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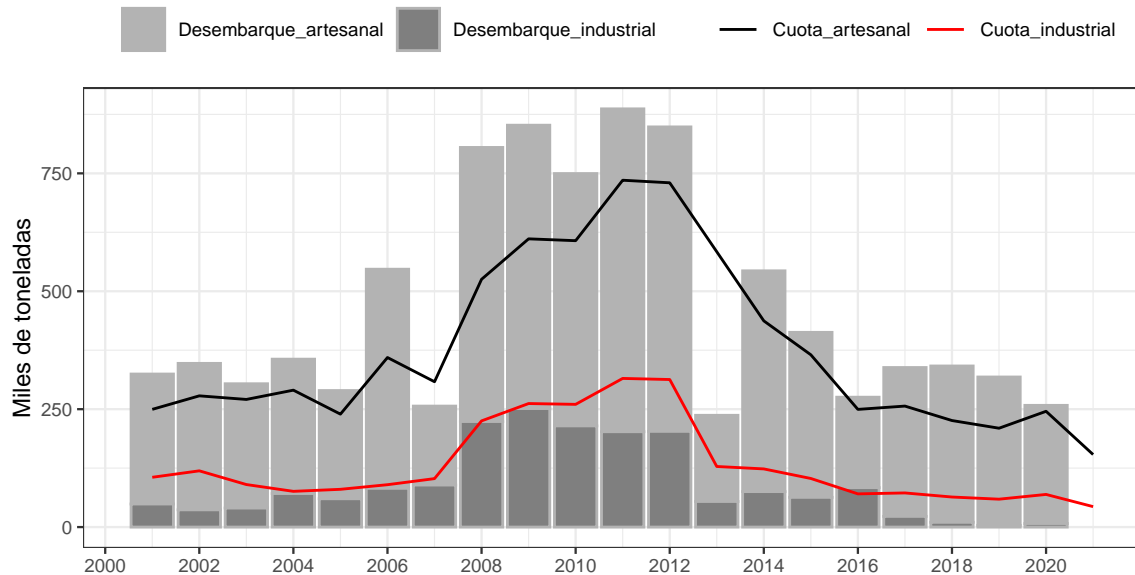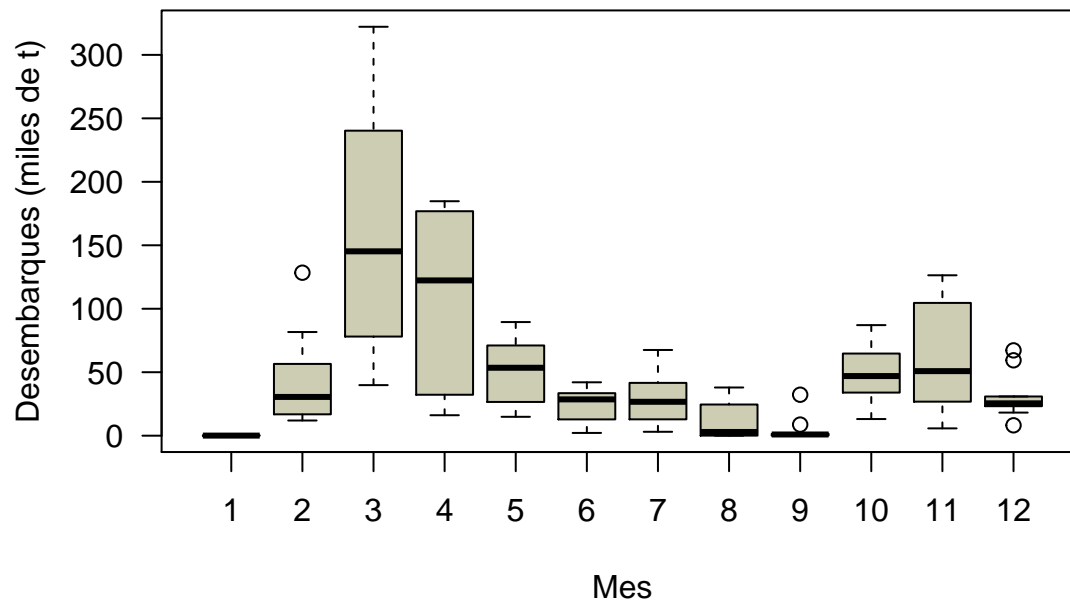
```
ano<-ant$desembarques_sernapesca[,1]
des_mes<-data.frame(mes=rep(seq(1,12,1),27),ano=gl(27,12,labels=ano),desem=c(t(ant$desembarques_sernapesca[,2:13])))

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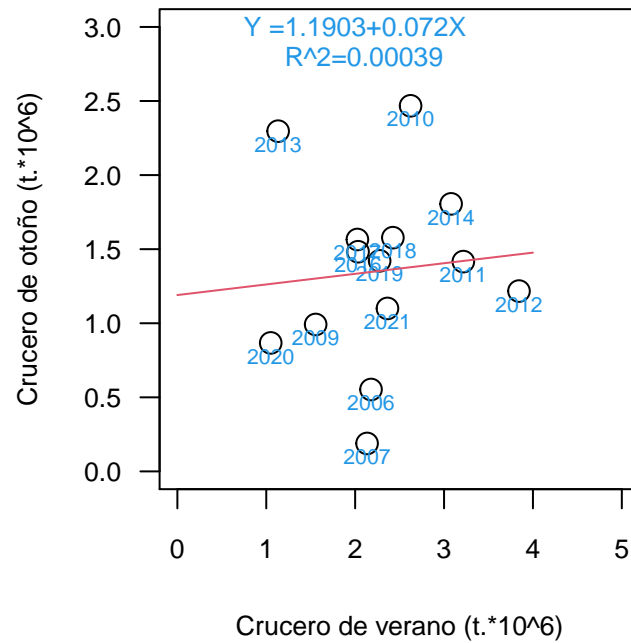
```
anorecl<-ant$reclas_BT_BR_AT_AR[,1]
BTreclas<-ant$reclas_BT_BR_AT_AR[,2]
BRreclas<-ant$reclas_BT_BR_AT_AR[,3]
ATreclas<-ant$reclas_BT_BR_AT_AR[,4]
anopela<-ant$pelaces_BT_AT[,1]
BTpela<-ant$pelaces_BT_AT[,2]
ATpela<-ant$pelaces_BT_AT[,3]

par(mar=c(2,4,1,1)+0.5)
plot(anorecl,BTreclas/1000000,ylim=c(0,5),xaxp=c(2000,2021,21),las=1,ylab="Biomasa acústica (millones de t.)",xlab="",type="o",p
lines(anorecl,BRreclas/1000000,type="o",pch=19,col=2,lwd=2)
legend(2000, 5,c("Biomasa Total","Biomasa Reclutas"),pch=19,lwd=2,col=c(1,2),bty="n",cex=0.8)
```
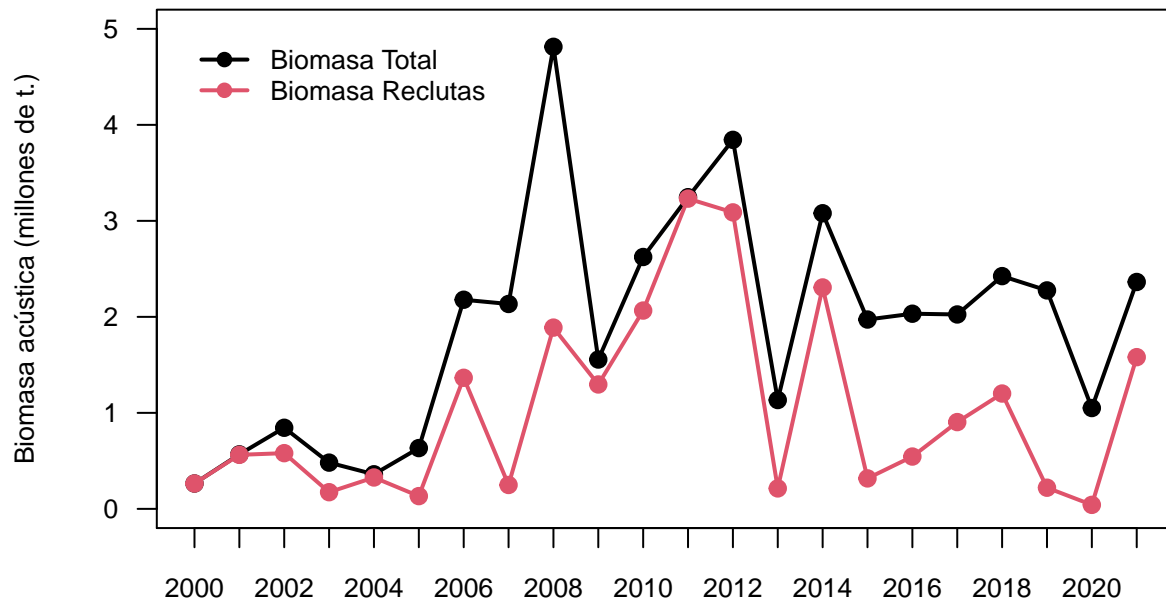
2. METODOLOGÍA

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

par(mfrow=c(1,1),mar=c(2,4,1,1))
plot(years,rep3$Reclutas,type="l",lty=2,pch=19,ylim=c(0,700000),
     xaxp=c(1990,2020,30),yaxs="i",xlab="",ylab="Reclutamientos",main="Análisis de quiebres",cex.main=0.8,cex.axis=0.8,cex.lab=0
points(years,rep3$Reclutas,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])+25000,round(c(fitted(fm1)[1],fitted(fm1)[18],fitted(fm1
```
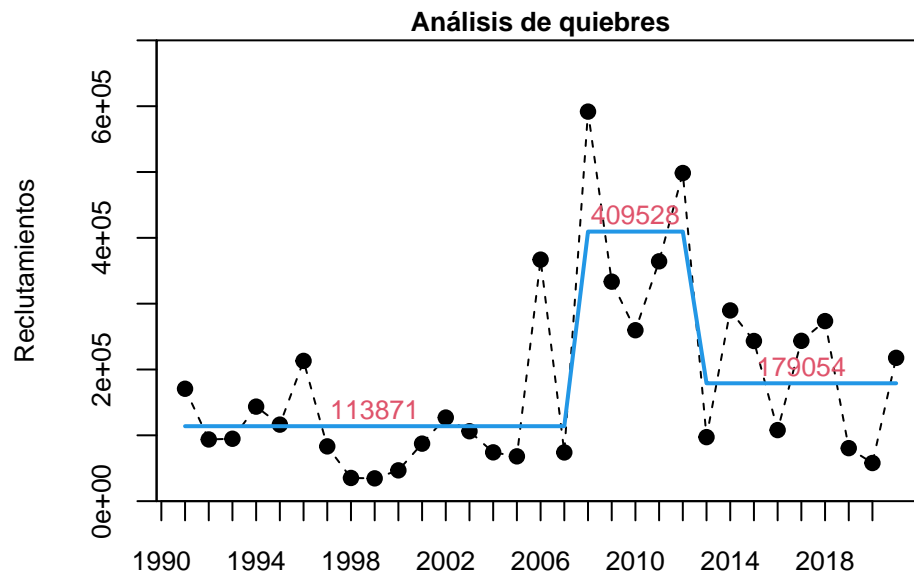
```
years3    <-rep3$years
nyears3   <-length(years3)
age       <-seq(0,4,1)
nage      <-length(age)
pobsF     <-rep3$pf_obs

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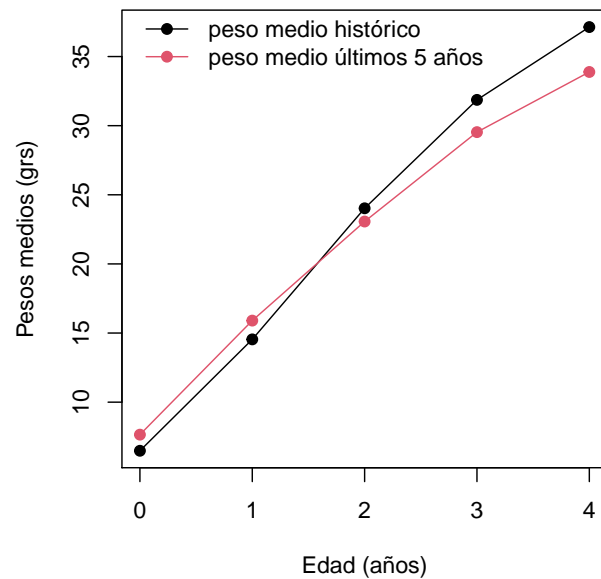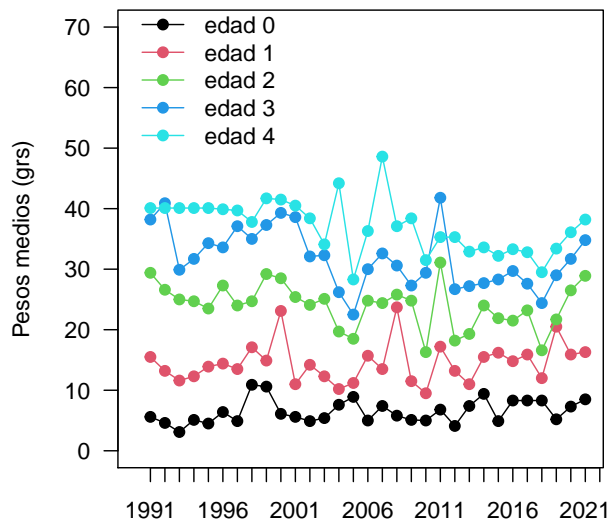
Año.biológico	Desembarques.t.	Porcentaje.descarte	Captura.descartada.t.	Captura.total.t.
1990-91	494567	0%	0	494567
1991-92	514787	0%	0	514787
1992-93	250237	0%	0	250237
1993-94	358949	0%	0	358949
1994-95	120608	0%	0	120608
1995-96	361735	0%	0	361735
1996-97	552515	0%	0	552515
1997-98	73892	0%	0	73892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

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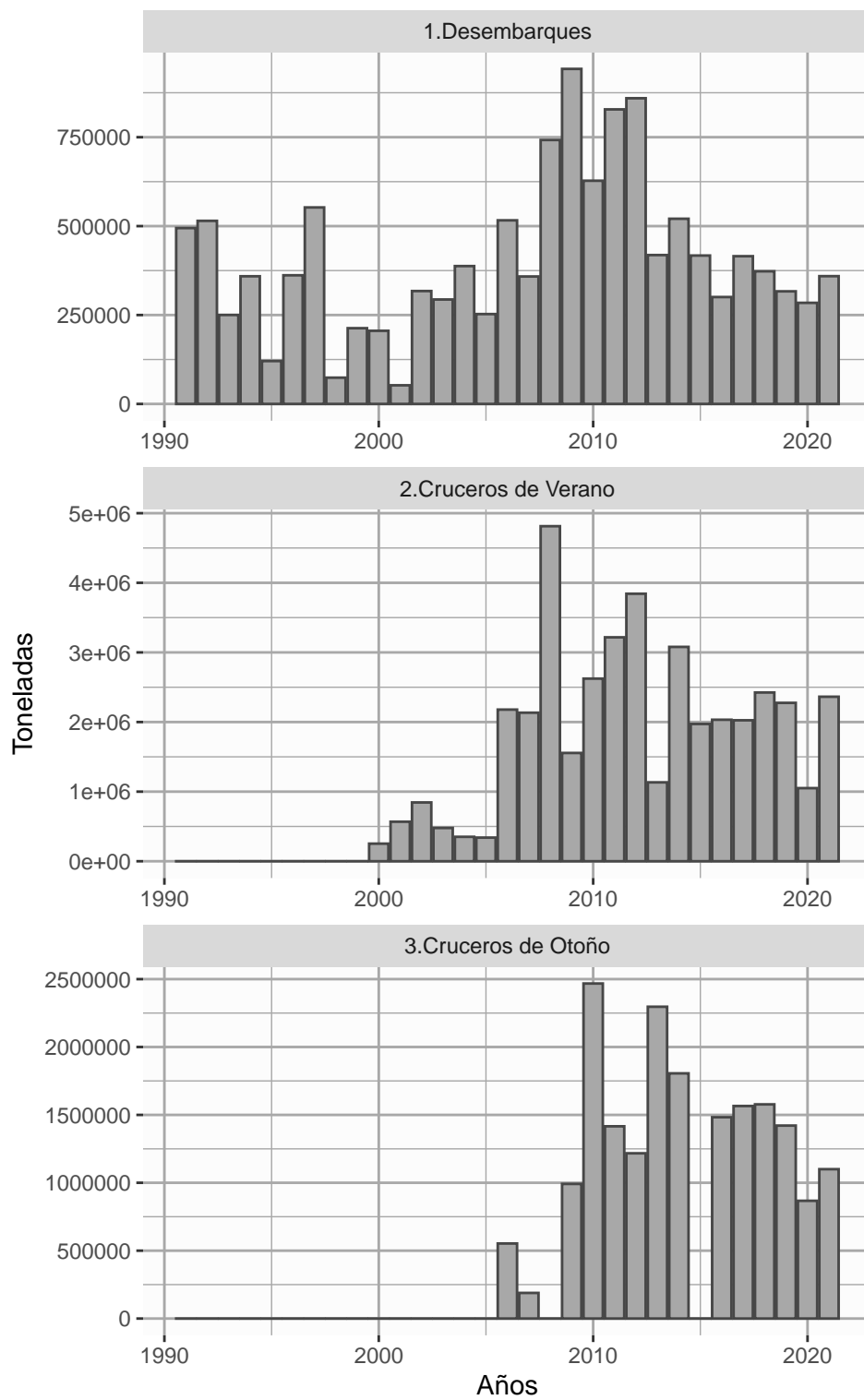
```
years      <- rep3$years
nyears     <- length(years)
age        <- seq(0,4,1)
nage       <- length(age)
WmedF      <- dat3$Wmed
WiniF      <- dat3$Wini
pobsF      <- rep3$pf_obs

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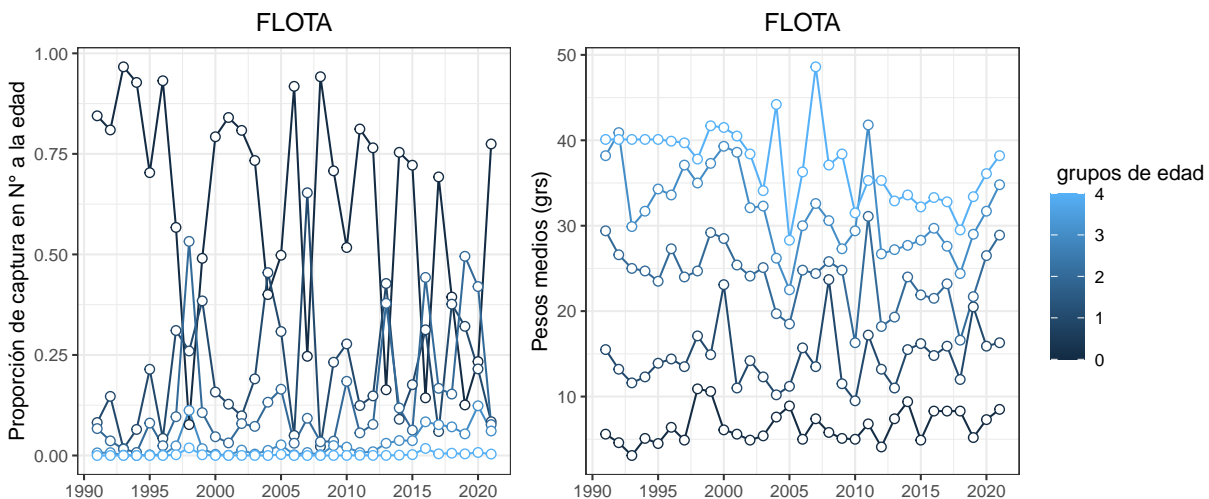
```r
pobsF      <- rep3$pf_obs
pF         <- c(pobsF); pF[pF==0]  <-NA
WmedF      <- dat3$Wmed
Wm         <- c(WmedF); Wm[Wm==0]  <-NA

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

Pesos medios de la Flota
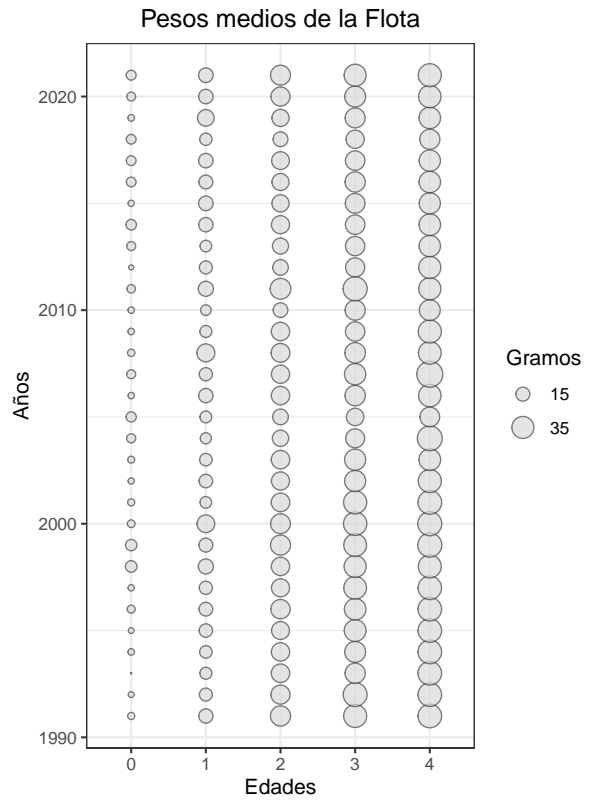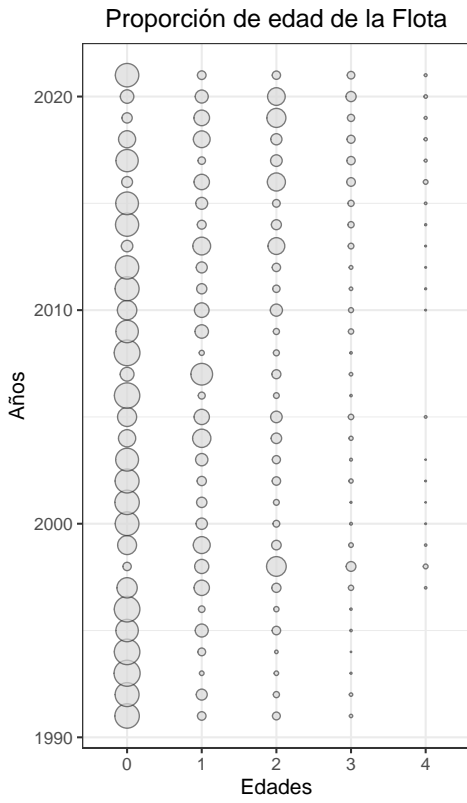
```
years      <- rep3$years
nyears     <- dat3$nanos
age        <- seq(0,4,1)
nage       <- length(age)
pobsR      <- rep3$pobs_RECLAS
pobsP      <- rep3$pobs_PELACES


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

pobsP <- as.data.frame(pobsP) %>%
                       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
```
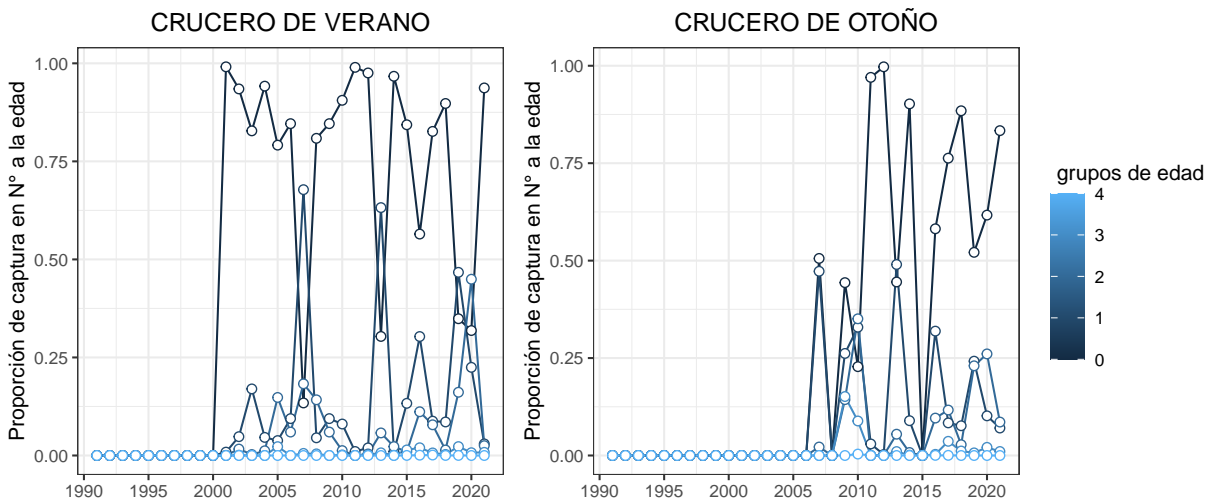
```r
pobsR     <- rep3$pobs_RECLAS
pR        <- c(pobsR); pR[pR==0]  <-NA
pobsP     <- rep3$pobs_PELACES
pP        <- c(pobsP); pP[pP==0]  <-NA

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
```
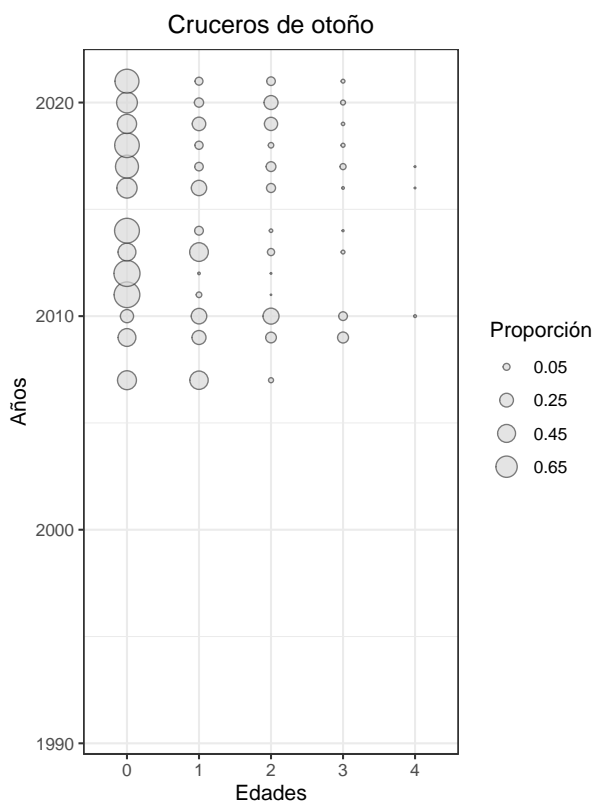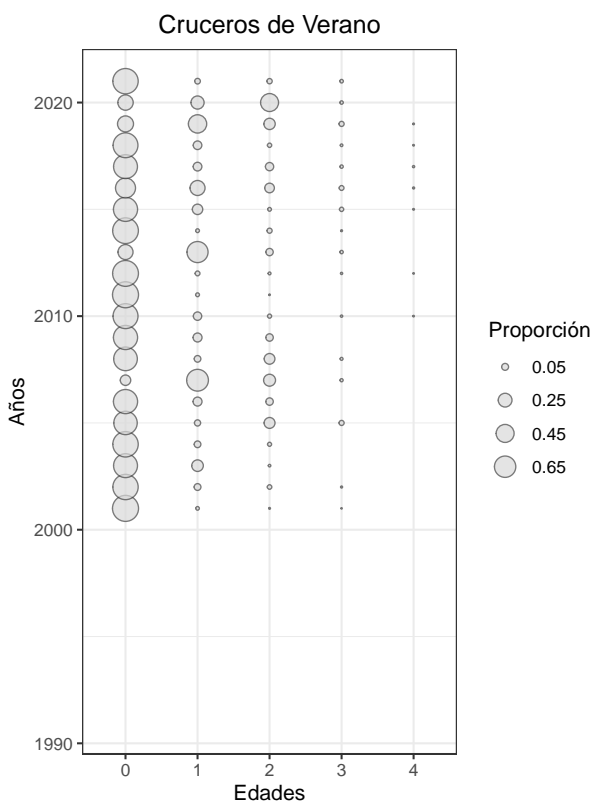
3.1. Ajuste del modelo a los datos

```r
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))
################################################################################################
# FIGURAS
################################################################################################
BcV <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Crucero_verano'),
       aes(yrs,value/1000000)) +
       geom_line(aes(colour=Asesoria), size=0.8) +
       scale_colour_manual(values=c('blue','red','black')) +
       geom_point(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_verano'),
       aes(yrs,value/1000000), shape = 19, colour = 'gray30') +
```

```r
      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")

BcV2 <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Crucero_verano'),
      aes(yrs,value/1000000)) +
      geom_line(aes(linetype = Asesoria, color=Asesoria, size=Asesoria, stat='identity')) +
      scale_linetype_manual(values=c("solid", "longdash", "solid")) +
      scale_colour_manual(values=c('blue','red','black')) +
      scale_size_manual(values=c(1, 1, 1)) +
      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), size=0.8) +
      scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
      scale_linetype_manual(values=c("solid", "dashed","solid")) +
      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))

BcP2 <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Crucero_otoño'),
      aes(yrs,value/1000000)) +
      geom_line(aes(linetype = Asesoria, color=Asesoria, size=Asesoria, stat='identity'))+
      scale_linetype_manual(values=c("solid", "longdash", "solid")) +
      scale_colour_manual(values=c('blue','red','black')) +
      scale_size_manual(values=c(1, 1, 1)) +
      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=10) +
      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), size=0.8) +
      scale_colour_manual(values=c('blue','red','black')) +
      scale_linetype_manual(values=c("solid", "dashed","solid"))+
      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=10) +
        ggtitle('Desembarques') +
        theme(plot.title = element_text(hjust = 0.5),legend.position="none")

d2   <- ggplot(base1 %>% filter(Asesoria!='observado', variable=='Desembarques'),
        aes(yrs,value/1000)) +
        geom_line(aes(linetype = Asesoria, color=Asesoria, size=Asesoria, stat='identity')) +
        scale_linetype_manual(values=c("solid", "longdash", "solid")) +
        scale_colour_manual(values=c('blue','red','black')) +
        scale_size_manual(values=c(1, 1, 1)) +
        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=10) +
        ggtitle('Desembarques') +
        theme(plot.title = element_text(hjust = 0.5),legend.position="none")


BcV2/BcP2/d2 + plot_layout(guides="collect")
```

Crucero de verano

Crucero de otoño

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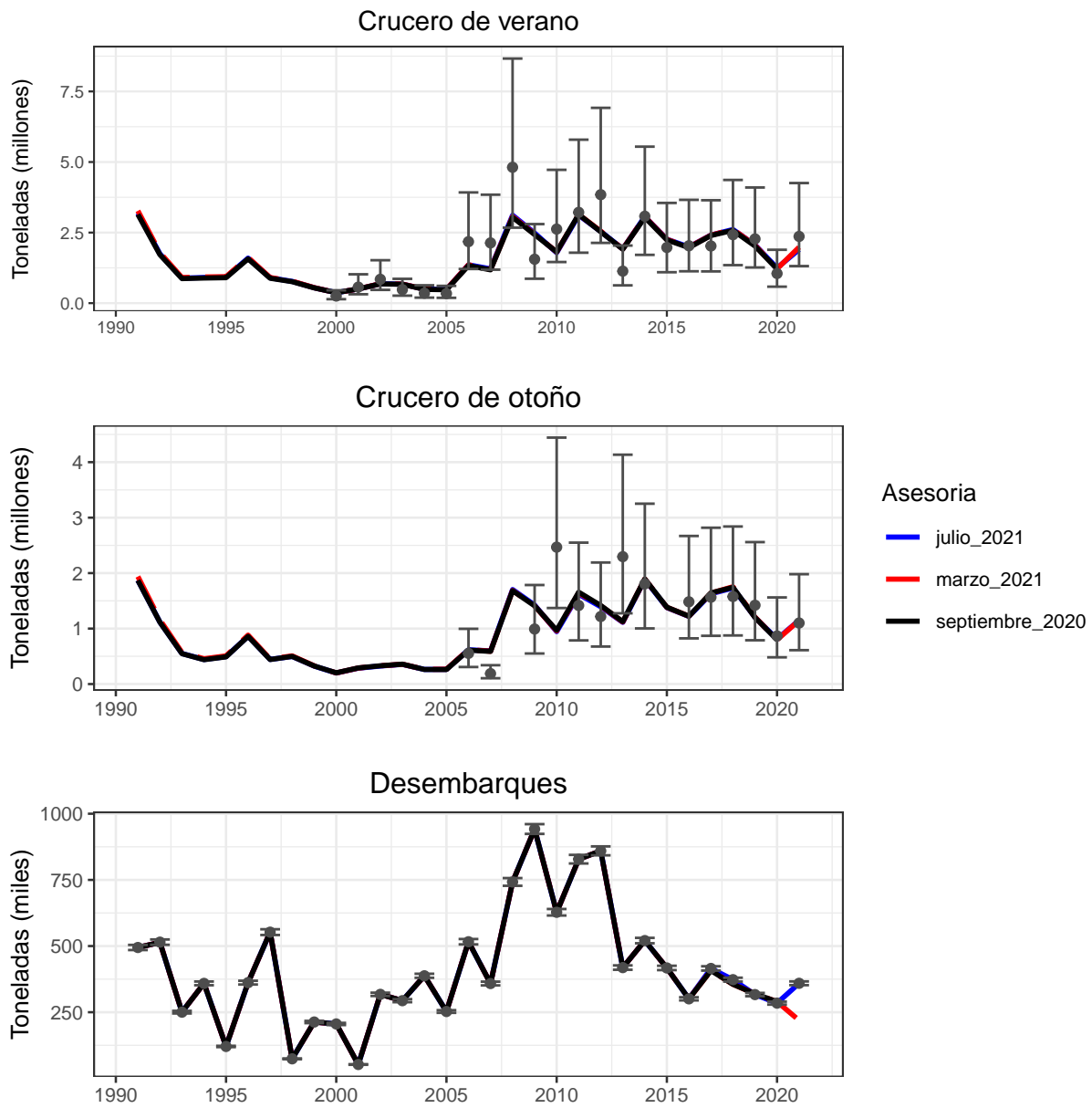
```r
# I. INDICES DE ABUNDANCIA                                          #
years   <- dat3$Ind[,1]
nyears <- dat3$nanos
age     <- seq(0,4,1)
nage    <- dat3$nedades
Amax    <- dat3$nedades
Age     <- seq(0,4,1)
#Observado
obsR <- rep3$reclasobs          ;obsR[obsR<=1] <-NA
obsP <- rep3$pelacesobs  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

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

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

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

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

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

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

plot(years,Res_Desemb,xaxp=x1,cex.axis=0.8,ylim=c(-1.1,1.1),type="h",main="Desembarques",ylab="Residuales (escala log)",xlab="
#   mtext("b)",side=3,line=0.25,adj=-0.15,cex=1.5)
    abline(h=0,col="darkgray")
    plot(log(predD),Res_Desemb, ylim=c(-1.1,1.1),main="Residuales vs ajustado",ylab="Residuales",xlab="Valor ajustado")
    abline(h=0,col="darkgray")
    #hist(Res_Desemb,xlab="Residuales",ylab="Frecuencia",main="Histograma de Residuos")
    qqnorm(Res_Desemb,ylim=c(-1.1,1.1)); qqline(Res_Desemb, col = 2)
```
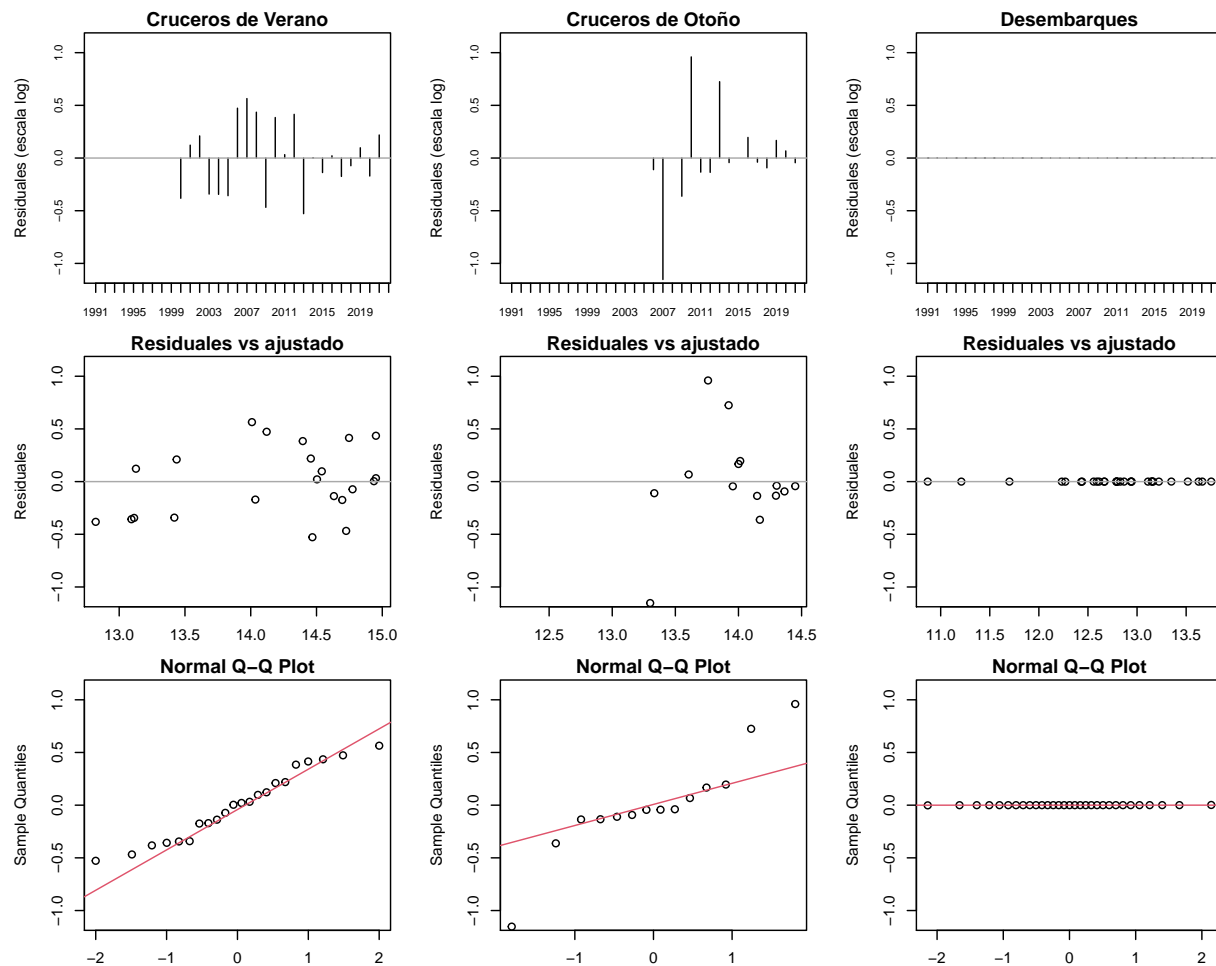
```r
years    <- dat3$Ind[,1]
nyears   <- length(years)
age      <- seq(0,4,1)
nage     <- length(age)

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

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

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

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

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

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

 fig1 <- ggplot(filter(mat, type=='obs')) +
         geom_bar(aes(x = edad, y = value), stat="identity", fill='gray66', color = 'gray28') +
         facet_wrap(~year, dir = 'v', as.table = TRUE) +
         labs(x = 'Edad', y = 'Proporción') +
         geom_line(data = mat %>% filter(type != 'obs'), aes(x = edad, y = value, colour=type,
         linetype = type, stat='identity')) +
         scale_linetype_manual(values=c("solid", "longdash", 'solid')) +
         scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
         theme(panel.background = element_rect(fill ="gray99")) +
         theme(panel.grid=element_line(color=NA)) +
         ggtitle("FLOTA") + theme(plot.title = element_text(size = 12))
 fig1
```
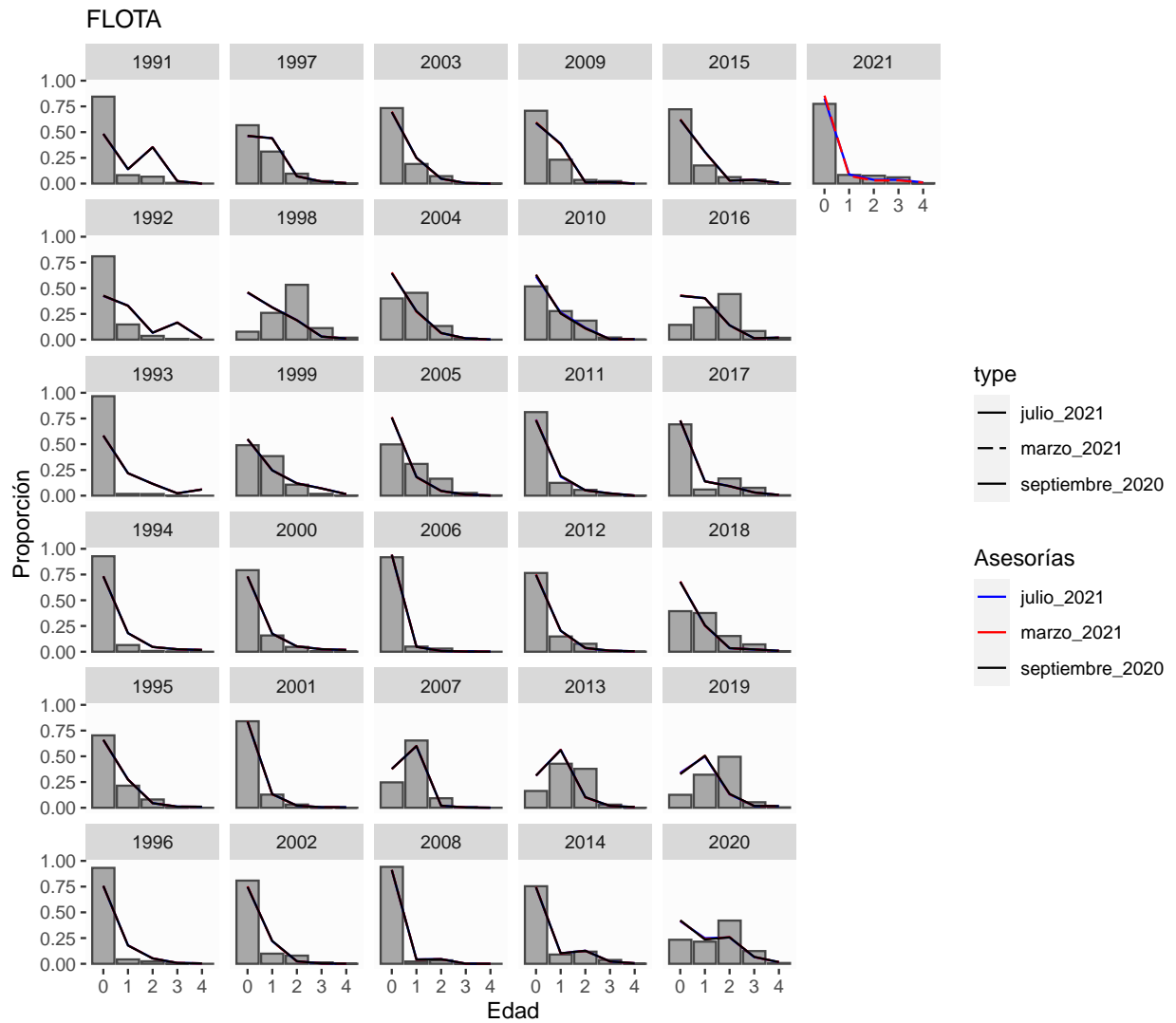
```r
years    <- dat3$Ind[,1]
nyears   <- length(years)
age      <- seq(0,4,1)
nage     <- length(age)

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, stat='identity')) +
         scale_linetype_manual(values=c("solid", "longdash", 'solid')) +
         scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
         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
```
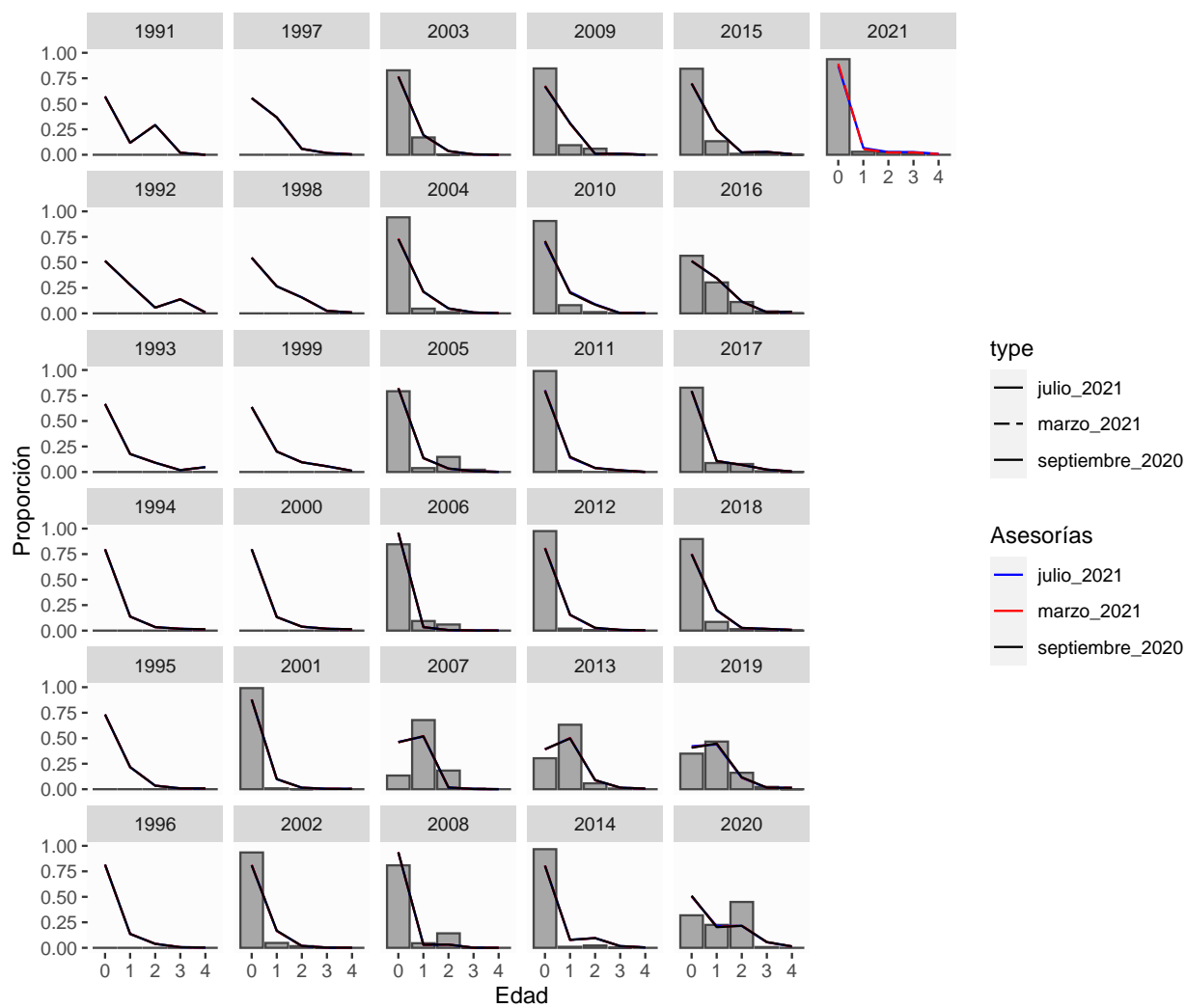
CRUCEROS DE VERANO

```
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, stat='identity')) +
         scale_linetype_manual(values=c("solid", "longdash", 'solid')) +
         scale_colour_manual(values=c('blue','red','black'),name="Asesorías") +
         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
```
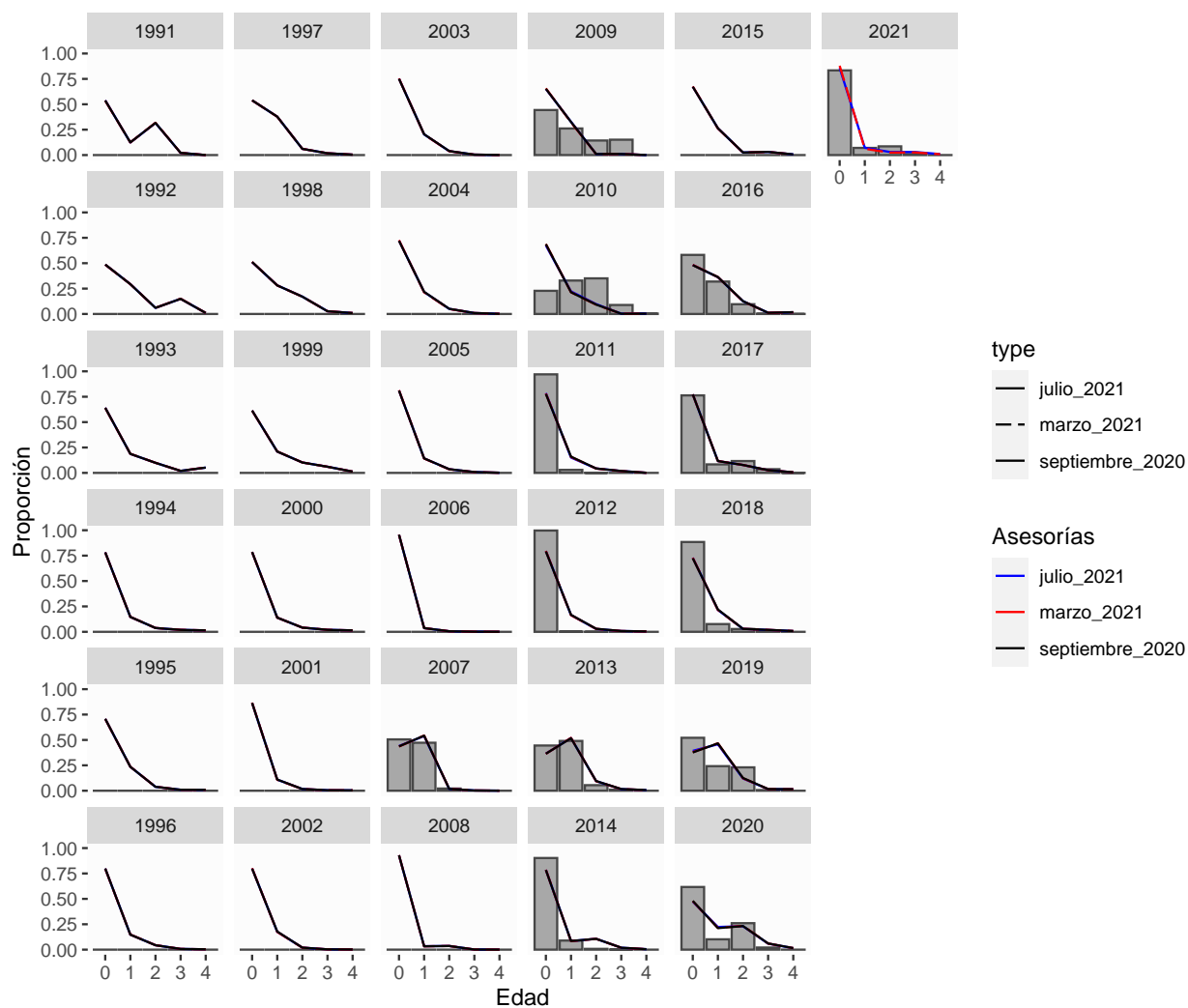
CRUCEROS DE OTOÑO

```
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()
```


31
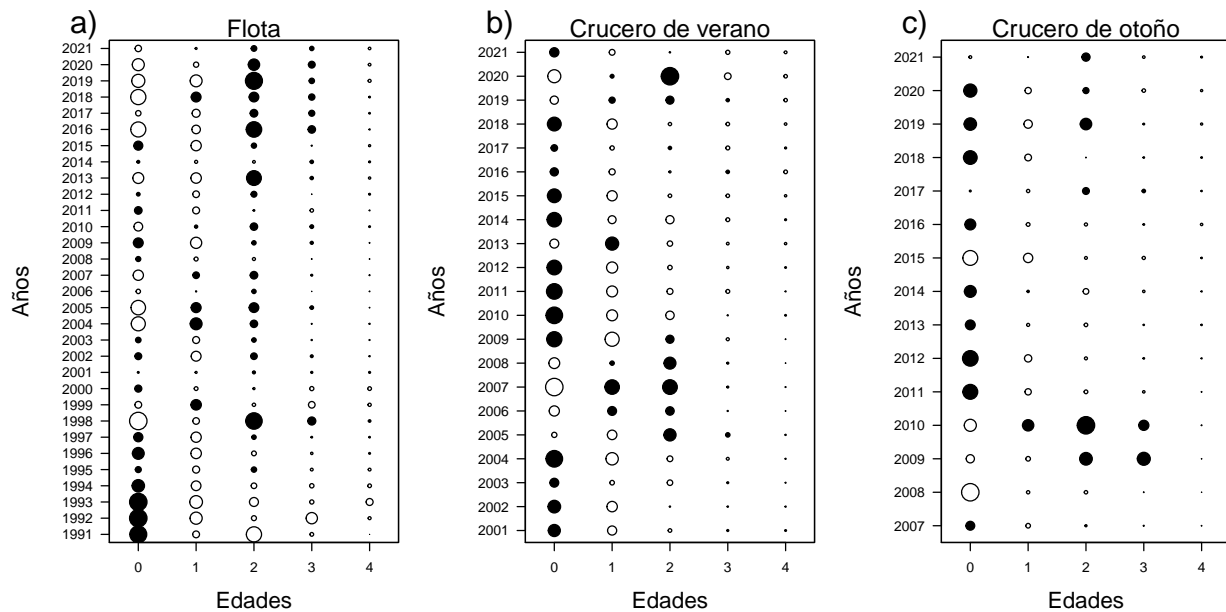
3.2. Comparación con asesorías previas

```r
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))
```

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

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


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

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

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

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

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


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


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

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


Rt/BD/Ft
```
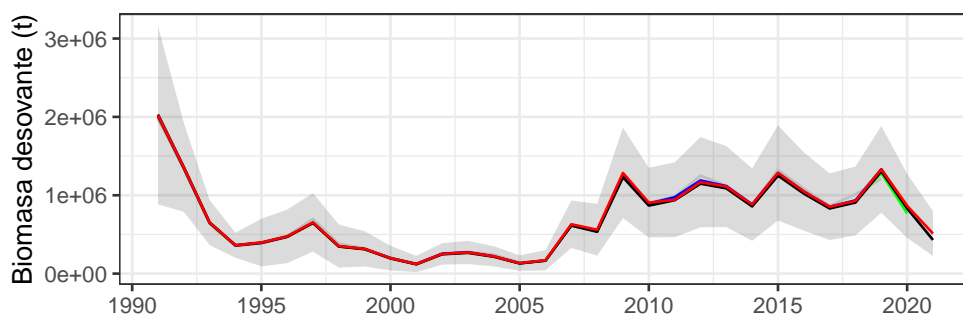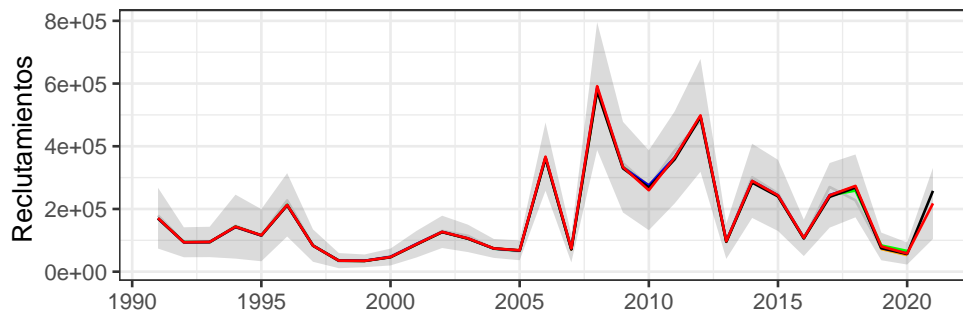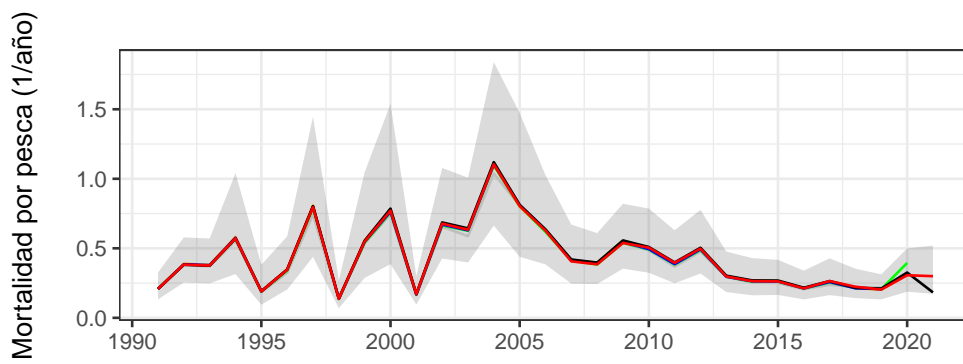
3.3. Análisis retrospectivo

```
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],
```

```r
                            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])
```

```r
#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
```
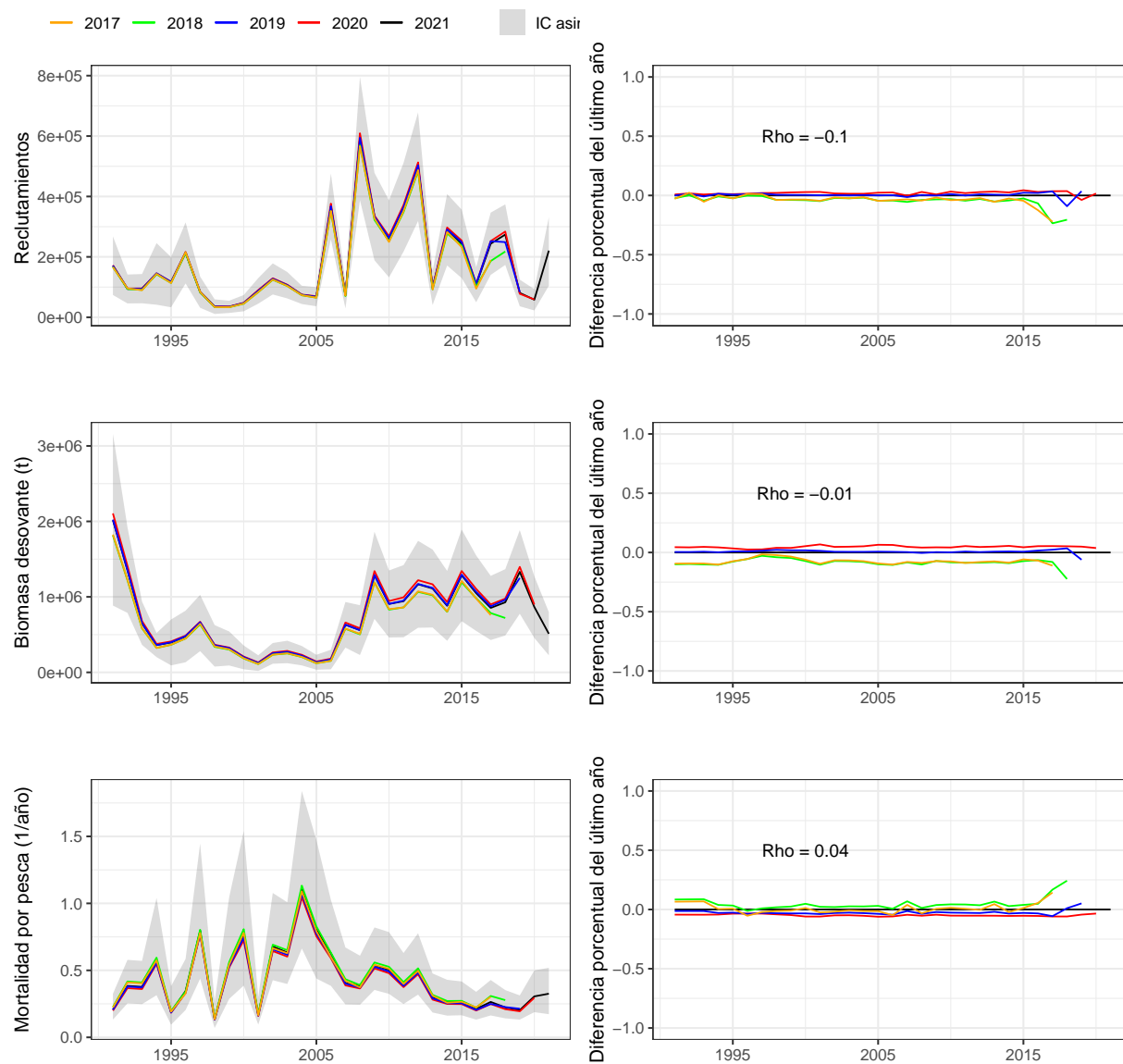
3.4. Perfil de verosimilitud

```
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)
```
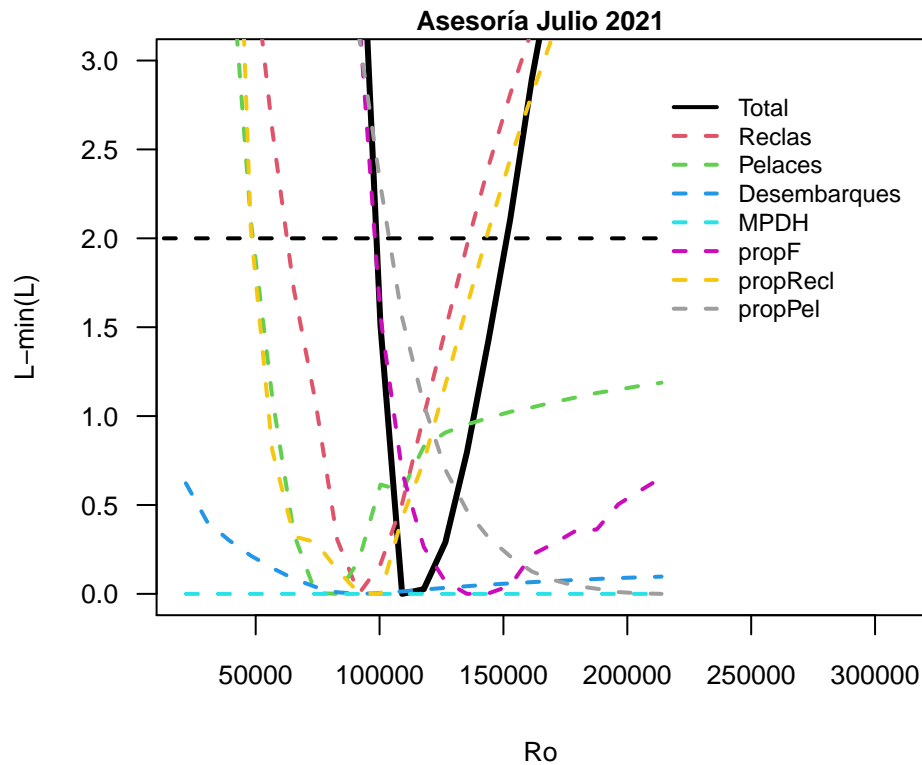


```
#legend(230000,1.5,names[9:14],col=9:14,lty=3,lwd=2,bty="n",cex=0.8)
```

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))
```

```r
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))
```

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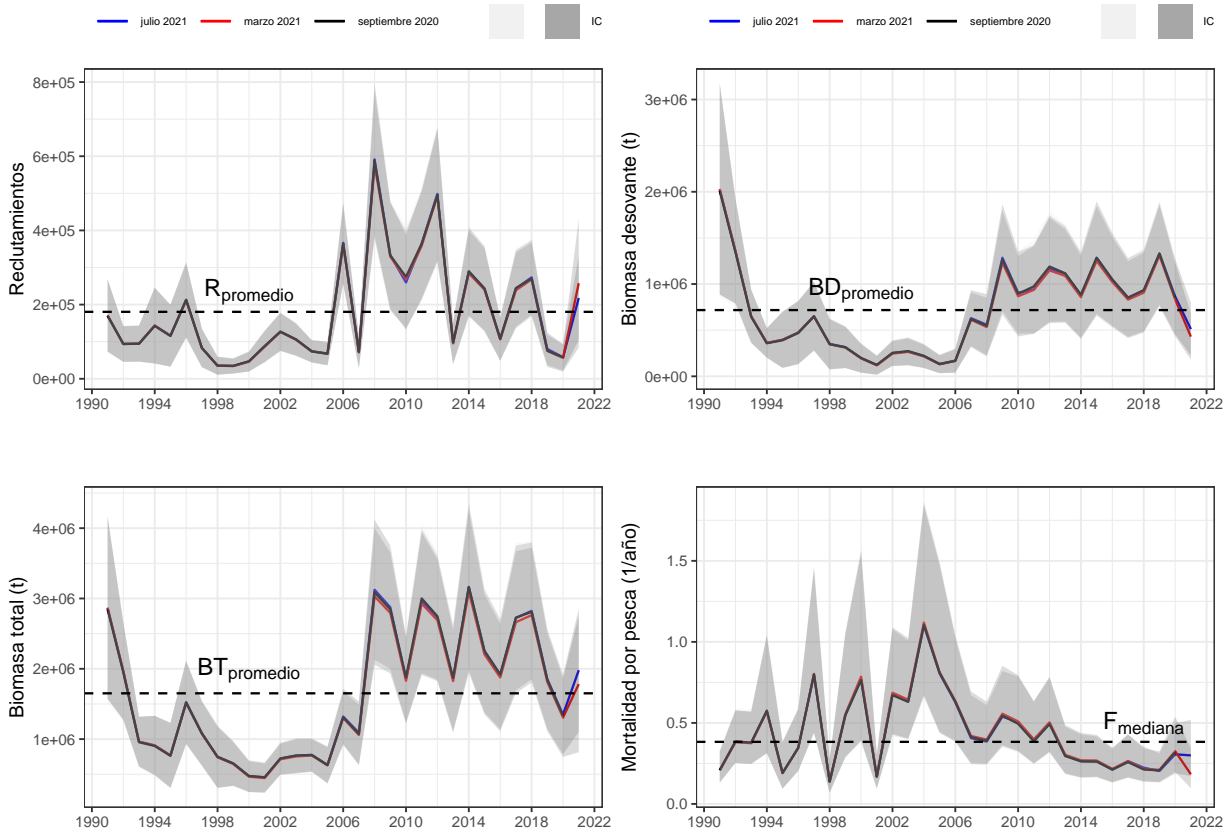
```r
yearsb<-c("1990/91","1991/92","1992/93","1993/94","1994/95","1995/96","1996/97","1997/98","1998/99","1999/00","2000/01","2001/02

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	2021390	2844200	2870400	2861740	169670	170120	170728	0.209	0.207	0.208
1991/92	1344500	1358500	1354880	1949500	1966700	1961700	93768	94041	93758	0.386	0.382	0.383
1992/93	645250	652550	650872	955290	964360	962568	94409	94707	94800.3	0.379	0.375	0.376
1993/94	358150	362070	361676	902180	909000	909926	142470	143180	143610	0.576	0.57	0.572
1994/95	390940	395090	396217	761620	767170	769802	115500	115760	116279	0.192	0.19	0.19
1995/96	469770	473120	475448	1518000	1517100	1526780	212650	211490	213067	0.347	0.347	0.346
1996/97	648700	647450	653836	1080200	1077600	1086090	83311	82828	83190.6	0.8	0.803	0.796
1997/98	348370	346010	351385	746840	741130	749167	35378	35062	35242.2	0.137	0.138	0.137
1998/99	314830	311640	316011	653870	646260	653852	34847	34292	34626.5	0.547	0.555	0.548
1999/00	198580	194090	198079	475590	465230	473045	47251	46073	46770.4	0.764	0.786	0.771
2000/01	123590	118470	122215	457800	444970	453202	88252	86319	87397.5	0.167	0.172	0.169
2001/02	254560	246340	251404	725490	713020	721906	126940	126130	127005	0.671	0.686	0.678
2002/03	272510	264590	270344	766550	753550	764739	105990	105110	106197	0.63	0.643	0.634
2003/04	221470	215090	220837	773620	767100	775588	73689	73955	74144.3	1.104	1.12	1.104
2004/05	132870	130190	133812	629360	626840	634301	67496	67638	68067.3	0.809	0.813	0.804
2005/06	167690	166450	170205	1310300	1299600	1321180	364340	361230	366909	0.631	0.636	0.628
2006/07	621470	612730	629884	1074400	1058400	1091190	72290	70839	74013.6	0.412	0.419	0.406
2007/08	546580	533910	559665	3087000	3029800	3124280	586530	576230	591751	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	1285110	2846100	2794700	2874860	332590	329460	333416	0.545	0.557	0.539
2009/10	894040	867720	905648	1877000	1828600	1852100	275020	268470	259648	0.494	0.509	0.505
2010/11	974810	936800	942439	3000800	2926400	2962570	364240	358290	364339	0.386	0.398	0.396
2011/12	1189500	1147700	1166630	2747600	2690600	2726970	495590	492960	498486	0.493	0.504	0.498
2012/13	1116600	1088100	1110660	1869900	1824500	1862040	97434	95115	97281	0.296	0.303	0.297
2013/14	883910	857790	881264	3164100	3096700	3164380	289240	284180	289716	0.263	0.269	0.264
2014/15	1284500	1250400	1285340	2252000	2202700	2253160	243240	240020	243291	0.262	0.268	0.262
2015/16	1047700	1021300	1048650	1916400	1876300	1920340	107500	106000	107971	0.212	0.217	0.212
2016/17	851980	831090	853346	2728000	2663200	2724600	244410	238570	243523	0.258	0.264	0.264
2017/18	934650	907150	927486	2809100	2763000	2823360	270150	267990	273536	0.213	0.216	0.224
2018/19	1331300	1307200	1330320	1841000	1811000	1853540	75649	75099	80526	0.207	0.21	0.203
2019/20	849310	832960	864909	1333000	1305400	1349550	58067	56309	57934.8	0.319	0.326	0.306
2020/21	NA	430060	511531	NA	1782600	1979300	NA	257750	217704	NA	0.183	0.299

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

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```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)
```

```
#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
```
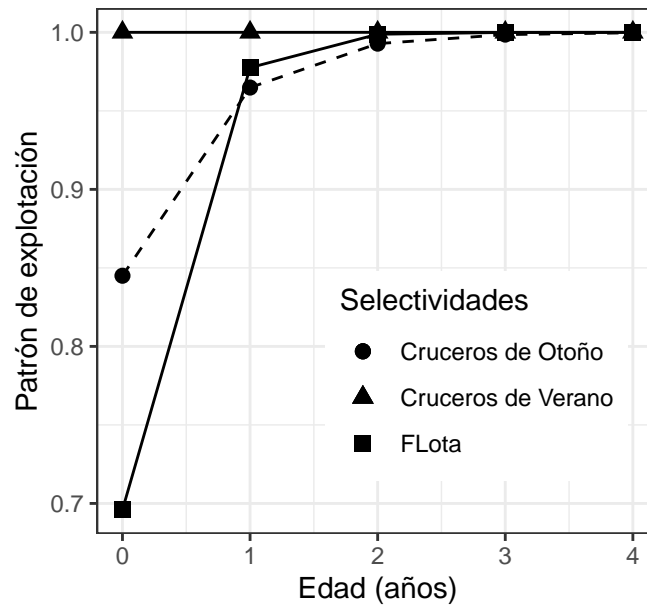
3.6. Puntos biológicos de referencia

```r
#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)

# 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
```

```r
# 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
```

```r
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"), size=0.5)+
    geom_line(data=VarPobMar,aes(y=BD2, x=x, colour = "marzo 2021"), size=0.5)+
    geom_line(data=VarPobSep,aes(y=BD1, x=x, colour = "septiembre 2020"), size=0.5)+
    geom_ribbon(data=VarPobJul,aes(ymin=lowerBD3, ymax=upperBD3, x=x, fill = "IC"), alpha = 0.2)+
    geom_ribbon(data=VarPobMar,aes(ymin=lowerBD2, ymax=upperBD2, x=x, fill = "IC"), 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_fill_manual("",values=c("grey90","grey30",'gray75'))+
    theme_bw(base_size=12) +
    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"), size=0.5)+
    geom_line(data=VarPobMar,aes(y=Ft2, x=x, colour = "marzo 2021"), size=0.5)+
    geom_line(data=VarPobSep,aes(y=Ft1, x=x, colour = "septiembre 2020"), size=0.5)+
    geom_ribbon(data=VarPobJul,aes(ymin=lowerFt3, ymax=upperFt3, x=x, fill = "IC"), alpha = 0.2)+
    geom_ribbon(data=VarPobMar,aes(ymin=lowerFt2, ymax=upperFt2, x=x, fill = "IC"), 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_fill_manual("",values=c("grey90","grey30",'gray75'))+
    theme_bw(base_size=12) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

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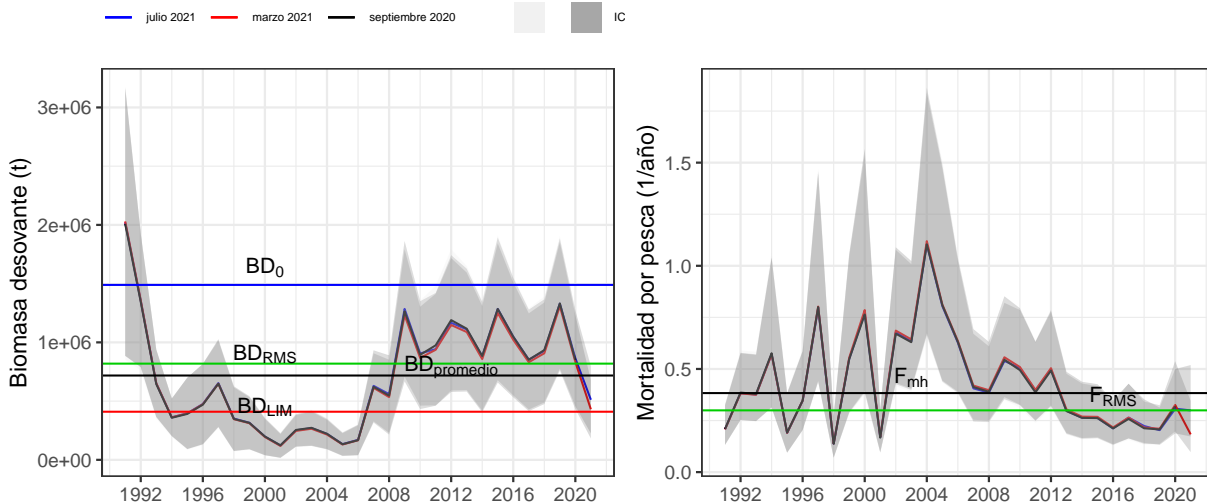
```
sel_Flota <- rep3$Sel_flota[1,]
madurez   <- dat3$madurezsexual
Fspr      <- SPRcurv3[,1]
BDspr     <- SPRcurv3[,4]

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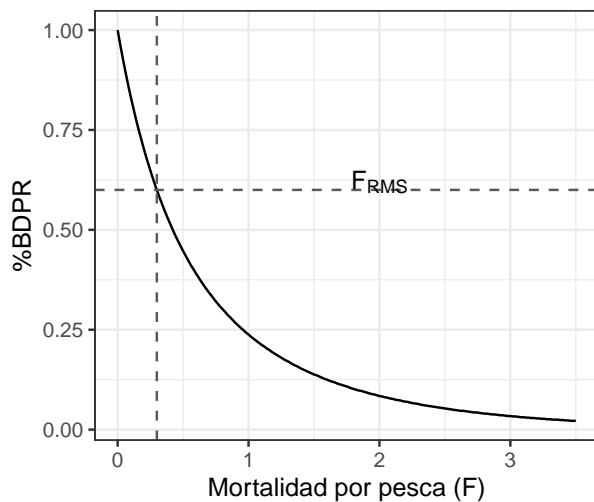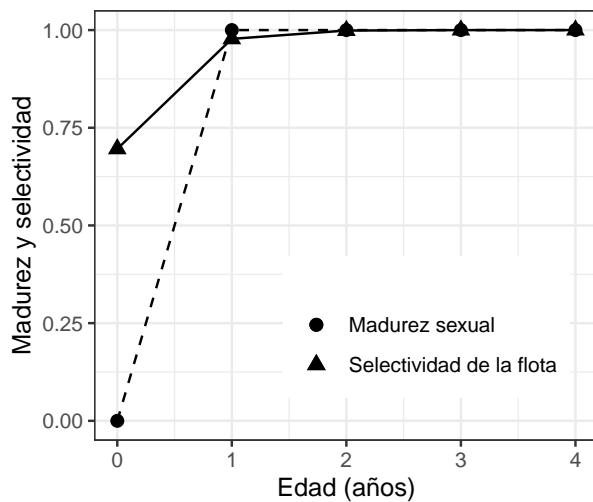
```r
years1<-rep2$years
nyears1<-length(years1)
#para serie histórica
Rpr1      <- c(subset(std1,name=="RPRequ3")$value,NA);
Rpr1std   <- c(subset(std1,name=="RPRequ3")$std,NA)
Frpr1     <- c(subset(std1,name=="Frpr")$value,NA);
Frpr1std  <- c(subset(std1,name=="Frpr")$std,NA)

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

```r
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)
### *Probailidad de sobrepesca*
#Asesoría marzo #P(F>Frms)
pe_mar<-1-pnorm(1.1,FrprMARZO,FrprMARZOstd,lower.tail = TRUE,log.p = F)

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

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

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

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

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

### *Probabilidad de estar bajo BRMS*
#Asesoría julio #P(BD<BDrms)
pa_jul<-pnorm(1,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar bajo FRMS*
#Asesoría julio#P(F>Frms)
pb_jul<-1-pnorm(1,FrprJULIO,FrprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de sobreexplotacion*
#Asesoría julio #P(BD<BDrms)
pc_jul<-pnorm(0.9,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probabilidad de estar en zona de colapso*
#Asesoría julio #P(BD<BDrms)
pd_jul<-pnorm(0.5,rprJULIO,rprJULIOstd,lower.tail = TRUE,log.p = F)
### *Probailidad 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"), size=0.5)+
    geom_line(data=EstatusMar,aes(y=Rpr2, x=x, colour = "marzo 2021"), size=0.5)+
    geom_line(data=EstatusSep,aes(y=Rpr1, x=x, colour = "septiembre 2020"), size=0.5)+
    geom_ribbon(data=EstatusJul,aes(ymin=lowerRpr3, ymax=upperRpr3, x=x, fill = "IC"), alpha = 0.2)+
    geom_ribbon(data=EstatusMar,aes(ymin=lowerRpr2, ymax=upperRpr2, x=x, fill = "IC"), 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_fill_manual("",values=c("grey90","grey30",'gray75'))+
    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"), size=0.5)+
    geom_line(data=EstatusMar,aes(y=Frpr2, x=x, colour = "marzo 2021"), size=0.5)+
    geom_line(data=EstatusSep,aes(y=Frpr1, x=x, colour = "septiembre 2020"), size=0.5)+
    geom_ribbon(data=EstatusJul,aes(ymin=lowerFrpr3, ymax=upperFrpr3, x=x, fill = "IC"), alpha = 0.2)+
    geom_ribbon(data=EstatusMar,aes(ymin=lowerFrpr2, ymax=upperFrpr2, x=x, fill = "IC"), 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_fill_manual("",values=c("grey90","grey30",'gray75'))+
    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="gray85")+
    geom_polygon(data=densb_bm,aes(x=x, y=y, group=t,alpha=0.9),fill="gray75")+
    geom_polygon(data=densb_bs,aes(x=x, y=y, group=t,alpha=0.9),fill="gray35")+
    geom_line(aes(xbj,ybj), size=0.3,color="blue")+
    geom_line(aes(xbm,ybm), size=0.3,color="red")+
    geom_line(aes(xbs,ybs), size=0.3,color="black")+
    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")  +
    scale_colour_manual("",values=c('blue','red',"black"))+
    scale_fill_manual("",values=c("grey90","grey30",'gray75'))+
    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 = ""),fill="gray85")+
    geom_polygon(data=densb_fm,aes(x=x, y=y, group=t,alpha=0.9,fill = ""),fill="gray75")+
    geom_polygon(data=densb_fs,aes(x=x, y=y, group=t,alpha=0.9),fill="gray35")+
    geom_line(aes(xfj,yfj), size=0.3,color="blue")+
    geom_line(aes(xfm,yfm), size=0.3,color="red")+
    geom_line(aes(xfs,yfs), size=0.3,color="black")+
    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")
```
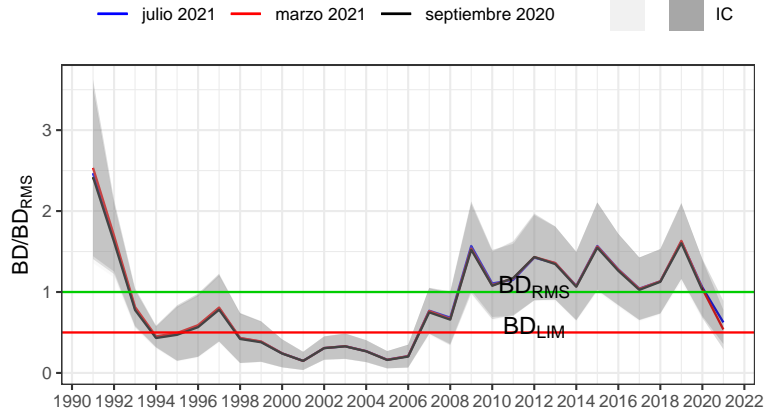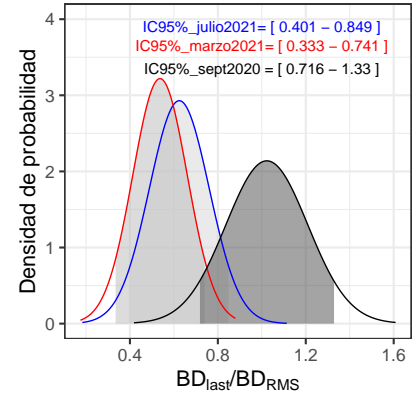
```
{(BD_BDrms / F_Frms)   | (fig_desnb/fig_desnf)} + plot_layout(ncol=2,widths=c(2,1))
```
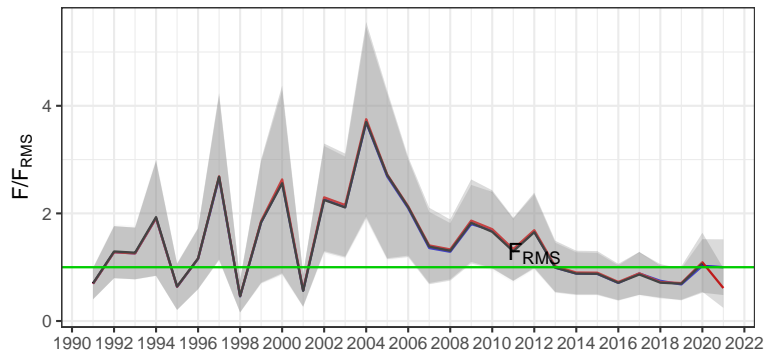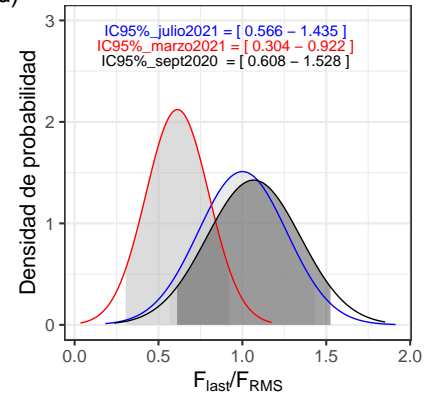
a)

b)

c)

d)

```
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	0.694	2.419	2.534	2.468
1991/92	1.293	1.279	1.28	1.619	1.696	1.654
1992/93	1.27	1.256	1.256	0.777	0.815	0.795
1993/94	1.931	1.911	1.91	0.431	0.452	0.442
1994/95	0.643	0.637	0.635	0.471	0.493	0.484
1995/96	1.164	1.161	1.155	0.566	0.591	0.58
1996/97	2.682	2.689	2.659	0.781	0.808	0.798
1997/98	0.461	0.464	0.458	0.42	0.432	0.429
1998/99	1.835	1.859	1.832	0.379	0.389	0.386
1999/00	2.561	2.632	2.576	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	2.264	0.307	0.308	0.307
2002/03	2.111	2.155	2.117	0.328	0.33	0.33
2003/04	3.701	3.751	3.69	0.267	0.269	0.27
2004/05	2.713	2.724	2.687	0.16	0.163	0.163
2005/06	2.116	2.131	2.097	0.202	0.208	0.208
2006/07	1.383	1.405	1.356	0.748	0.765	0.769
2007/08	1.305	1.331	1.286	0.658	0.667	0.683
2008/09	1.825	1.865	1.8	1.522	1.536	1.569
2009/10	1.657	1.707	1.686	1.077	1.083	1.106
2010/11	1.295	1.335	1.322	1.174	1.17	1.151
2011/12	1.651	1.688	1.663	1.433	1.433	1.424
2012/13	0.991	1.016	0.993	1.345	1.358	1.356
2013/14	0.881	0.901	0.881	1.065	1.071	1.076
2014/15	0.878	0.898	0.876	1.547	1.561	1.569
2015/16	0.71	0.726	0.708	1.262	1.275	1.28
2016/17	0.865	0.886	0.883	1.026	1.038	1.042
2017/18	0.713	0.725	0.747	1.126	1.133	1.132
2018/19	0.693	0.705	0.68	1.603	1.632	1.624
2019/20	1.068	1.091	1.023	1.023	1.04	1.056
2020/21	NA	0.613	1.001	NA	0.537	0.625

```
#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	0.262	0.179	0.178	0.178
1992/93	0.262	0.26	0.26	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	0.293
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	0.263
2002/03	0.383	0.39	0.384	0.252	0.256	0.252
2003/04	0.501	0.505	0.5	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	0.156
2008/09	0.331	0.337	0.328	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	0.28	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	0.165	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	0.157	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	0.211	0.152	0.155	0.147
2020/21	NA	0.123	0.182	NA	0.08	0.127

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

```r
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
```



**Asesoría de Septiembre 2020**
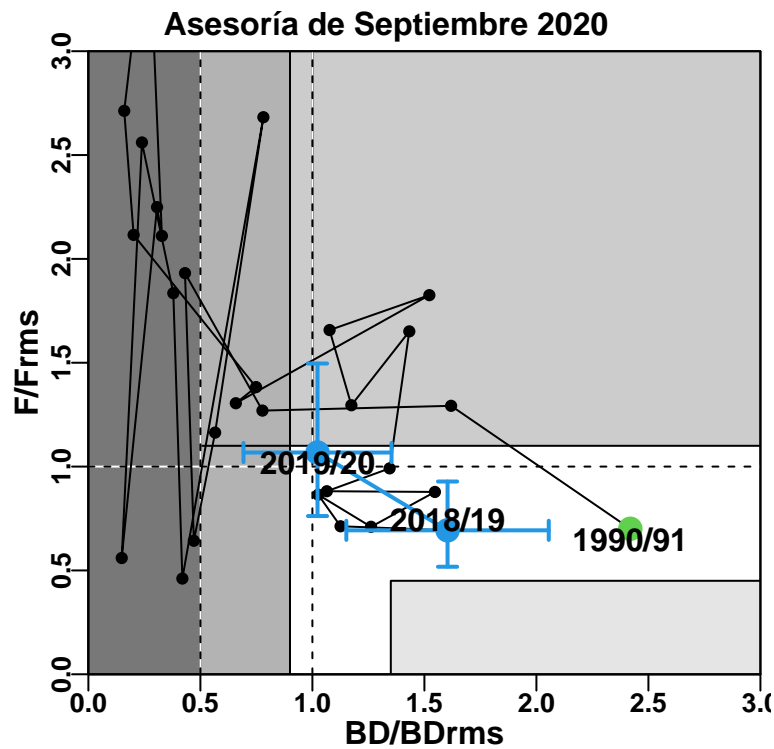
```
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name2<-"Asesoría de Marzo 2021"
years2<-rep2$years
nyears2<-length(years2)

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
```



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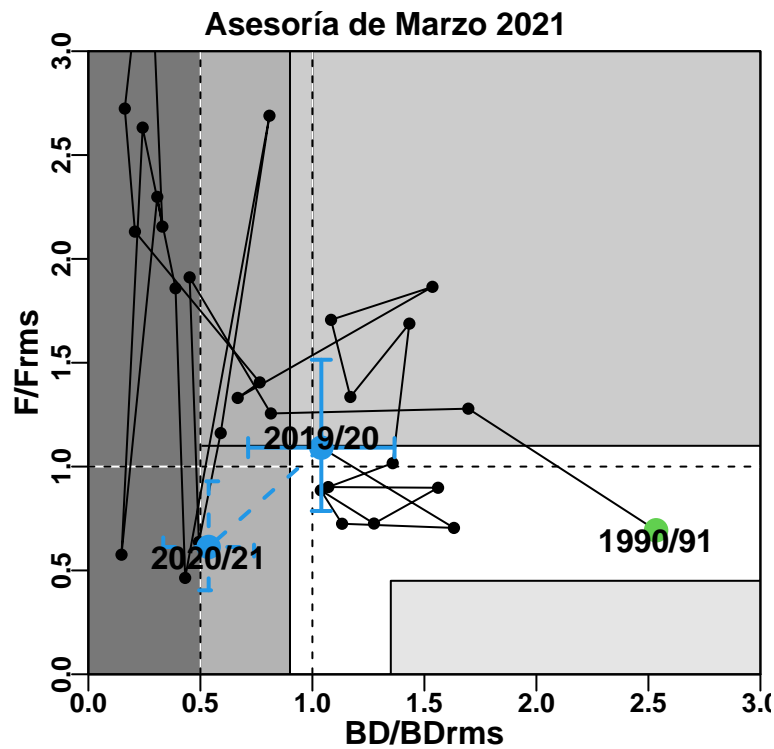
```r
source(paste(dir.fun,"Fn_DiagramaFase2.R",sep=""))
name3<-"Asesoría de Julio 2021"
years3<-rep3$years
nyears3<-length(years3)

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
```


Asesoría de Julio 2021
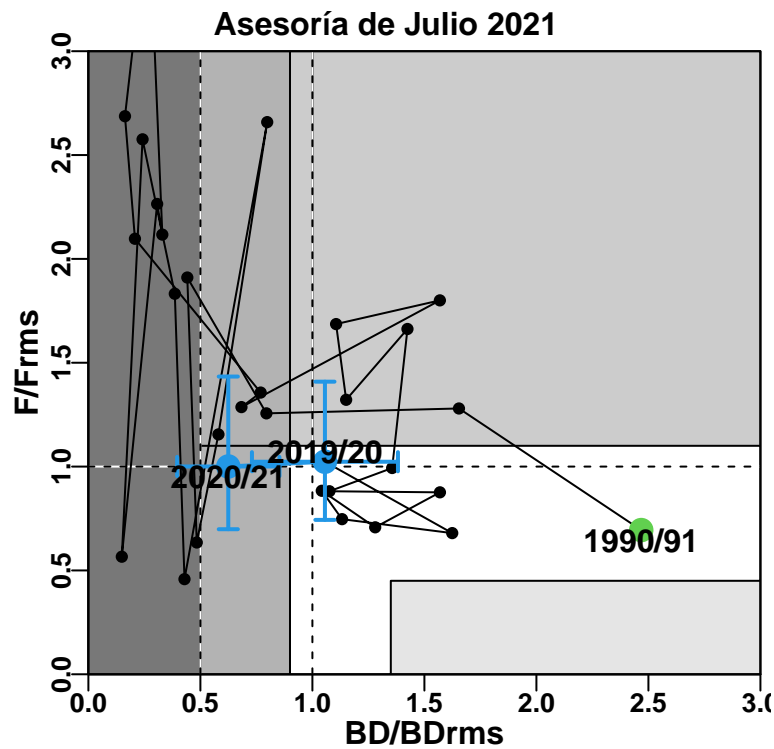
```r
Tabla4.1<-rbind("Año biológico"=c("2019/20",
                                  "2020/21",
                                  "2020/21"),
                "$F_{RMS}$"=c(round(FRMS1,2),
                             round(FRMS2,2),
                             round(FRMS3,2)),
                "$BD_{RMS}$"=c(round(BRMS1/10^3,0),
                              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')
```
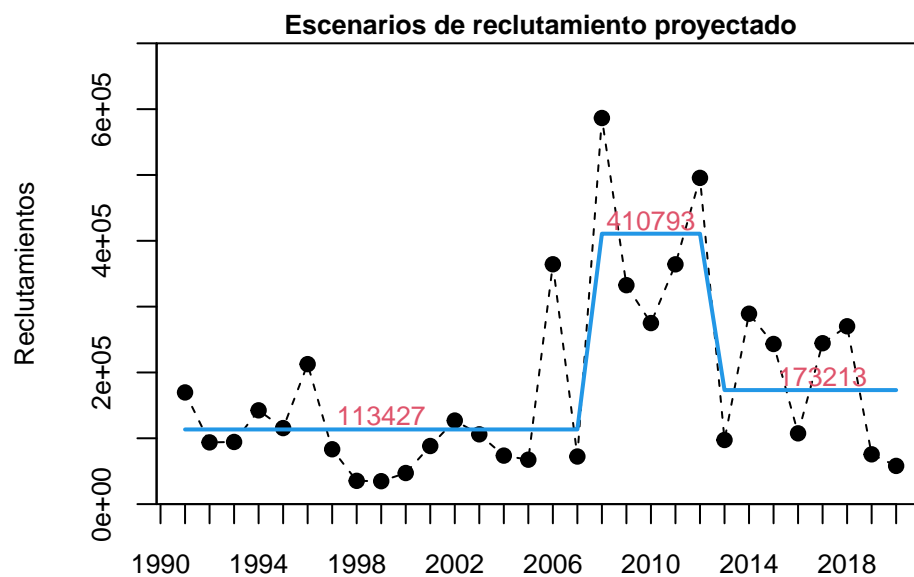
	Septiembre 2020	Marzo 2021	Julio 2021
Año biológico	2019/20	2020/21	2020/21
F_{RMS}	0.3	0.3	0.3
BD_{RMS}	830	801	819
BD_{LIM}	415	401	410
$p(BD_{last} < BD_{RMS})$	0.45	1	1
$p(F_{last} > F_{RMS})$	0.6	0.02	0.5
$p(sobre-explotación)$	0.26	1	0.98
$p(agotado/colapsado)$	0	0.38	0.18
$p(sobrepesca)$	0.45	0	0.35

3.8. CBA 2021 Inicial (Asesoría de septiembre 2020)

Escenarios de reclutamiento proyectado

	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)

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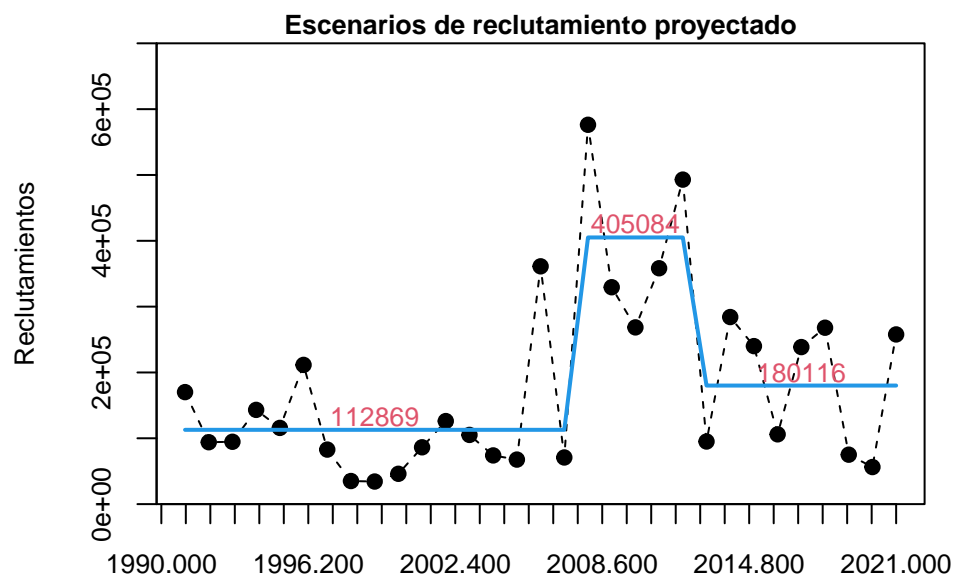
	1991-2007	2008-2012	2013-2021
mean	271720	313030	279570
std	29384	34291	33911
10%	234063	269084	236111
20%	246990	284170	251030
30%	256311	295048	261787
40%	264276	304342	270979
50%	271720	313030	279570

	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)

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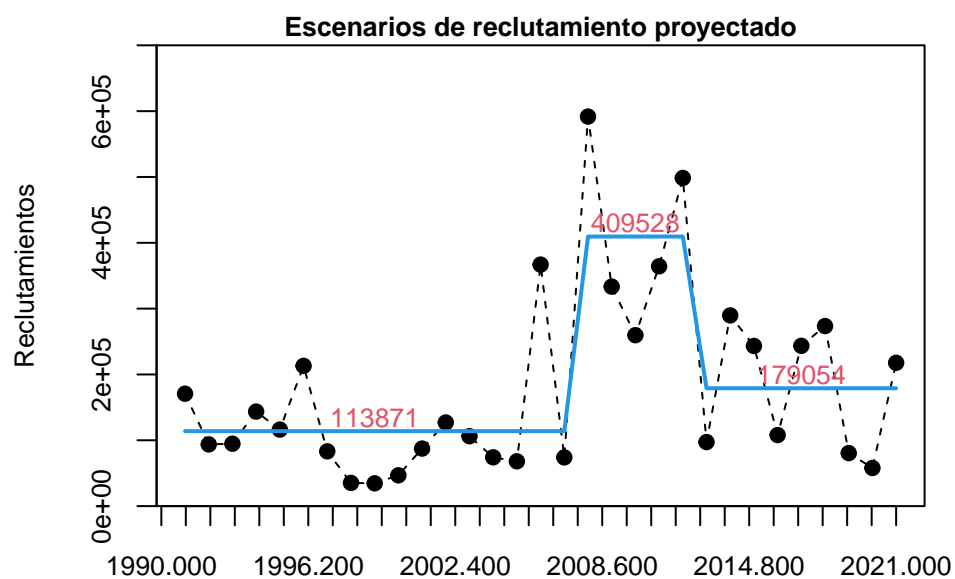
	1991-2007	2008-2012	2013-2021
mean	378670	419950	385460
std	22259	28186	25850
10%	350144	383828	352332
20%	359936	396228	363704
30%	366997	405169	371904
40%	373031	412809	378911
50%	378670	419950	385460

	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")
```
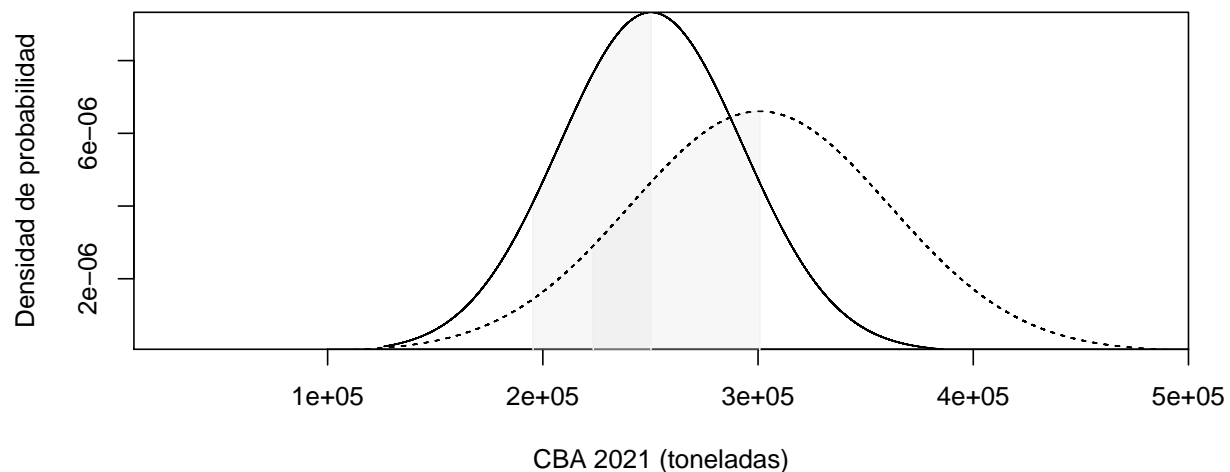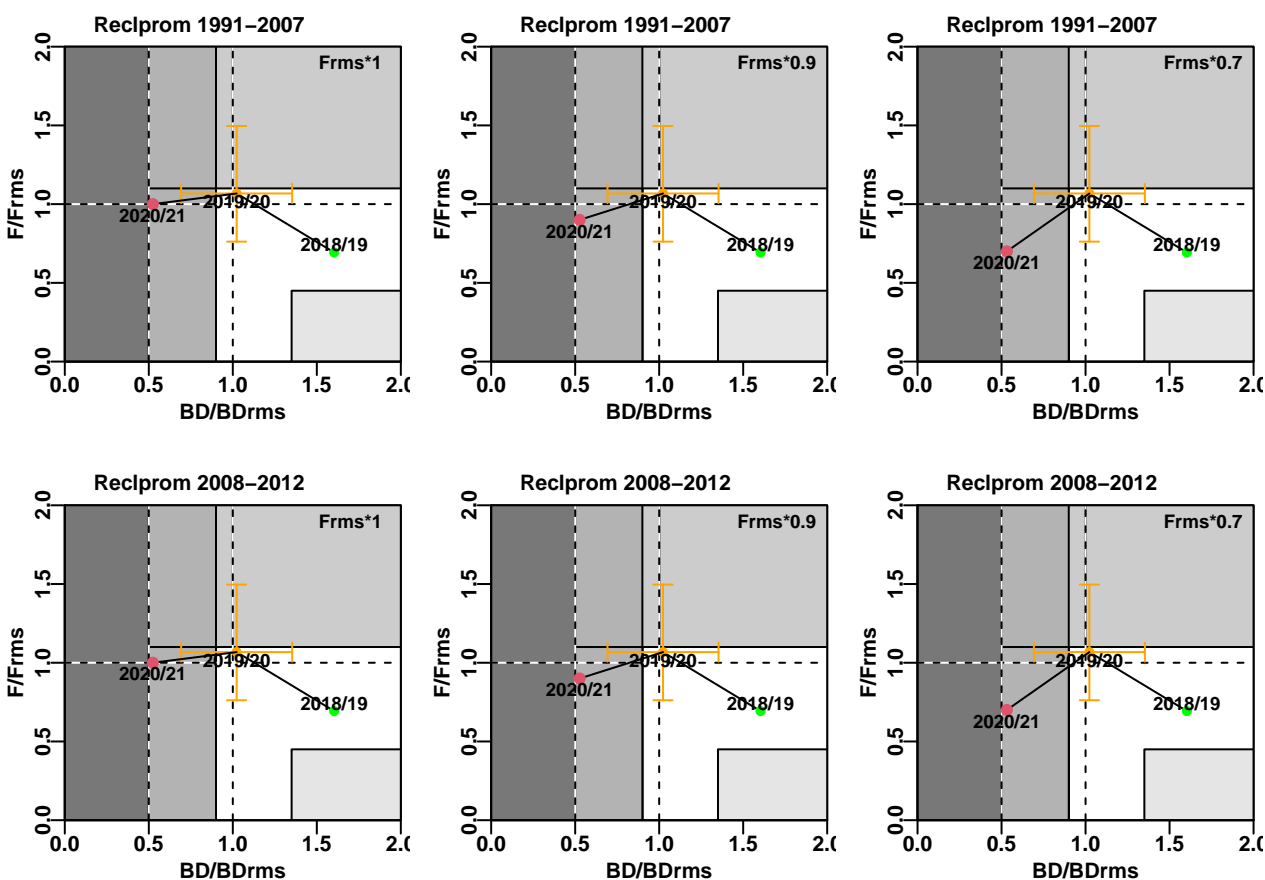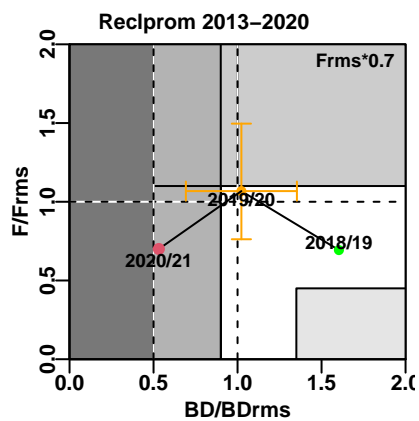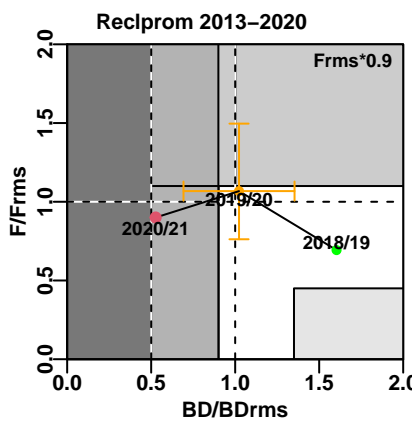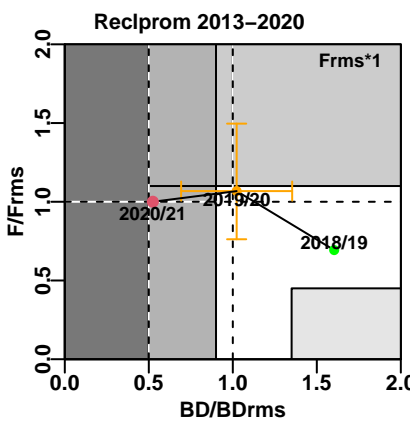
4.0. Proyección del stock (Asesoría de septiembre 2020)

	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

	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

	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

5. DISCUSIÓN