CFP Indicators
Testing stability of indicator Decadal trends in Recruitment

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Contents

1 Background

```
library(lme4)
library(ggplot2)
library(lattice)
library(latticeExtra)
library(reshape2)
library(parallel)
library(influence.ME)
library(xtable)
load("../analysis/RData.nea")
options(stringsAsFactors=FALSE, width = 60)
theme_set(theme_bw())
sc <- scale_x_continuous(breaks=2003:2018)
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5))
nc <- 3
it <- 240
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)
```

2 Decada trends in Recruitment

```
saeu0$sfI10 <- !is.na(saeu0$Recruitment)
df0 <- saeu0[saeu0$sfI10,]
# data for table about stocks and inicators
sfI10 <- subset(df0, Year>=iniYear & Year<=fnlYear)
sfI10 <- tapply(sfI10$Year, sfI10$FishStock, max)
sfI10 <- data.frame(FishStock=names(sfI10), Year=sfI10, variable="sfI10", value=TRUE)
# project and compute indicator
df0 <- projectStkStatus(df0, vpy)
for(i in (iniYear):fnlYear) df0 <- decadalR(df0, i)
df0 <- subset(df0, Year>=iniYear & Year<=fnlYear)
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))
# fit
fit <- glmer(decadalR ~ Year + (1|FishStock), data =  df0, family = Gamma("log"), control=glmerControl(
summary(fit)


## Generalized linear mixed model fit by maximum likelihood
##   (Laplace Approximation) [glmerMod]
##  Family: Gamma  ( log )
## Formula: decadalR ~ Year + (1 | FishStock)
##    Data: df0
## Control: glmerControl(optimizer = "nlminbwrap")
##
##      AIC      BIC   logLik deviance df.resid
##    271.7    355.2   -117.9    235.7      746
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.4232 -0.6010 -0.0463  0.4560  4.1870
##
```

```
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  FishStock (Intercept) 0.04799  0.2191
##  Residual              0.11565  0.3401
## Number of obs: 764, groups:  FishStock, 49
##
## Fixed effects:
##              Estimate Std. Error t value Pr(>|z|)
## (Intercept) -0.130487   0.080870  -1.614   0.1066
## Year2004     0.082835   0.066604   1.244   0.2136
## Year2005    -0.011160   0.066411  -0.168   0.8665
## Year2006     0.002057   0.066146   0.031   0.9752
## Year2007    -0.048875   0.066137  -0.739   0.4599
## Year2008    -0.064785   0.066176  -0.979   0.3276
## Year2009    -0.044178   0.066258  -0.667   0.5049
## Year2010    -0.086757   0.065682  -1.321   0.1865
## Year2011    -0.101687   0.065758  -1.546   0.1220
## Year2012    -0.129781   0.065815  -1.972   0.0486 *
## Year2013    -0.099974   0.065837  -1.519   0.1289
## Year2014    -0.068404   0.065845  -1.039   0.2989
## Year2015    -0.031528   0.065841  -0.479   0.6320
## Year2016     0.012702   0.065821   0.193   0.8470
## Year2017     0.087614   0.065866   1.330   0.1835
## Year2018     0.166062   0.065848   2.522   0.0117 *
## ---
## Signif. codes:
## 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
xyplot(residuals(fit)~predict(fit))
```

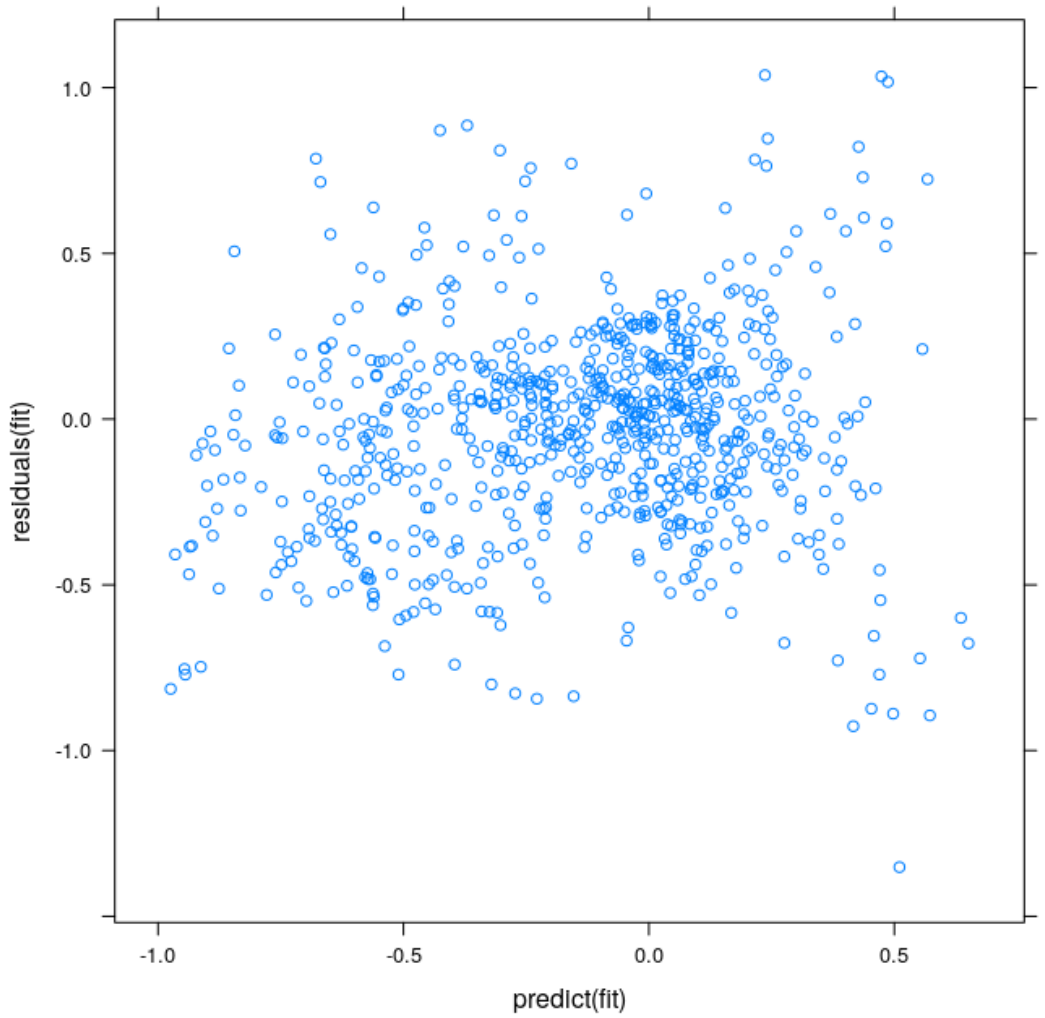


Figure 1: Homogeneity of variance in the GLMM

```
xyplot(residuals(fit)~predict(fit)|df0[,"FishStock"], main="homogeneity of variance",
    scales=list(x=list(relation="free")))
```

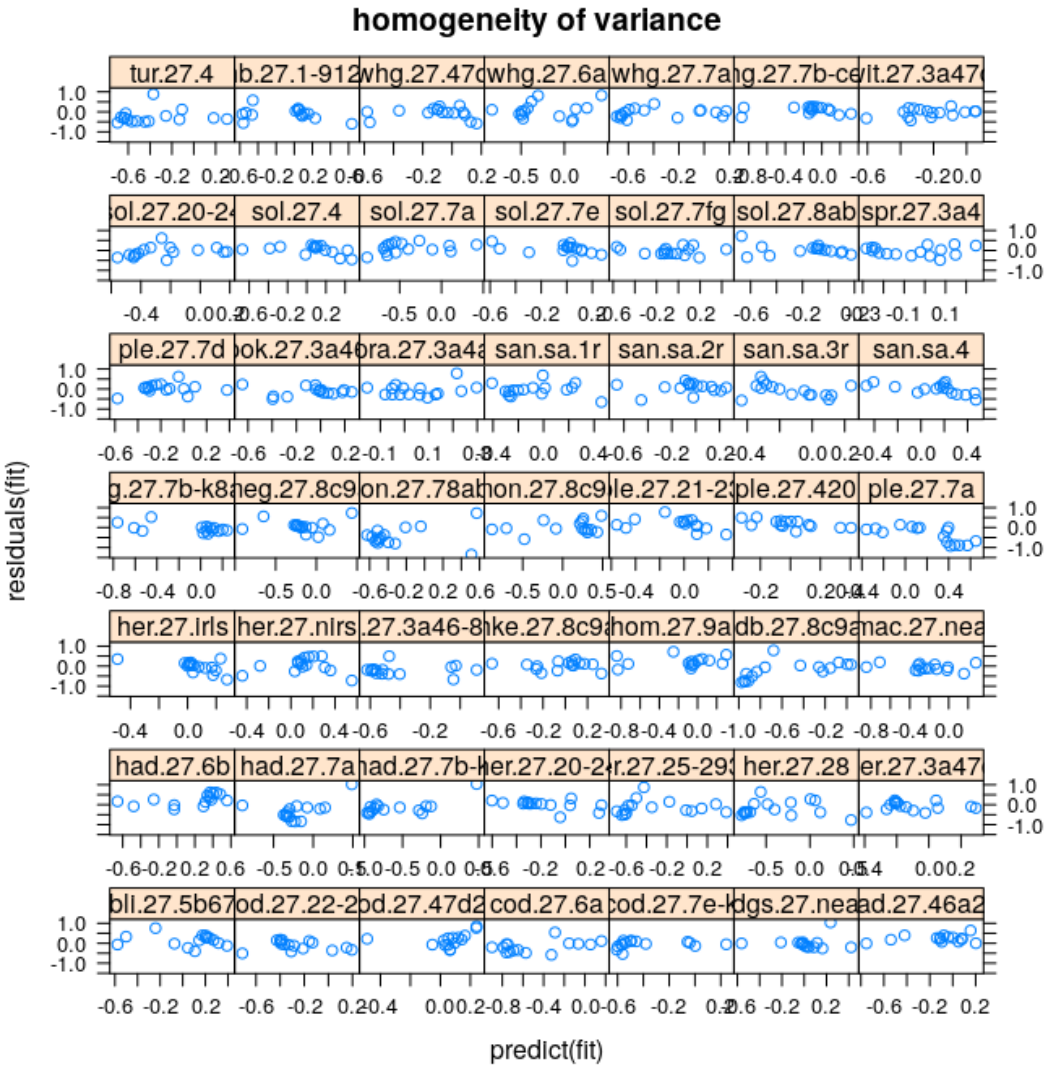


Figure 2: Homogeneity of variance by stock in the GLMM

```
pfun <- function(x, ...){
        panel.qqmathline(x, col="gray50")
        panel.qqmath(x, ...)
}
qqmath(residuals(fit), panel=pfun, pch=19, cex=0.5)
```

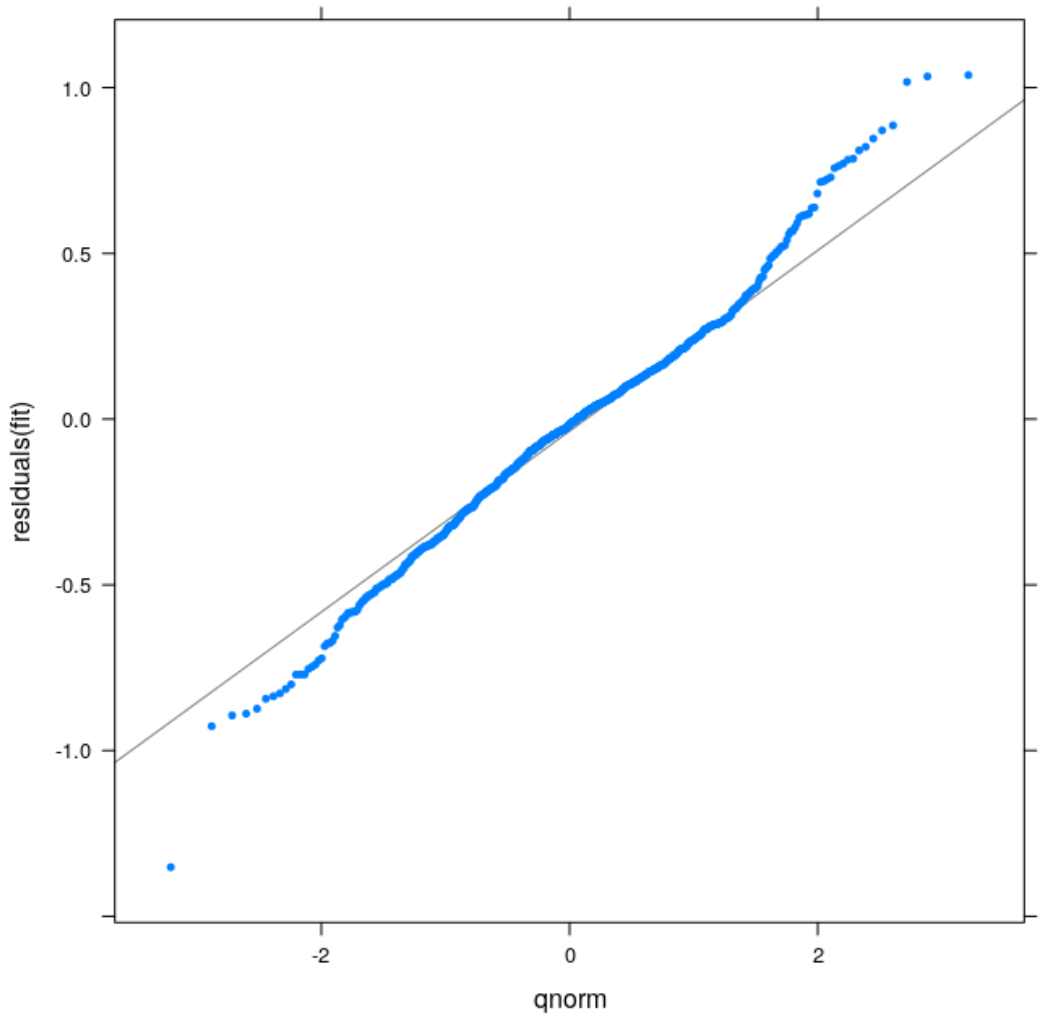


Figure 3: Normality of residuals in the GLMM

```
qqmath(~residuals(fit)|df0[,"FishStock"], panel=pfun, pch=19, cex=0.5)
```

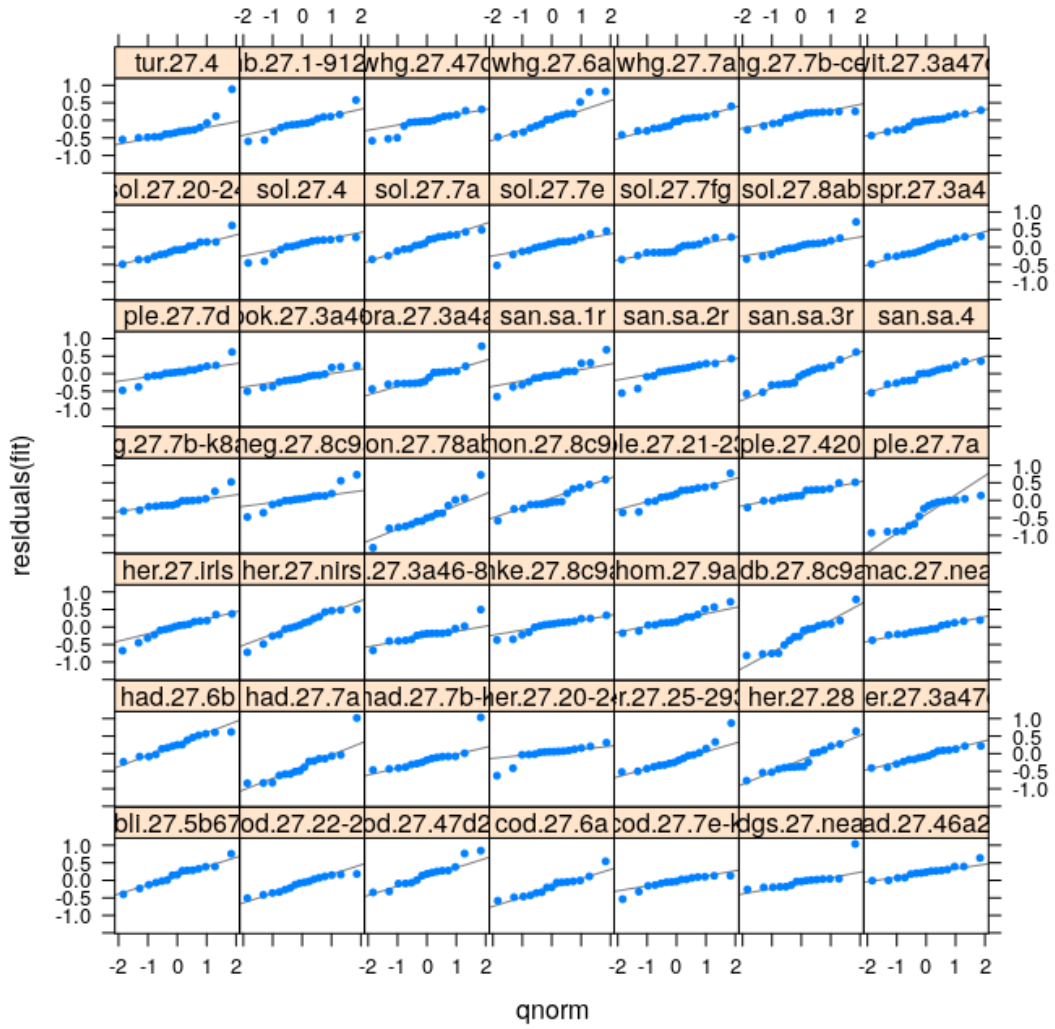


Figure 4: Normality of residuals by stock in the GLMM

```
dotplot(ranef(fit, condVar = TRUE), main=FALSE)

## $FishStock
```

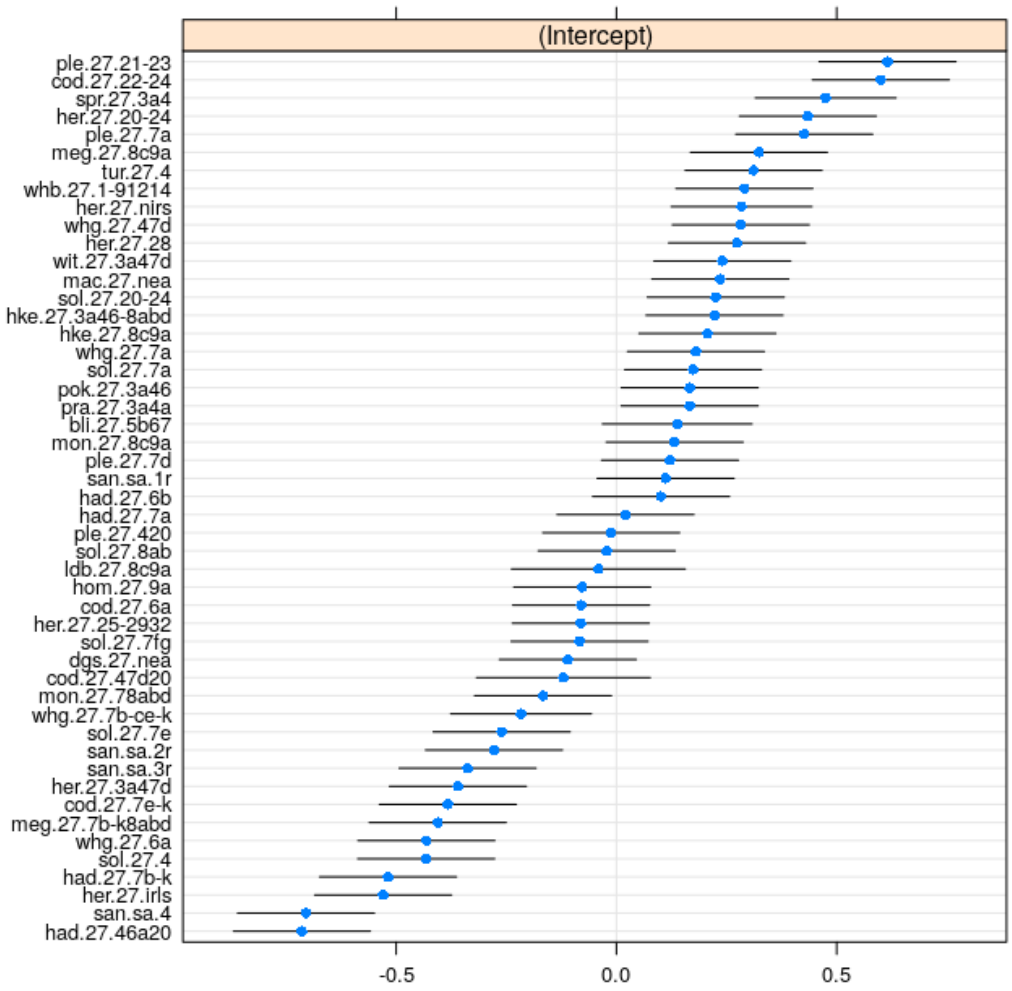


Figure 5: Random effects

```
ifl.stk <- influence.stk(fit, df0, "FishStock", nc, nd)
dotplot(FishStock~sd, data=ifl.stk)
```

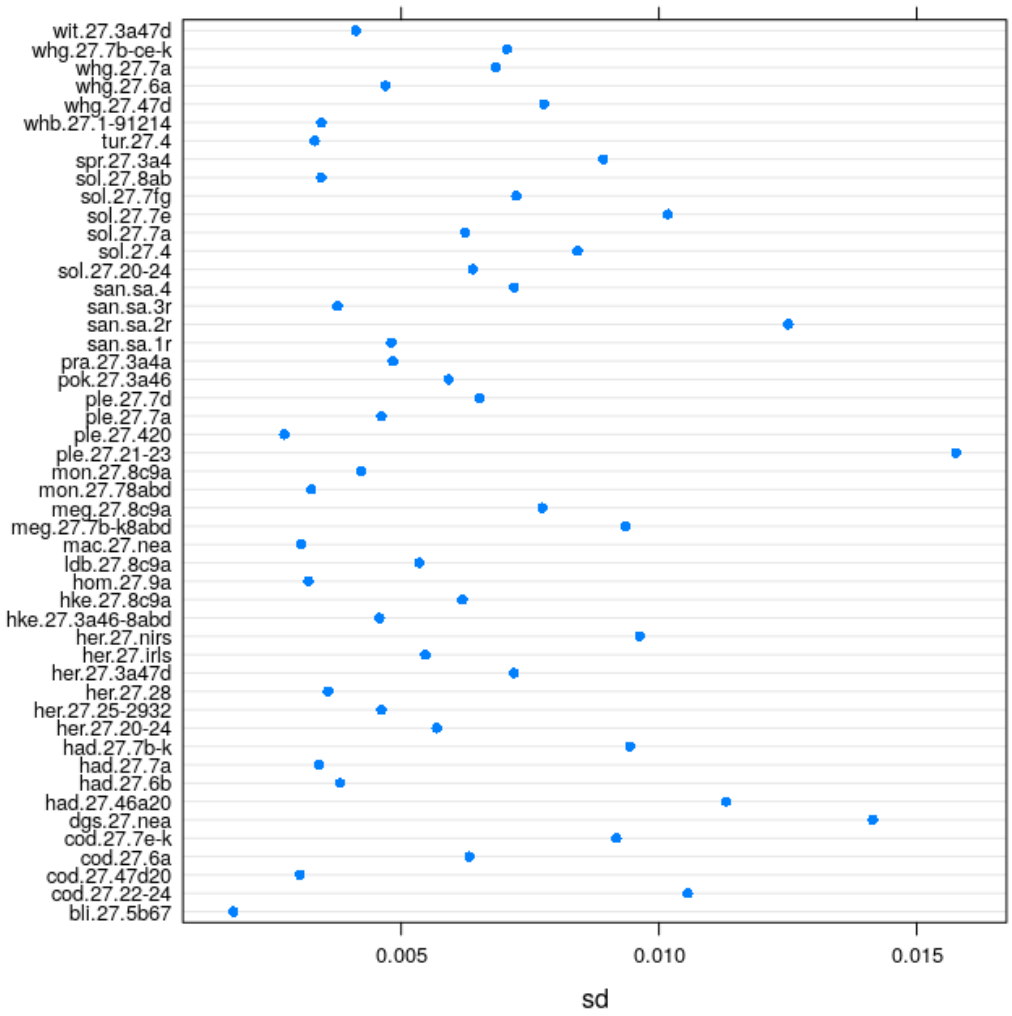
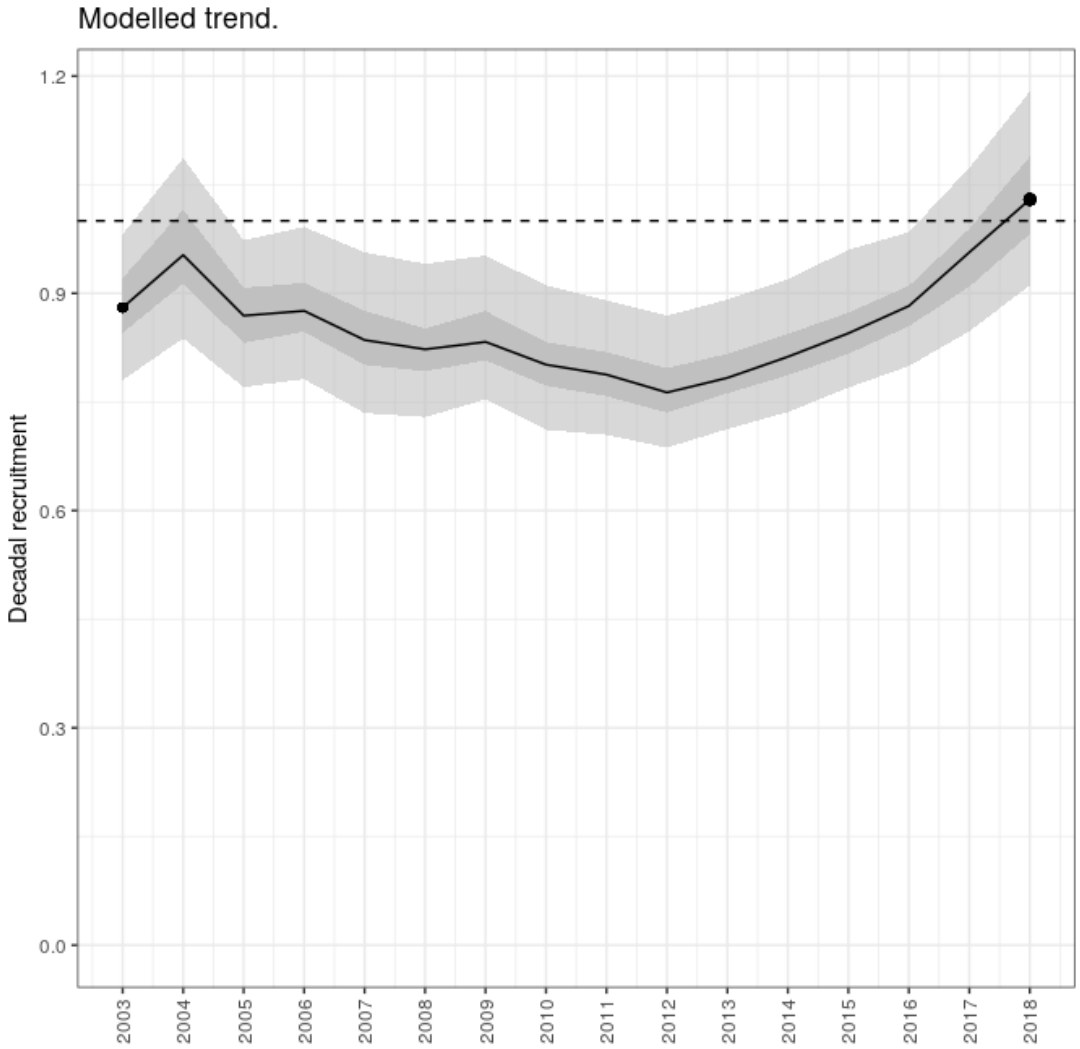


Figure 6: Influence on fixed effect "year" in the GLMM

```
# bootstrap
stk <- unique(df0$FishStock)
bs <- split(1:it, 1:it)
bs <- mclapply(bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
        fit <- glmer(decadalR ~ Year + (1|FishStock), data = df1, family = Gamma("log"), control=glmerC
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
}, mc.cores=nc)
ifitm <- do.call("rbind", bs)
ifitq <- apply(ifitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))
```

```
#png("figNEAI5outmod.png", 600, 400)
ggplot(ifitq, aes(x=Year)) +
  geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
```

```
  geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
  geom_line(aes(y=`50%`)) + expand_limits(y=0) +
  geom_point(aes(x=Year[1], y=`50%`[1])) +
  geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
  geom_hline(yintercept = 1, linetype=2) +
  ylab("Decadal recruitment") + xlab("") +
  theme(legend.position = "none") + sc + th +
    ggtitle("Modelled trend.")
```



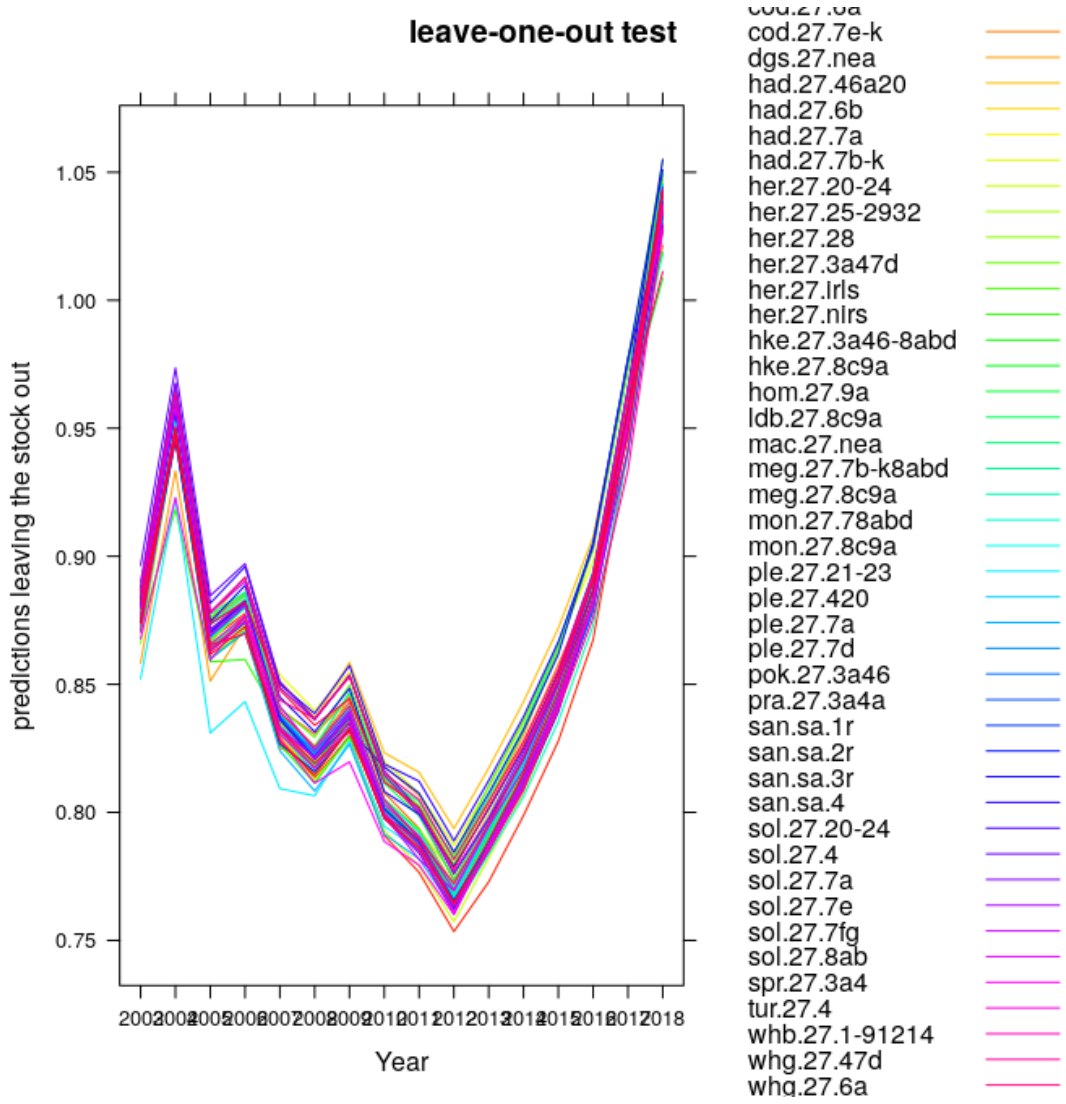

```
#dev.off()
```

```
neafout <- list(fit=fit, bs=bs)
```

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
2.5%	0.78	0.84	0.77	0.78	0.73	0.73	0.75	0.71	0.70	0.69	0.71	0.74	0.77	0.80	0.85	0.91
25%	0.85	0.91	0.83	0.85	0.80	0.79	0.81	0.77	0.76	0.73	0.76	0.79	0.82	0.85	0.91	0.98
50%	0.88	0.95	0.87	0.88	0.83	0.82	0.83	0.80	0.79	0.76	0.78	0.81	0.84	0.88	0.96	1.03
75%	0.92	1.02	0.91	0.91	0.88	0.85	0.88	0.83	0.82	0.80	0.82	0.84	0.87	0.91	0.99	1.09
97.5%	0.98	1.09	0.97	0.99	0.96	0.94	0.95	0.91	0.89	0.87	0.89	0.92	0.96	0.98	1.07	1.18

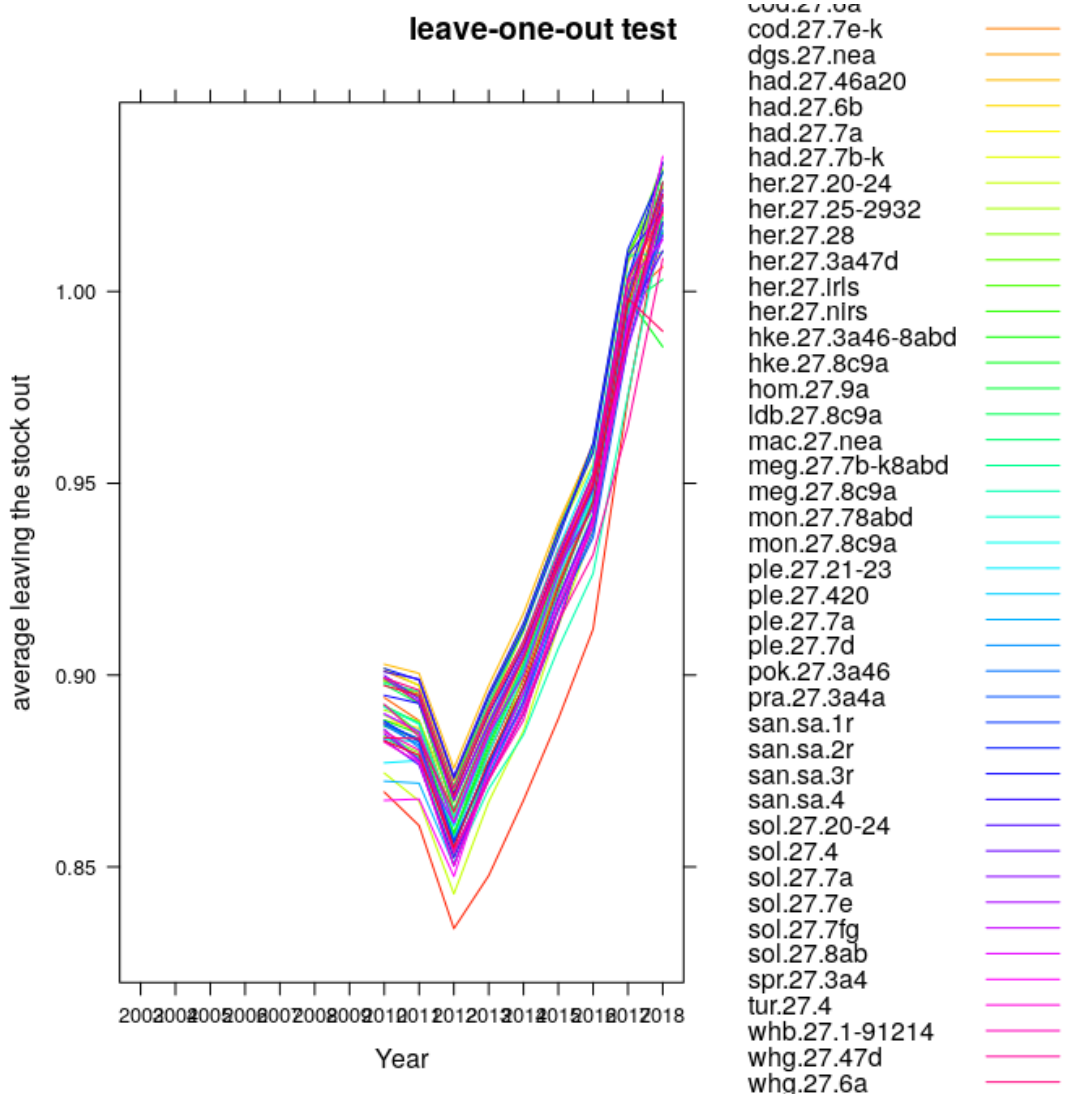
3 Individual stocks' impact with leave-one-out algorithm

```
stks <- unique(df0$FishStock)
test <- split(stks, stks)
for(i in stks){
        fit <- glmer(decadalR ~ Year + (1|FishStock), data = df0[df0$FishStock!=i,],
                family = Gamma("log"), control=glmerControl(optimizer="nlminbwrap"))
        test[[i]] <- data.frame(nd, spp=i,
                pred=predict(fit, re.form=~0, type="response", newdata=nd))
}
test <- do.call("rbind", test)
```



4 Individual stocks' impact on average estimates with leave-one-out algorithm

```
test2 <- split(stks, stks)
for(i in stks){
        test2[[i]] <- data.frame(nd, spp=i,
                avg=tapply(df0[df0$FishStock!=i,'decadalR'], df0[df0$FishStock!=i,'Year'], mean))
}
test2 <- do.call("rbind", test2)
```



5 Conclusions

6 References

ICES 2012. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 42 pp.

Jardim E., Scott F., Mosqueira I., Osio C., Vasilakopoulos P., Mannini A., Casey J. (Editors) 2017. Scientific, Technical and Economic Committee for Fisheries (STECF) - Monitoring the performance of the Common Fisheries Policy (STECF-17-XX). EUR XXXX EN; doi:XXXXXXXX

Vasilakopoulos P., Jardim E. 2017. Compilation and quality check of the ICES stock assessment data. EUR XXXX EN; doi:XXXXXXXX