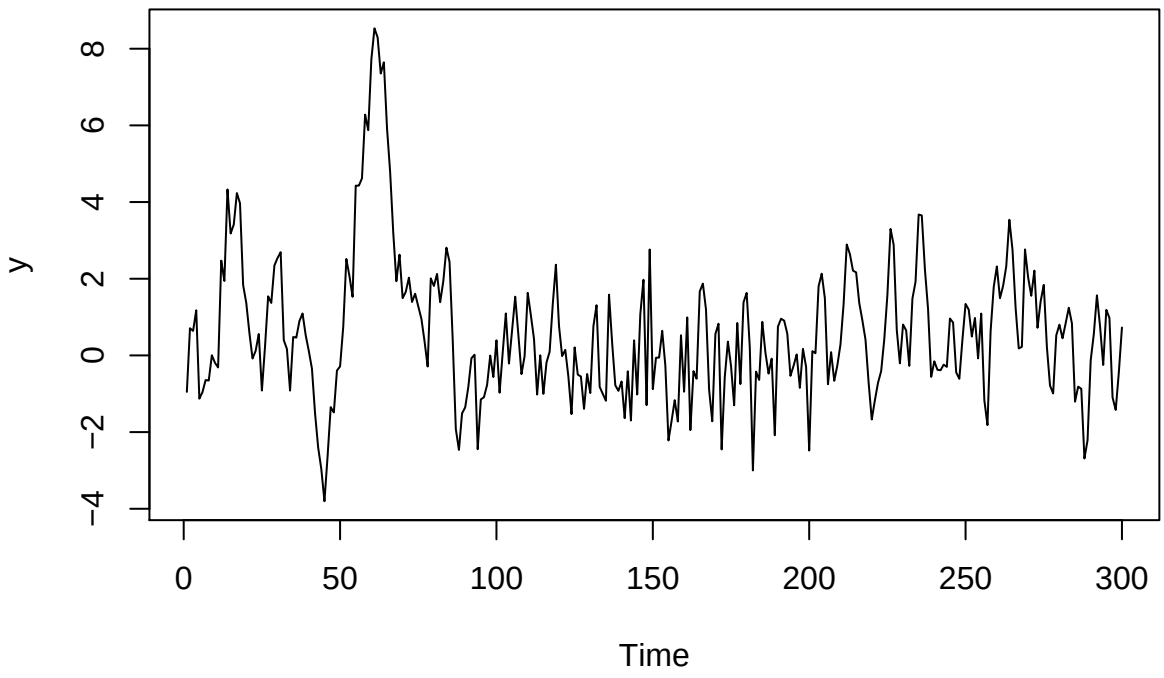
```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:reshape':
##
##     stamp
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
x1 <- arima.sim(model = list(ar = 0.9), n = 100)
x2 <- arima.sim(model = list(ma = 0.1), n = 100)
x3 <- arima.sim(model = list(ar = 0.5, ma = 0.3), n = 100)

y <- c((1 + x1), x2,(0.5 - x3))

plot.ts(y)
```




```
dat <- tibble(ylag0 = y,ylag1 = lag(y))

  qlr <- Fstats(ylag0 ~ ylag1, data = dat)

sctest(qlr, type = "supF")
```

```
##
##  supF test
##
## data:  qlr
## sup.F = 36.423, p-value = 4.495e-07
```

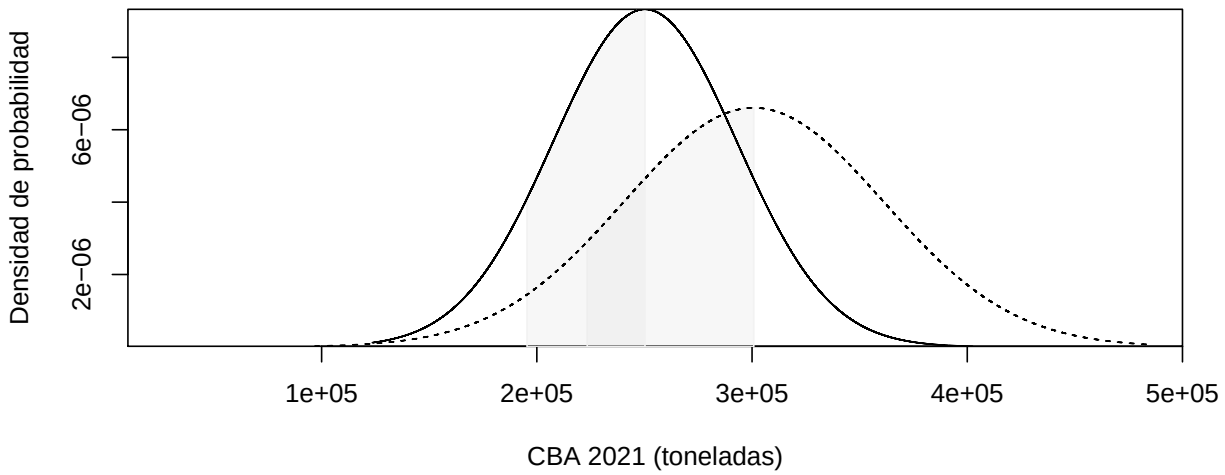
| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| mean | 378670 | 419950 | 385460 |
| std | 22259 | 28186 | 25850 |
| 10% | 350144 | 383828 | 352332 |
| 20% | 359936 | 396228 | 363704 |
| 30% | 366997 | 405169 | 371904 |
| 40% | 373031 | 412809 | 378911 |
| 50% | 378670 | 419950 | 385460 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 0.08 | 0.09 | 0.09 |
| 20% | 0.05 | 0.06 | 0.06 |
| 30% | 0.03 | 0.04 | 0.04 |
| 40% | 0.01 | 0.02 | 0.02 |
| 50% | 0.00 | 0.00 | 0.00 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 336138 | 368475 | 338239 |
| 20% | 345539 | 380379 | 349156 |
| 30% | 352317 | 388962 | 357028 |
| 40% | 358110 | 396297 | 363755 |
| 50% | 363523 | 403152 | 370042 |

| | 1991-2007 | 2008-2012 | 2013-2021 |
|---|---|---|---|
| 10% | 83 | 11 | 61 |
| 20% | 72 | 5 | 49 |
| 30% | 65 | 1 | 41 |
| 40% | 59 | -2 | 36 |
| 50% | 55 | -4 | 31 |

```
#####################################################
# Asesoría septiembre R1
#####################################################
#  densidad de probabilidad
xbs1a <-rnorm(1000, mean = CBAp_sept[1], sd = CBApstd_sept[1])
xbsa  <-seq(min(xbs1a),max(xbs1a),0.5)
ybsa  <-dnorm(xbsa, mean = CBAp_sept[1], sd =CBApstd_sept[1])
icbsa <-qnorm(c(0.10,0.50,0.5),CBAp_sept[1],CBApstd_sept[1])

#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 R2
#####################################################
#  densidad de probabilidad
xbs1b <-rnorm(1000, mean = CBAp_sept[3], sd = CBApstd_sept[3])
xbsb  <-seq(min(xbs1b),max(xbs1b),0.5)
ybsb  <-dnorm(xbsb, mean = CBAp_sept[3], sd = CBApstd_sept[3])
icbsb <-qnorm(c(0.10,0.50,0.5),CBAp_sept[3],CBApstd_sept[3])

#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))

plot(xbsa,ybsa ,type="n",ylab="Densidad de probabilidad",xaxs="i",yaxs= "i",xlab="CBA 2021 (toneladas)", main="",xlim=c(10000,50
polygon(xxbsb,yybsb,col=gray(0.9,0.3),border="gray95")
polygon(xxbsa,yybsa,col=gray(0.9,0.3),border="gray95")
lines(xbsb,ybsb,lwd=1,lty=2,col=1)
lines(xbsa,ybsa,lwd=1,lty=1,col=1)
legend(1000,0.00017,c("CBA2021_Hito1_Rbajo","CBA2021_Hito1_Rreciente"),lwd=c(2,1),col=c(1,2),lty=c(1,1),bty="n",cex=0.8)
text(904.3,0.0022,"Crms")
```

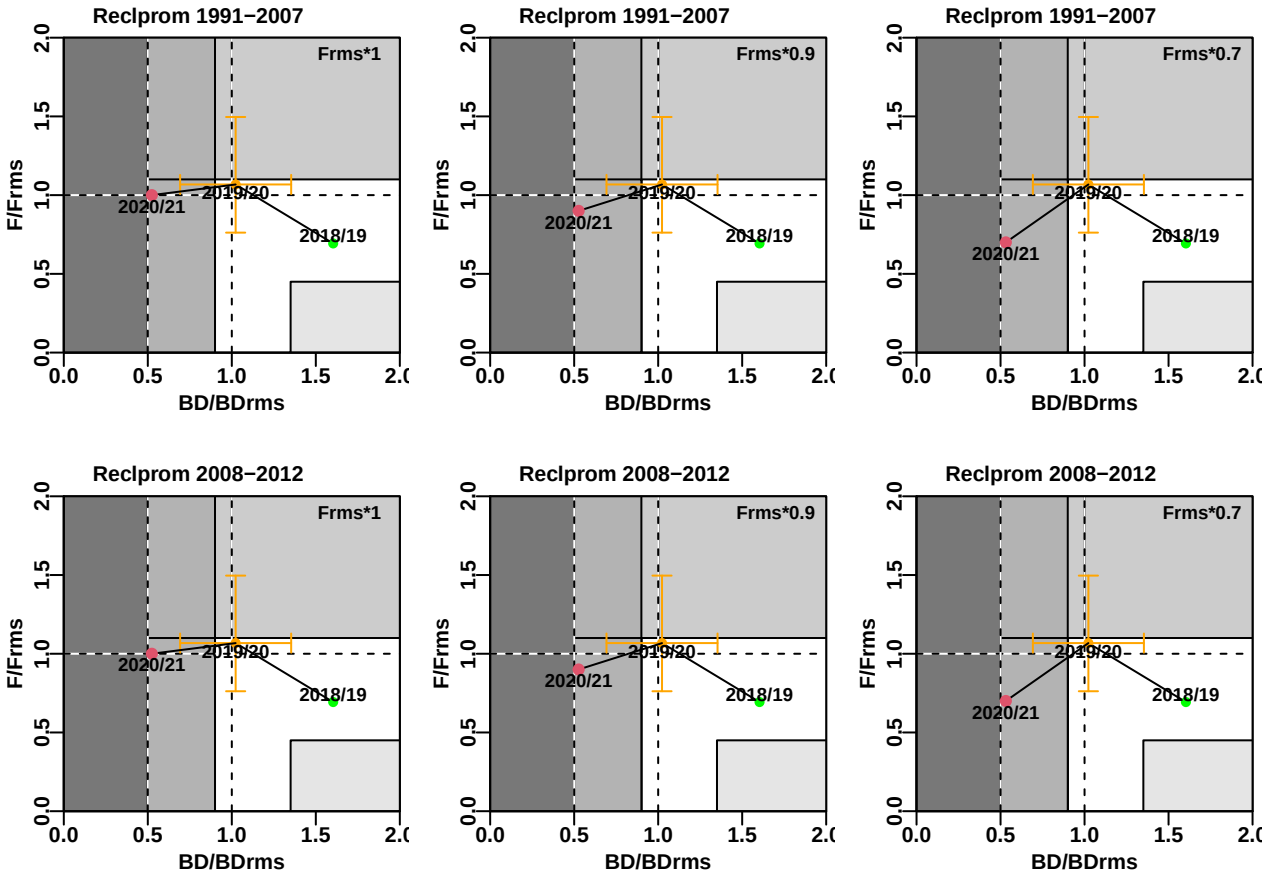


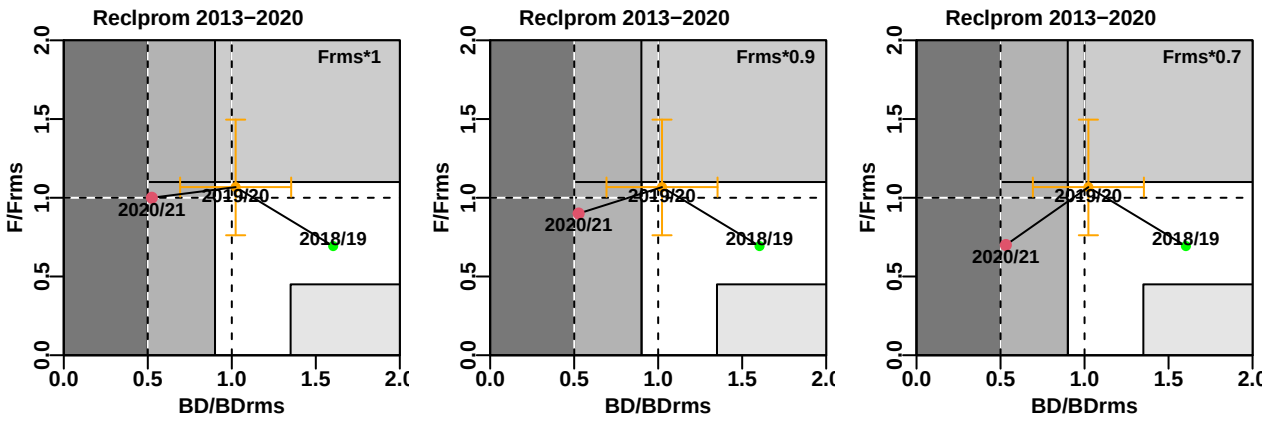
## 4.0. Proyección del stock (Asesoría de septiembre 2020)

| | 1991-2007[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(sobre-explotación)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(colapso)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2019/20 | 0.26 | 0.26 | 0.26 |
| p(colapso)_2019/20 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(colapso)_2020/21 | 0.42 | 0.41 | 0.40 |

| | 2008-2012[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(sobre-explotación)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(colapso)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2019/20 | 0.26 | 0.26 | 0.26 |
| p(colapso)_2019/20 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(colapso)_2020/21 | 0.42 | 0.41 | 0.40 |

| | 2013-2020[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(sobre-explotación)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(colapso)_2018/19 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2019/20 | 0.26 | 0.26 | 0.26 |
| p(colapso)_2019/20 | 0.00 | 0.00 | 0.00 |
| p(sobre-explotación)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(colapso)_2020/21 | 0.42 | 0.41 | 0.40 |

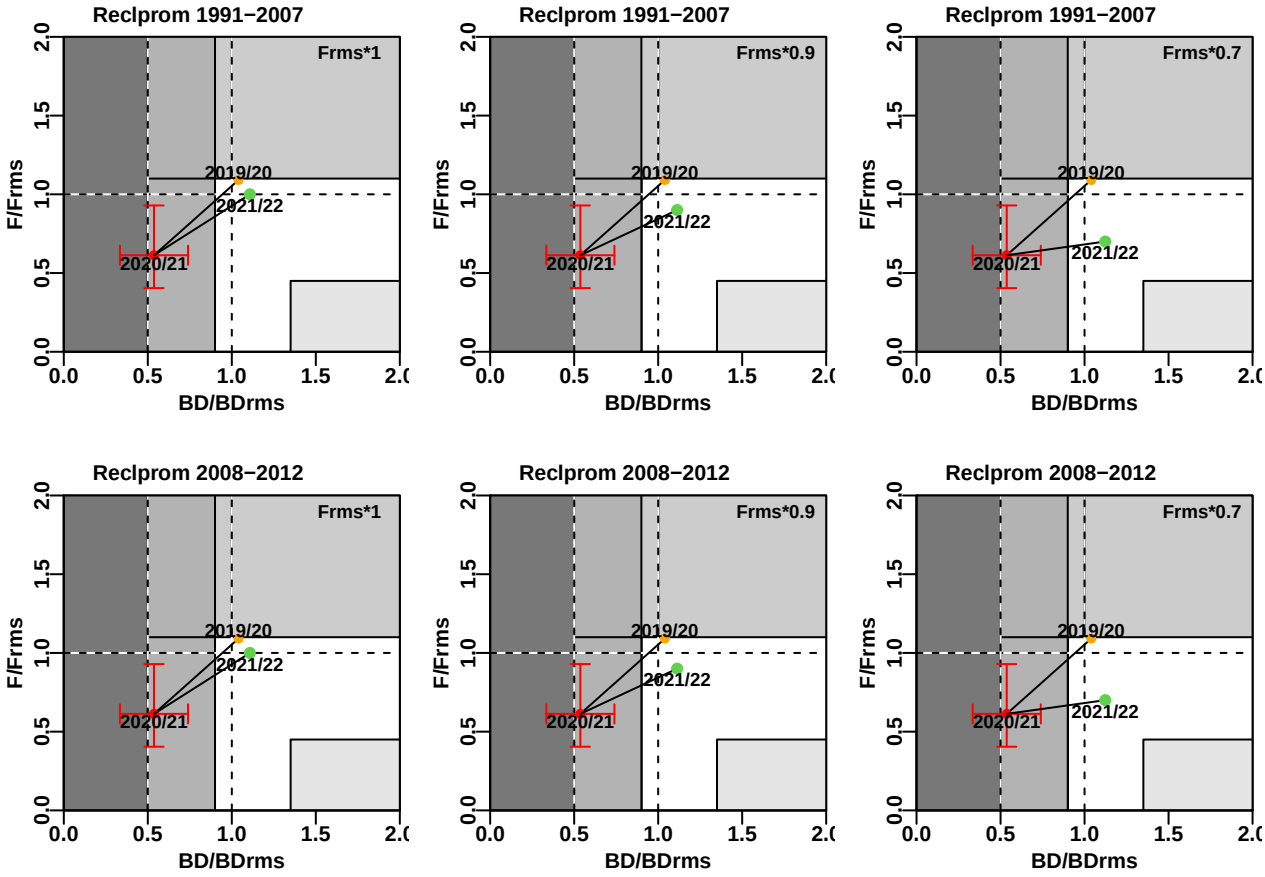


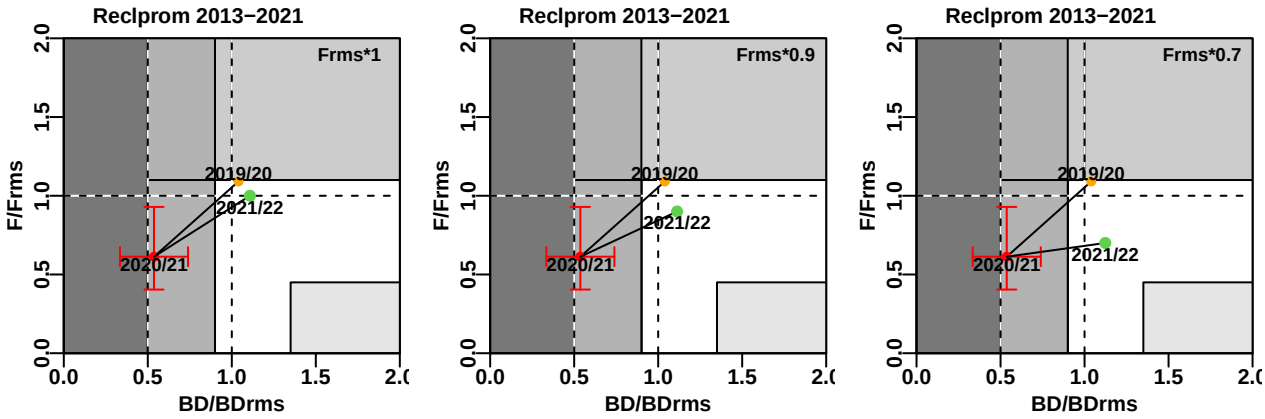

Reclprom 2013−2020
Frms*1
F/Frms
BD/BDrms
2020/21
2019/20
2018/19
Reclprom 2013−2020
Frms*0.9
F/Frms
BD/BDrms
2020/21
2019/20
2018/19
Reclprom 2013−2020
Frms*0.7
F/Frms
BD/BDrms
2020/21
2019/20
2018/19

| | 1991-2007[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.38 | 0.38 | 0.38 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.27 | 0.26 | 0.26 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |

| | 2008-2012[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.38 | 0.38 | 0.38 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.27 | 0.26 | 0.26 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |

| | 2013-2021[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 1.00 | 1.00 | 1.00 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.38 | 0.38 | 0.38 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.27 | 0.26 | 0.26 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |

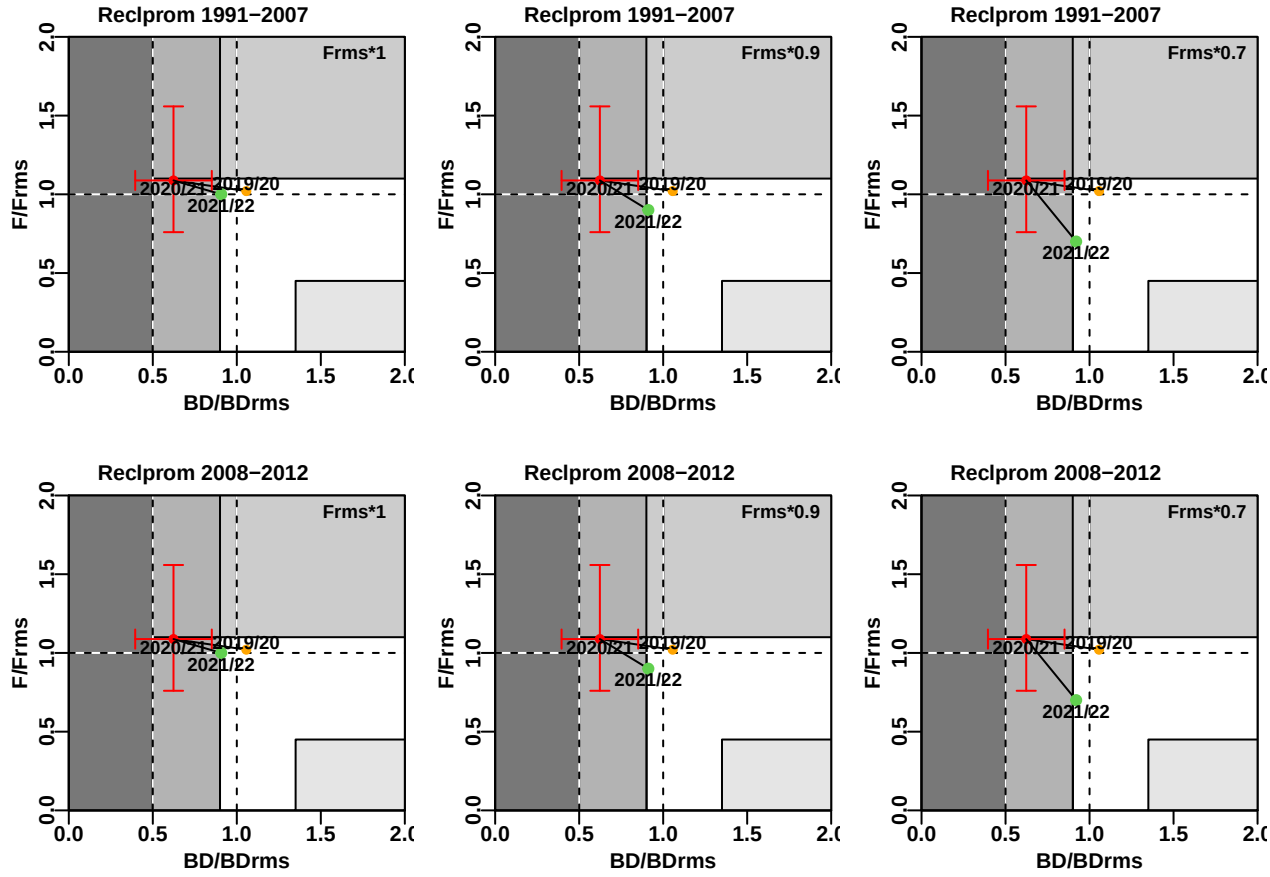


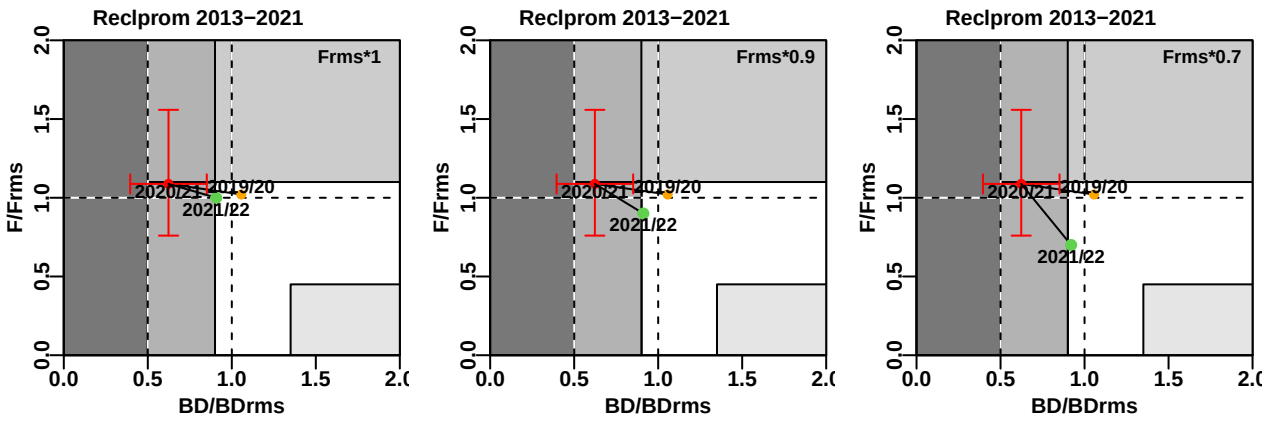

Reclprom 2013−2021
Frms*1
2019/20
2021/22
2020/21
F/Frms
BD/BDrms
0.0
0.5
1.0
1.5
2.0
Reclprom 2013−2021
Frms*0.9
2019/20
2021/22
2020/21
F/Frms
BD/BDrms
Reclprom 2013−2021
Frms*0.7
2019/20
2021/22
2020/21
F/Frms
BD/BDrms

| | 1991-2007[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 0.98 | 0.98 | 0.98 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.18 | 0.18 | 0.18 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.49 | 0.48 | 0.46 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |

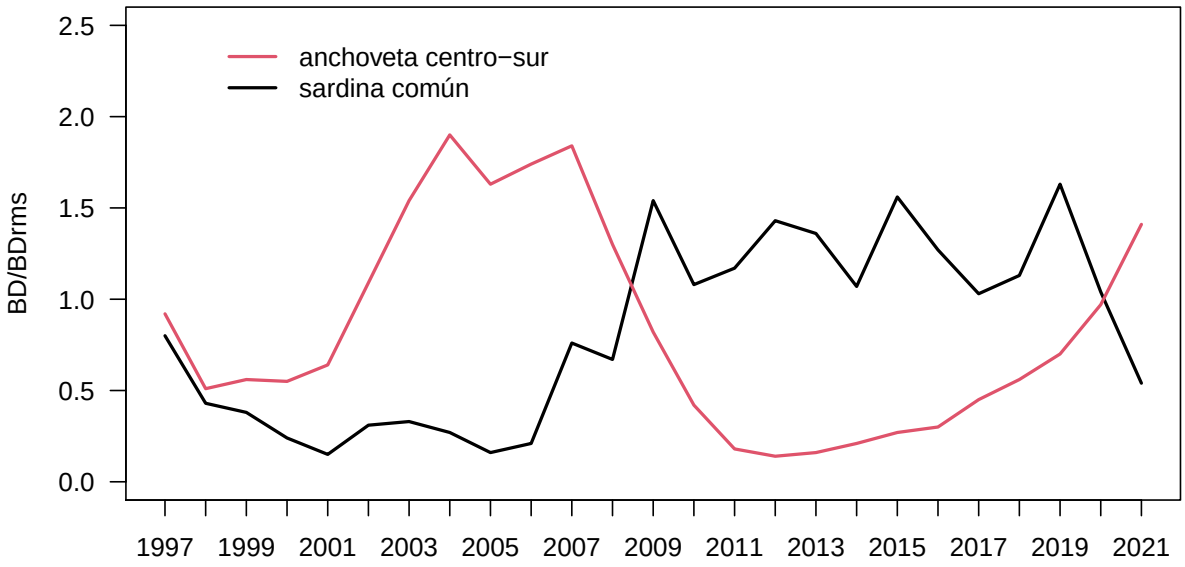
| | 2008-2012[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 0.98 | 0.98 | 0.98 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.18 | 0.18 | 0.18 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.49 | 0.48 | 0.46 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |

| | 2013-2021[$F_{RMS}$*1] | [$F_{RMS}$*0.9] | [$F_{RMS}$*0.7] |
|---|---|---|---|
| p(BD<0,9$BD_{RMS}$)_2020/21 | 0.98 | 0.98 | 0.98 |
| p(BD<0,5$BD_{RMS}$)_2020/21 | 0.18 | 0.18 | 0.18 |
| p(BD<0,9$BD_{RMS}$)_2021/22 | 0.49 | 0.48 | 0.46 |
| p(BD<0,5$BD_{RMS}$)_2021/22 | 0.04 | 0.03 | 0.03 |




Reclprom 2013−2021
Frms*1
F/Frms
BD/BDrms
2020/21
2019/20
2021/22
Reclprom 2013−2021
Frms*0.9
F/Frms
BD/BDrms
2020/21
2019/20
2021/22
Reclprom 2013−2021
Frms*0.7
F/Frms
BD/BDrms
2020/21
2019/20
2021/22

# 5. DISCUSIÓN




- ¿Cuánto se sobrepasa el RMS en la captura 2020/21?

Por lo tanto, podríamos concluir que la causa de exceder el objetivo de manejo Frms para el año 2020/21 se debe al remanente de cuota autorizado.

### ¿Cuál es la captura semestral del año biológico 2020/21 y la captura descartada?

- CBA recomendada 2021 = 251.316 t
- Desembarque 1er semestre 2021 = 22% sobre CBA recomendada (306.406 t)

## ¿Cuál debería haber sido la captura para un $F_{RMS}$?

La captura 2020/21 al RMS debería ser 359.250 ($C_{RMS}$) - 14.370 (4%descarte) = 344.880 t

Por lo tanto, de las 344.880 t que se podían capturar entre el 2020/21, si consideramos que durante el 2do semestre 2020 se capturaron 69.839 t, entonces, durante el 1er semetre 2021 la captura no debería haber superado las 275.041 t. Se sobrepasó en torno a las 31 mil toneladas la captura biológicamente aceptable 2020/21.

## Sobre las estacionalidad de las capturas

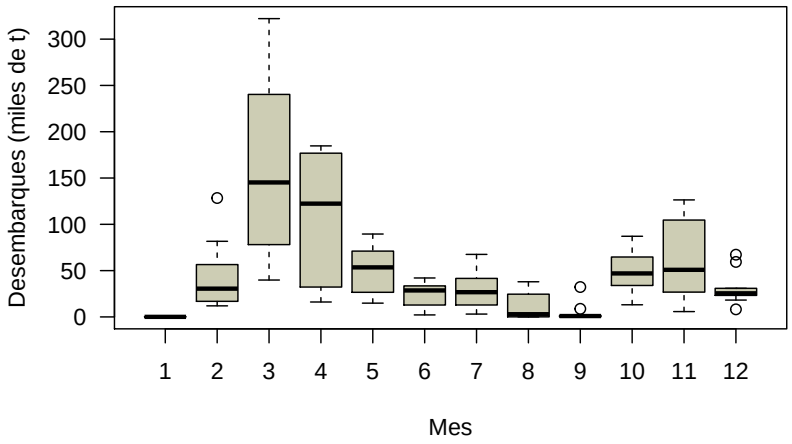



Figure 1: Capturas mensuales de sardina común realizadas entre 2007-2021, registradas por SERNAPESCA en la zona centro-sur.

- Revisar la estacionalidad de la captura en año biológico

```
prop1ersemestre<-c(0.81,   0.70,   0.65,   0.77,   0.47,   0.81,   0.72,   0.81,   0.85,   0.90,   0.8

plot(seq(1991,2021),prop1ersemestre,type="o",ylab="Proporción de captura 1er semestre (año biológico",x
```

Separar la Captura en año biológico para revisar el efecto de la Captura 2020/21 sobre el cálculo de CBA en año calendario

**Qué pasaría si los usuarios deciden no capturar durante el 2do semestres y traspasar ese remanente de cuota para el 1er semestre del siguiente año???**

**cuál es la captura biológicamente aceptable 2021/2022**