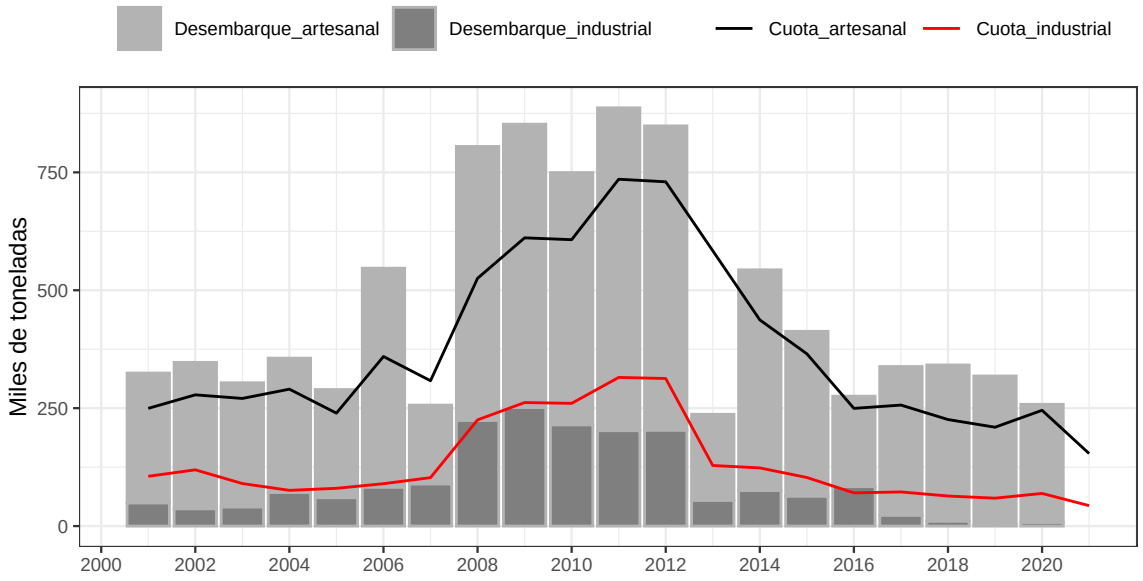
Figuras y Tablas para Tercer Informe de sardina común Centro sur

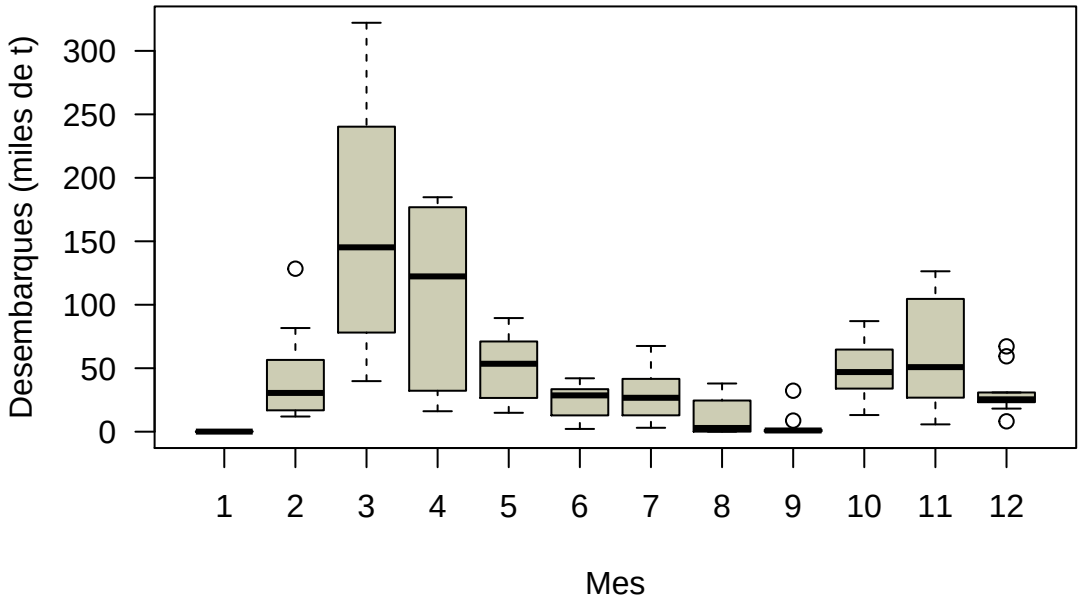
1. ANTECEDENTES

```
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")
```

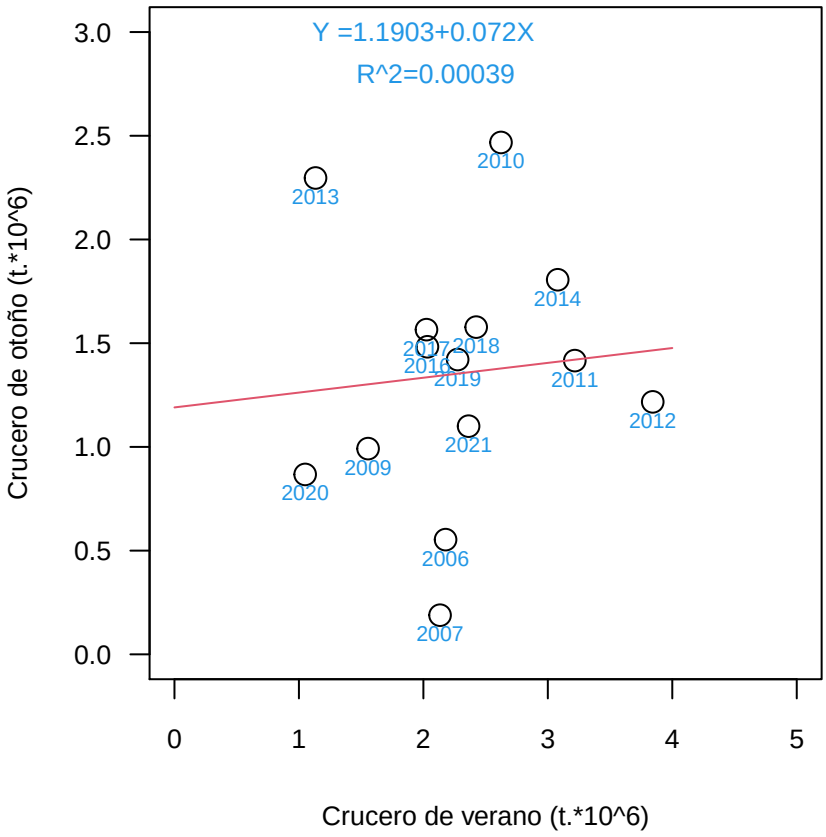
```r
dataDesem2  <- data.frame(ant$year_cuota,ant$des_art,ant$des_ind)
colnames(dataDesem2) <- c("Years",
                          "Desembarque_artesanal",
                          "Desembarque_industrial")

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")
```



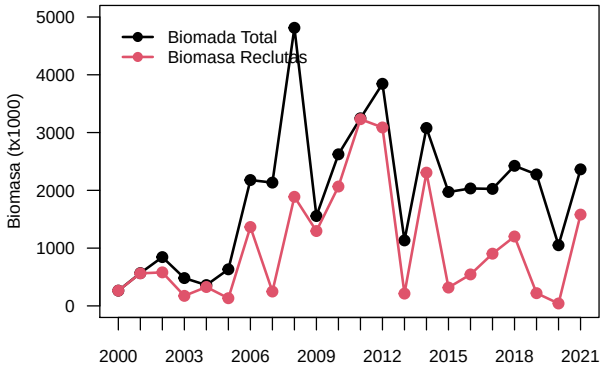
```r
ano<-ant$desembarques_sernapesca[,1]
des_mes<-data.frame(mes=rep(seq(1,12,1),27),ano=gl(27,12,labels=ano),desem=c(t(ant$desembarques_sernapesca[,2:13])))

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")
```

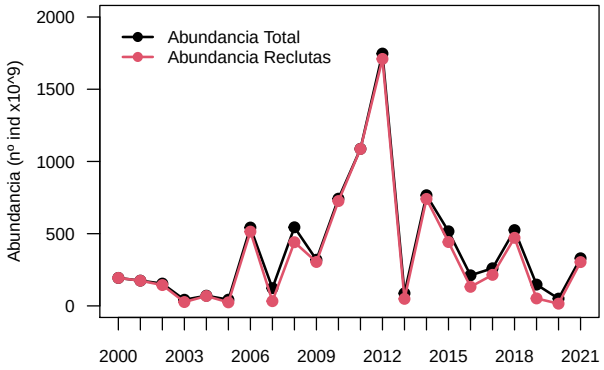


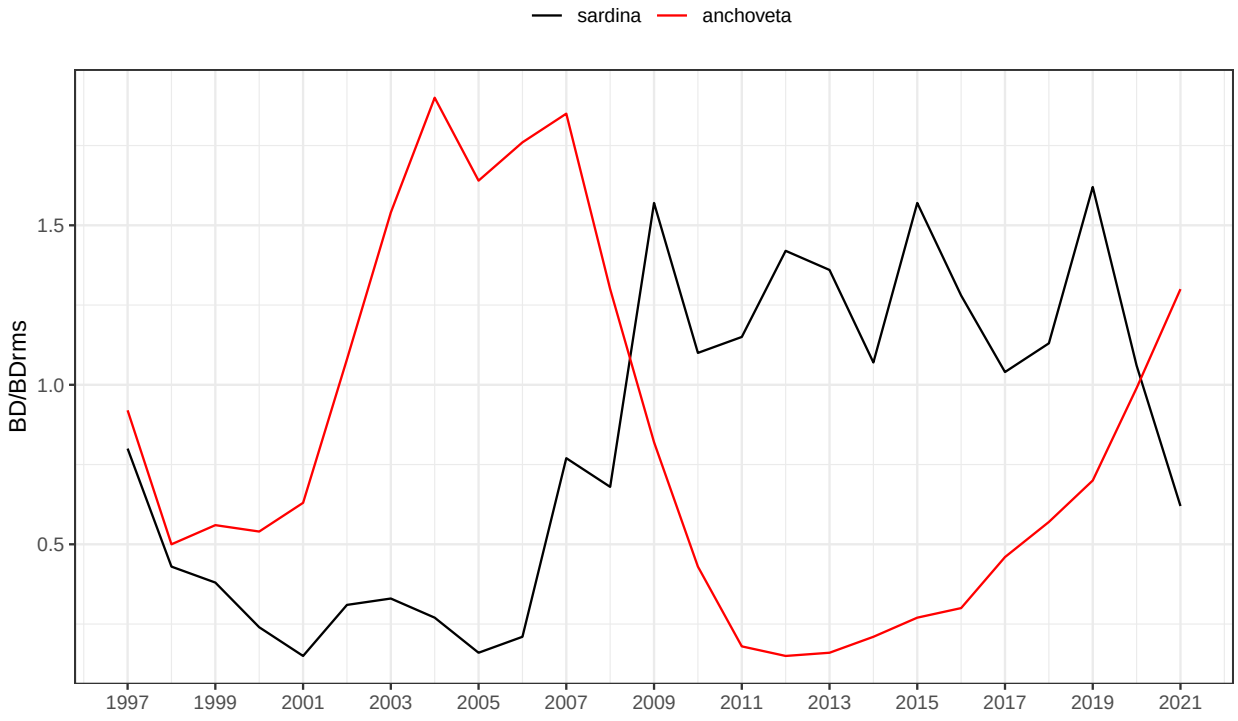
```
x<-rep3$reclasobs[rep3$reclasobs>0&rep3$pelacesobs>0]/10^6
y<-rep3$pelacesobs[rep3$reclasobs>0&rep3$pelacesobs>0]/10^6
years<-rep3$years

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)
```

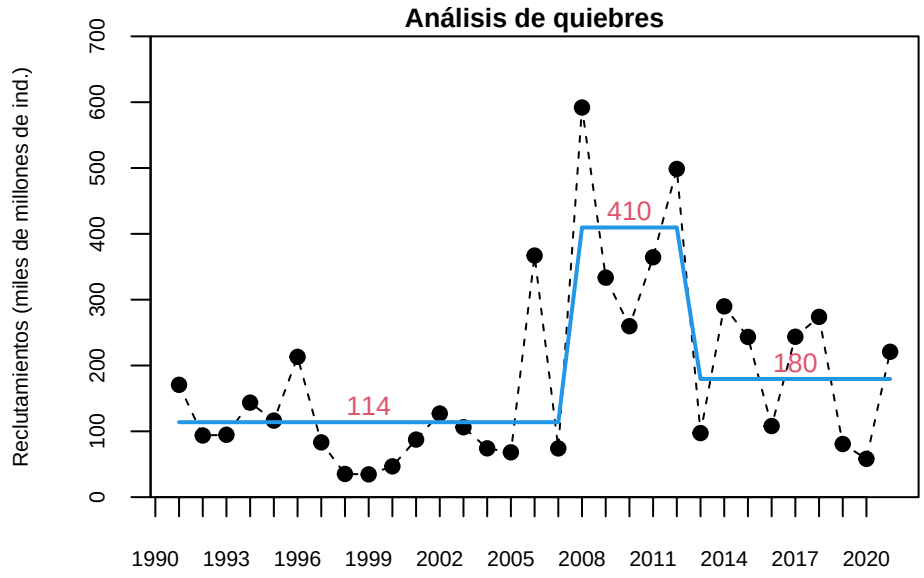




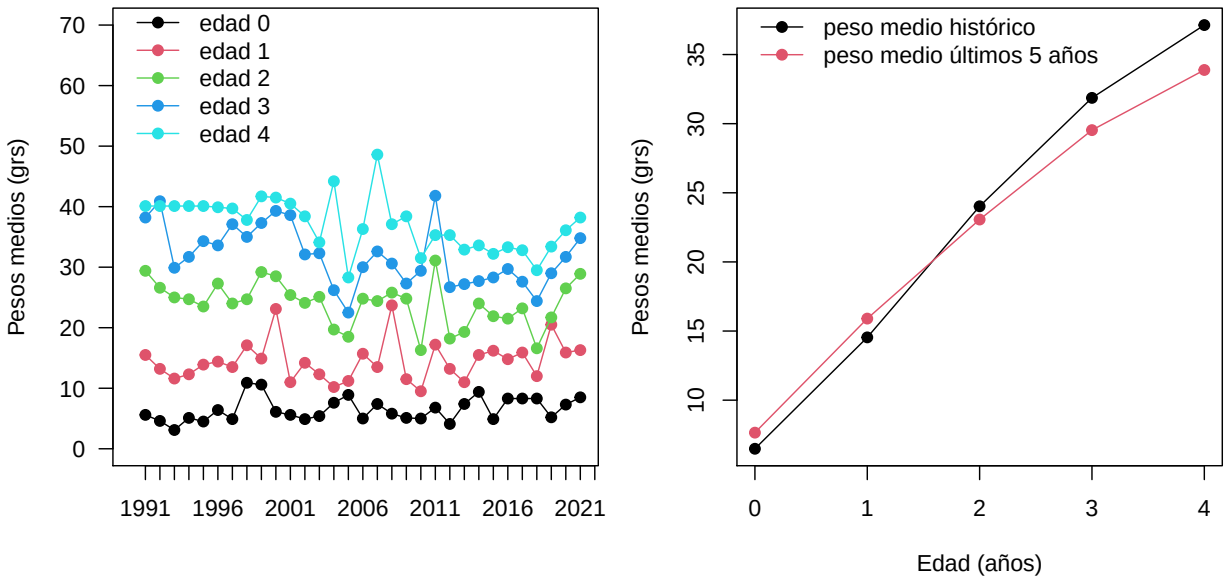

sardina
anchoveta
BD/BDrms
1.5
1.0
0.5
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021

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")
```

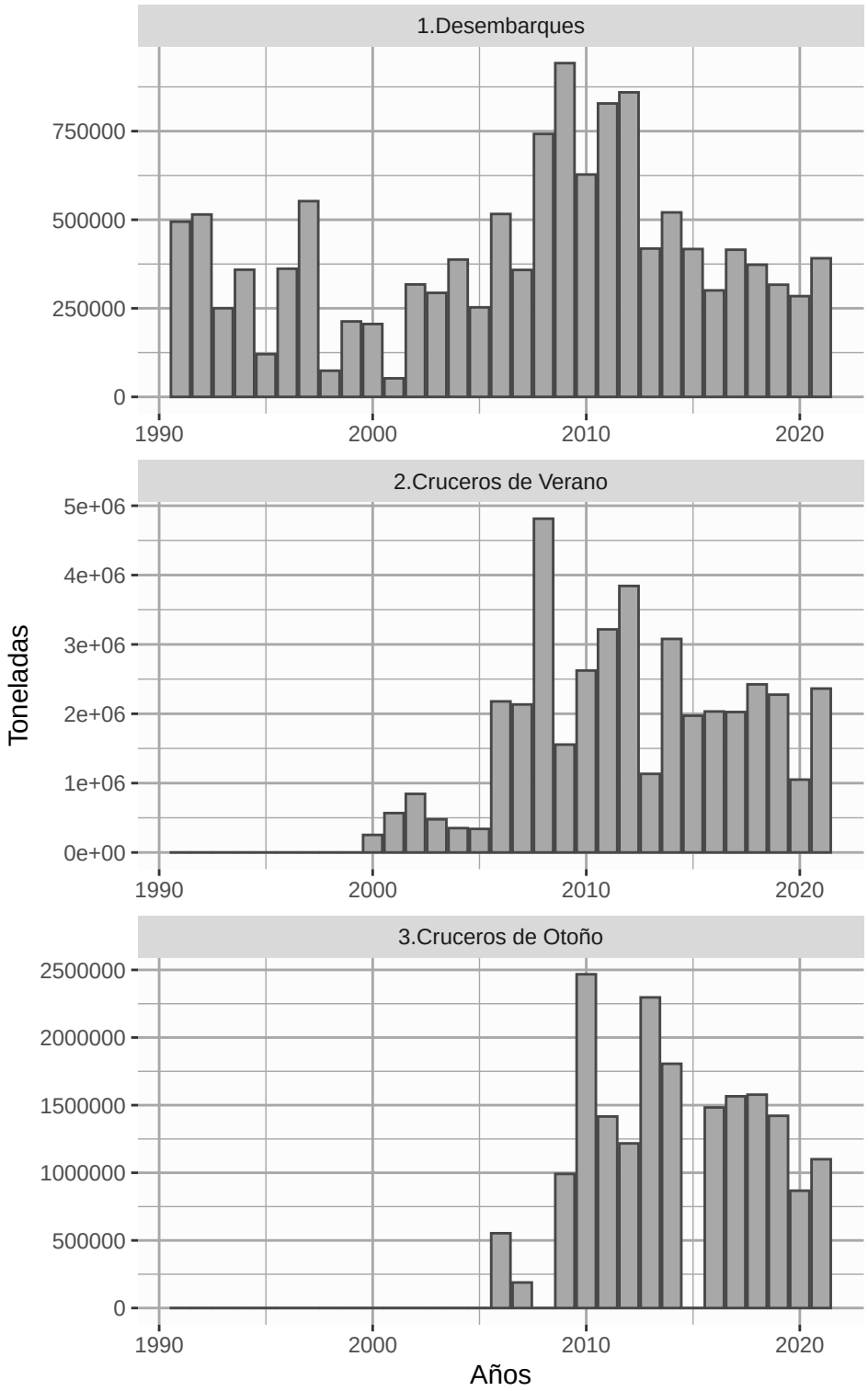


Año.biológico	Desembarques.t.	Porcentaje.descarte	Captura.descartada.t.	Captura.total.t.
1990-91	494567	0%	0	494567
1991-92	514787	0%	0	514787
1992-93	250237	0%	0	250237
1993-94	358949	0%	0	358949
1994-95	120608	0%	0	120608
1995-96	361735	0%	0	361735
1996-97	552515	0%	0	552515
1997-98	73892	0%	0	73892
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

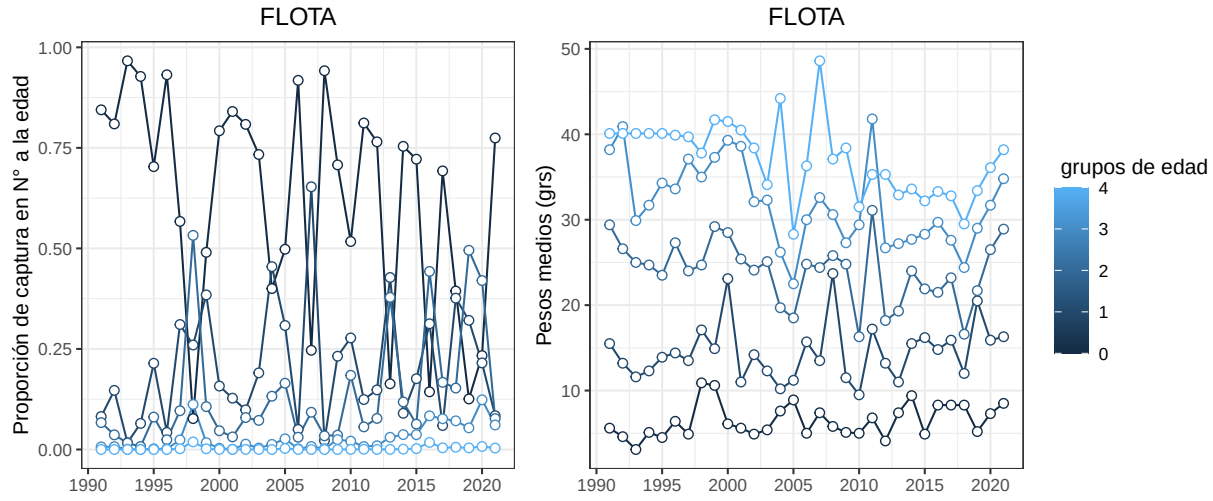
3. RESULTADOS

```
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()
```

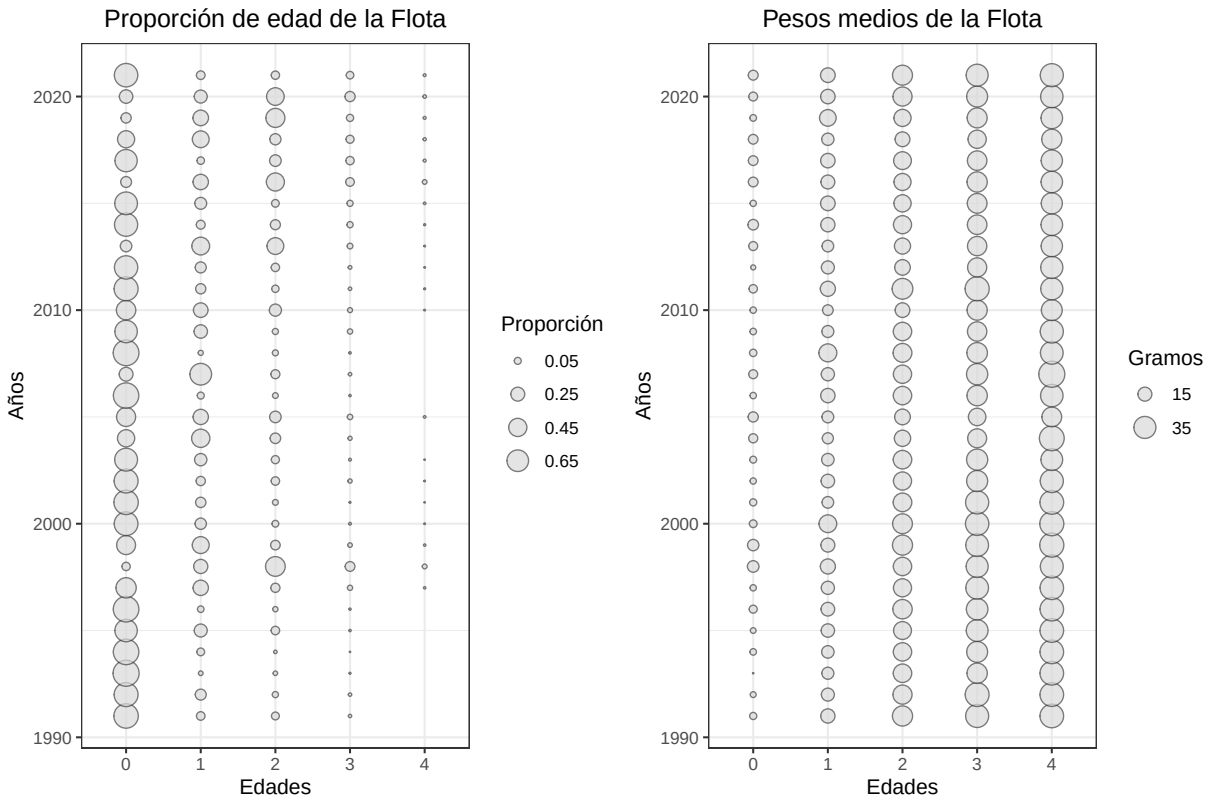
```
des_obs <- data.frame(rep3$desembarqueobs)
bc_obs  <- data.frame(rep3$reclasobs)
bp_obs  <- data.frame(rep3$pelacesobs)
yearc   <- rep3$years
nyearc  <-length(yearc)

 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

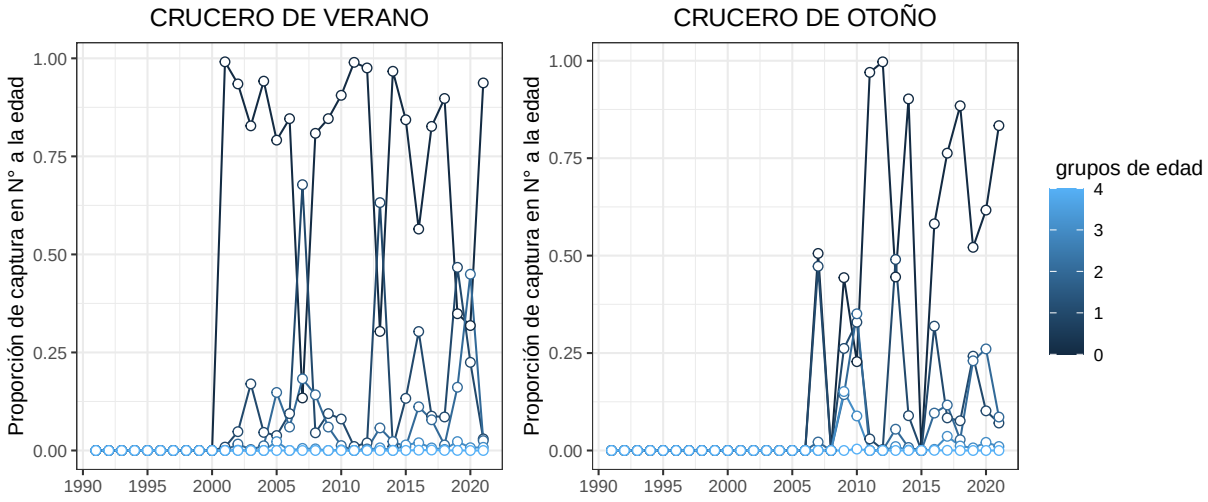
```
years    <- rep3$years
nyears   <- length(years)
age      <- seq(0,4,1)
nage     <- length(age)
WmedF    <- dat3$Wmed
WiniF    <- dat3$Wini
pobsF    <- rep3$pf_obs

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
```



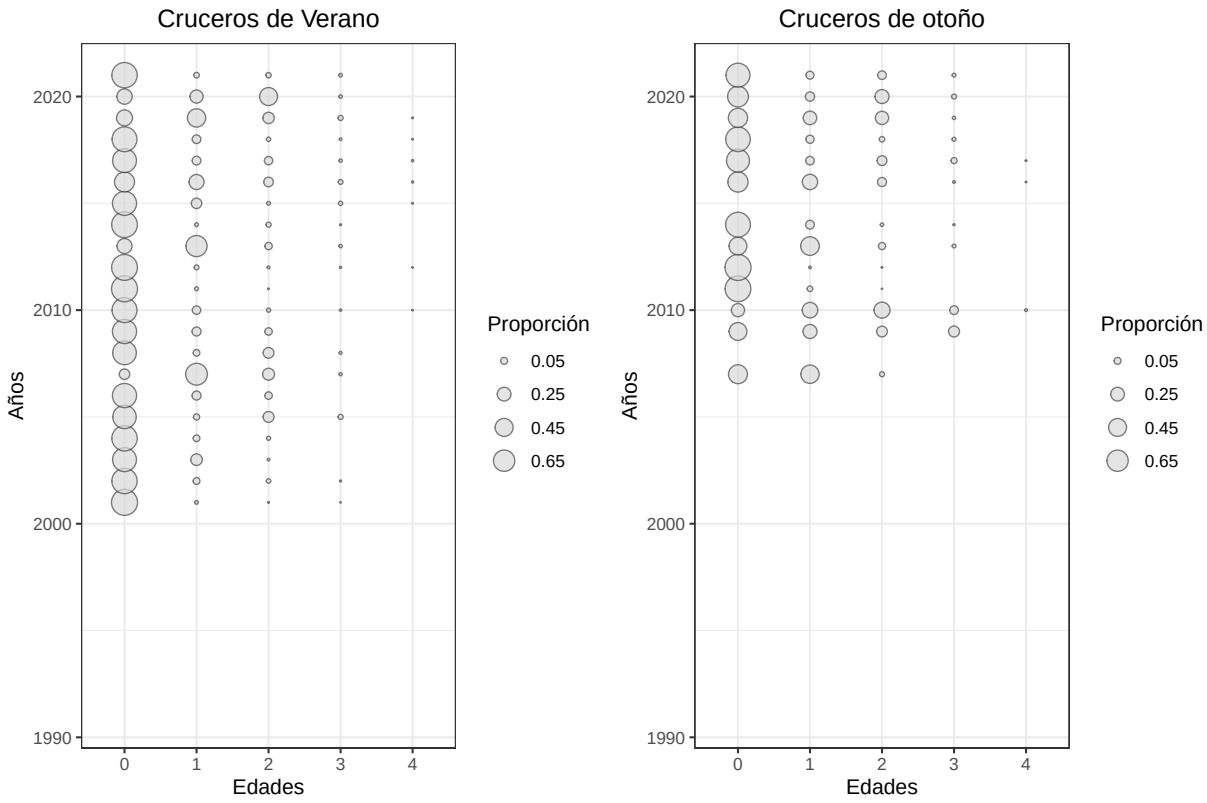
```r
pobsF    <- rep3$pf_obs
pF       <- c(pobsF); pF[pF==0]  <-NA
WmedF    <- dat3$Wmed
Wm       <- c(WmedF); Wm[Wm==0]  <-NA

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
```



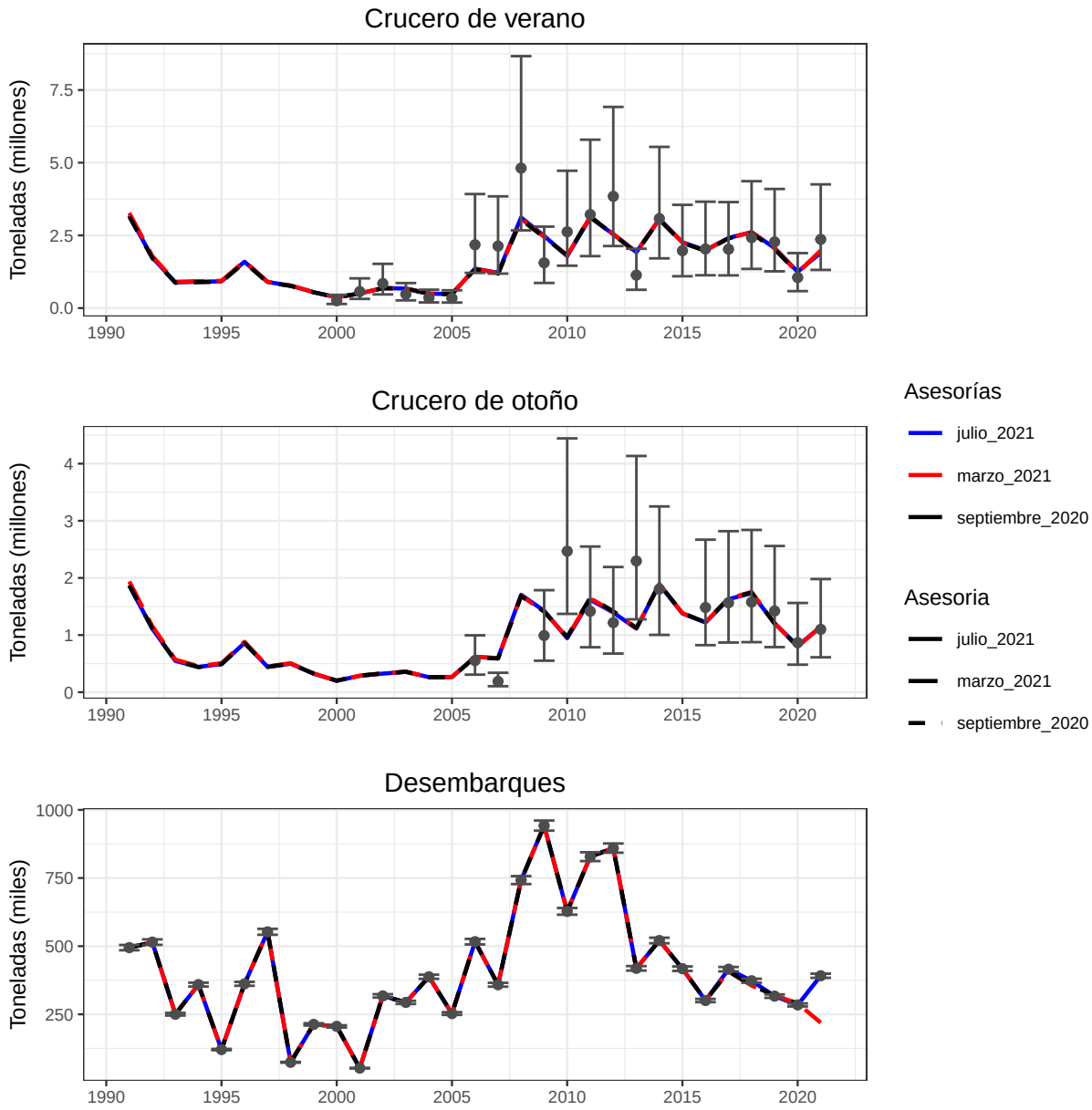
```
pobsR    <- rep3$pobs_RECLAS
pR       <- c(pobsR); pR[pR==0]  <-NA
pobsP    <- rep3$pobs_PELACES
pP       <- c(pobsP); pP[pP==0]  <-NA

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

3.1. Ajuste del modelo a los datos

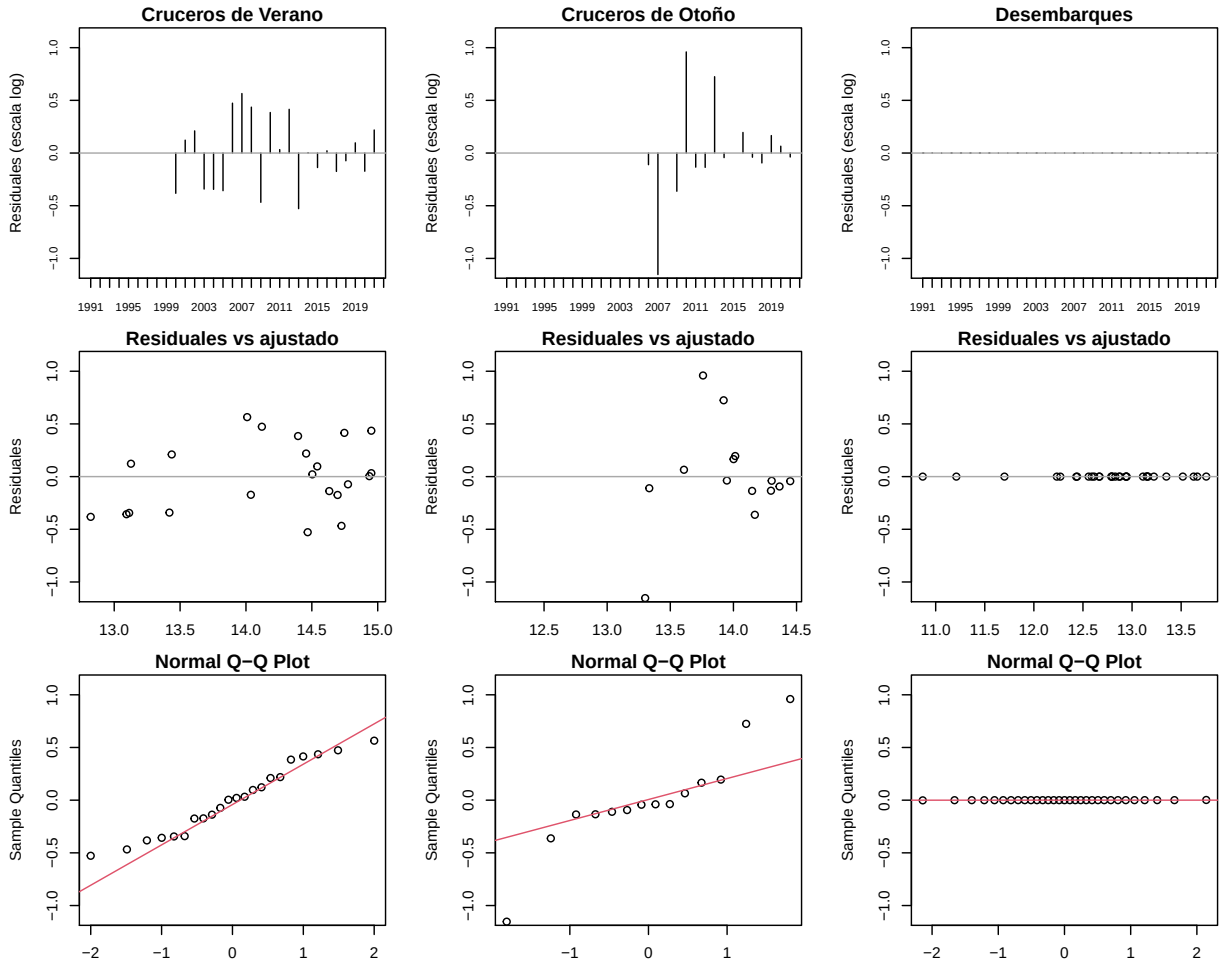
```
yrs   <- rep3$years
nyrs  <- length(yrs)
lasty <- yrs[nyrs]
cvBcV   <-0.30
cvBcO   <-0.30
cvdes   <-0.01
#=============================================================================
ind_obs           <- cbind(c(rep3$reclasobs),
                           c(rep3$pelacesobs),
                           c(rep3$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")
```

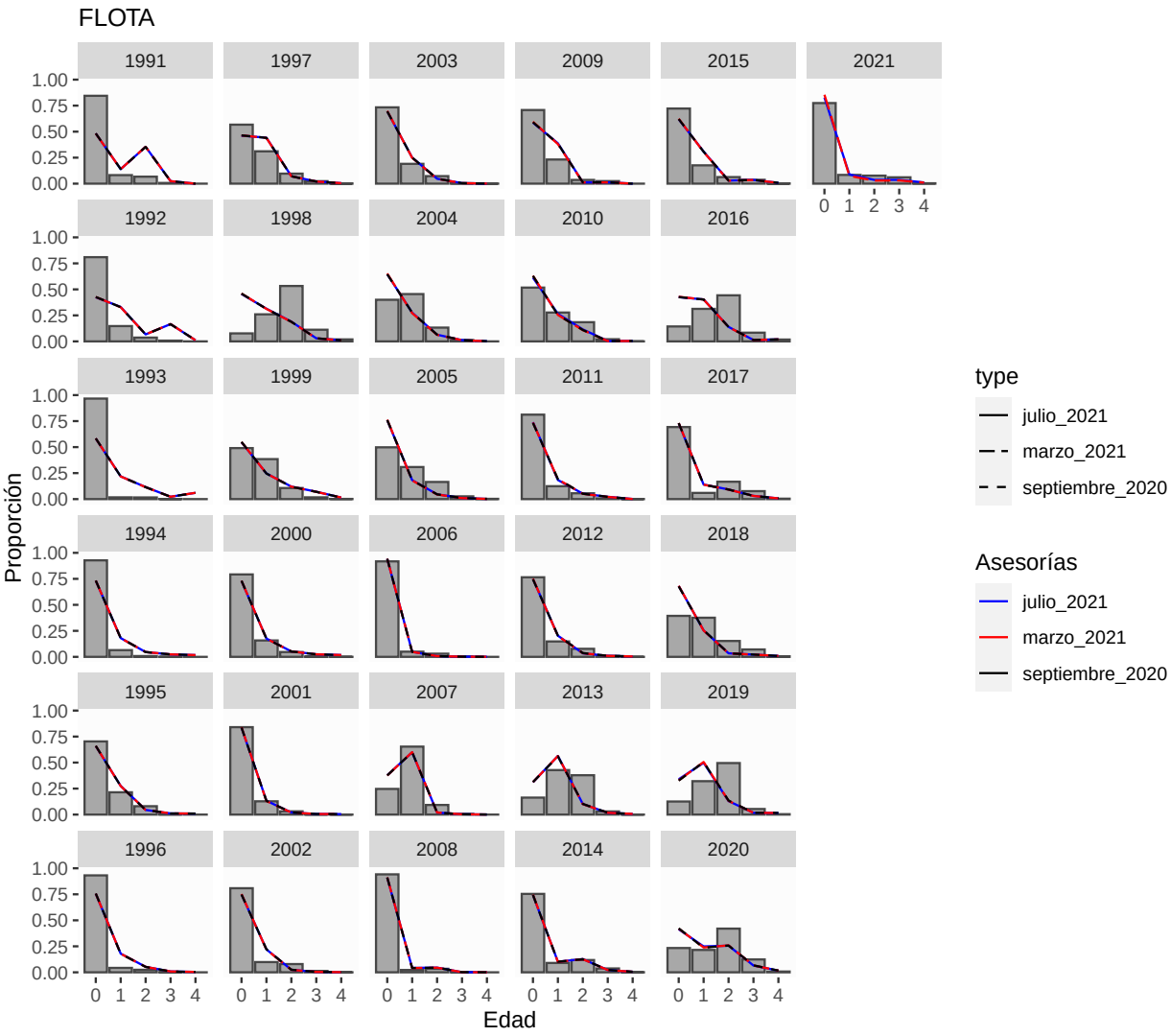

Crucero de verano
Toneladas (millones)
7.5
5.0
2.5
0.0
1990
1995
2000
2005
2010
2015
2020
Crucero de otoño
Toneladas (millones)
4
3
2
1
0
Desembarques
Toneladas (miles)
1000
750
500
250
Asesorías
julio_2021
marzo_2021
septiembre_2020
Asesoria
julio_2021
marzo_2021
septiembre_2020

```
# 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)
```

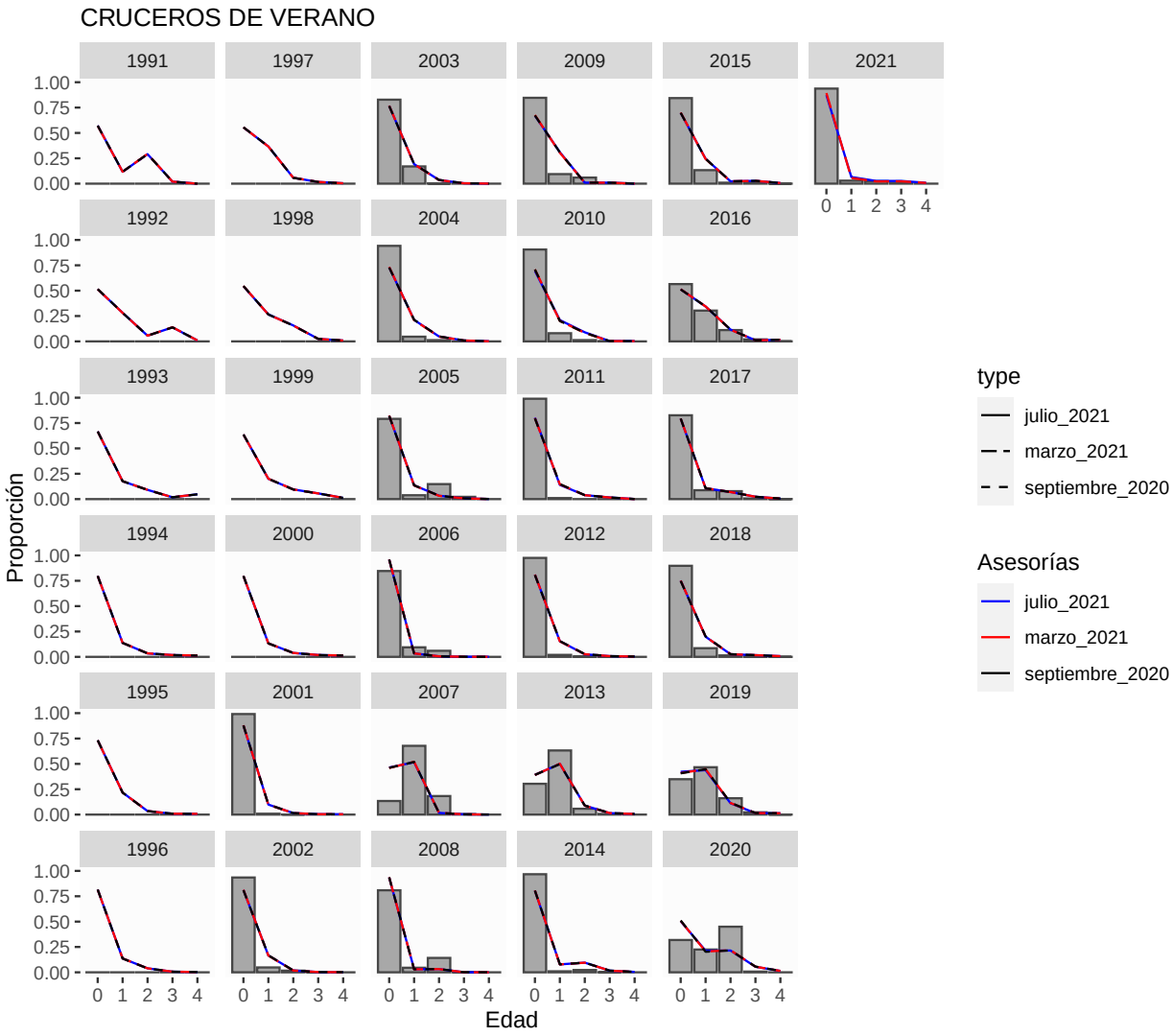
```r
par(mfcol=c(3,3),mar=c(2,4,1,1)+0.5)

 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)
```



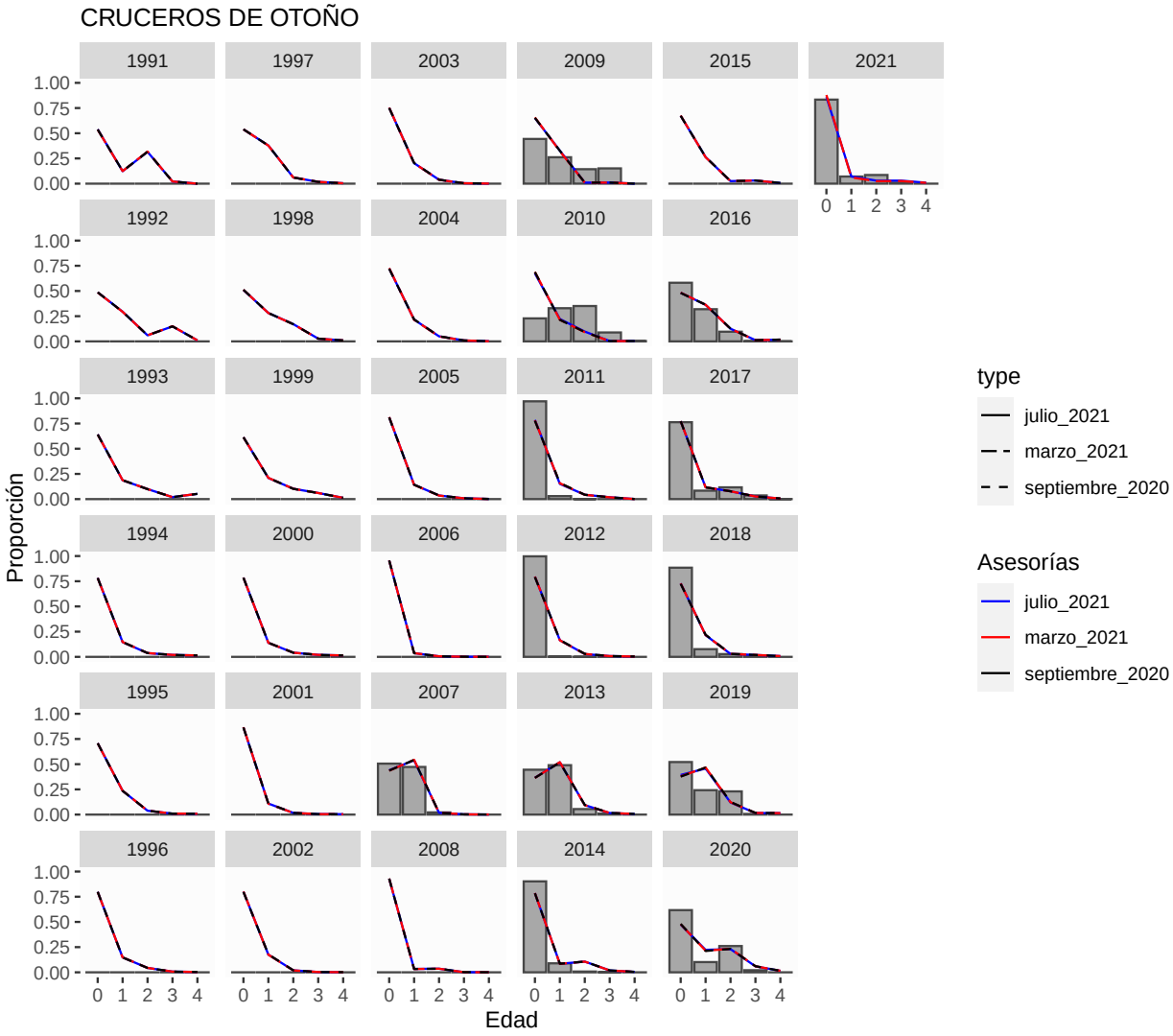
```r
years   <- dat3$Ind[,1]
nyears  <- length(years)
age     <- seq(0,4,1)
nage    <- length(age)

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
```

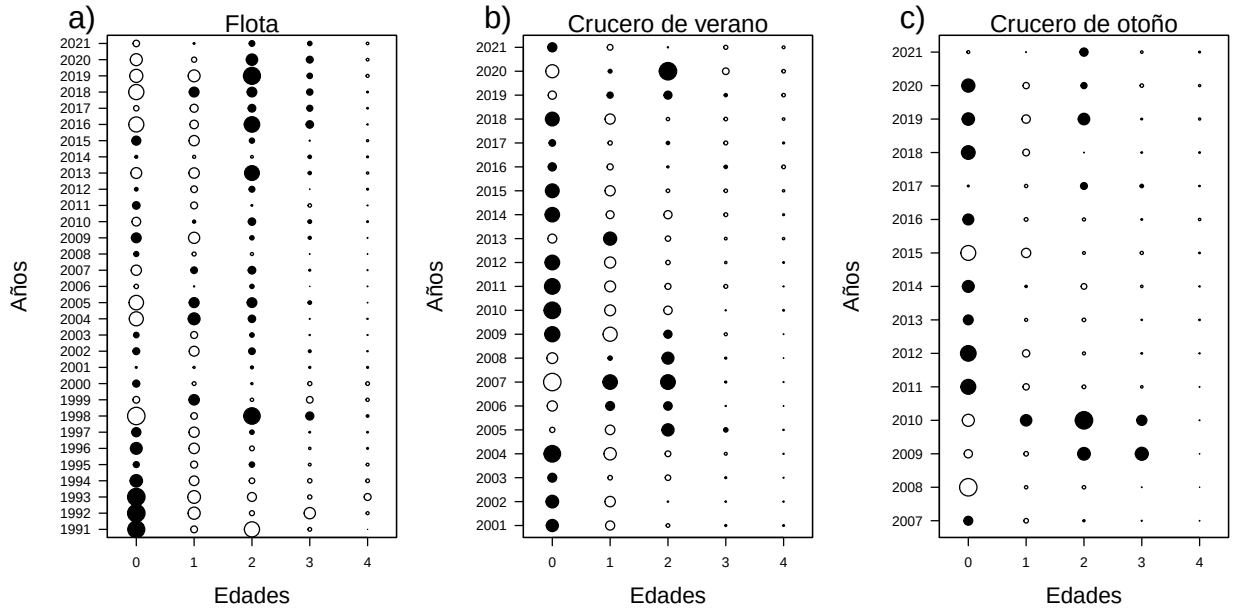

CRUCEROS DE VERANO
1991
1997
2003
2009
2015
2021
1992
1998
2004
2010
2016
1993
1999
2005
2011
2017
1994
2000
2006
2012
2018
1995
2001
2007
2013
2019
1996
2002
2008
2014
2020
Proporción
Edad
type
julio_2021
marzo_2021
septiembre_2020
Asesorías
julio_2021
marzo_2021
septiembre_2020

```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
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

```
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()
```

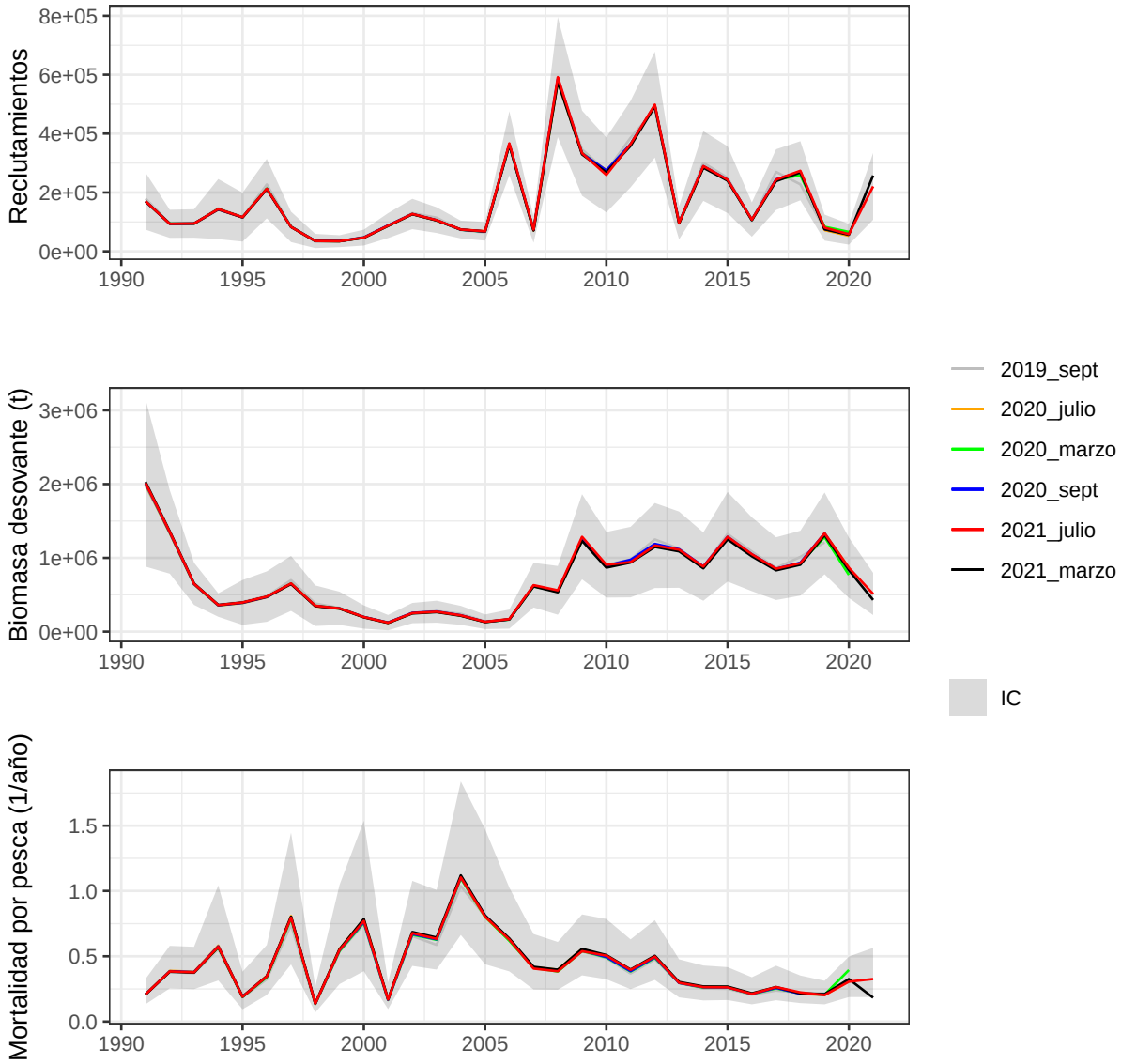


3.2. Comparación con asesorías previas

```
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))
```

```
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

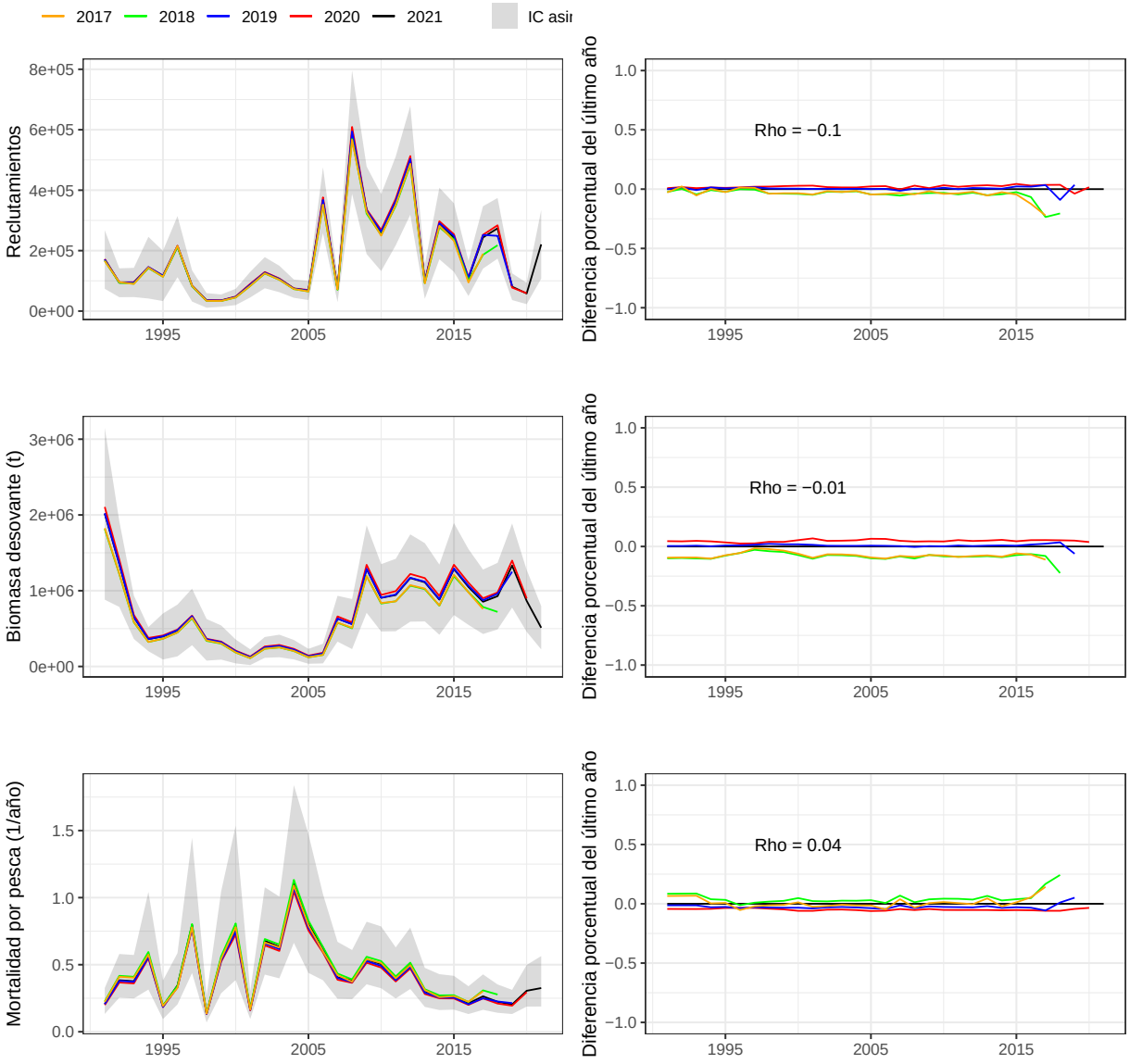
3.3. Análisis retrospectivo

```
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])
```

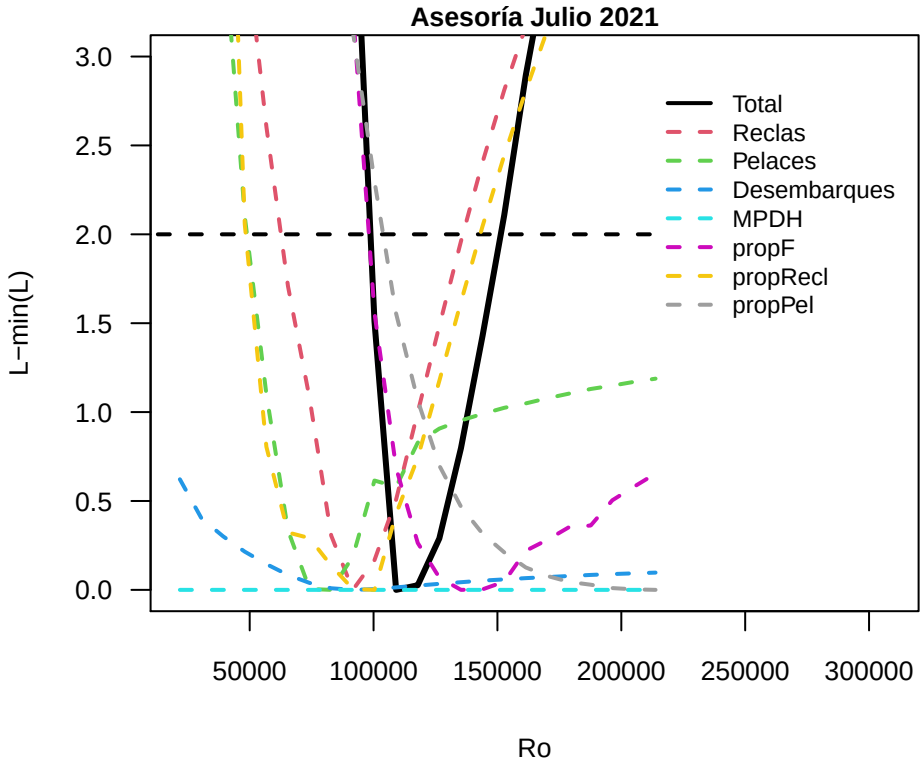
```
#Retrospectivo tradicional
Rt <- ggplot(Rt_retro) +
    geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = "IC asintótico"), alpha = 0.2)+
    geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, 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)
```



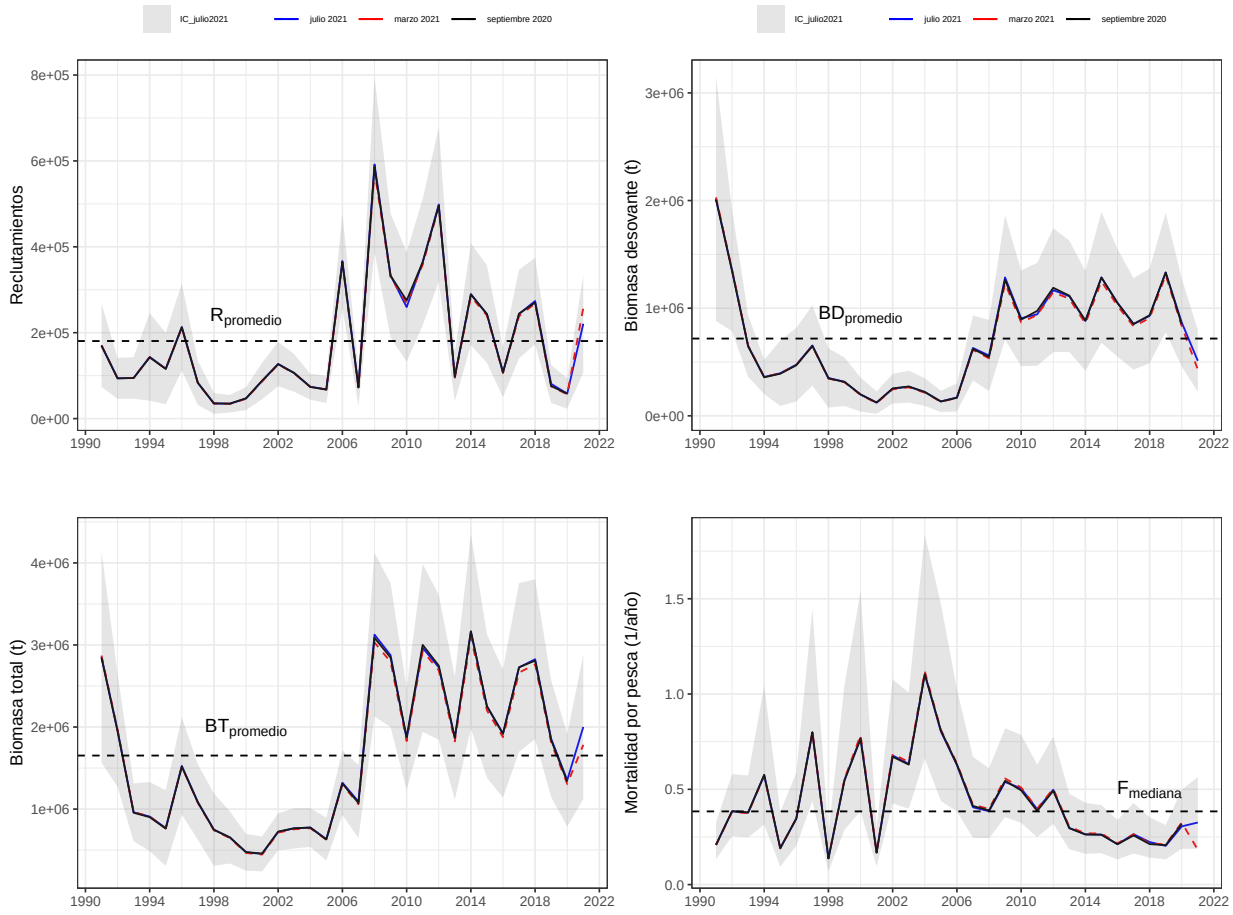

```
#legend(230000,1.5,names[9:14],col=9:14,lty=3,lwd=2,bty="n",cex=0.8)
```

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

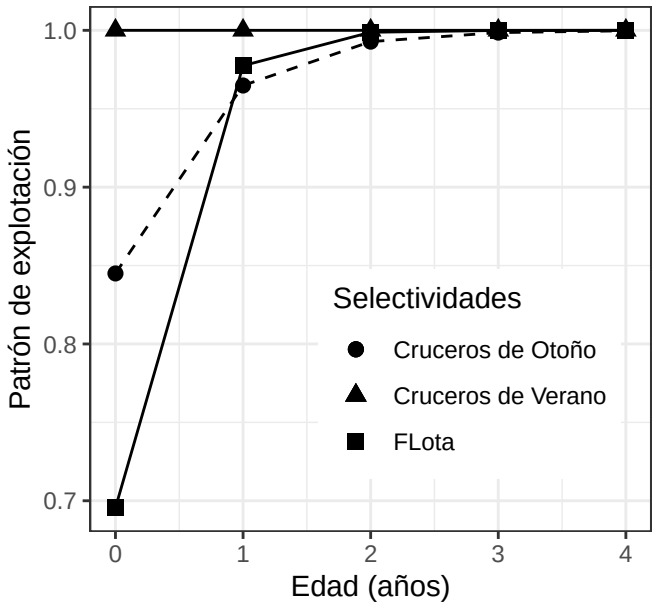
Año	BD_{sept}	BD_{marzo}	BD_{julio}	BT_{sept}	BT_{marzo}	BT_{julio}	R_{sept}	R_{marzo}	R_{julio}	F_{sept}	F_{marzo}	F_{julio}
2008/09	1263800	1230300	1285730	2846100	2794700	2875880	332590	329460	333486	0.545	0.557	0.539
2009/10	894040	867720	906147	1877000	1828600	1852850	275020	268470	259700	0.494	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)
```

```r
# 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)
```

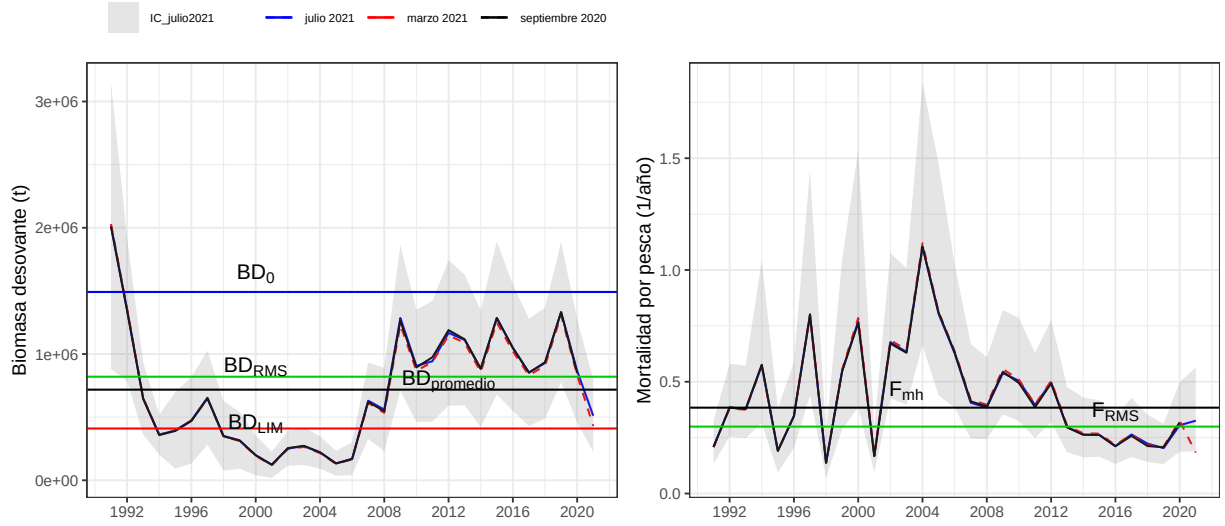
```r
# ASESORÍA DE SEPTIEMBRE
Bo1           <- rep1$SSBpbr[1]                        # Paso 4: Obtenci?n de Bo
BRMS1         <- rep1$SSBpbr[3]                        # Paso 5: Obtenci?n de Brms = 60%SPRo = 55%Bo
FRMS1         <- rep1$Fs[2]
BLIM1         <- Bo1*0.275                             # Paso 6: Obtenci?n de Blim = 20%Bo
FLIM1         <- rep1$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
```

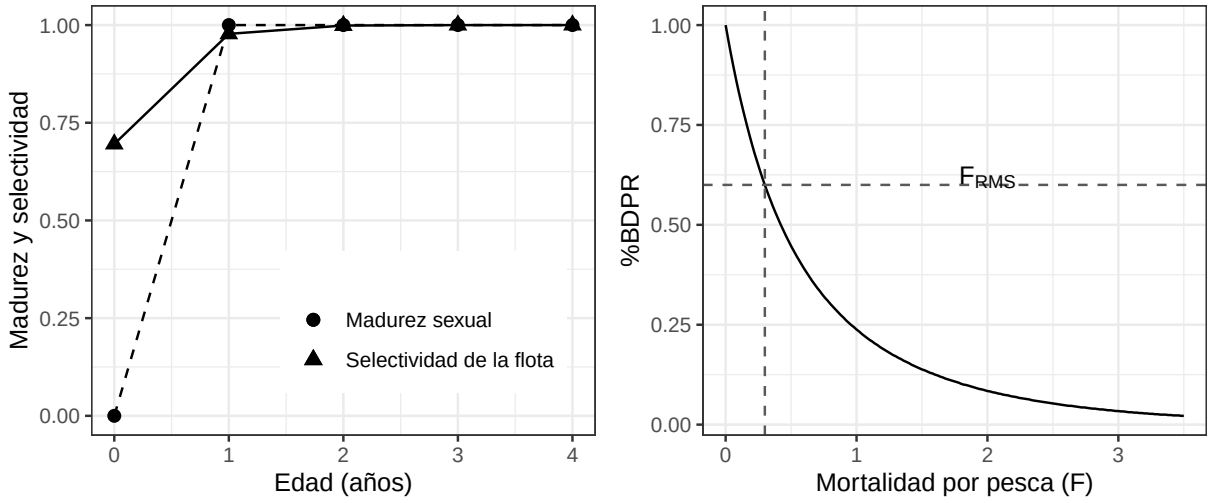
```
# ASESORÍA DE SEPTIEMBRE
Bo3           <- rep3$SSBpbr[1]                    # Paso 4: Obtenci?n de Bo
BRMS3         <- rep3$SSBpbr[3]                    # Paso 5: Obtenci?n de Brms = 60%SPRo = 55%Bo
FRMS3         <- rep3$Fs[2]
BLIM3         <- Bo3*0.275                         # Paso 6: Obtenci?n de Blim = 20%Bo
FLIM3         <- rep3$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

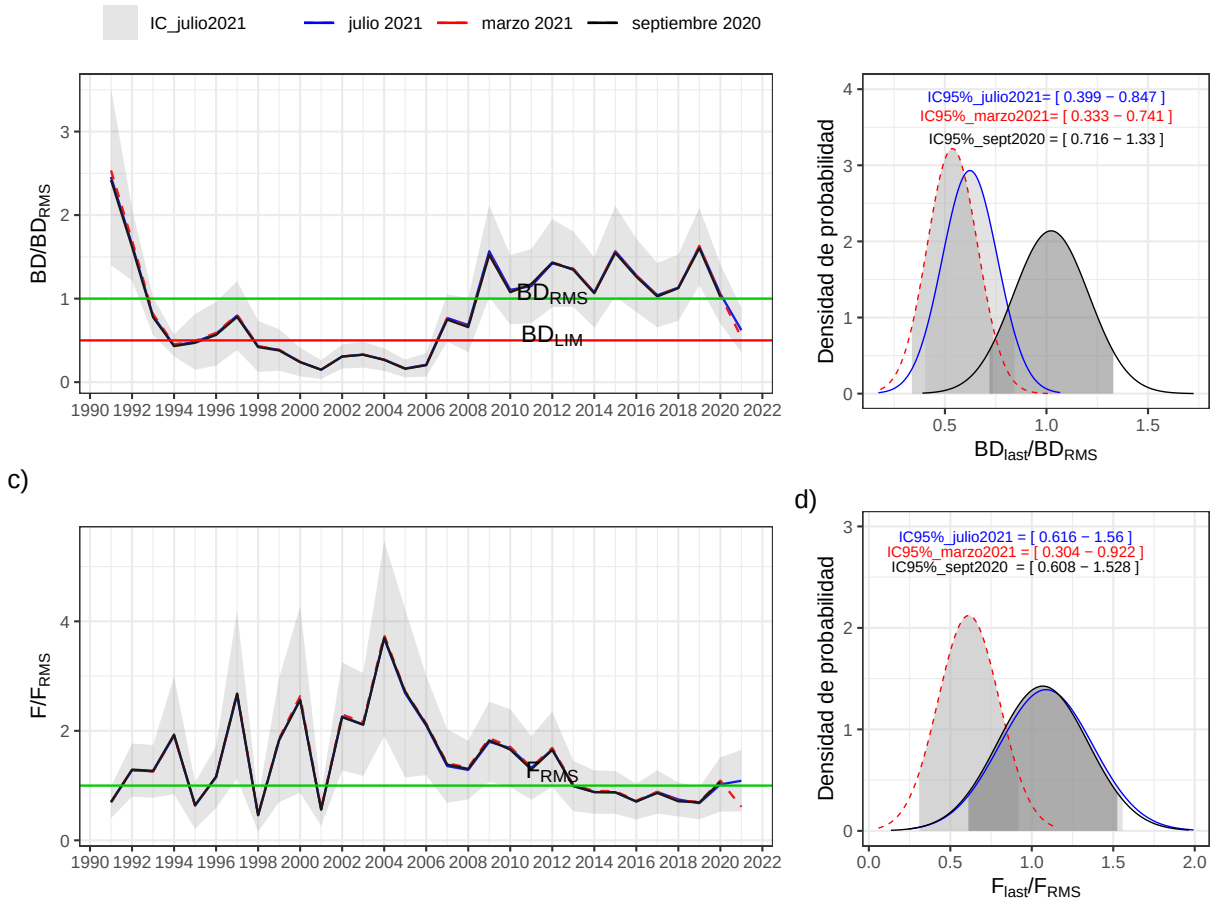
```
years2<-rep2$years
nyears2<-length(years2)

#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)
```

```
#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))
```



```
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

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

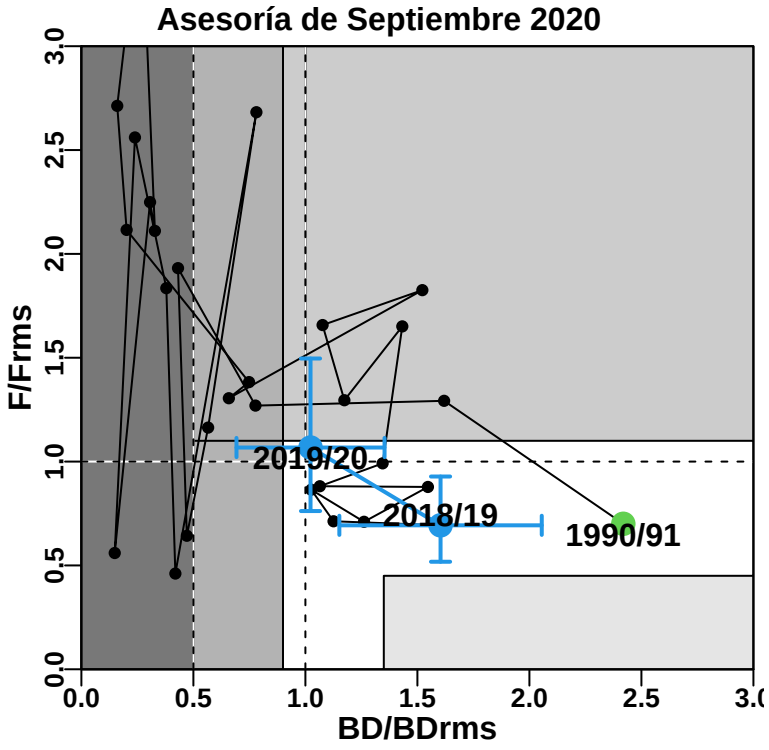
```
yearsb<-c("1990/91","1991/92","1992/93","1993/94","1994/95","1995/96","1996/97","1997/98","1998/99","1999/00","2000/01","2001/02

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

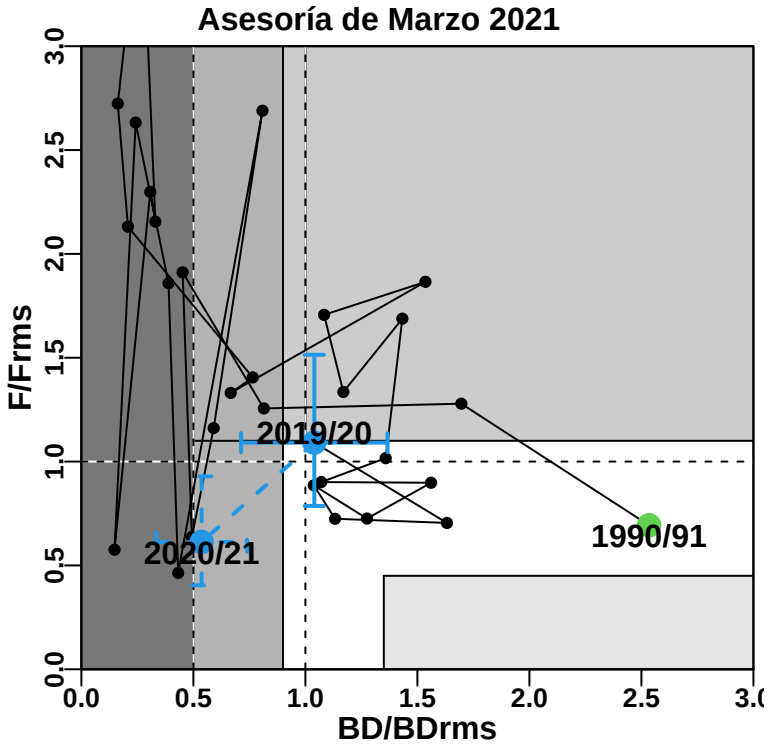
Años	Y/BT_{sept}	Y/BT_{marzo}	Y/BT_{julio}	C/N_{sept}	C/N_{marzo}	C/N_{julio}
1994/95	0.158	0.157	0.157	0.088	0.088	0.087
1995/96	0.238	0.238	0.237	0.148	0.149	0.147
1996/97	0.512	0.513	0.509	0.323	0.324	0.321
1997/98	0.099	0.1	0.099	0.069	0.069	0.069
1998/99	0.326	0.33	0.326	0.233	0.236	0.233
1999/00	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)
```

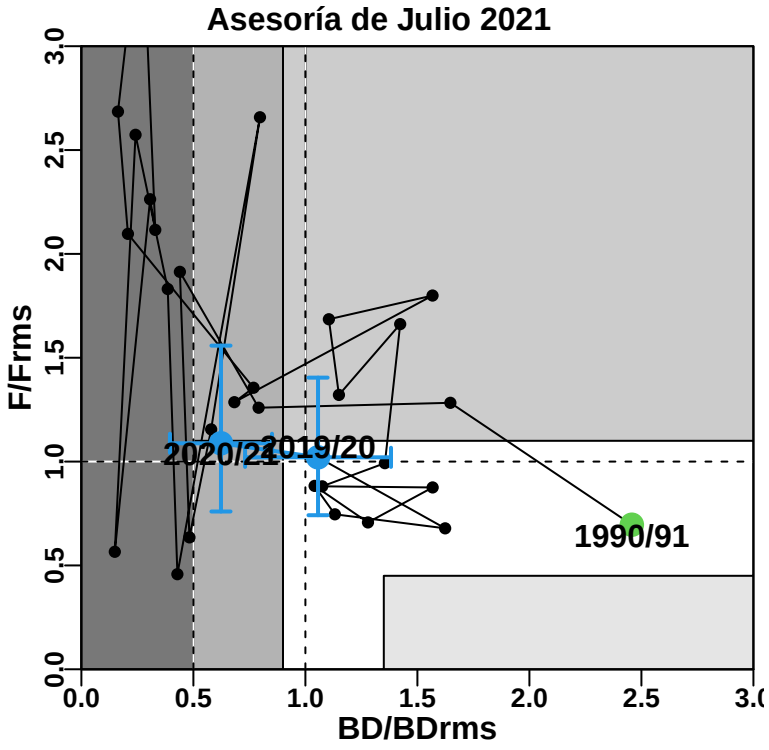
```
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name1<-"Asesoría de Septiembre 2020"
years1<-rep1$years
nyears1<-length(years1)

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
```



```
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
```



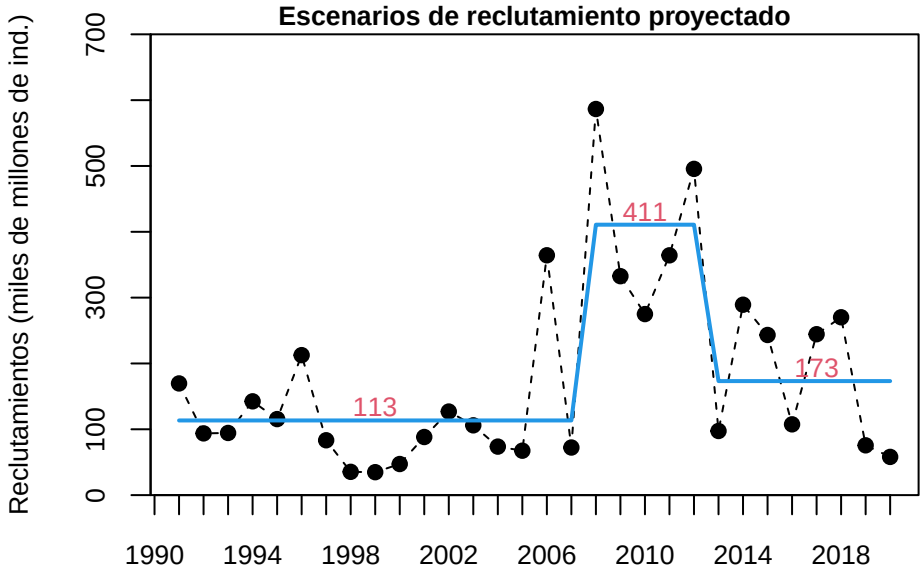
```
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name3<-"Asesoría de Julio 2021"
years3<-rep3$years
nyears3<-length(years3)

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)



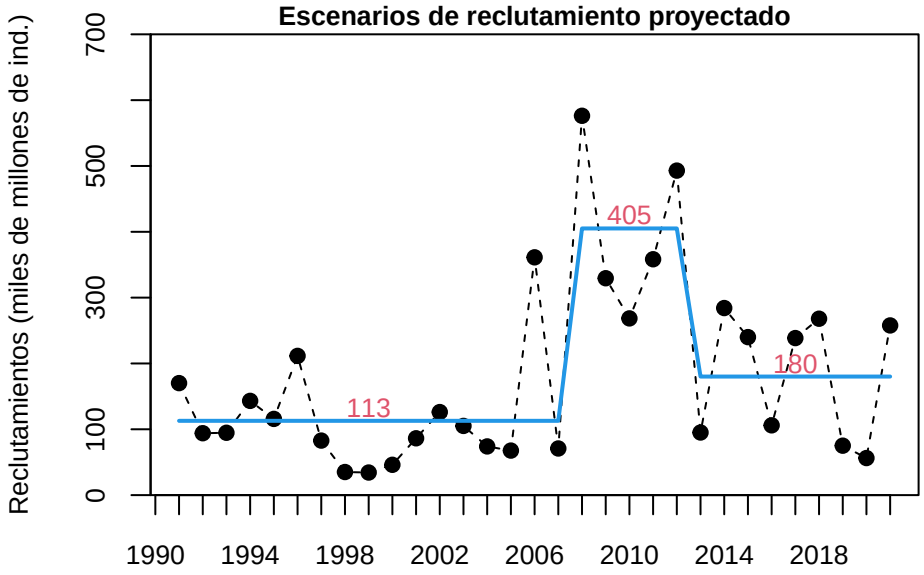
	1991-2007	2008-2012	2013-2020
mean	250260	447840	300810
std	42769	73667	60397
10%	195449	353432	223408
20%	214265	385840	249979
30%	227832	409209	269138
40%	239425	429177	285509
50%	250260	447840	300810

	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)



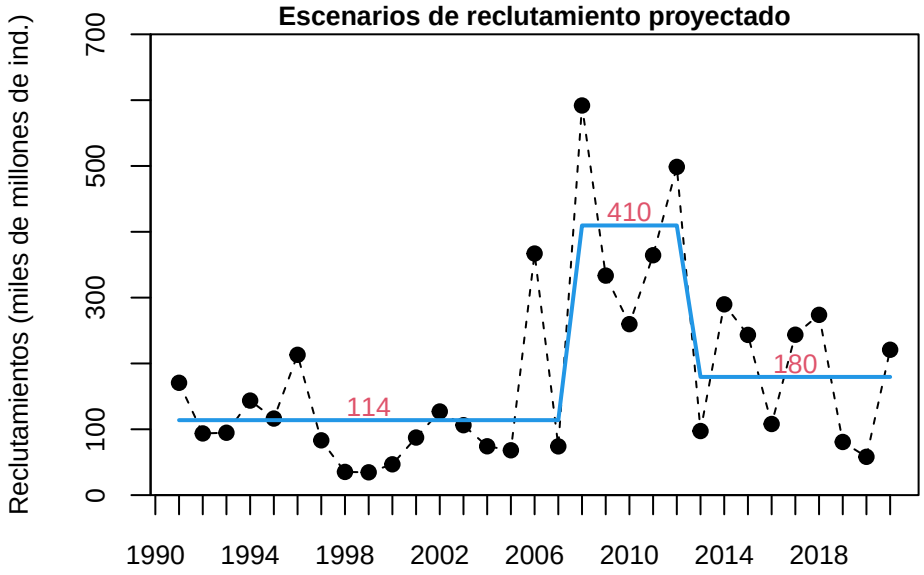
	1991-2007	2008-2012	2013-2021
mean	271720	313030	279570
std	29384	34291	33911
10%	234063	269084	236111
20%	246990	284170	251030
30%	256311	295048	261787
40%	264276	304342	270979
50%	271720	313030	279570

	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()
```

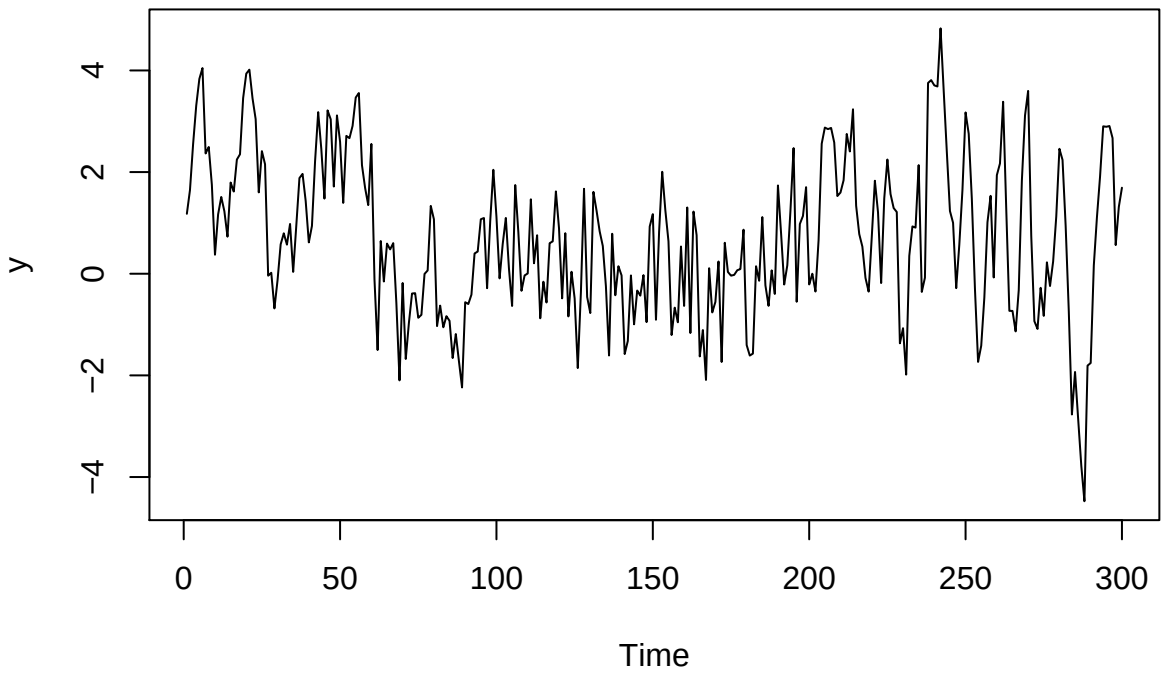
```
library(lubridate)
```

```
##
## 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 = 11.34, p-value = 0.05554
```

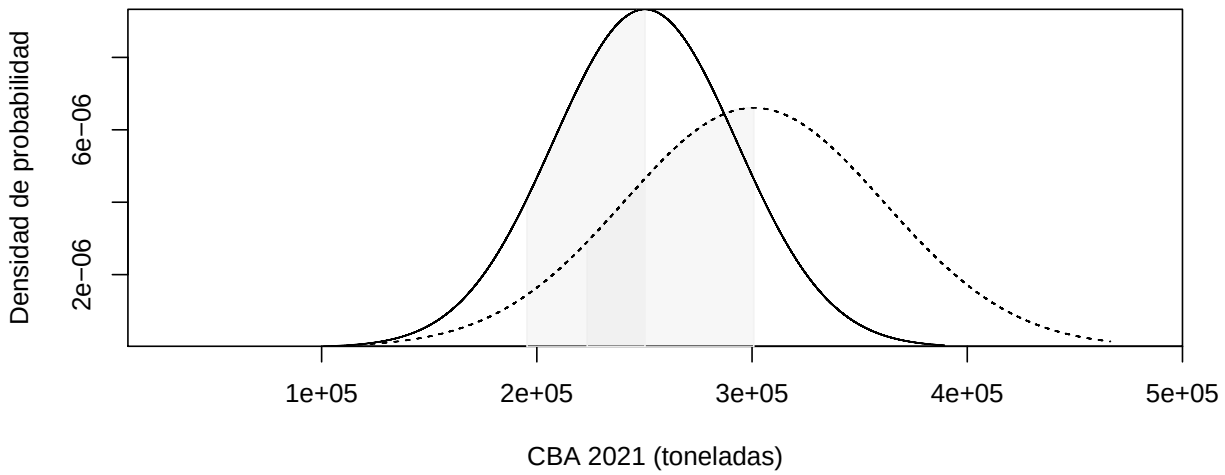
	1991-2007	2008-2012	2013-2021
mean	378670	419950	385460
std	22259	28186	25850
10%	350144	383828	352332
20%	359936	396228	363704
30%	366997	405169	371904
40%	373031	412809	378911
50%	378670	419950	385460

	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")
```

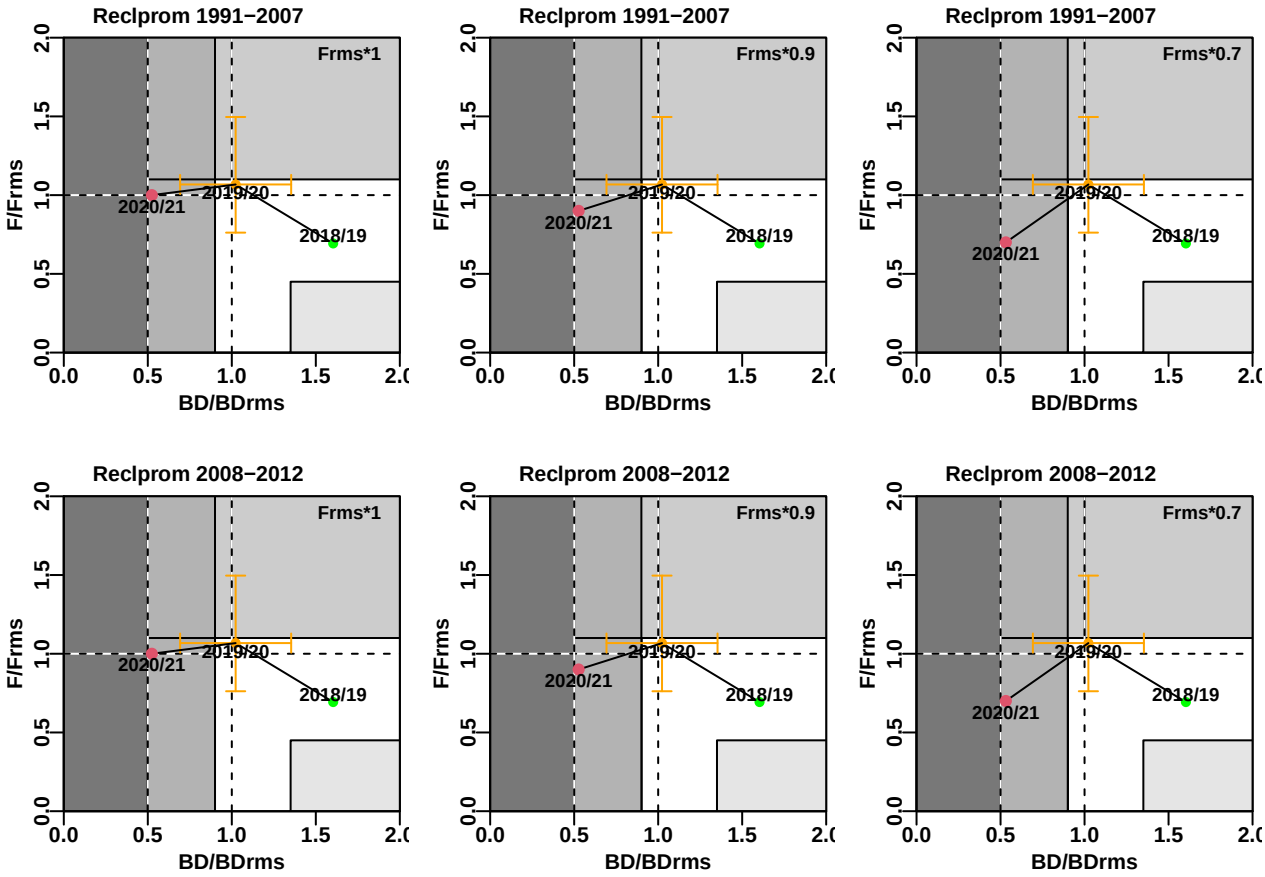


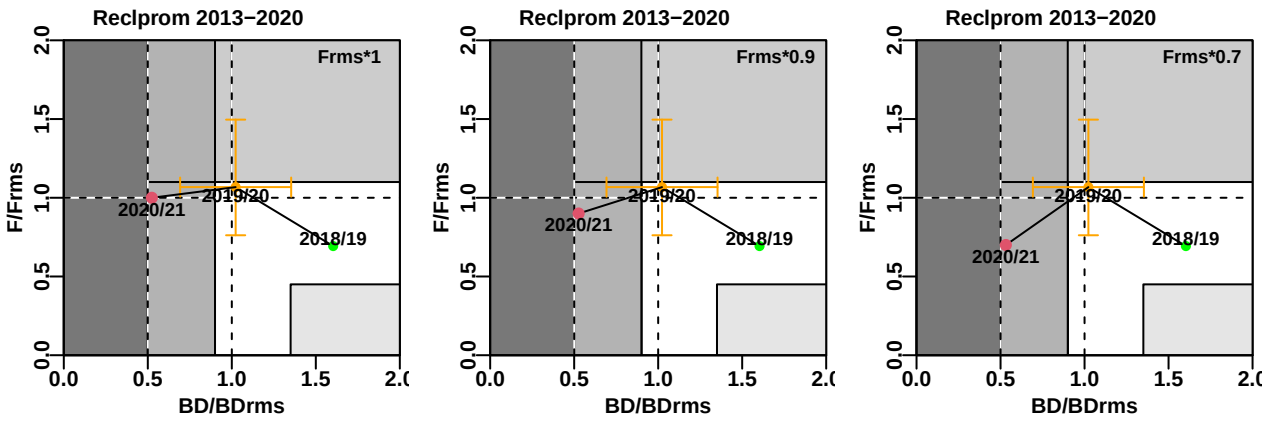
4.0. Proyección del stock (Asesoría de septiembre 2020)

	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

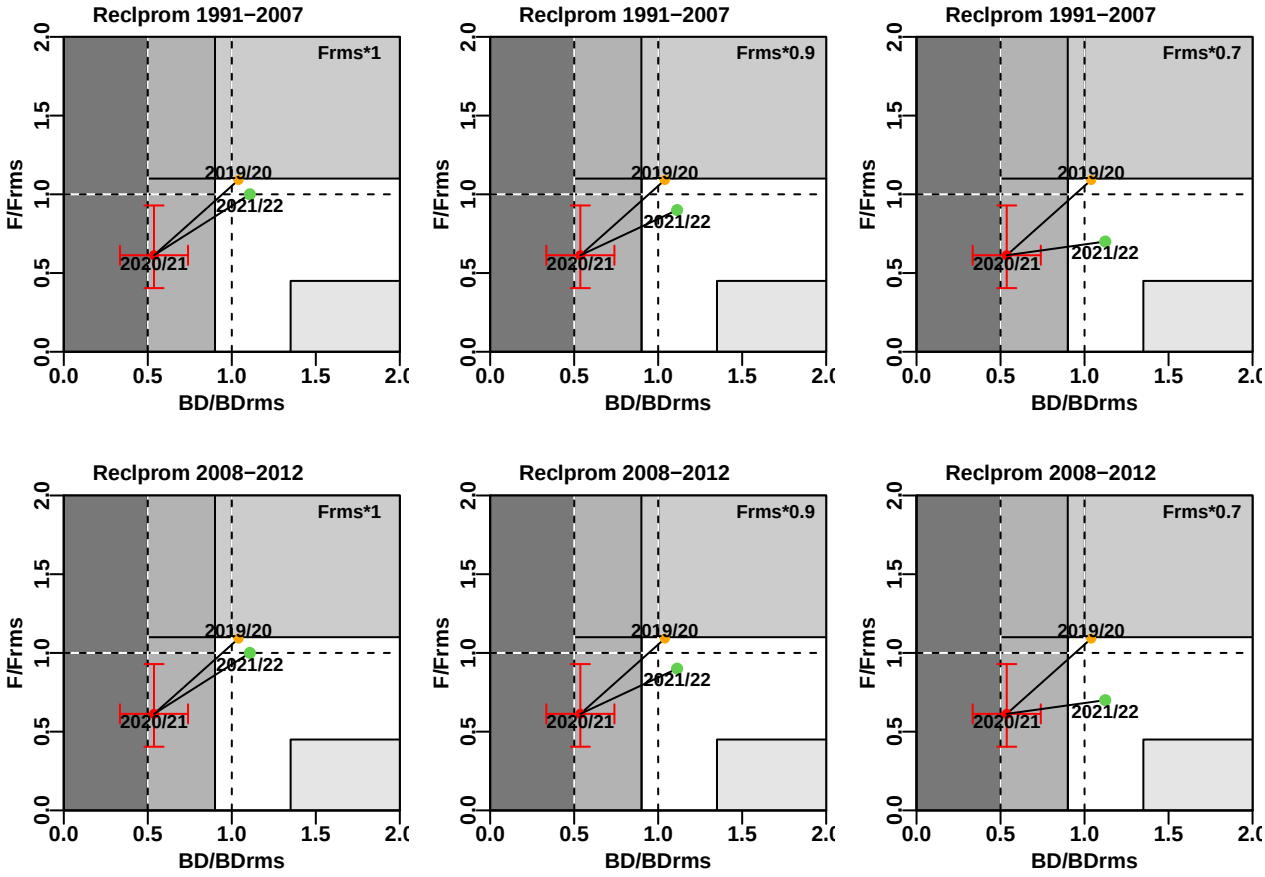


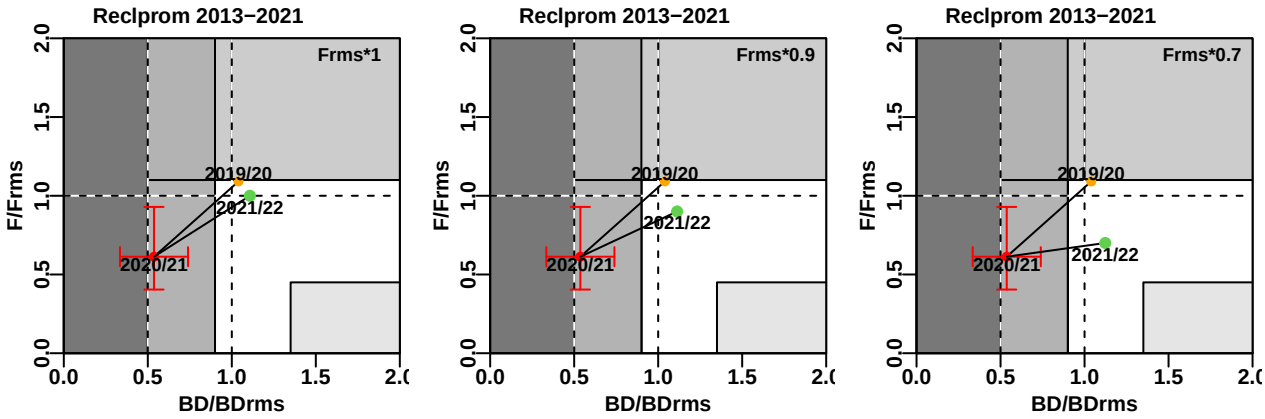

Reclprom 2013−2020
Frms*1
F/Frms
BD/BDrms
2020/21
2019/20
2018/19
Reclprom 2013−2020
Frms*0.9
F/Frms
BD/BDrms
2020/21
2019/20
2018/19
Reclprom 2013−2020
Frms*0.7
F/Frms
BD/BDrms
2020/21
2019/20
2018/19

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

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

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

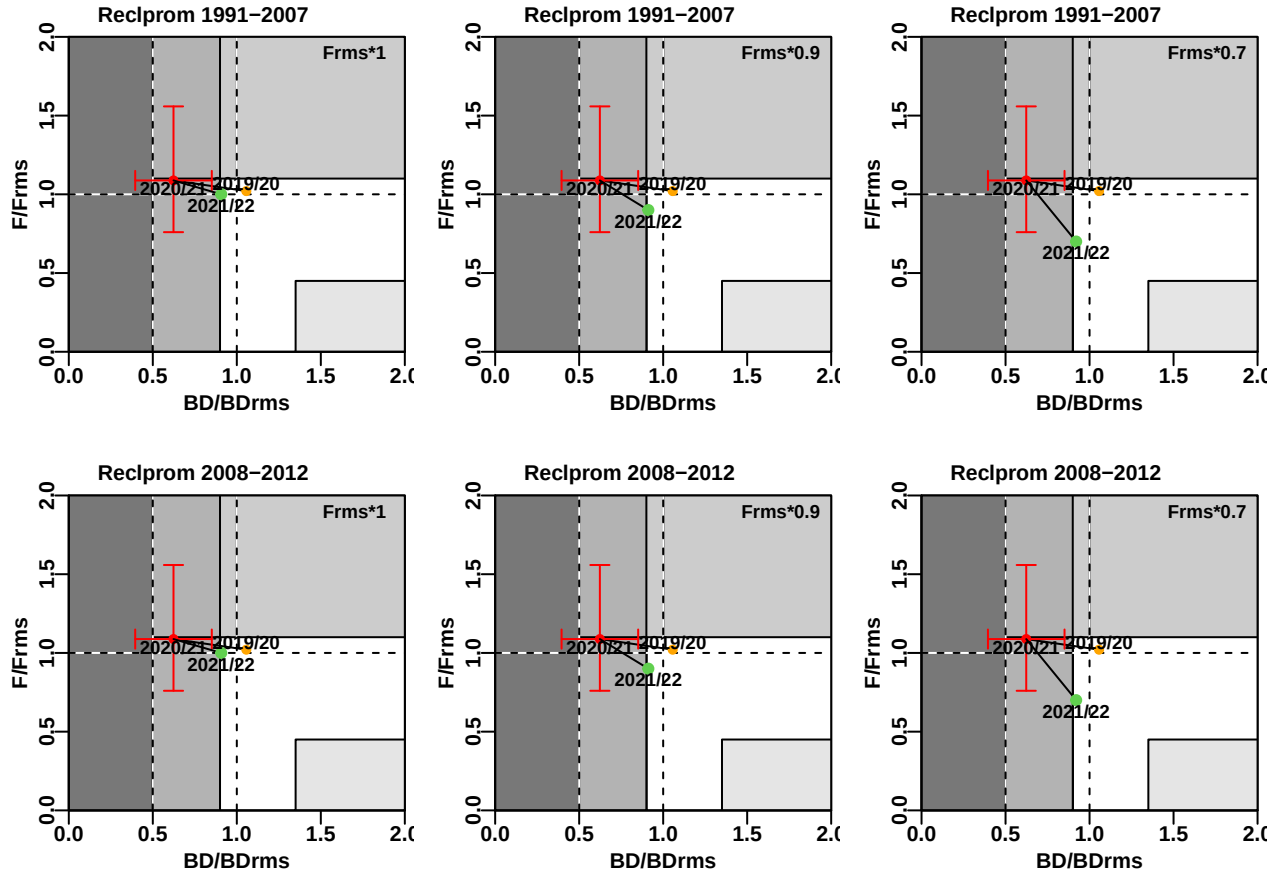


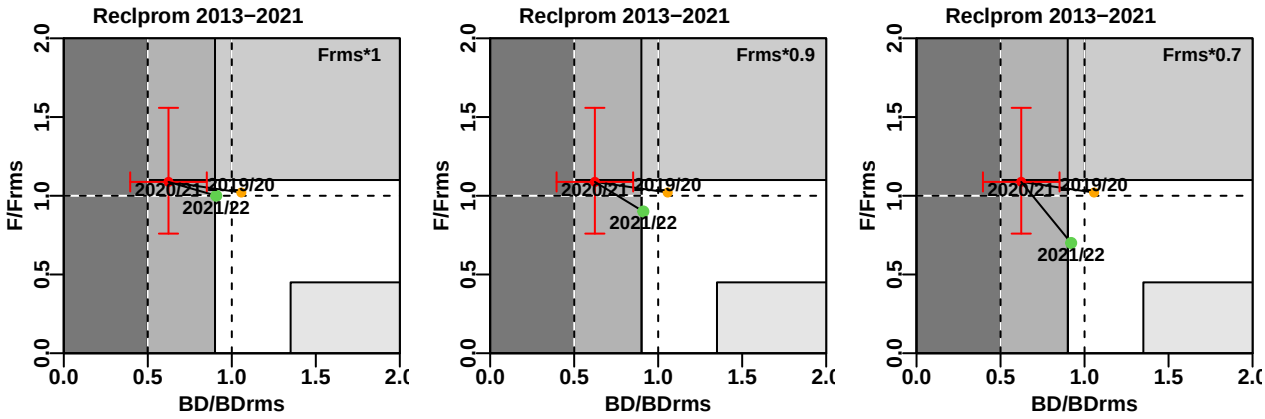

Reclprom 2013−2021
Frms*1
2019/20
2021/22
2020/21
F/Frms
BD/BDrms
0.0
0.5
1.0
1.5
2.0
Reclprom 2013−2021
Frms*0.9
2019/20
2021/22
2020/21
F/Frms
BD/BDrms
Reclprom 2013−2021
Frms*0.7
2019/20
2021/22
2020/21
F/Frms
BD/BDrms

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

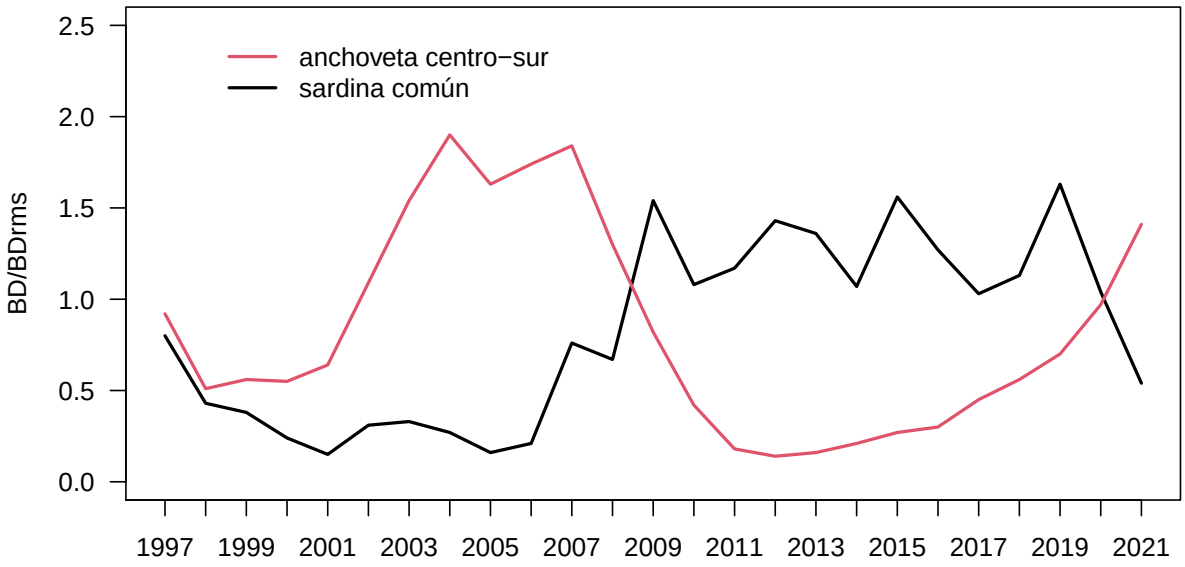
	2008-2012[F_{RMS}*1]	[F_{RMS}*0.9]	[F_{RMS}*0.7]
p(BD<0,9BD_{RMS})_2020/21	0.98	0.98	0.98
p(BD<0,5BD_{RMS})_2020/21	0.18	0.18	0.18
p(BD<0,9BD_{RMS})_2021/22	0.49	0.48	0.46
p(BD<0,5BD_{RMS})_2021/22	0.04	0.03	0.03

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




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

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

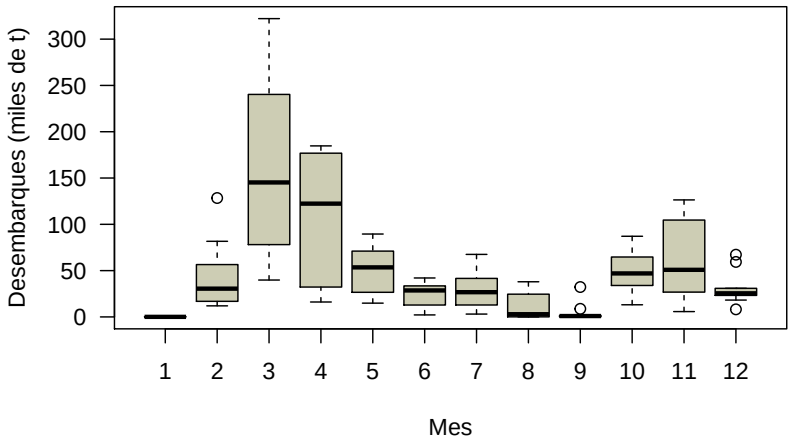


Figure 1: Capturas mensuales de sardina común realizadas entre 2007-2021, registradas por SERNAPESCA en la zona centro-sur.

- 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