

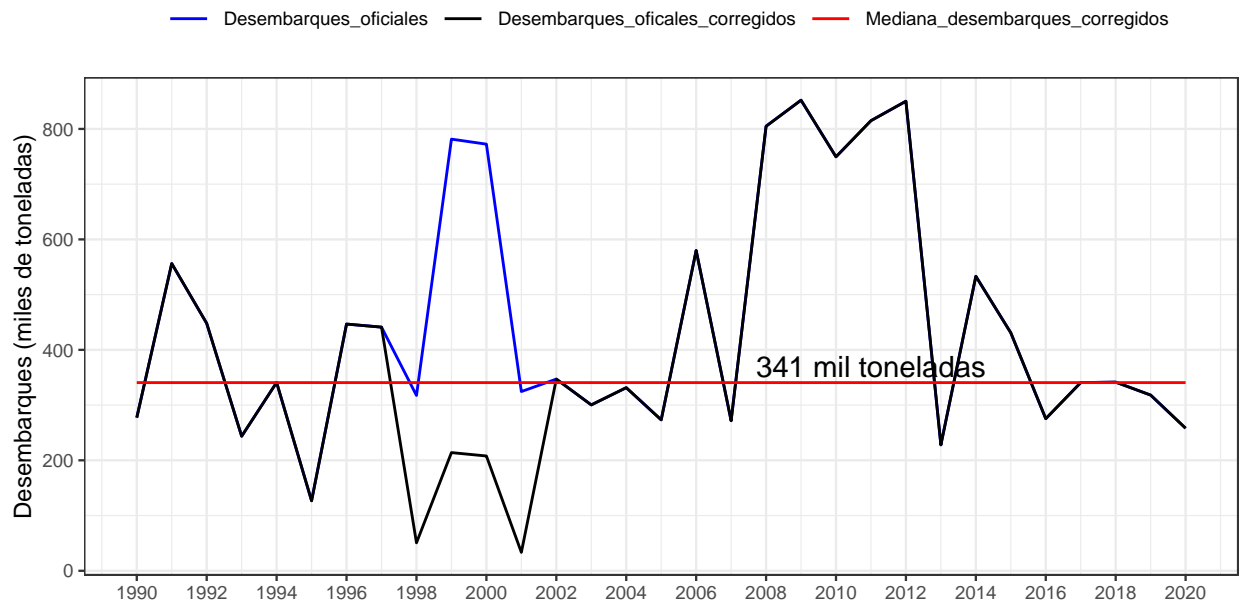
# Figuras y Tablas para Tercer Informe de sardina común Centro sur

## 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")
```



```

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)

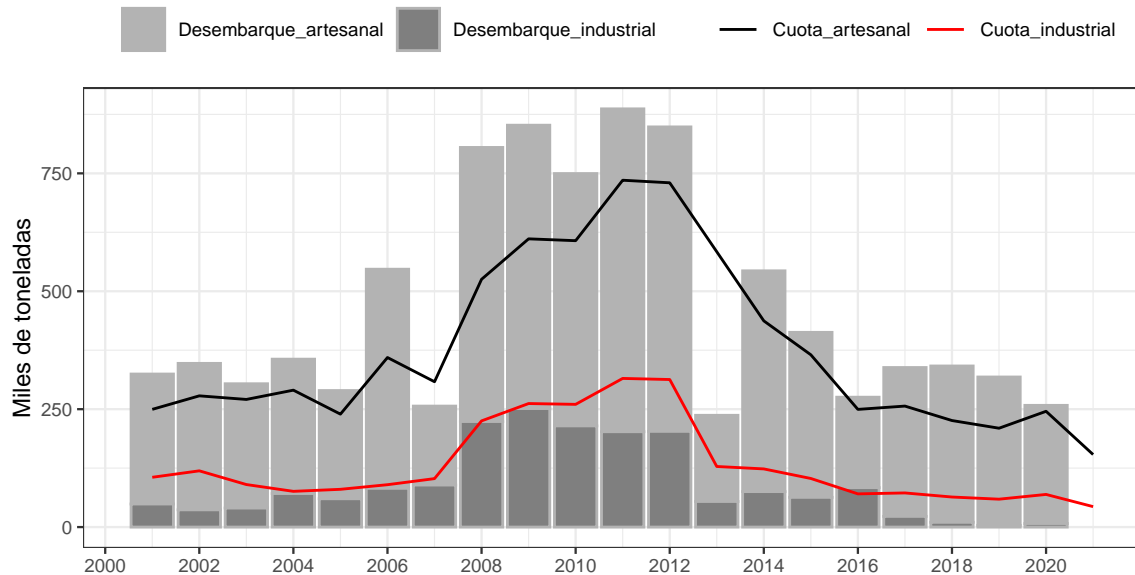
colnames(dataDesem3) <- c("Years",
                          "Cuota_artesanal",
                          "Cuota_industrial")

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")

```

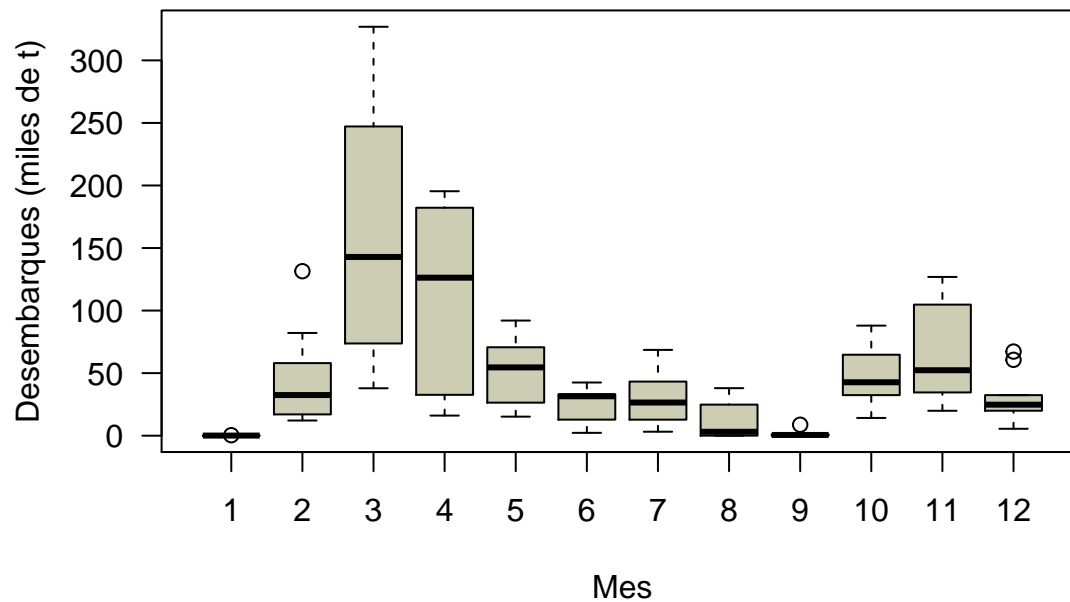


```

ano<-ant$desembarques_sernapesca[,1]
des_mes<-data.frame(mes=rep(seq(1,12,1),22),ano=g1(22,12,labels=ano),desem=c(t(ant$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")

```



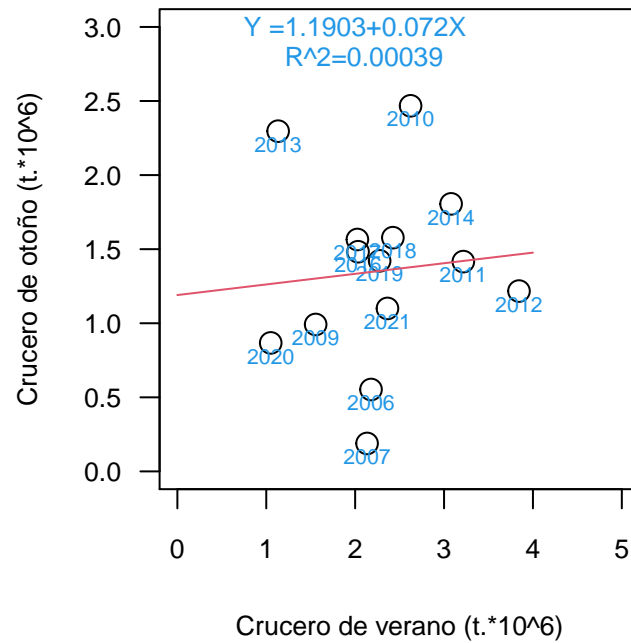
```

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)

```

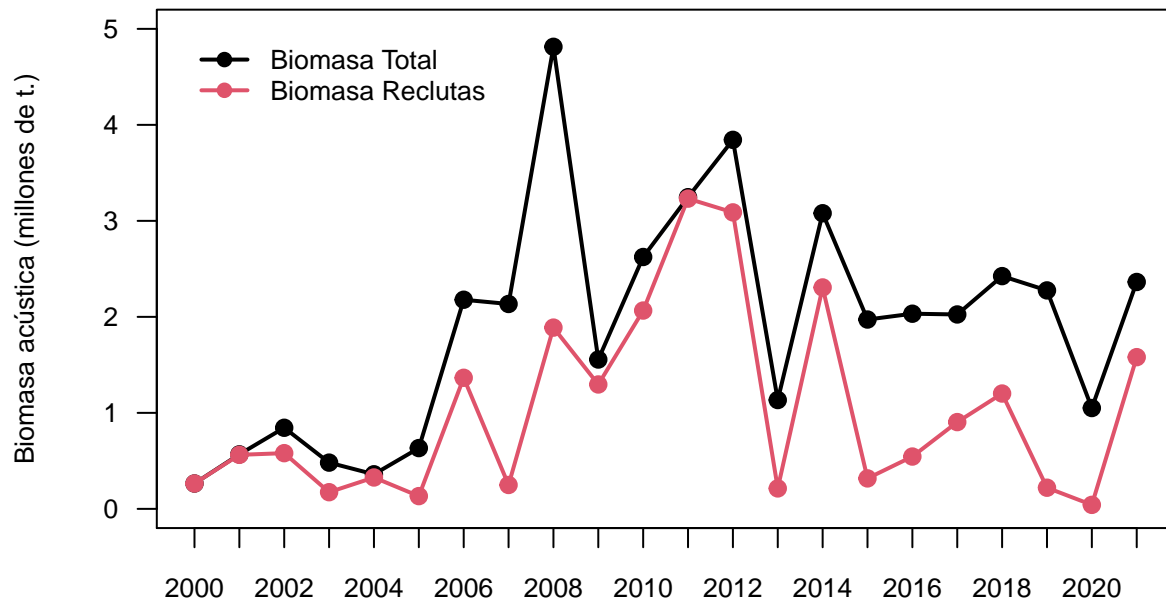


```

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",pch=19,col=2,lwd=2)
lines(anorecl,BRreclas/1000000,type="o",pch=19,col=1,lwd=2)
legend(2000, 5,c("Biomasa Total","Biomasa Reclutas"),pch=19,lwd=2,col=c(1,2),bty="n",cex=0.8)

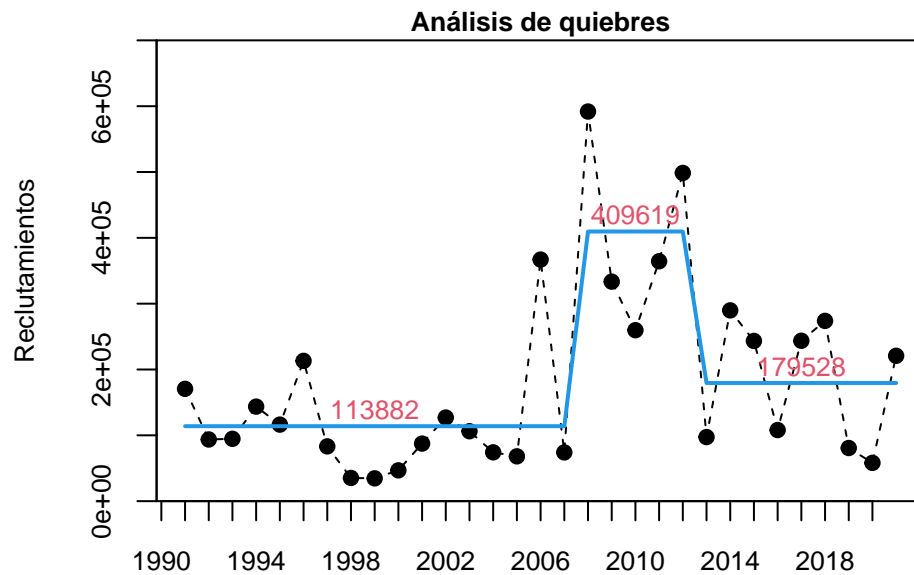
```



## 2. METODOLOGÍA

```
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$Reclutas,type="l",lty=2,pch=19,ylim=c(0,700000),
      xaxp=c(1990,2020,30),yaxs="i",xlab="",ylab="Reclutamientos",main="Análisis de quiebres",cex.main=0.8,cex.axis=0.8,cex.lab=0.8)
points(years,rep3$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)[23])+25000,0))
```



```

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

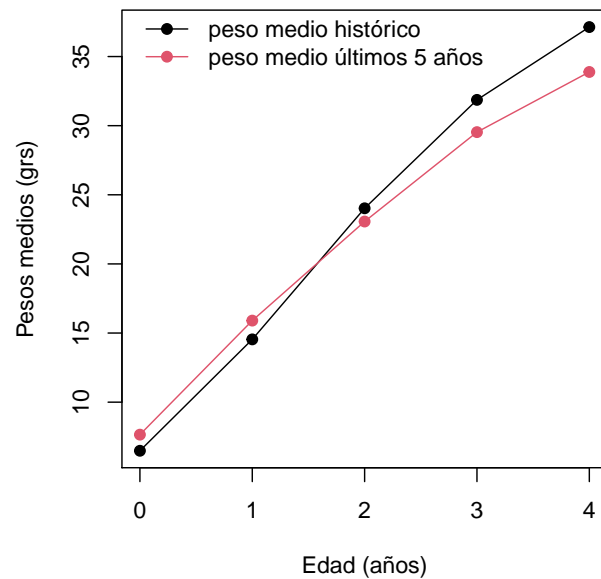
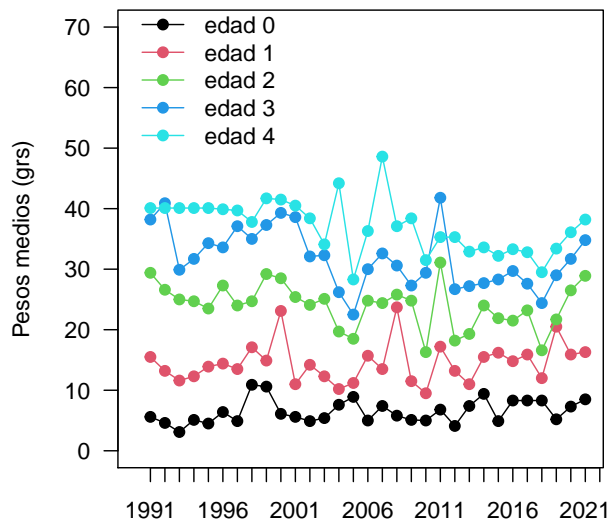
#Proporcion observada
WmedF <-dat3$Wmed
WiniF <-dat3$Wini

#Proporciones
Wm <-c(WmedF); Wm[Wm==0] <-NA
Wi <-c(WiniF); Wi[Wi==0] <-NA

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

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

```



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



### 3. RESULTADOS

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

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

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

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

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

box()
```



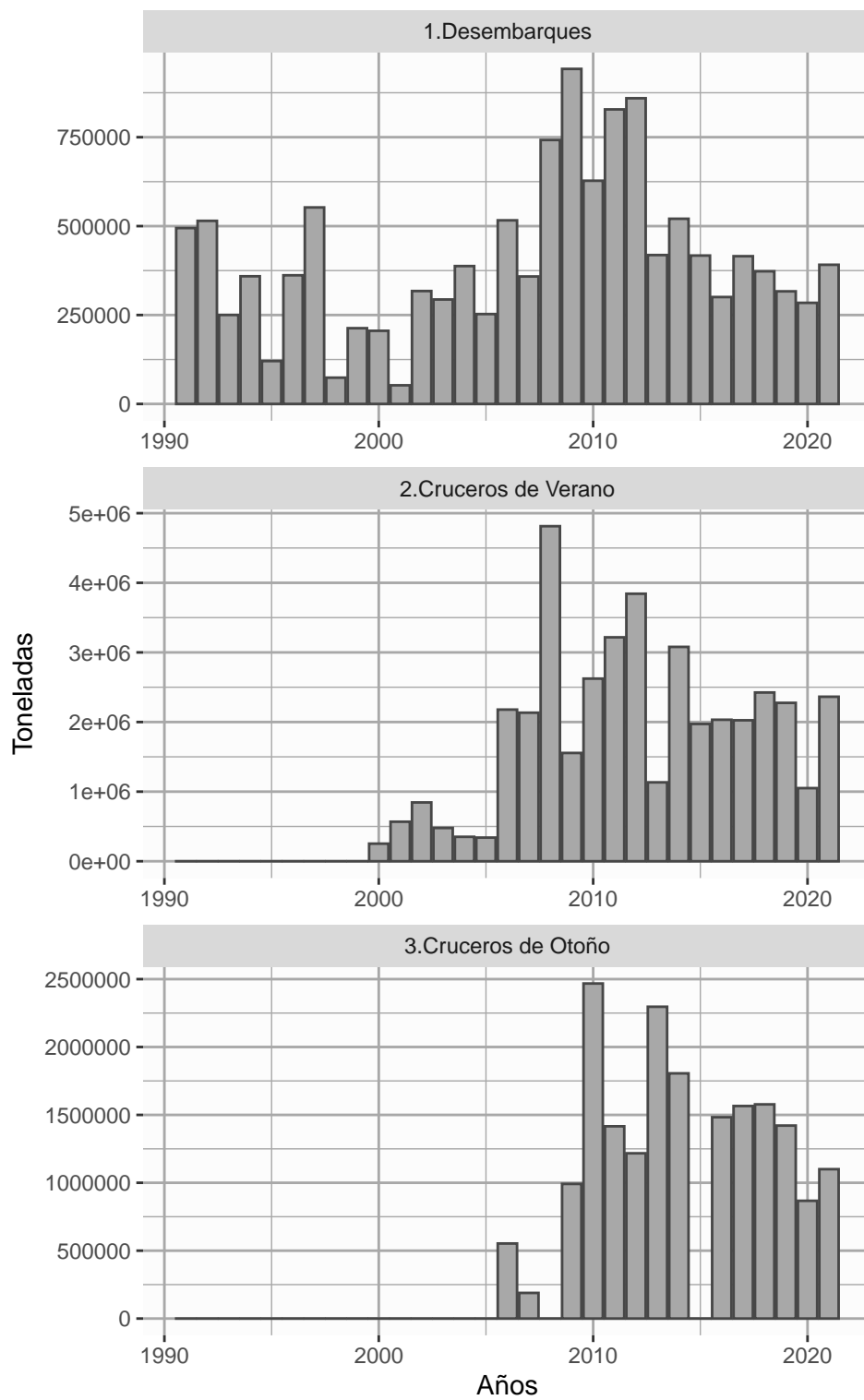
```

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')

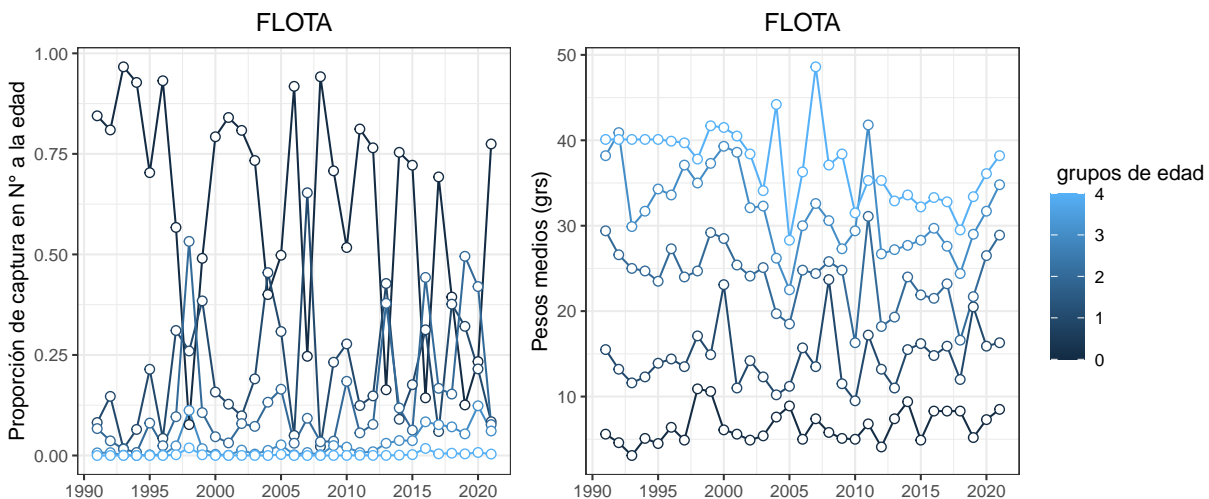
pobsF <- as.data.frame(pobsF) %>%
  mutate(years=years) %>%
  melt(id.vars='years') %>%
  mutate(edad = rep(age, each=nyears)) %>%
  mutate(type='pobsF')

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

```



```

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)

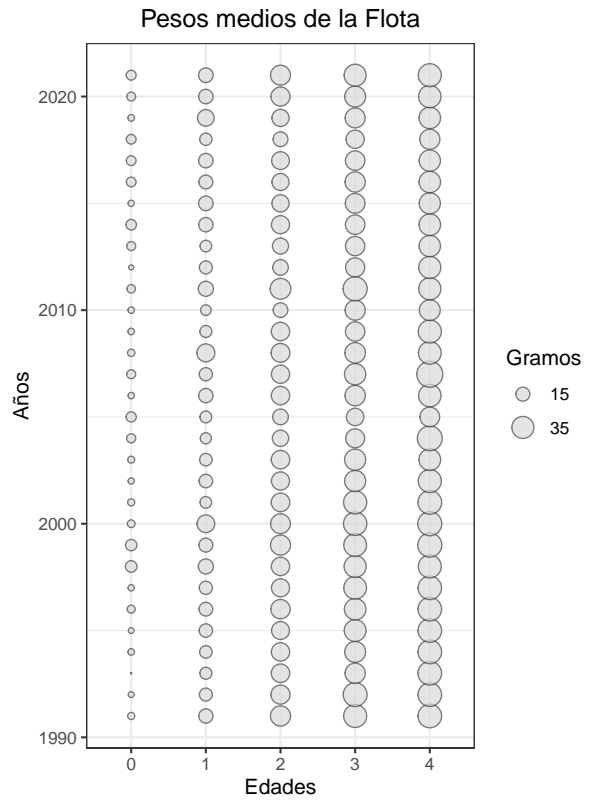
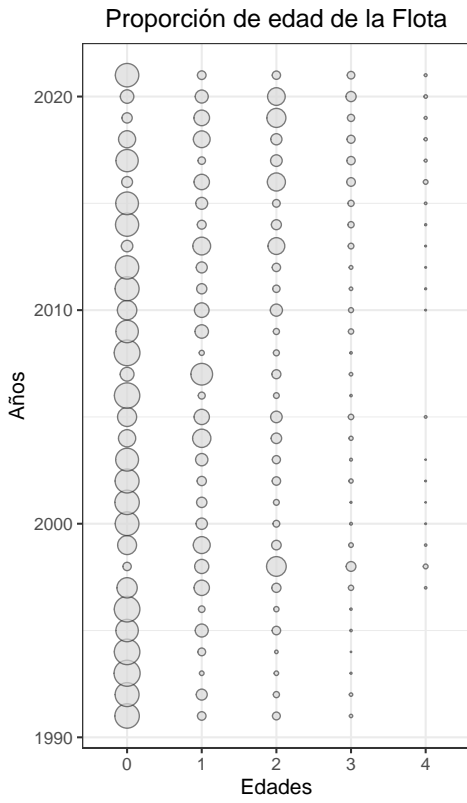
datosProp=data.frame(x=edad,y=anos,tamano=pF)
datosWmed=data.frame(x=edad,y=anos,tamano=Wm )

g1 <- ggplot (datosProp,aes(x,y)) +
  geom_point(aes(size=tamano),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=tamano),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

```



```

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')

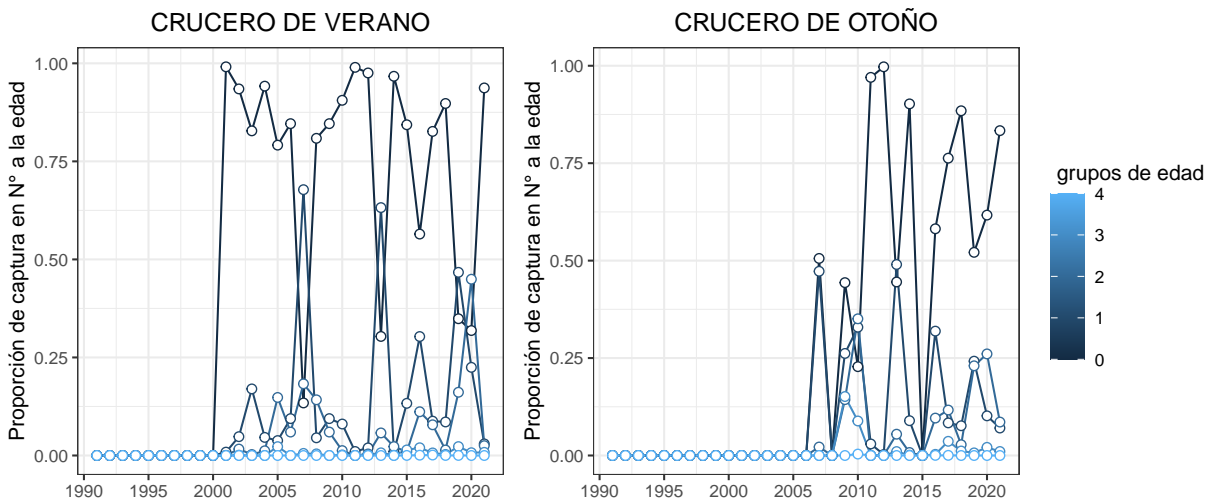
pobsP <- as.data.frame(pobsP) %>%
  mutate(years=years) %>%
  melt(id.vars='years') %>%
  mutate(edad = rep(age, each=nyears)) %>%
  mutate(type='pobsP')

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

```



```

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

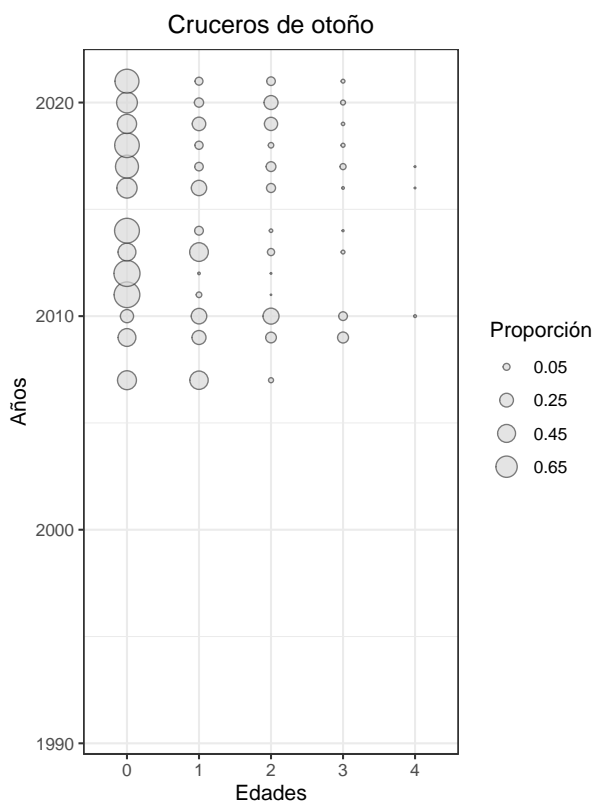
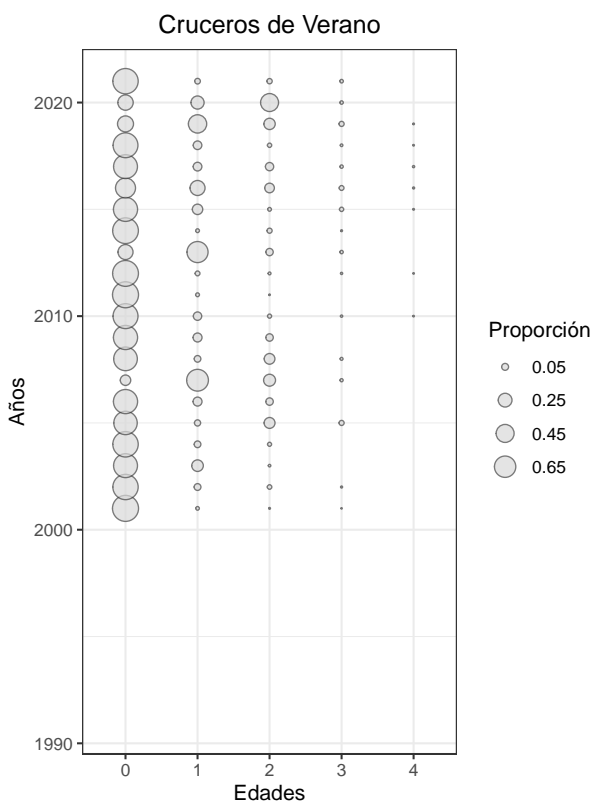
g1 <- ggplot (datosPropR,aes(x,y)) +
  geom_point(aes(size=tamano),color = 'gray25',shape=21, fill="gray85",alpha = 0.7) +
  scale_size_continuous(breaks = seq(0.05,0.65,0.2),range=c(0,6))+
  labs(x = 'Edades', y = 'Años',size="Proporción") +
  ggtitle("Cruceros de Verano")+
  theme_bw(base_size=11)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

g2 <- ggplot (datosPropP,aes(x,y)) +
  geom_point(aes(size=tamano),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

```
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') +
```

```

geom_errorbar(data = base1 %>% filter(Asesoria=='observado', variable=='Crucero_verano'),
aes(ymin = value*exp(-1.96*cvBcD)*10^-6, ymax = value*exp(1.96*cvBcD)*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*cvBcD)*10^-6, ymax = value*exp(1.96*cvBcD)*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)') +

```

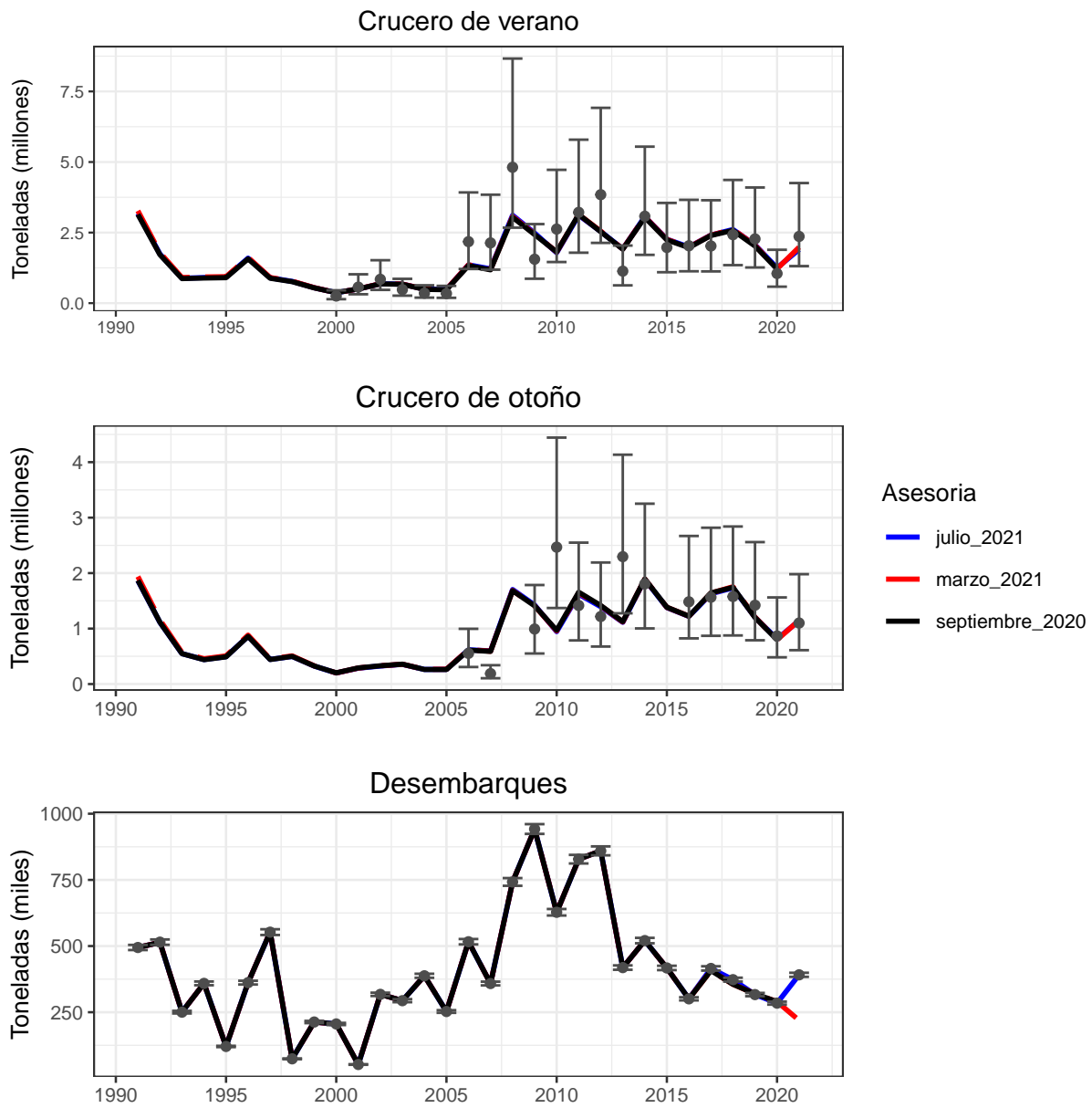
```

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")

```



```

# 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 #stápredicho
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)

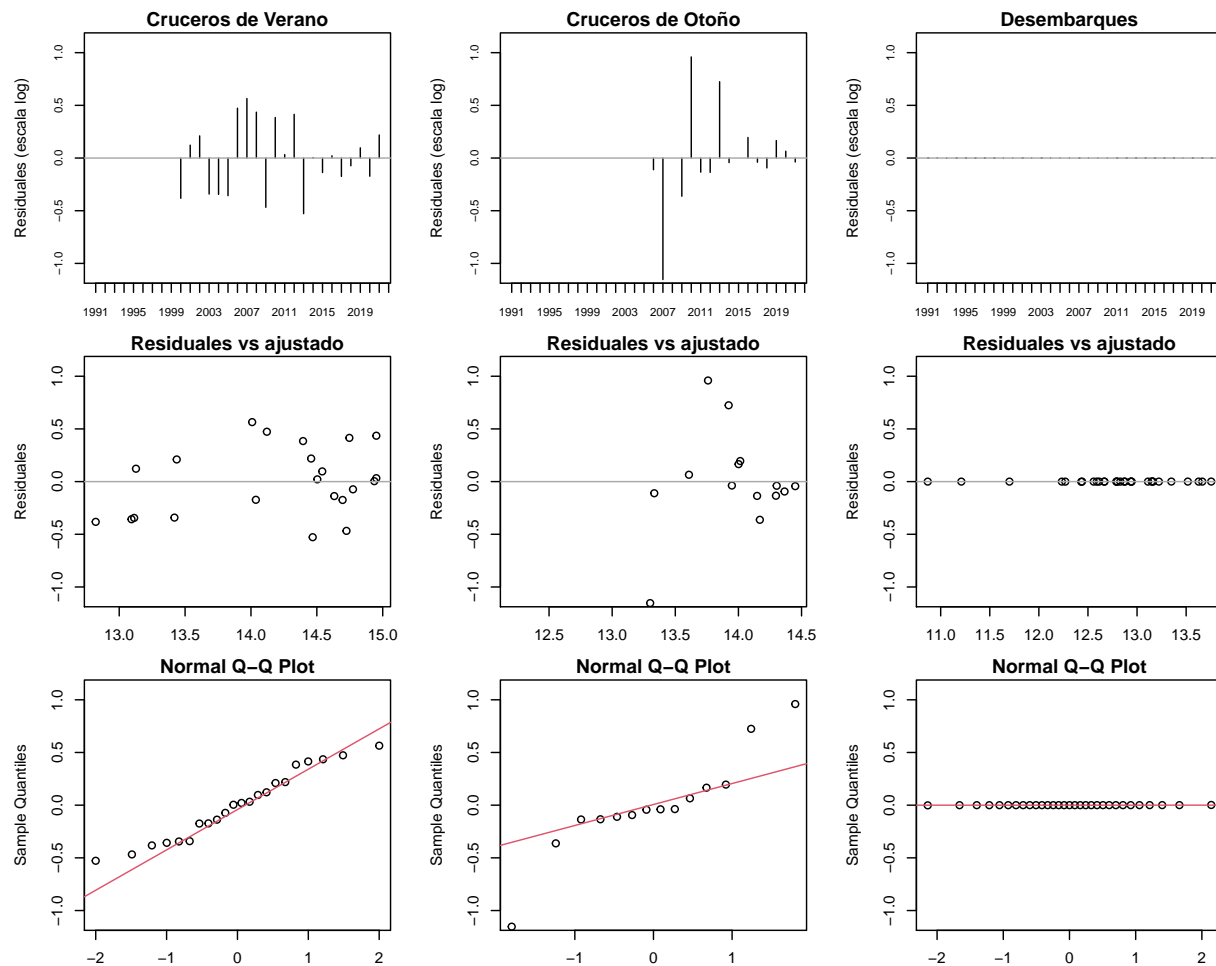
```

```
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)",xlab="Valor ajustado")
#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)",xlab="Valor ajustado")
#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="Valor ajustado")
#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)
```



```

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')

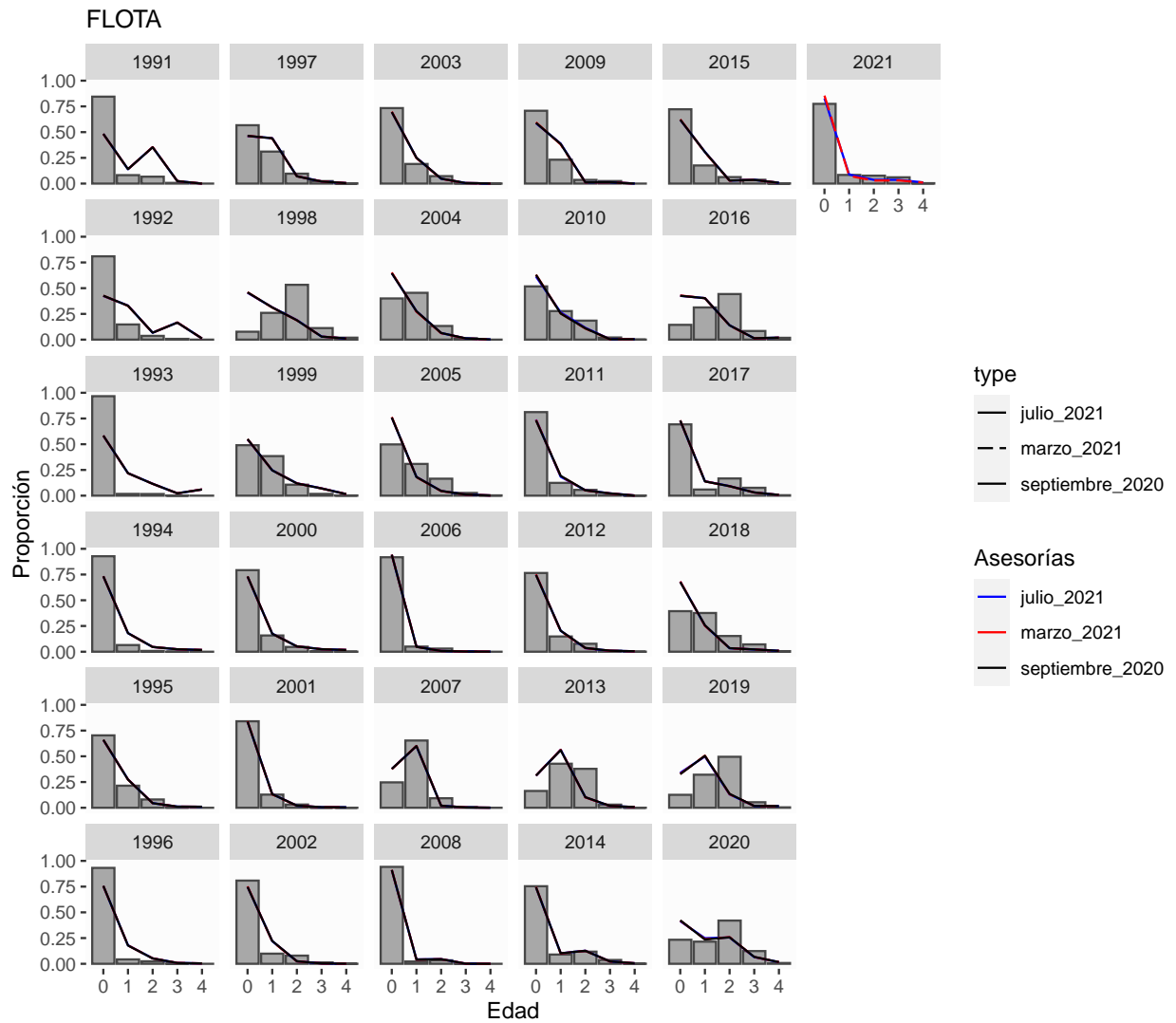
mat <- rbind(obs,pred_sep,pred_marzo,pred_julio)

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

```





```

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')

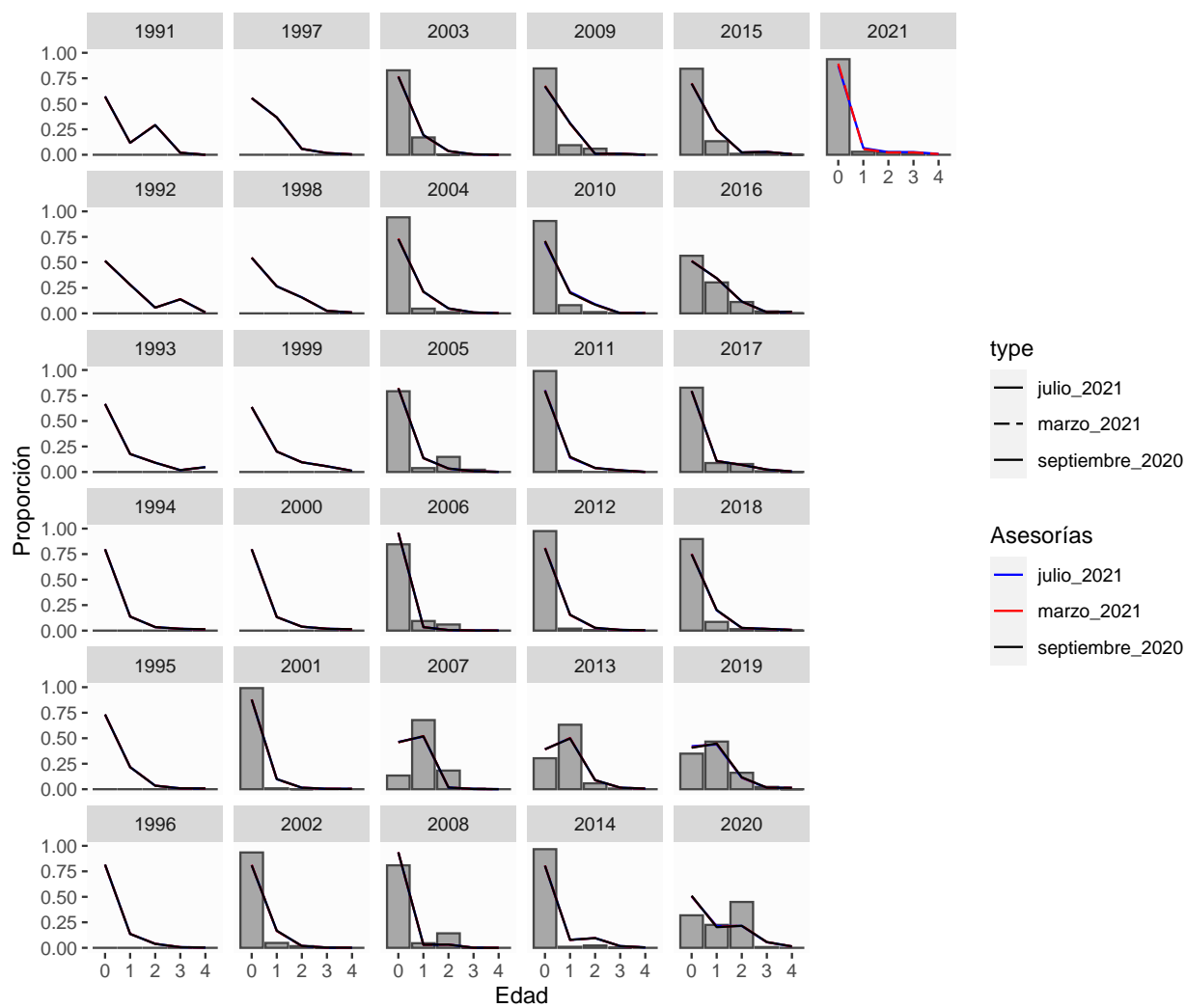
mat <- rbind(obs,pred_sep,pred_marzo,pred_julio)

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')

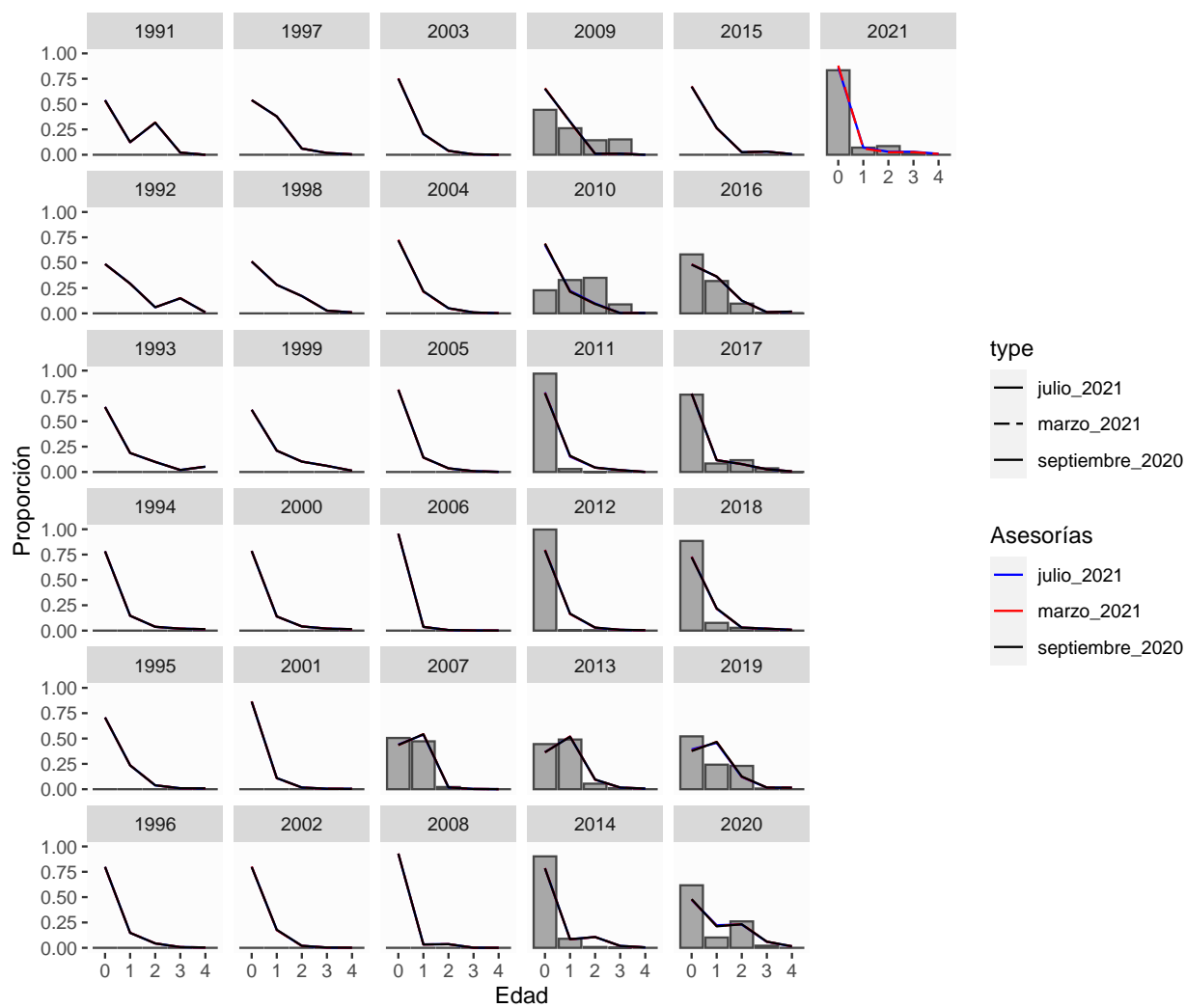
mat <- rbind(obs,pred_sep,pred_marzo,pred_julio)

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,]

```

```

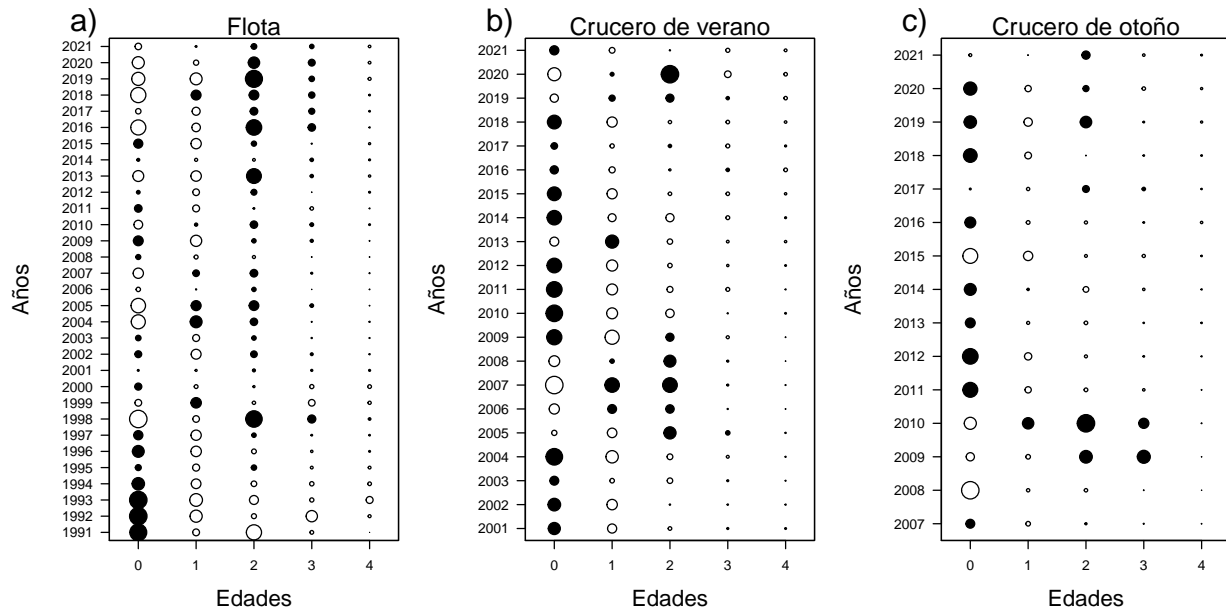
resP <-obsP-preP

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()

```



### 3.2. Comparación con asesorías previas

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

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

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



```

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

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

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

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

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

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

```

```

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

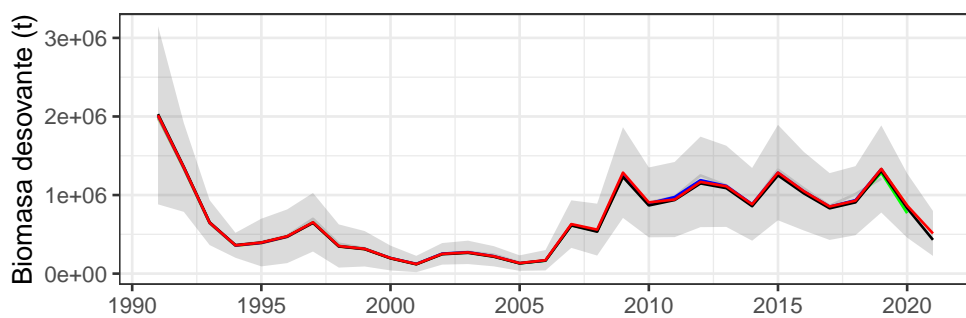
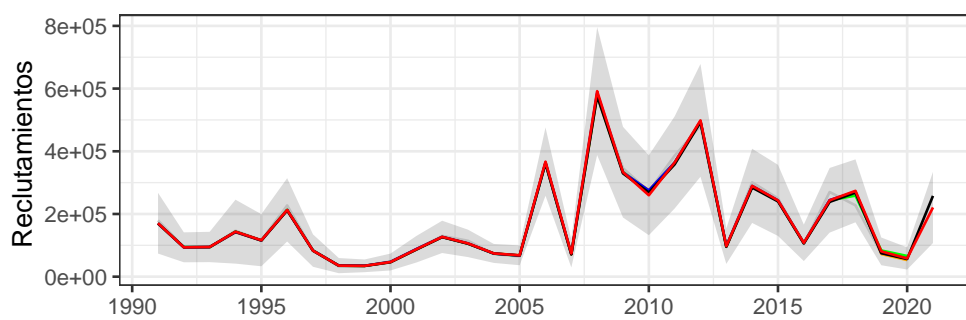
#Retrospectivo tradicional
Rt <- ggplot(Rtcomp) +
  geom_ribbon(data=VarPob,aes(ymin=lowerRt3, ymax=upperRt3, x=x, fill = "IC"), alpha = 0.2)+
  geom_line(aes(y=Rt_sept19, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=Rt_mar20, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=Rt_jul20,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

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

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

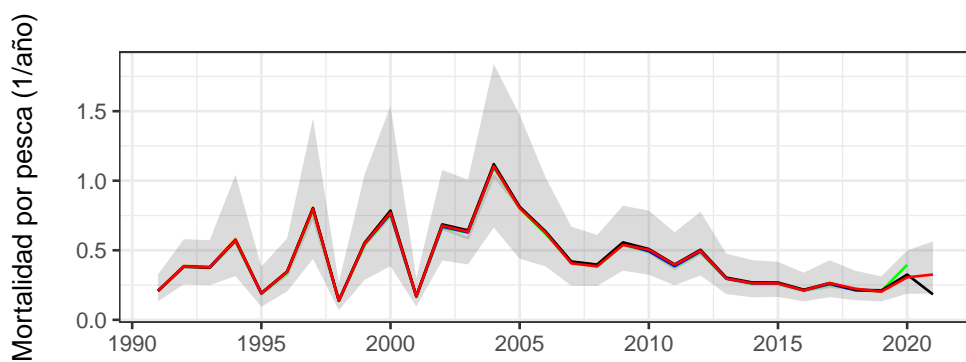
Rt/BD/Ft

```



2019\_sept  
 2020\_julio  
 2020\_marzo  
 2020\_sept  
 2021\_julio  
 2021\_marzo

IC



### 3.3. Análisis retrospectivo

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

years<-rep3$years
nyears<-length(years)
retros<-seq(1,5)
nretros<-length(retros)
year_retros<-as.factor(years[(nyears-(nretros-1)):nyears])

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

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

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

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

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

# Arreglo datos

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

```

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

#Para restrospectivo relativo
Rt_retroRel<- data.frame(x=years,
                        y1=rel.diff.r[,1],
                        y2=rel.diff.r[,2],
                        y3=rel.diff.r[,3],
                        y4=rel.diff.r[,4],
                        y5=rel.diff.r[,5])
BD_retroRel<- data.frame(x=years,
                        y1=rel.diff.ssb[,1],
                        y2=rel.diff.ssb[,2],
                        y3=rel.diff.ssb[,3],
                        y4=rel.diff.ssb[,4],
                        y5=rel.diff.ssb[,5])
Ft_retroRel<- data.frame(x=years,
                        y1=rel.diff.f[,1],
                        y2=rel.diff.f[,2],
                        y3=rel.diff.f[,3],
                        y4=rel.diff.f[,4],
                        y5=rel.diff.f[,5])

```

```

#Retrospectivo tradicional
Rt <- ggplot(Rt_retro) +
  geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = "IC asintótico"), alpha = 0.2)+
  geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
  geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
  geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
  labs(x = '', y = 'Reclutamientos ',colour='Asesorías') +
  scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
  scale_colour_manual("",values=c("orange","green","blue","red","black"))+
  scale_fill_manual("",values=c("grey30"))+
  theme_bw(base_size=12) +
  ggtitle('')+
  theme(plot.title = element_text(hjust = 0.5),legend.position="top")

BD <- ggplot(BD_retro) +
  geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = ""), alpha = 0.2)+
  geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
  geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
  geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
  labs(x = '', y = 'Biomasa desovante (t)',colour='Asesorías') +
  scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
  scale_colour_manual("",values=c("orange","green","blue","red","black"))+
  scale_fill_manual("",values=c("grey30"))+
  theme_bw(base_size=12) +
  ggtitle('')+
  theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Ft <- ggplot(Ft_retro) +
  geom_ribbon(aes(ymin=lower, ymax=upper, x=x, fill = ""), alpha = 0.2)+
  geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
  geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
  geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
  labs(x = '', y = 'Mortalidad por pesca (1/año)',colour='Asesorías') +
  scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
  scale_colour_manual("",values=c("orange","green","blue","red","black"))+
  scale_fill_manual("",values=c("grey30"))+
  theme_bw(base_size=12) +
  ggtitle('')+
  theme(plot.title = element_text(hjust = 0.5),legend.position="none")

#Retrospectivo relativo
Rtrel <- ggplot(Rt_retroRel) + lims(y=c(-1,1)) +
  geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
  geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
  geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
  annotate("text", x=2000, y=0.5,label=paste("Rho =",round(ave.mohn.r,2))) +
  labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías') +
  scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
  scale_colour_manual("",values=c("orange","green","blue","red","black"))+
  scale_fill_manual("",values=c("grey30"))+
  theme_bw(base_size=12) +
  ggtitle('')+
  theme(plot.title = element_text(hjust = 0.5),legend.position="none")

BDrel <- ggplot(BD_retroRel) + lims(y=c(-1,1)) +
  geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
  geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
  geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
  geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+

```

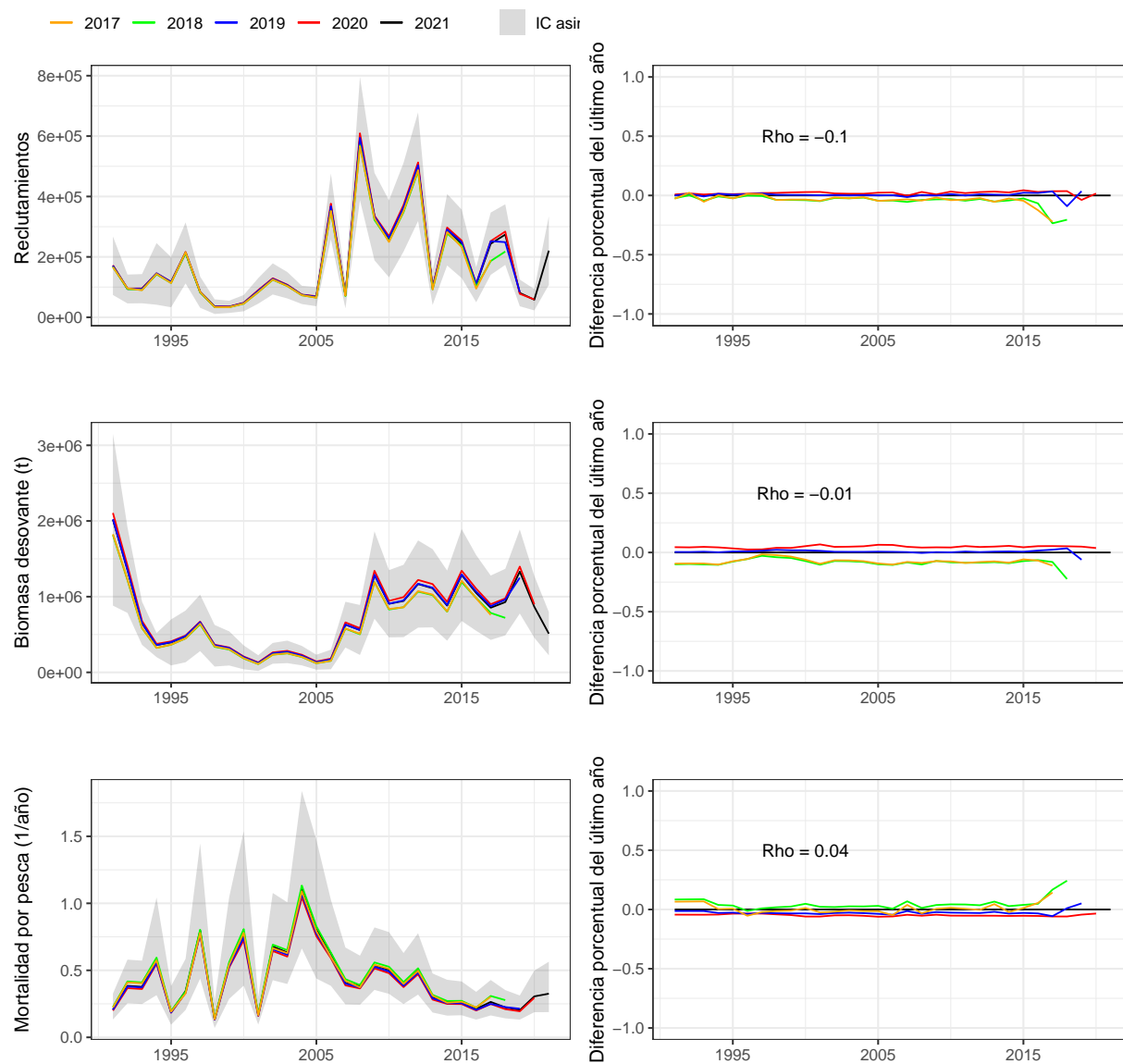
```

    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
    annotate("text", x=2000, y=0.5,label=paste("Rho =",round(ave.mohn.ssb,2))) +
    labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías') +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Ftrel <- ggplot(Ft_retroRel) + lims(y=c(-1,1)) +
    geom_line(aes(y=y1, x=x, colour = year_retros[nretros]), size=0.5)+
    geom_line(aes(y=y2, x=x, colour = year_retros[nretros-1]), size=0.5)+
    geom_line(aes(y=y3, x=x, colour = year_retros[nretros-2]), size=0.5)+
    geom_line(aes(y=y4, x=x, colour = year_retros[nretros-3]), size=0.5)+
    geom_line(aes(y=y5, x=x, colour = year_retros[nretros-4]), size=0.5)+
    annotate("text", x=2000, y=0.5,label=paste("Rho =",round(ave.mohn.f,2))) +
    labs(x = '', y = 'Diferencia porcentual del último año',colour='Asesorías') +
    scale_x_continuous(breaks = seq(from = 1995, to = 2020, by = 10)) +
    scale_colour_manual("",values=c("orange","green","blue","red","black"))+
    scale_fill_manual("",values=c("grey30"))+
    theme_bw(base_size=12) +
    ggtitle('')+
    theme(plot.title = element_text(hjust = 0.5),legend.position="none")

Rt/BD/Ft | Rtrel/BDrel/Ftrel

```





### 3.4. Perfil de verosimilitud

```

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

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

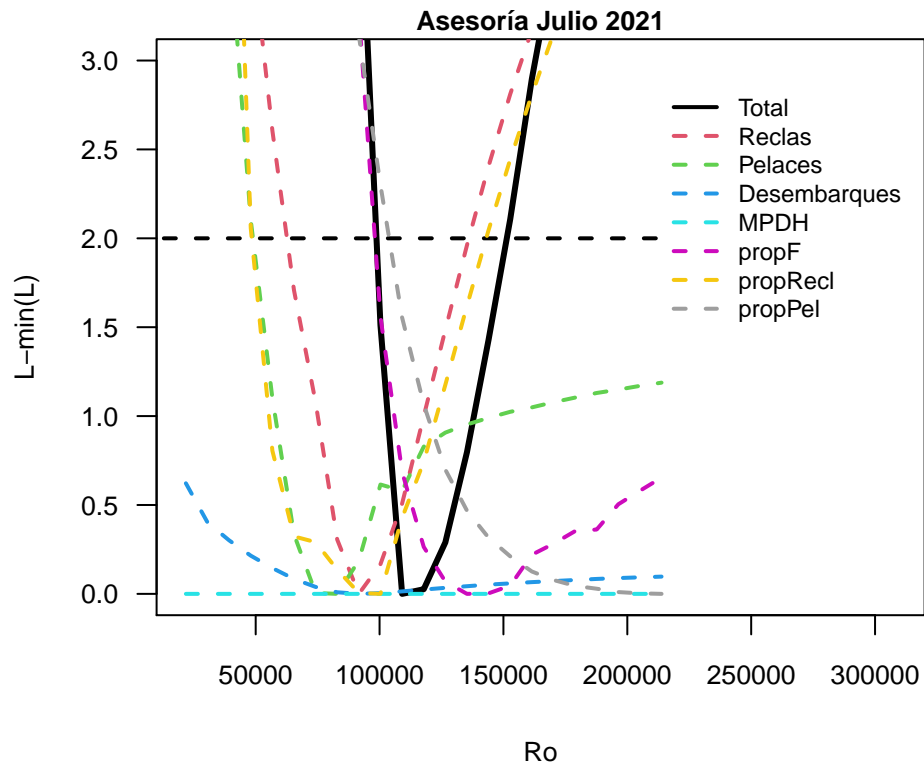
for(i in 1:casos){
  report    <- reptoRlist(paste(dir,"/MAE0721s",i,".rep",sep=""))
  logRo[i]  <- report$log_Ro
  likeval[i,] <- report$likeval}

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

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

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

```



```

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

```

### 3.5. Variables poblacionales

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

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

VarPobSep<- data.frame(x=years1, Rt1=Rt1,BT1=BT1,BD1=BD1,Ft1=exp(Ft1),
  lowerRt1 = (Rt1 -1.96*Rt1std), upperRt1 = (Rt1+1.96*Rt1std),
  lowerBT1 = (BT1 -1.96*BT1std), upperBT1 = (BT1+1.96*BT1std),
  lowerBD1 = (BD1 -1.96*BD1std), upperBD1 = (BD1+1.96*BD1std),
  lowerFt1 = exp(Ft1 -1.96*Ft1std), upperFt1 = exp(Ft1+1.96*Ft1std))
```

```

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

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

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

```

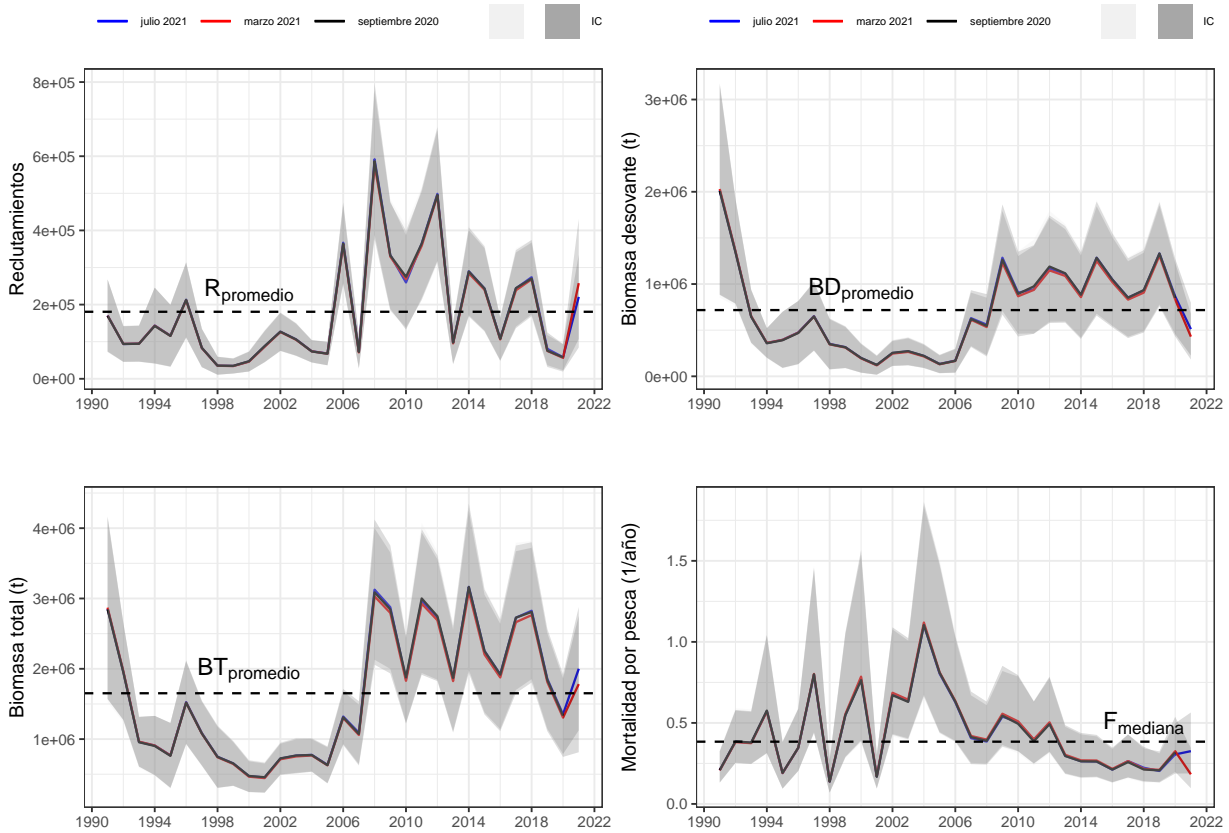
```

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

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

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

```



```

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

kable(VarPobl1)

```

| Año     | $BD_{sept}$ | $BD_{marzo}$ | $BD_{julio}$ | $BT_{sept}$ | $BT_{marzo}$ | $BT_{julio}$ | $R_{sept}$ | $R_{marzo}$ | $R_{julio}$ | $F_{sept}$ | $F_{marzo}$ | $F_{julio}$ |
|---------|-------------|--------------|--------------|-------------|--------------|--------------|------------|-------------|-------------|------------|-------------|-------------|
| 1990/91 | 2008700     | 2030000      | 2015480      | 2844200     | 2870400      | 2854570      | 169670     | 170120      | 170639      | 0.209      | 0.207       | 0.208       |
| 1991/92 | 21344500    | 1358500      | 1351070      | 1949500     | 1966700      | 1957010      | 93768      | 94041       | 93684.9     | 0.386      | 0.382       | 0.384       |
| 1992/93 | 2645250     | 652550       | 648897       | 955290      | 964360       | 960132       | 94409      | 94707       | 94732.2     | 0.379      | 0.375       | 0.377       |
| 1993/94 | 258150      | 362070       | 360662       | 902180      | 909000       | 908707       | 142470     | 143180      | 143611      | 0.576      | 0.57        | 0.573       |
| 1994/95 | 390940      | 395090       | 395593       | 761620      | 767170       | 769117       | 115500     | 115760      | 116301      | 0.192      | 0.19        | 0.19        |
| 1995/96 | 469770      | 473120       | 475138       | 1518000     | 1517100      | 1526620      | 212650     | 211490      | 213115      | 0.347      | 0.347       | 0.346       |
| 1996/97 | 48700       | 647450       | 653825       | 1080200     | 1077600      | 1086140      | 83311      | 82828       | 83214       | 0.8        | 0.803       | 0.796       |
| 1997/98 | 48370       | 346010       | 351479       | 746840      | 741130       | 749454       | 35378      | 35062       | 35261.1     | 0.137      | 0.138       | 0.137       |
| 1998/99 | 314830      | 311640       | 316169       | 653870      | 646260       | 654159       | 34847      | 34292       | 34642.9     | 0.547      | 0.555       | 0.548       |
| 1999/00 | 98580       | 194090       | 198246       | 475590      | 465230       | 473346       | 47251      | 46073       | 46792.4     | 0.764      | 0.786       | 0.77        |
| 2000/01 | 123590      | 118470       | 122362       | 457800      | 444970       | 453525       | 88252      | 86319       | 87439.7     | 0.167      | 0.172       | 0.169       |
| 2001/02 | 254560      | 246340       | 251598       | 725490      | 713020       | 722233       | 126940     | 126130      | 127032      | 0.671      | 0.686       | 0.678       |
| 2002/03 | 72510       | 264590       | 270551       | 766550      | 753550       | 765101       | 105990     | 105110      | 106224      | 0.63       | 0.643       | 0.633       |
| 2003/04 | 21470       | 215090       | 221022       | 773620      | 767100       | 775923       | 73689      | 73955       | 74159.6     | 1.104      | 1.12        | 1.104       |
| 2004/05 | 32870       | 130190       | 133954       | 629360      | 626840       | 634685       | 67496      | 67638       | 68097.8     | 0.809      | 0.813       | 0.804       |
| 2005/06 | 67690       | 166450       | 170388       | 1310300     | 1299600      | 1321650      | 364340     | 361230      | 366988      | 0.631      | 0.636       | 0.628       |
| 2006/07 | 21470       | 612730       | 630224       | 1074400     | 1058400      | 1091760      | 72290      | 70839       | 74055.3     | 0.412      | 0.419       | 0.406       |
| 2007/08 | 46580       | 533910       | 560080       | 3087000     | 3029800      | 3125370      | 586530     | 576230      | 591892      | 0.389      | 0.397       | 0.385       |

| Año     | $BD_{sept}$ | $BD_{marzo}$ | $BD_{julio}$ | $BT_{sept}$ | $BT_{marzo}$ | $BT_{julio}$ | $R_{sept}$ | $R_{marzo}$ | $R_{julio}$ | $F_{sept}$ | $F_{marzo}$ | $F_{julio}$ |
|---------|-------------|--------------|--------------|-------------|--------------|--------------|------------|-------------|-------------|------------|-------------|-------------|
| 2008/09 | 263800      | 1230300      | 1285730      | 2846100     | 2794700      | 2875880      | 332590     | 329460      | 333486      | 0.545      | 0.557       | 0.539       |
| 2009/10 | 94040       | 867720       | 906147       | 1877000     | 1828600      | 1852850      | 275020     | 268470      | 259700      | 0.494      | 0.509       | 0.505       |
| 2010/11 | 74810       | 936800       | 942980       | 3000800     | 2926400      | 2963710      | 364240     | 358290      | 364438      | 0.386      | 0.398       | 0.395       |
| 2011/12 | 189500      | 1147700      | 1167280      | 2747600     | 2690600      | 2728000      | 495590     | 492960      | 498579      | 0.493      | 0.504       | 0.498       |
| 2012/13 | 116600      | 1088100      | 1111240      | 1869900     | 1824500      | 1862960      | 97434      | 95115       | 97325.9     | 0.296      | 0.303       | 0.297       |
| 2013/14 | 883910      | 857790       | 881823       | 3164100     | 3096700      | 3165820      | 289240     | 284180      | 289821      | 0.263      | 0.269       | 0.264       |
| 2014/15 | 284500      | 1250400      | 1286070      | 2252000     | 2202700      | 2254280      | 243240     | 240020      | 243378      | 0.262      | 0.268       | 0.262       |
| 2015/16 | 047700      | 1021300      | 1049280      | 1916400     | 1876300      | 1921390      | 107500     | 106000      | 108023      | 0.212      | 0.217       | 0.212       |
| 2016/17 | 51980       | 831090       | 853911       | 2728000     | 2663200      | 2726220      | 244410     | 238570      | 243660      | 0.258      | 0.264       | 0.264       |
| 2017/18 | 34650       | 907150       | 928190       | 2809100     | 2763000      | 2826010      | 270150     | 267990      | 273830      | 0.213      | 0.216       | 0.223       |
| 2018/19 | 331300      | 1307200      | 1331900      | 1841000     | 1811000      | 1855990      | 75649      | 75099       | 80726.6     | 0.207      | 0.21        | 0.203       |
| 2019/20 | 49310       | 832960       | 866506       | 1333000     | 1305400      | 1352630      | 58067      | 56309       | 58187.9     | 0.319      | 0.326       | 0.306       |
| 2020/21 | NA          | 430060       | 511108       | NA          | 1782600      | 2000590      | NA         | 257750      | 220797      | NA         | 0.183       | 0.326       |

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

```

# Reclutamientos 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 Último 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")

```

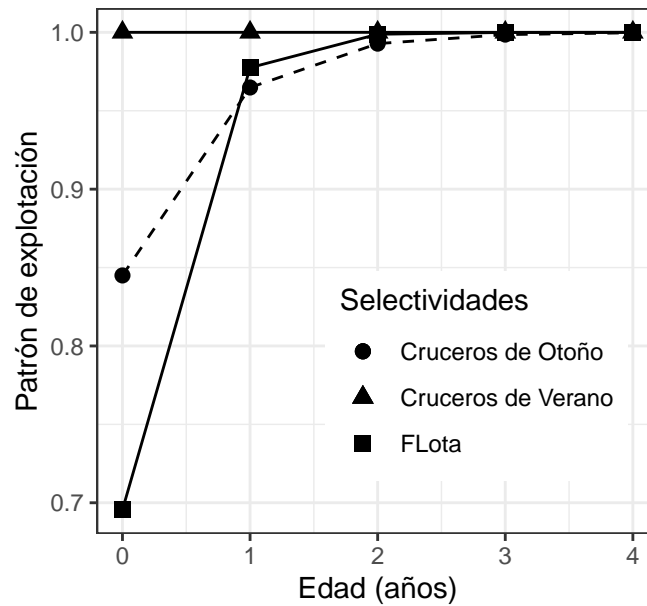


```

sel_Flota<-rep3$Sel_flota[1,]
sel_CruV <-rep3$Sel_reclas[1,]
sel_Cru0 <-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_Cru0),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_Cru0,shape="Cruceros de Otoño"),size=2.5) +
  #parámetros
  labs(x = 'Edad (años)', y = 'Patrón de explotación',shape="Selectividades") +
  ggtitle("")+
  theme_bw(base_size=11) +
  theme(plot.title = element_text(hjust = 0.5),legend.justification=c(1.1,0), legend.position=c(1,0.1))
g1

```



### 3.6. Puntos biológicos de referencia

```
#PBR año biológico
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)
```

```

#PBR año biológico
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)

```

```

#PBR año biológico
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$SSBpbr[1]                  # Paso 4: Obtención de Bo
BRMS1      <- rep1$SSBpbr[3]                  # Paso 5: Obtención de Brms = 60%SPRo = 55%Bo
FRMS1      <- rep1$Fs[2]
BLIM1      <- Bo1*0.275                        # Paso 6: Obtención de Blim = 20%Bo
FLIM1      <- rep1$Fs[3]                      # Paso 6: Obtención de Flim = 30%SPRo
SpB1       <- BD1                             # BD serie histórica de evaluación de stock
SpBSE1     <- BD1std                          # desviación estándar BD
ln_Fyr1    <- Ft1                             # logaritmo de Ft
ln_FSE1     <- Ft1std                         # logaritmo de la desviación estándar de Ft

```

```

# ASESORÍA DE SEPTIEMBRE
Bo2      <- rep2$SSBpbr[1]      # Paso 4: Obtención de Bo
BRMS2    <- rep2$SSBpbr[3]      # Paso 5: Obtención de Brms = 60%SPRo = 55%Bo
FRMS2    <- rep2$Fs[2]

BLIM2    <- Bo2*0.275           # Paso 6: Obtención de Blim = 20%Bo
FLIM2    <- rep2$Fs[3]         # Paso 6: Obtención de Flim = 30%SPRo
SpB2     <- BD2                # BD serie histórica de evaluación de stock
SpBSE2   <- BD2std             # desviación estándar BD
ln_Fyr2  <- Ft2                # logaritmo de Ft
ln_FSE2  <- Ft2std             # logaritmo de la desviación estándar de Ft

```

```

# ASESORÍA DE SEPTIEMBRE
Bo3      <- rep3$SSBpbr[1]      # Paso 4: Obtención de Bo
BRMS3    <- rep3$SSBpbr[3]      # Paso 5: Obtención de Brms = 60%SPRo = 55%Bo
FRMS3    <- rep3$Fs[2]

BLIM3    <- Bo3*0.275           # Paso 6: Obtención de Blim = 20%Bo
FLIM3    <- rep3$Fs[3]         # Paso 6: Obtención de Flim = 30%SPRo
SpB3     <- BD3                # BD serie histórica de evaluación de stock
SpBSE3   <- BD3std             # desviación estándar BD
ln_Fyr3  <- Ft3                # logaritmo de Ft
ln_FSE3  <- Ft3std             # logaritmo de la desviación estándar de Ft

```

```

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

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

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

```

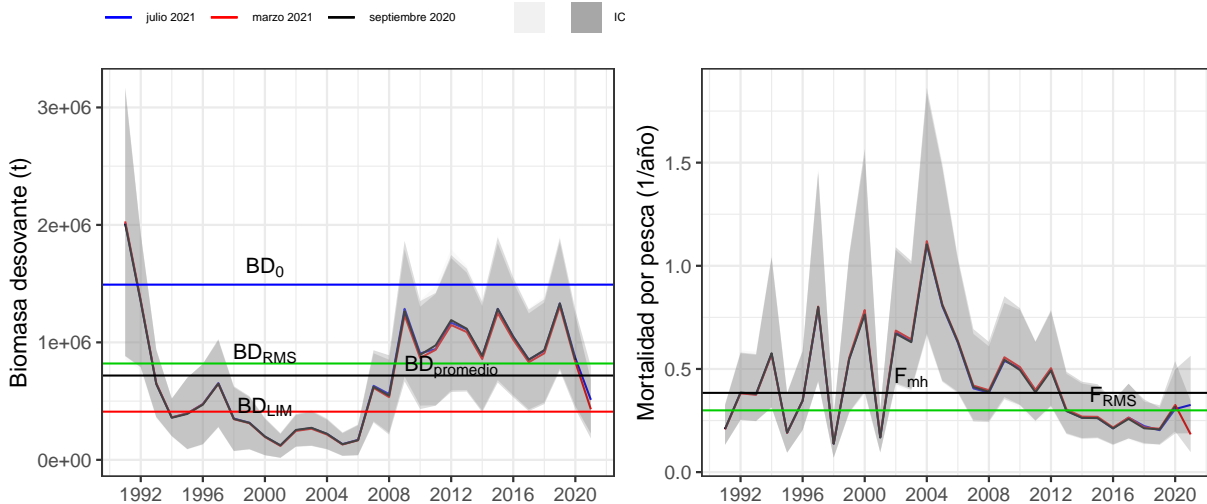
```

BD <- ggplot() +
  geom_line(data=VarPobJul,aes(y=BD3, x=x, colour = "julio 2021"), 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

```





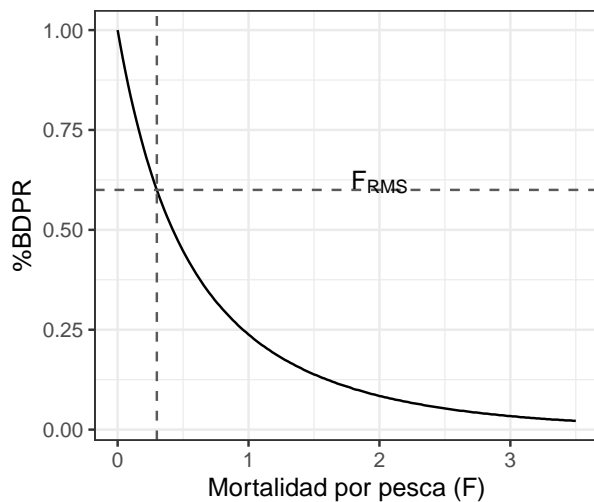
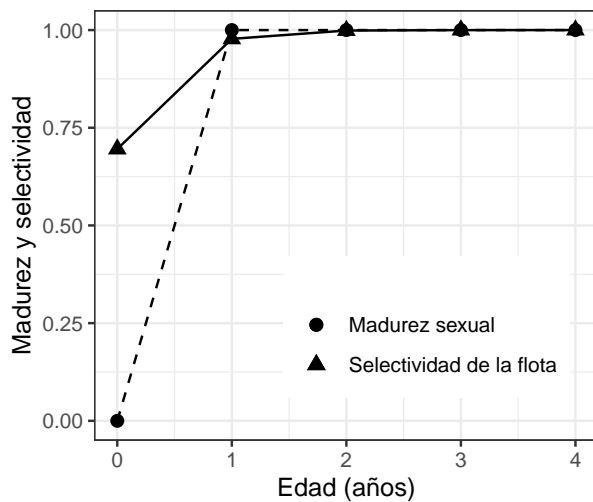
```

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

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

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

```



```

years1<-rep2$years
nyears1<-length(years1)
#para serie histórica
Rpr1      <- c(subset(std1,name=="RPrequ3")$value,NA);
Rpr1std   <- c(subset(std1,name=="RPrequ3")$std,NA)
Frpr1     <- c(subset(std1,name=="Frpr")$value,NA);
Frpr1std  <- c(subset(std1,name=="Frpr")$std,NA)

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

#Para densidad de probabilidad
rprSEPT    <-subset(std1,name=="RPrequ3")$value[nyears1-1]
rprSEPTstd  <-subset(std1,name=="RPrequ3")$std[nyears1-1]
FrprSEPT    <-subset(std1,name=="Frpr")$value[nyears1-1]
FrprSEPTstd <-subset(std1,name=="Frpr")$std[nyears1-1]

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

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

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

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

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

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

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

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

```

### 3.7. Estatus

```

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

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

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

#Para densidad de probabilidad
rprMARZO   <-subset(std2,name=="RPRequ3")$value[nyears2]
rprMARZOstd <-subset(std2,name=="RPRequ3")$std[nyears2]
FrprMARZO  <-subset(std2,name=="Frpr")$value[nyears2]
FrprMARZOstd <-subset(std2,name=="Frpr")$std[nyears2]
# biomasa desovante vs BDrms - densidad de probabilidad
xbm1 <-rnorm(1000, mean = rprMARZO, sd = rprMARZOstd)
xbm  <-seq(min(xbm1),max(xbm1),0.005)
ybm  <-dnorm(xbm, mean = rprMARZO, sd =rprMARZOstd)
icbm <-qnorm(c(0.05,0.95,0.5),rprMARZO,rprMARZOstd)
# mortalidad por pesca vs Frms - densidad de probabilidad
xfm1 <- rnorm(1000, mean = FrprMARZO, sd = FrprMARZOstd)
xfm  <-seq(min(xfm1),max(xfm1),0.005)
yfm  <-dnorm(xfm, mean = FrprMARZO, sd =FrprMARZOstd)
icfm <-qnorm(c(0.05,0.95,0.5),FrprMARZO,FrprMARZOstd)
#distribución probabilidad
xxbm  <- c(xbm[xbm>=icbm[1]&xbm<=icbm[2]],
           rev(xbm[xbm>=icbm[1]&xbm<=icbm[2]]))

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

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

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

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

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

```

```

#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")

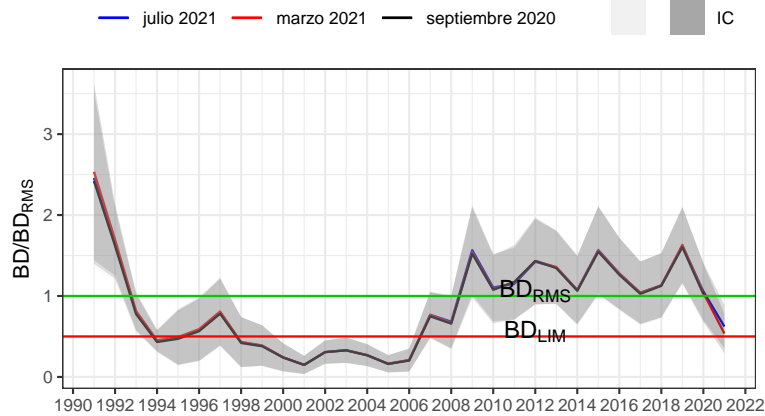
fig_desnb<- ggplot() + lims(y=c(0,4)) +
  geom_polygon(data=densb_bj,aes(x=x, y=y, group=t,alpha=0.9),fill="gray85")+
  geom_polygon(data=densb_bm,aes(x=x, y=y, group=t,alpha=0.9),fill="gray75")+
  geom_polygon(data=densb_bs,aes(x=x, y=y, group=t,alpha=0.9),fill="gray35")+
  geom_line(aes(xbj,ybj), size=0.3,color="blue")+
  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")

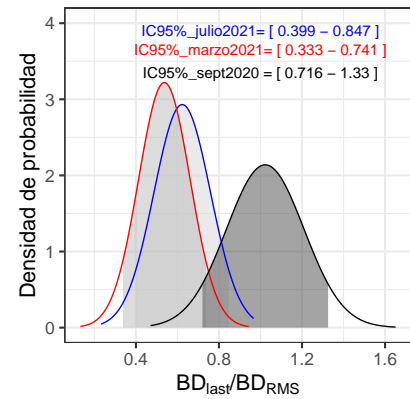
```

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

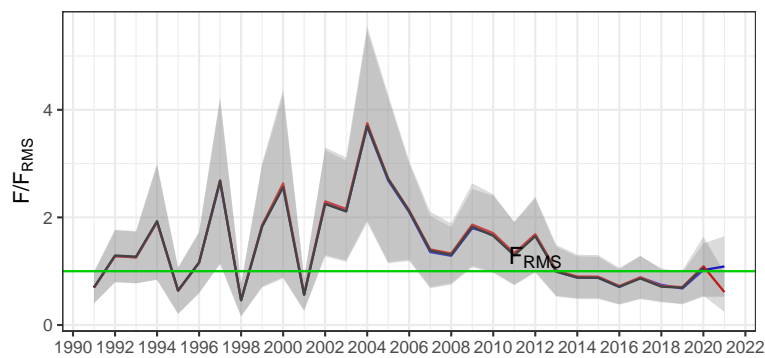
a)



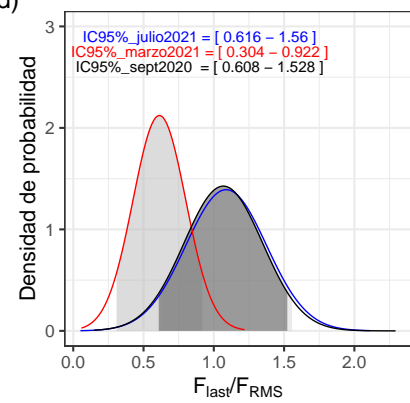
b)



c)



d)



```

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

```

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

```

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

years<-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'=years,
  "$Y/BT_{sept}"=c(round(rep1$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(c(rowSums(rep2$pred_Ctot)/rowSums(rep2$N),3)),
  "$C/N_{julio}"=c(round(c(rowSums(rep3$pred_Ctot)/rowSums(rep3$N),3)))
kable(VarPobl2b, align = 'c')

```

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

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

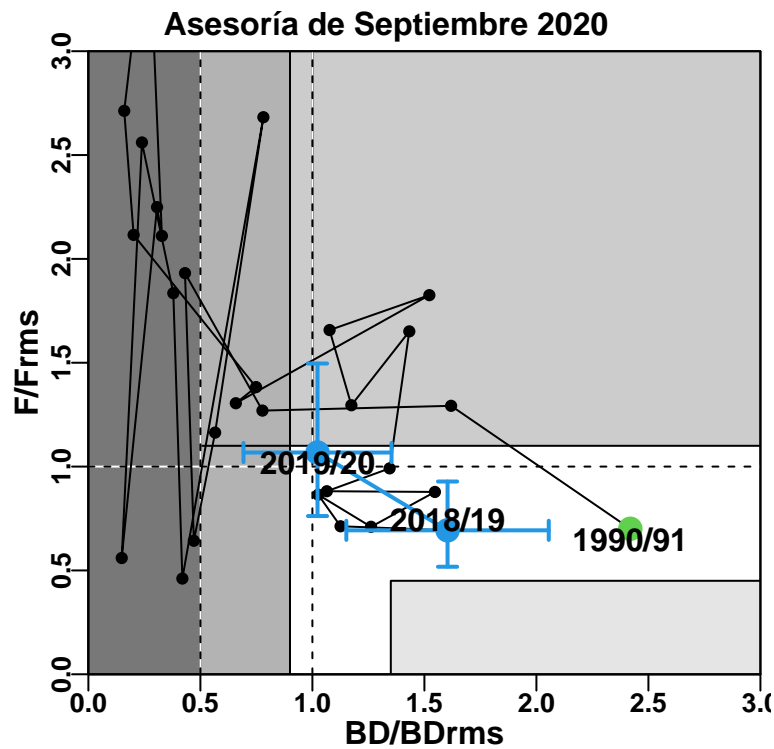
```
#setwd(dir.basedatos)
write.csv(VarPobl2b, file="Tabla_23_tasasExplotacion.csv")
#setwd(dir.1)
```



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

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

```
text(c(SpB1[1]/BRMS1,SpB1[nyears1]/BRMS1,SpB1[nyears1-1]/BRMS1),
  c(exp(ln_Fyr1[1])/FRMS1-0.05,exp(ln_Fyr1[nyears1])/FRMS1-0.05,exp(ln_Fyr1[nyears1-1])/FRMS1+0.05), c("1990/91","2019/20","2018/19"))
```



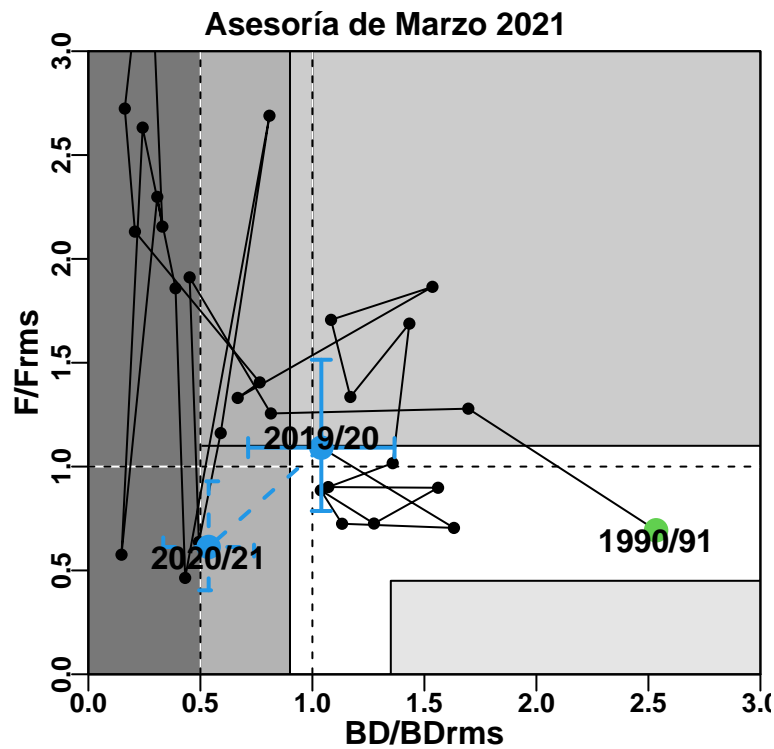
```

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","2019/20"))

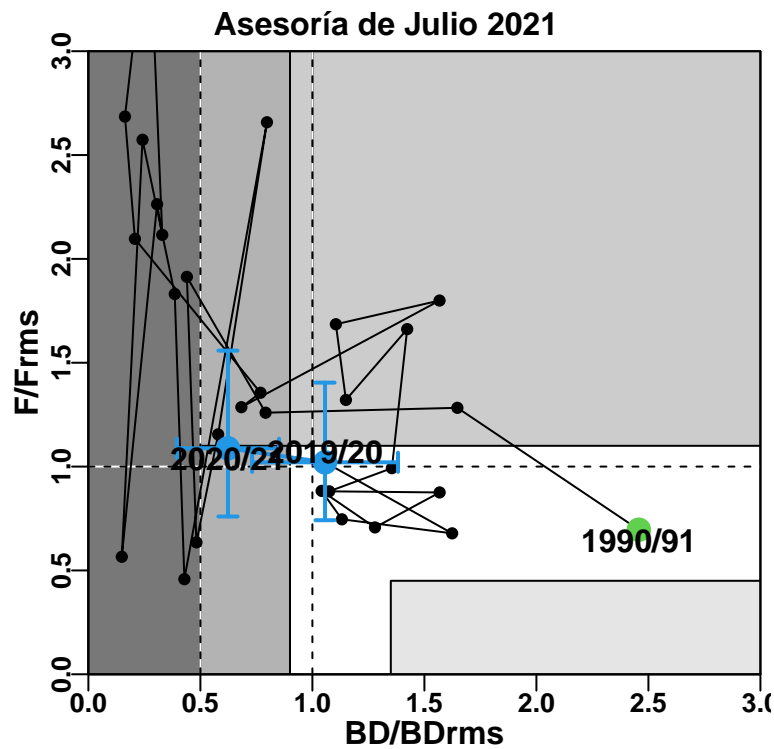
```



```
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","2019/20"))
```



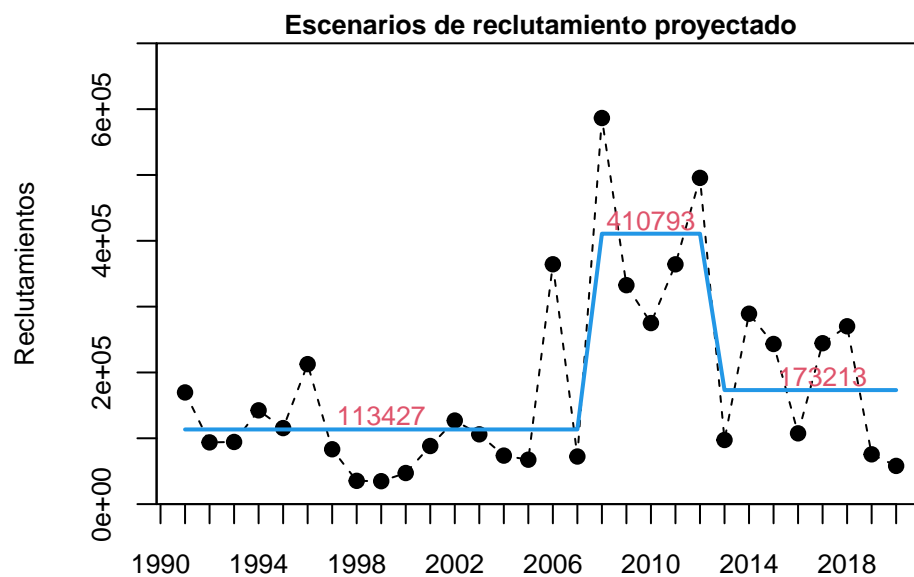
```

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

```

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

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



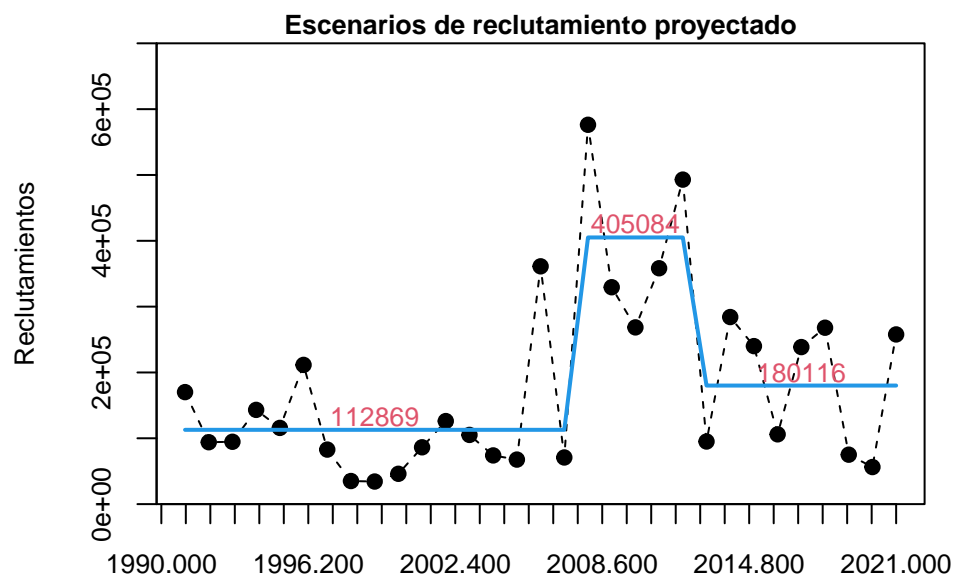
|      | 1991-2007 | 2008-2012 | 2013-2020 |
|------|-----------|-----------|-----------|
| mean | 250260    | 447840    | 300810    |
| std  | 42769     | 73667     | 60397     |
| 10%  | 195449    | 353432    | 223408    |
| 20%  | 214265    | 385840    | 249979    |
| 30%  | 227832    | 409209   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

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

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

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

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



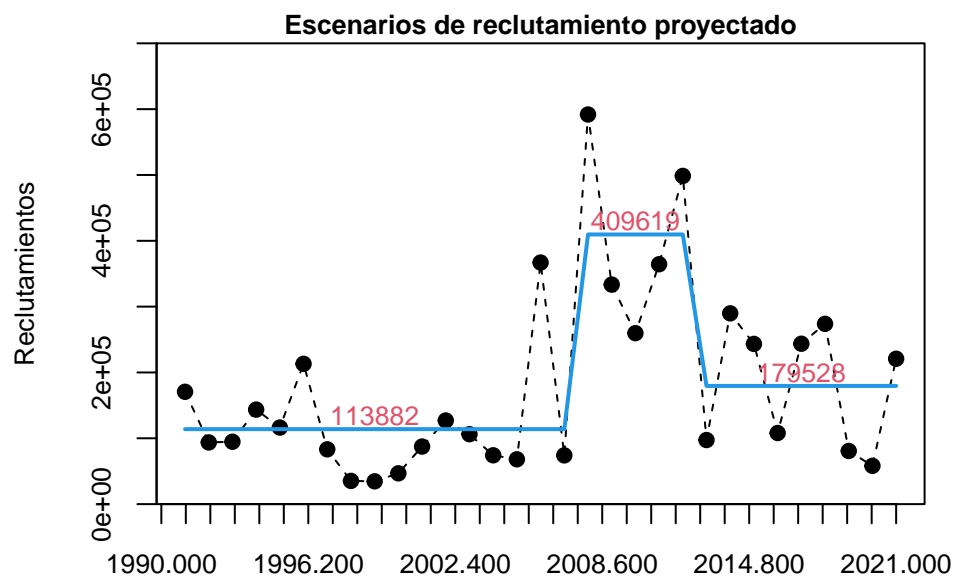
|      | 1991-2007 | 2008-2012 | 2013-2021 |
|------|-----------|-----------|-----------|
| mean | 271720    | 313030    | 279570    |
| std  | 29384     | 34291     | 33911     |
| 10%  | 234063    | 269084    | 236111    |
| 20%  | 246990    | 284170    | 251030    |
| 30%  | 256311    | 295048   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

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

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

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

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



|      | 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    |

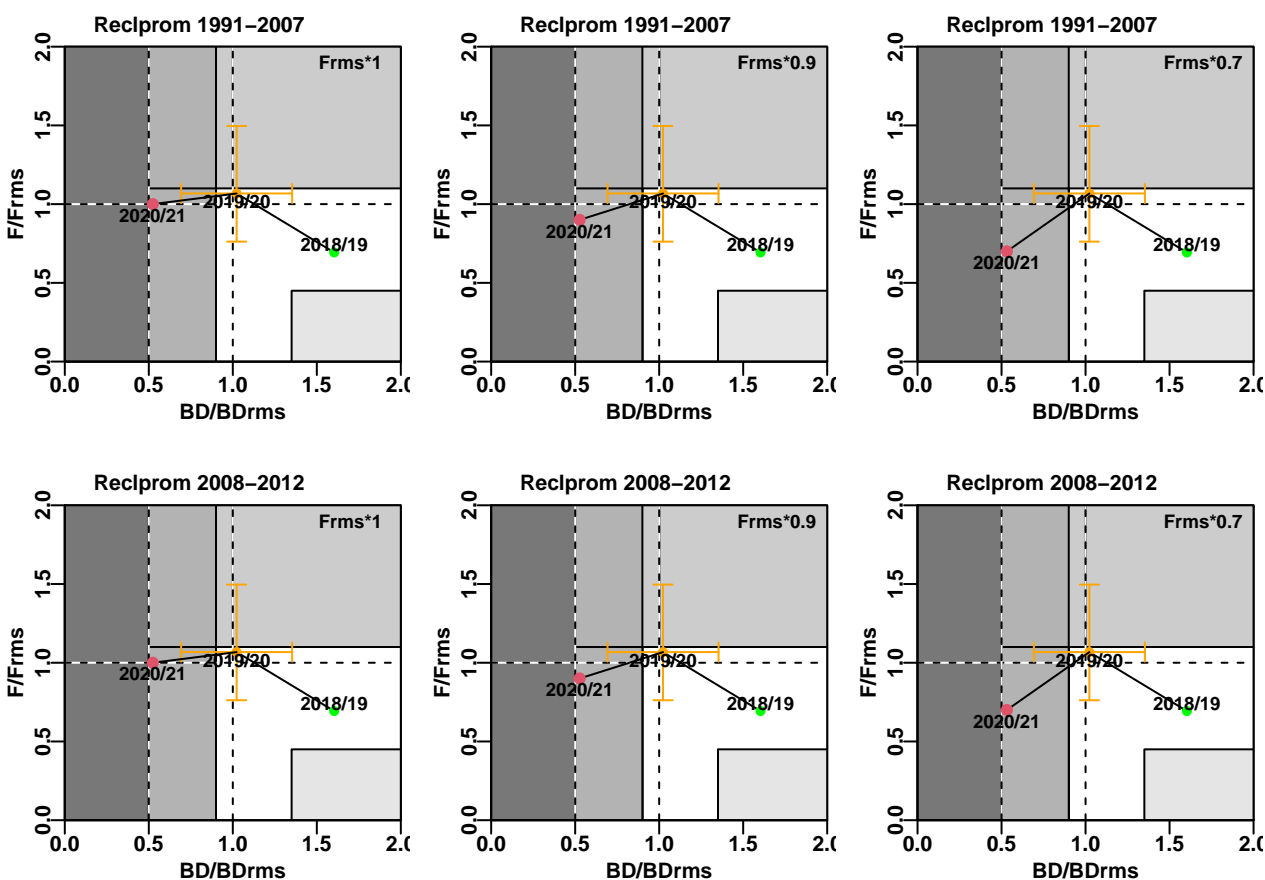
|     | 1991-2007 | 2008-2012 | 2013-2021 |
|-----|-----------|-----------|-----------|
| 10% | 83        | 11        | 61        |
| 20% | 72        | 5         | 49        |
| 30% | 65        | 1         | 41        |
| 40% | 59        | -2        | 36        |
| 50% | 55        | -4        | 31  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

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

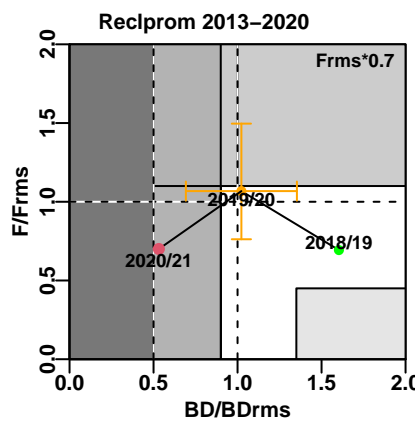
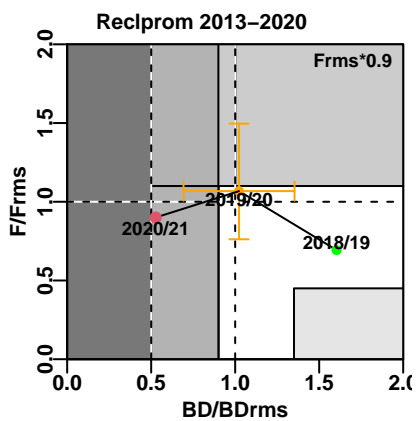
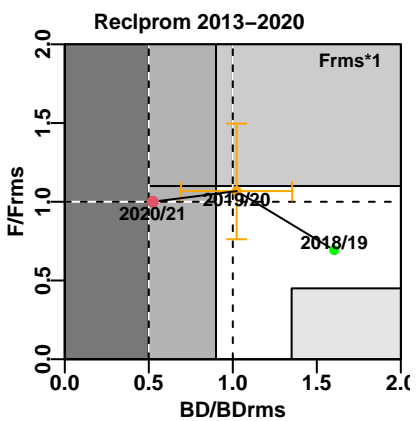
|                              | 1991-2007[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|------------------------------|--------------------------------|-------------------------|-------------------------|
| p(sobre-explotación)_2018/19 | 0.00                           | 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 <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *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 <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *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                    |







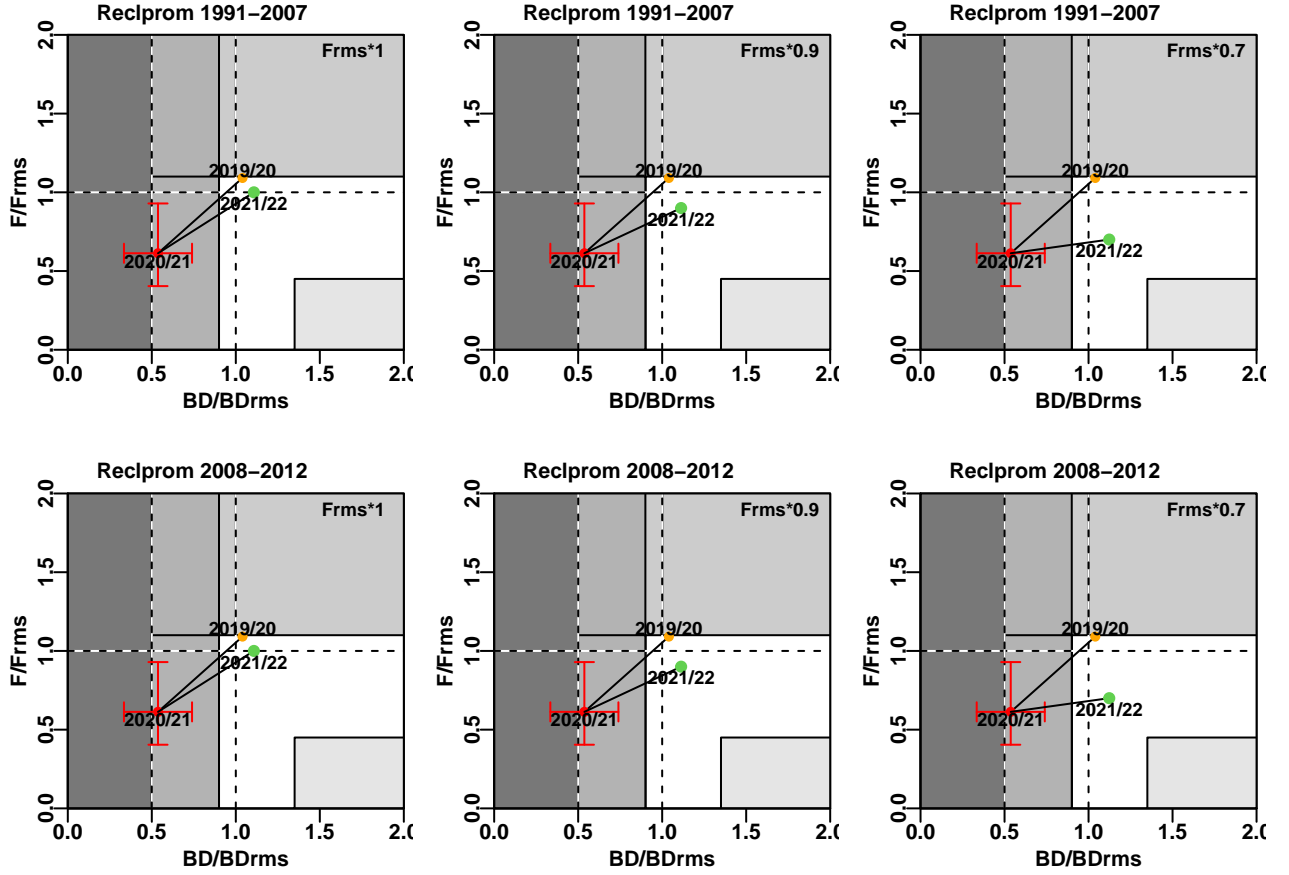
|                                     | 1991-2007[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|-------------------------------------|--------------------------------|-------------------------|-------------------------|
| p(BD<0,9BD <sub>RMS</sub> )_2020/21 | 1.00                           | 1.00                    | 1.00                    |
| p(BD<0,5BD <sub>RMS</sub> )_2020/21 | 0.38                           | 0.38                    | 0.38                    |
| p(BD<0,9BD <sub>RMS</sub> )_2021/22 | 0.27                           | 0.26                    | 0.26                    |
| p(BD<0,5BD <sub>RMS</sub> )_2021/22 | 0.04                           | 0.03                    | 0.03                    |

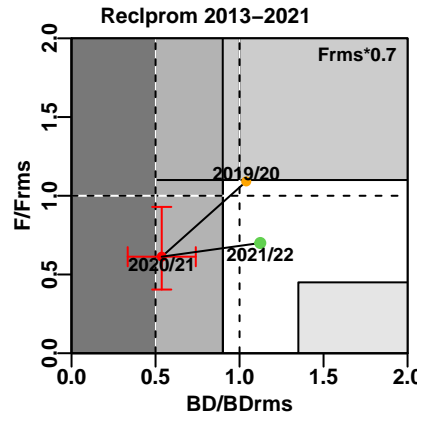
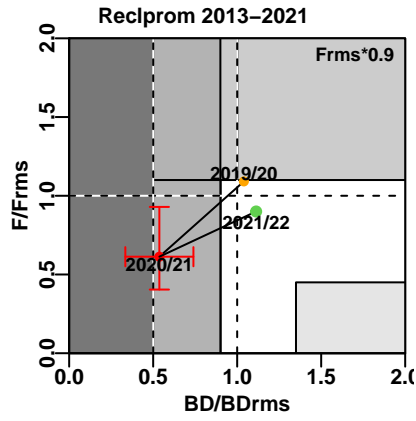
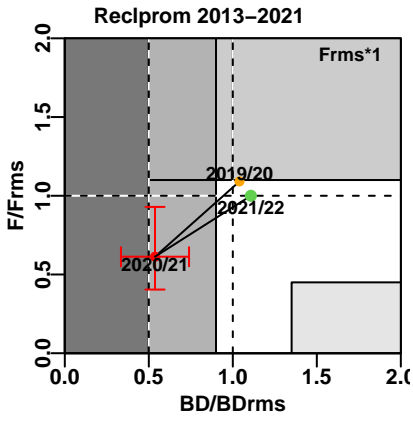
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|                                     | 2008-2012[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|-------------------------------------|--------------------------------|-------------------------|-------------------------|
| p(BD<0,9BD <sub>RMS</sub> )_2020/21 | 1.00                           | 1.00                    | 1.00                    |
| p(BD<0,5BD <sub>RMS</sub> )_2020/21 | 0.38                           | 0.38                    | 0.38                    |
| p(BD<0,9BD <sub>RMS</sub> )_2021/22 | 0.27                           | 0.26                    | 0.26                    |
| p(BD<0,5BD <sub>RMS</sub> )_2021/22 | 0.04                           | 0.03                    | 0.03                    |

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|                                     | 2013-2021[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|-------------------------------------|--------------------------------|-------------------------|-------------------------|
| p(BD<0,9BD <sub>RMS</sub> )_2020/21 | 1.00                           | 1.00                    | 1.00                    |
| p(BD<0,5BD <sub>RMS</sub> )_2020/21 | 0.38                           | 0.38                    | 0.38                    |
| p(BD<0,9BD <sub>RMS</sub> )_2021/22 | 0.27                           | 0.26                    | 0.26                    |
| p(BD<0,5BD <sub>RMS</sub> )_2021/22 | 0.04                           | 0.03                    | 0.03                    |





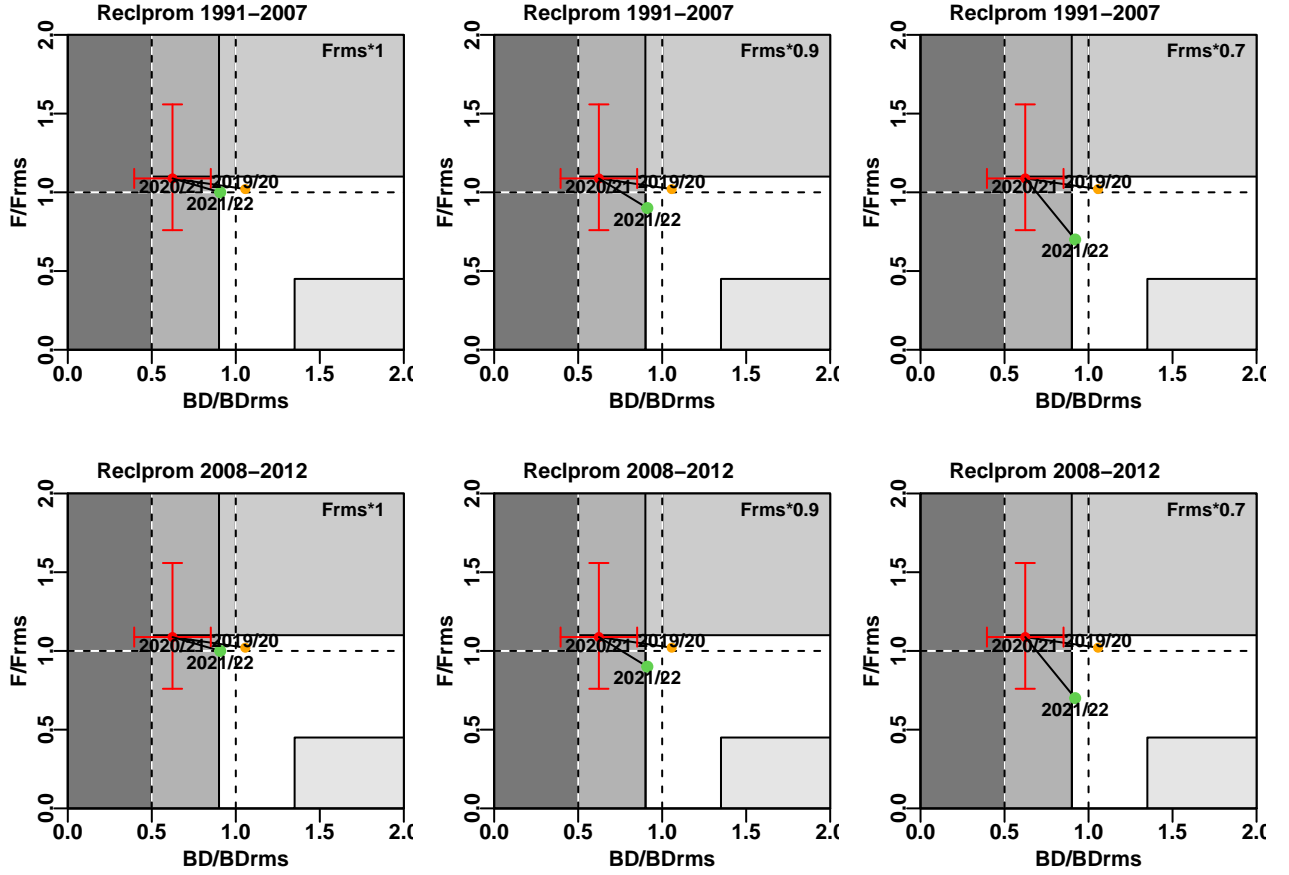
|                                     | 1991-2007[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|-------------------------------------|--------------------------------|-------------------------|-------------------------|
| p(BD<0,9BD <sub>RMS</sub> )_2020/21 | 0.98      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

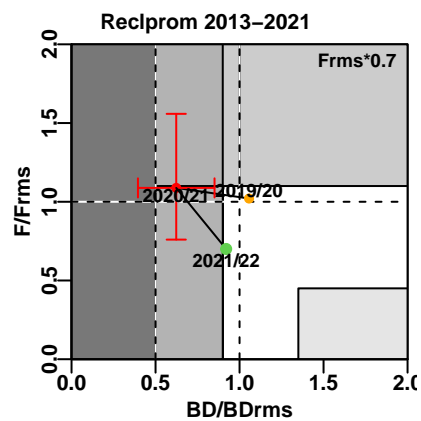
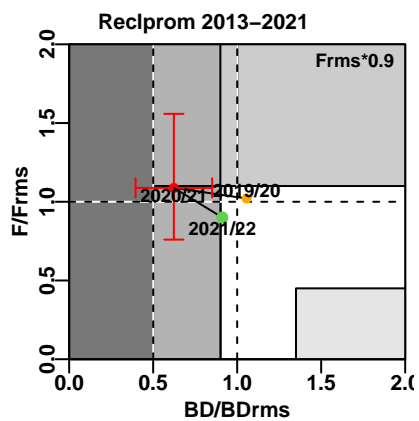
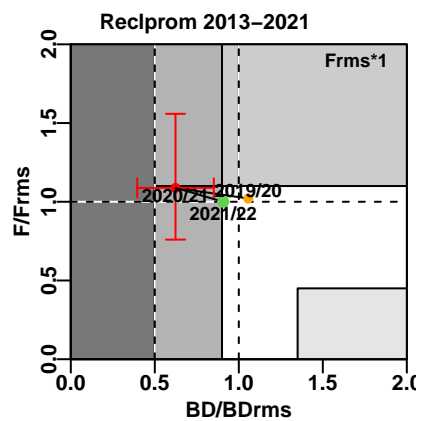
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|                                     | 2008-2012[F <sub>RMS</sub> *1] | [F <sub>RMS</sub> *0.9] | [F <sub>RMS</sub> *0.7] |
|-------------------------------------|--------------------------------|-------------------------|-------------------------|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

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





## 5. DISCUSIÓN

