

# CFP Indicators

## Testing stability of indicator $SSB$ trends for cat 3

Ernesto Jardim<sup>1</sup>

<sup>1</sup>European Commission, Joint Research Centre, Sustainable resources directorate, Water and Marine Resources unit, 21027 Ispra (VA), Italy

\*Corresponding author [ernesto.jardim@ec.europa.eu](mailto:ernesto.jardim@ec.europa.eu)

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# 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 $SSB$ trends for cat 3

```
df0 <- subset(isa, !(EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes", "Iceland Sea"))) & Data

# remove stocks with short time series
sts <- table(df0$FishStock, df0$Year)
sts <- rownames(sts)[apply(sts, 1, sum)<5]
df0 <- subset(df0, !(FishStock %in% sts))

# id
sfI12 <- tapply(df0$Year, df0$FishStock, max)
sfI12 <- data.frame(FishStock=names(sfI12), Year=sfI12, variable="sfI12", value=TRUE)

# project for stocks without 2015, 2016 estimates
# NEED CHECK
df0 <- projectStkStatus(df0, vpy)

# pre process for model
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))

# fit
fit <- glmer(StockSize ~ 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: StockSize ~ Year + (1 | FishStock)
## Data: df0
## Control: glmerControl(optimizer = "nlminbwrap")
```

```
##
##      AIC      BIC   logLik deviance df.resid
##  4875.9   4965.8  -2419.9   4839.9     1076
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -1.8569 -0.5631 -0.0611  0.4069  7.2397
##
## Random effects:
## Groups      Name      Variance Std.Dev.
## FishStock (Intercept) 2.076    1.4410
## Residual              0.280    0.5292
## Number of obs: 1094, groups: FishStock, 73
##
## Fixed effects:
##              Estimate Std. Error t value Pr(>|z|)
## (Intercept)  1.377556   0.322047   4.277 1.89e-05 ***
## Year2004      0.069194   0.091433   0.757 0.449184
## Year2005     -0.001855   0.088390  -0.021 0.983259
## Year2006     -0.033918   0.089501  -0.379 0.704715
## Year2007      0.015636   0.088400   0.177 0.859603
## Year2008      0.015293   0.088200   0.173 0.862342
## Year2009     -0.024860   0.088322  -0.281 0.778351
## Year2010      0.075710   0.087782   0.862 0.388424
## Year2011      0.126244   0.087502   1.443 0.149086
## Year2012      0.185278   0.088106   2.103 0.035474 *
## Year2013      0.241016   0.087819   2.744 0.006061 **
## Year2014      0.317425   0.088537   3.585 0.000337 ***
## Year2015      0.407829   0.088379   4.615 3.94e-06 ***
## Year2016      0.409451   0.088129   4.646 3.38e-06 ***
## Year2017      0.385192   0.087773   4.388 1.14e-05 ***
## Year2018      0.410763   0.089751   4.577 4.72e-06 ***
## ---
## Signif. codes:
## 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

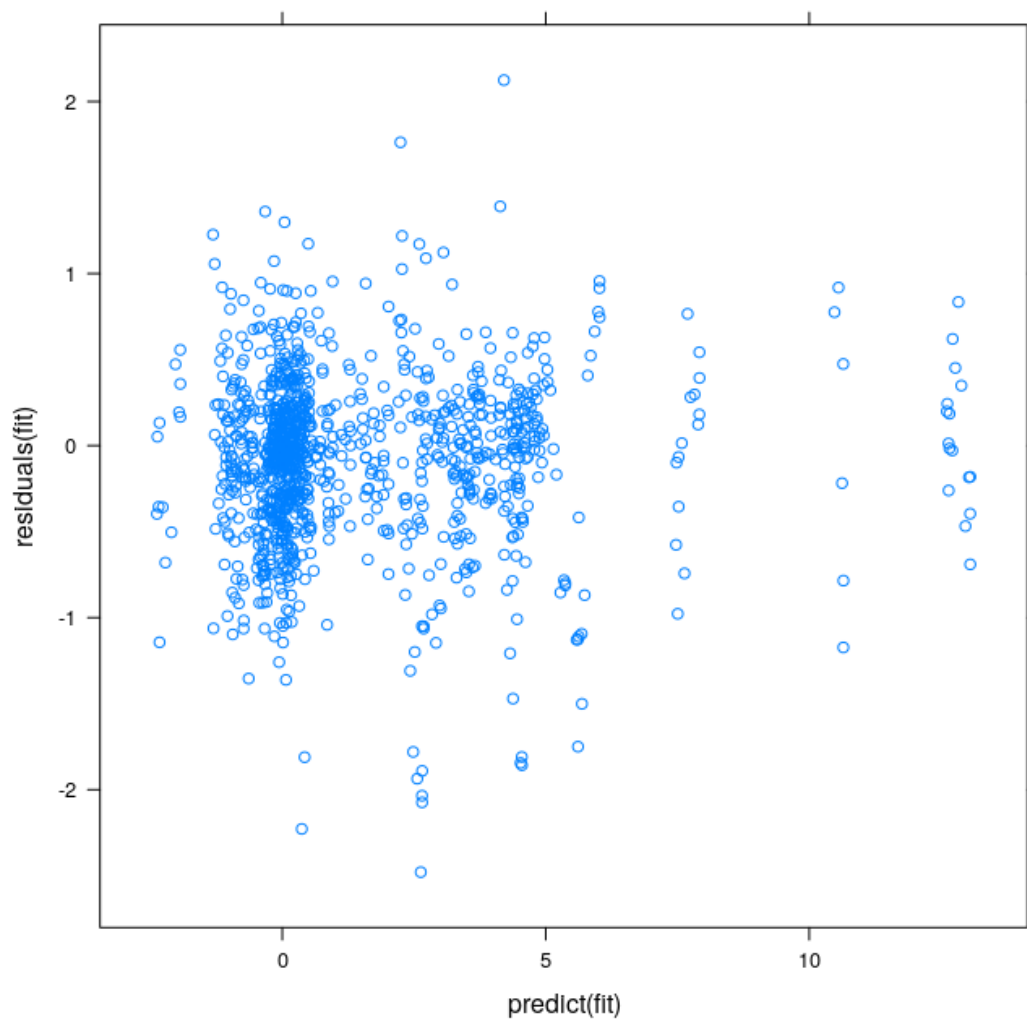


Figure 1: Homogeneity of variance in the GLMM

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

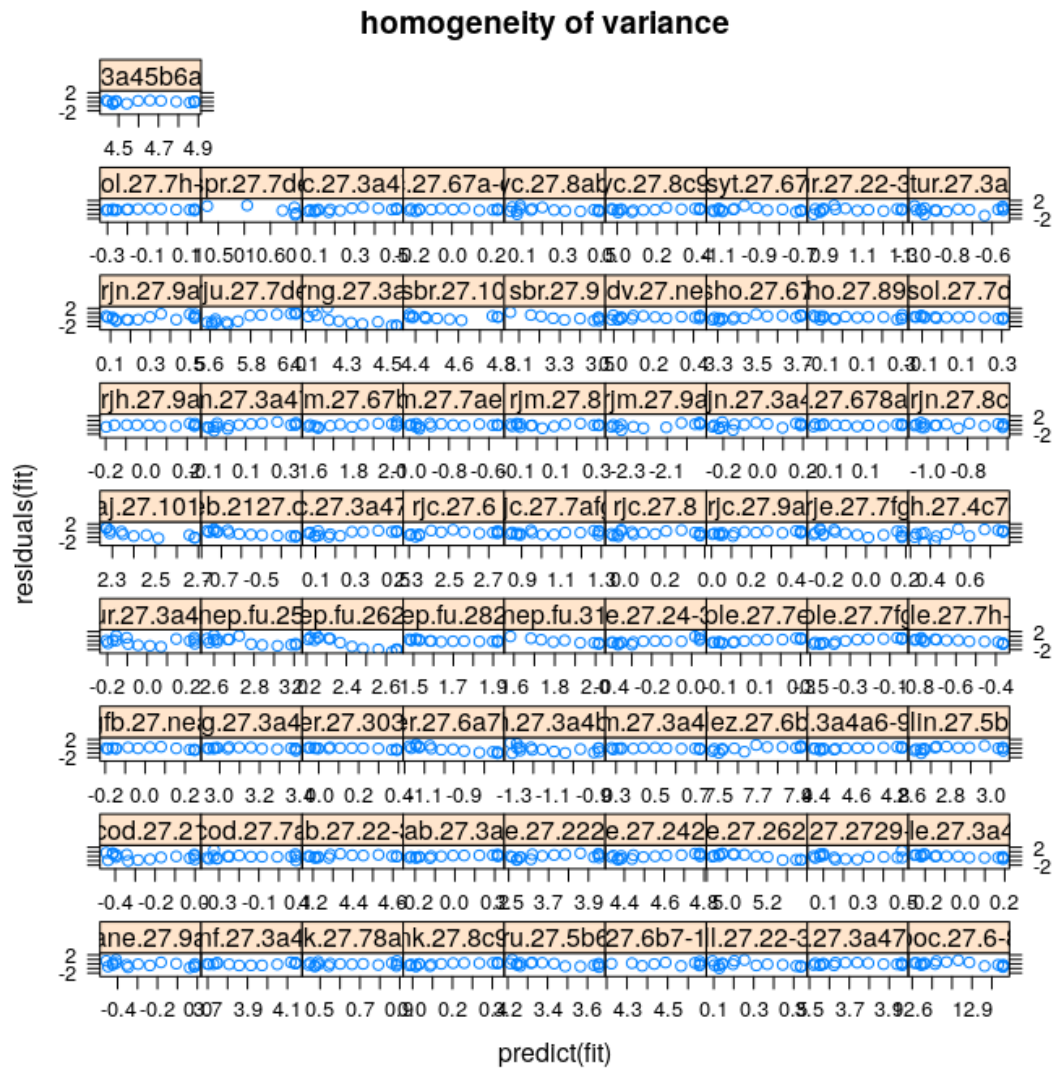


Figure 2: Homogeneity of variance by stock in the GLMM

```

pfun <- function(x, ...){
  panel.qqmathline(x, col="gray50")
  panel.qqmath(x, ...)
}

qqmath(residuals(fit), panel=pfun, pch=19, cex=0.5)

```

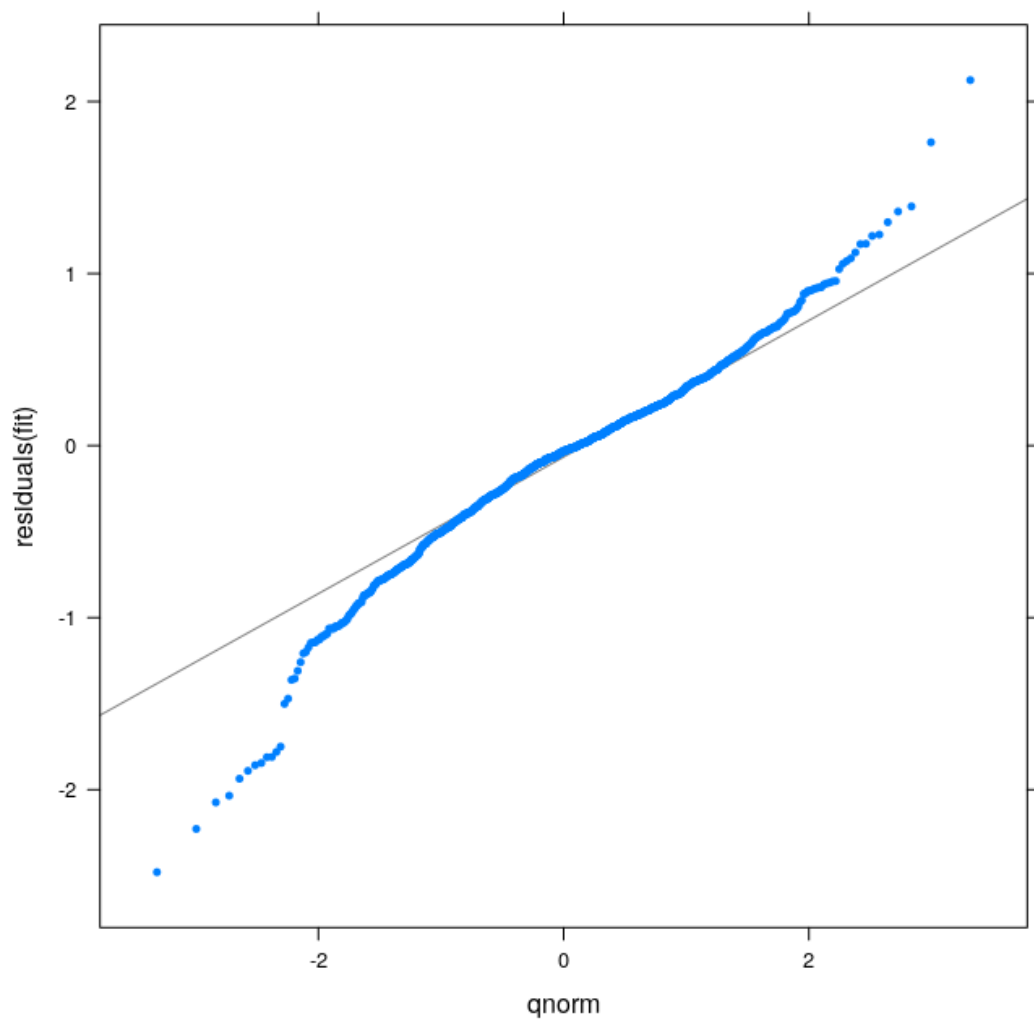


Figure 3: Normality of residuals in the GLMM

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

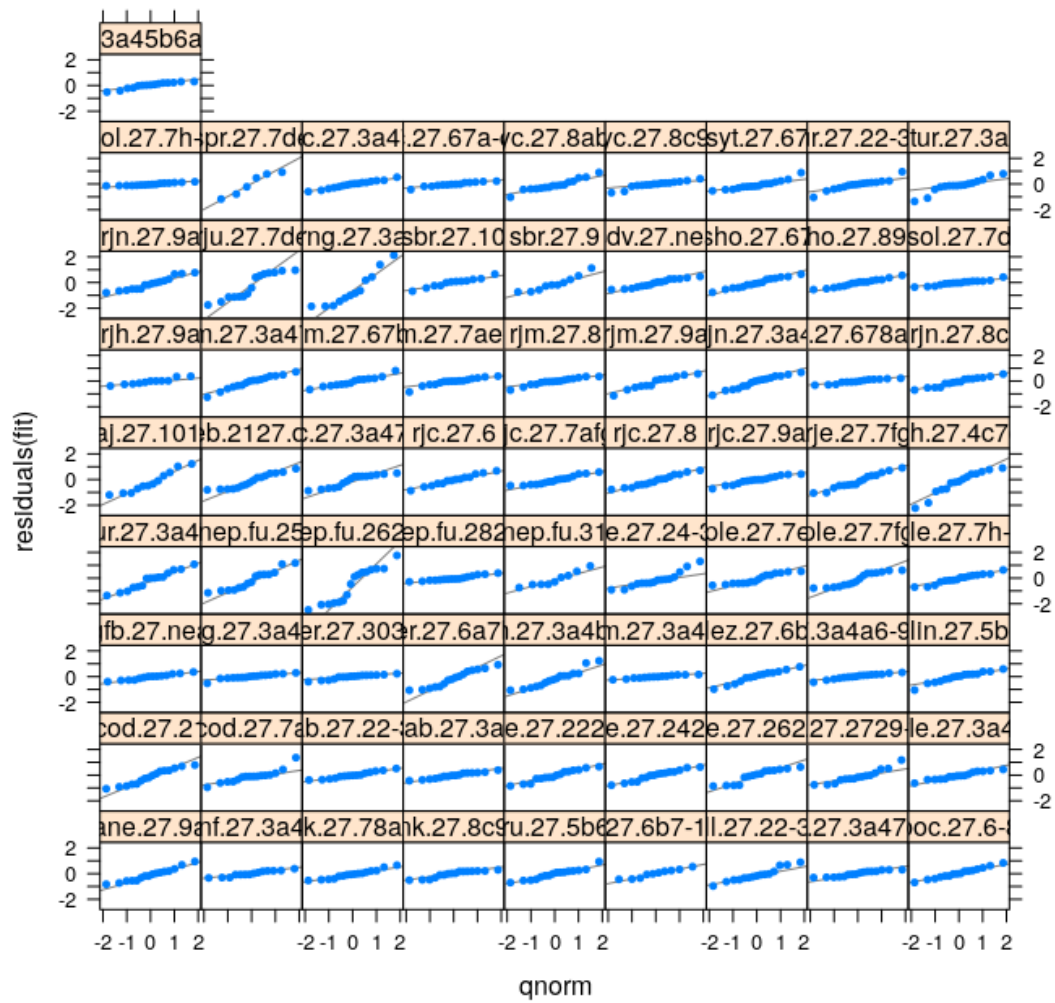


Figure 4: Normality of residuals by stock in the GLMM

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

```
## $FishStock
```



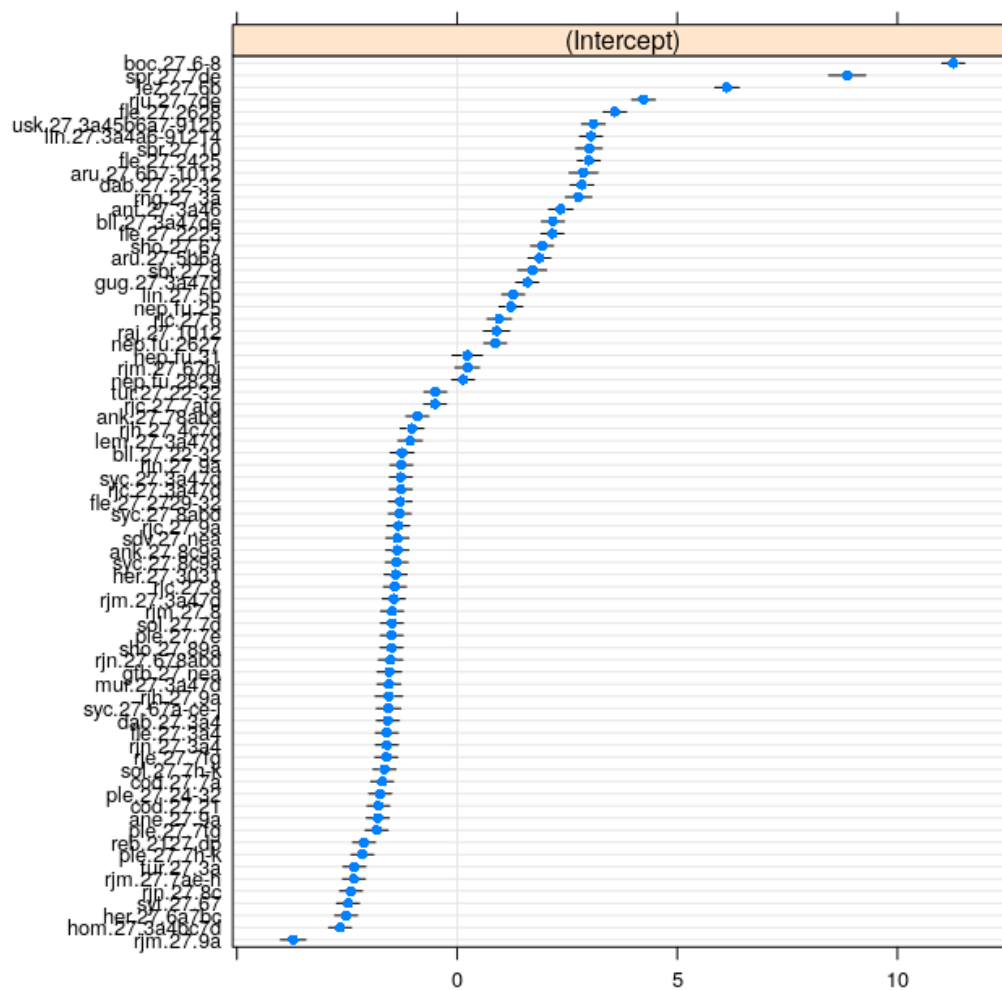


Figure 5: Random effects

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

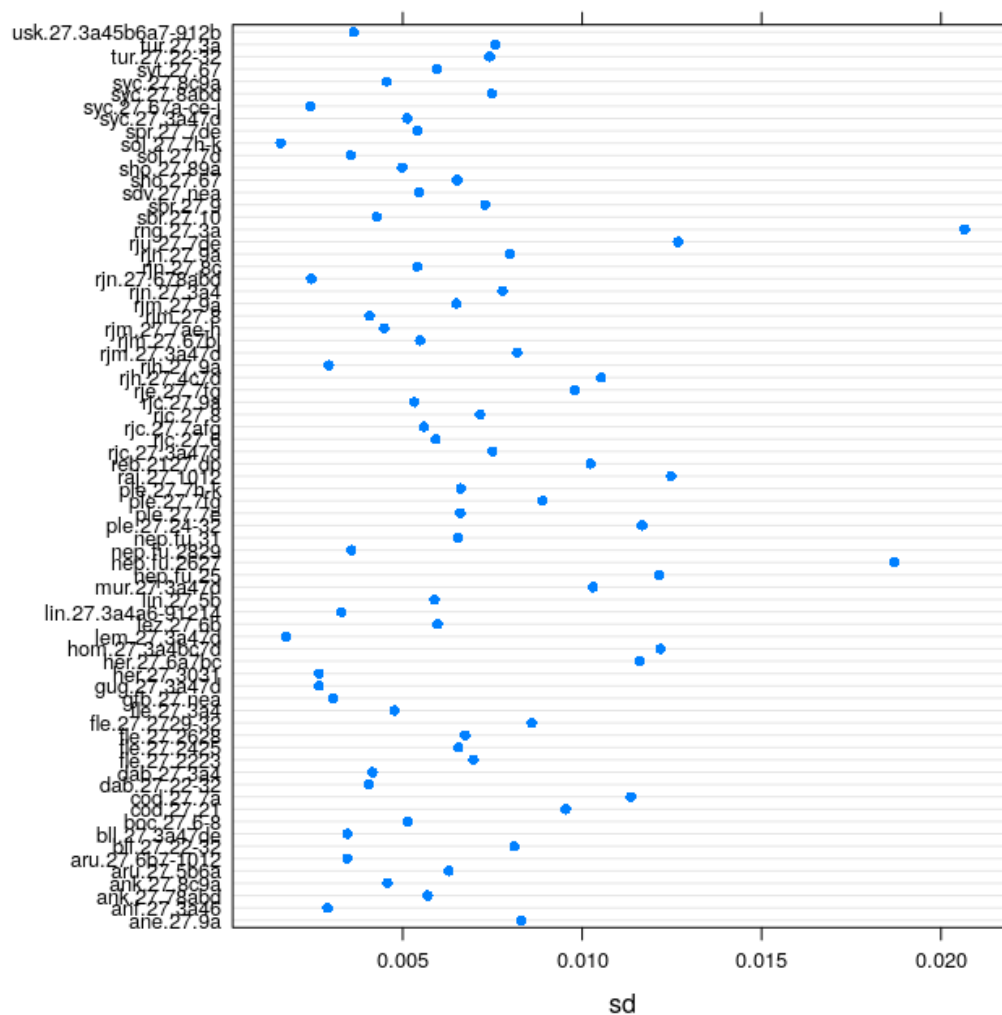


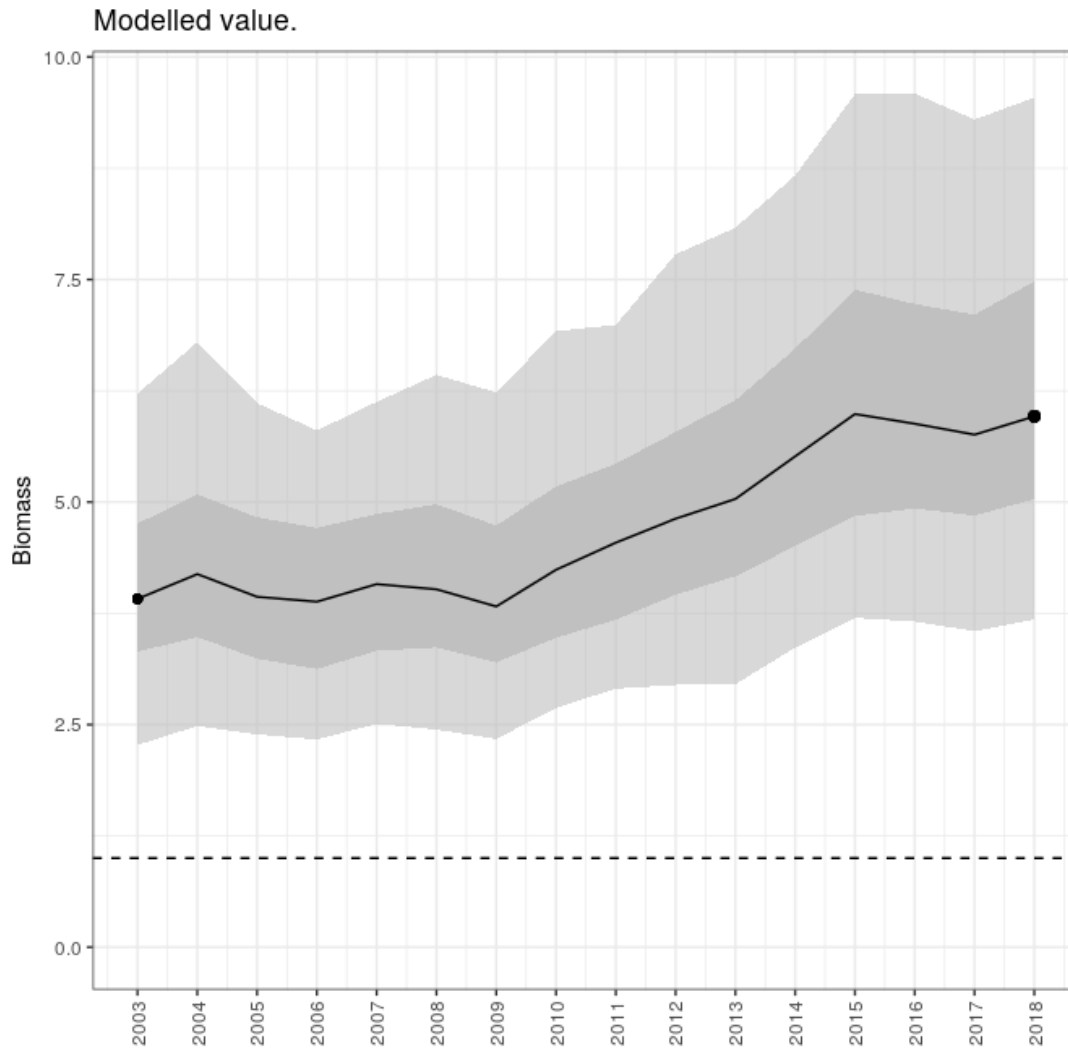
Figure 6: Influence on fixed effect "year" in the GLMM

```
# bootstrap
stk <- unique(df0$FishStock)
bs <- split(1:it, 1:it)
bs <- mclapply(bs, function(x){
  stk <- sample(stk, replace=TRUE)
  df1 <- df0[0,]
  for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
  fit <- glmer(StockSize ~ Year + (1|FishStock), data = df1, family = Gamma("log"), control=glmer
  v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
  if(length(fit@optinfo$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("Biomass") + xlab("") +
theme(legend.position = "none") + sc + th +
ggtitle("Modelled value.")
```



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

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

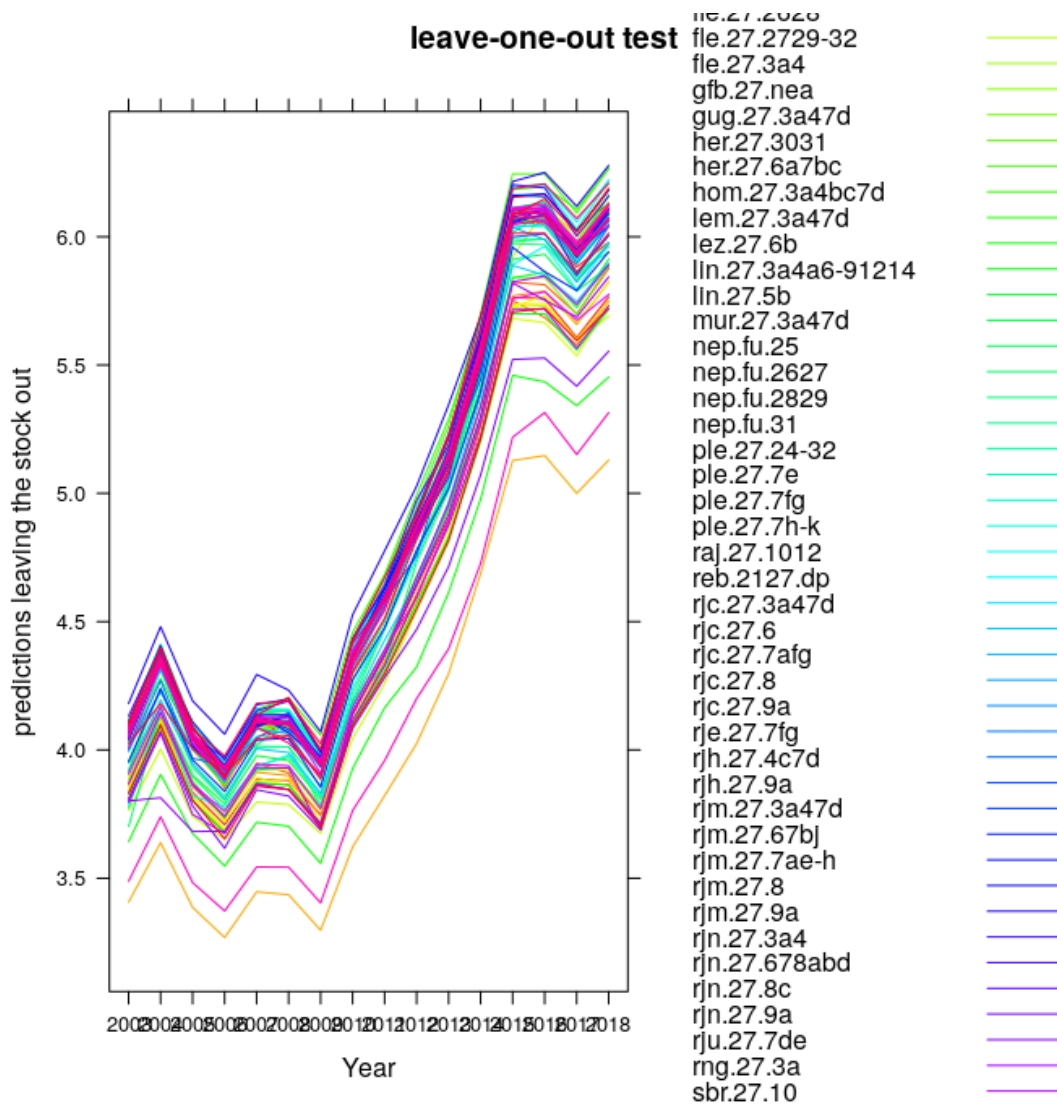
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
2.5%	2.27	2.48	2.39	2.33	2.51	2.44	2.34	2.69	2.90	2.95	2.95	3.36	3.70	3.66	3.55	3.68
25%	3.32	3.48	3.24	3.12	3.33	3.37	3.20	3.48	3.68	3.96	4.17	4.51	4.84	4.93	4.85	5.03
50%	3.91	4.19	3.94	3.88	4.08	4.02	3.83	4.24	4.54	4.81	5.03	5.51	5.99	5.88	5.76	5.96
75%	4.76	5.09	4.83	4.71	4.87	4.97	4.74	5.17	5.43	5.79	6.14	6.72	7.39	7.22	7.10	7.48
97.5%	6.22	6.80	6.11	5.80	6.13	6.43	6.23	6.92	6.99	7.78	8.08	8.67	9.58	9.59	9.30	9.54

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

```

stks <- unique(df0$FishStock)
test <- split(stks, stks)
for(i in stks){
  fit <- glmer(StockSize ~ Year + (1|FishStock), data = df0[df0$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)

```



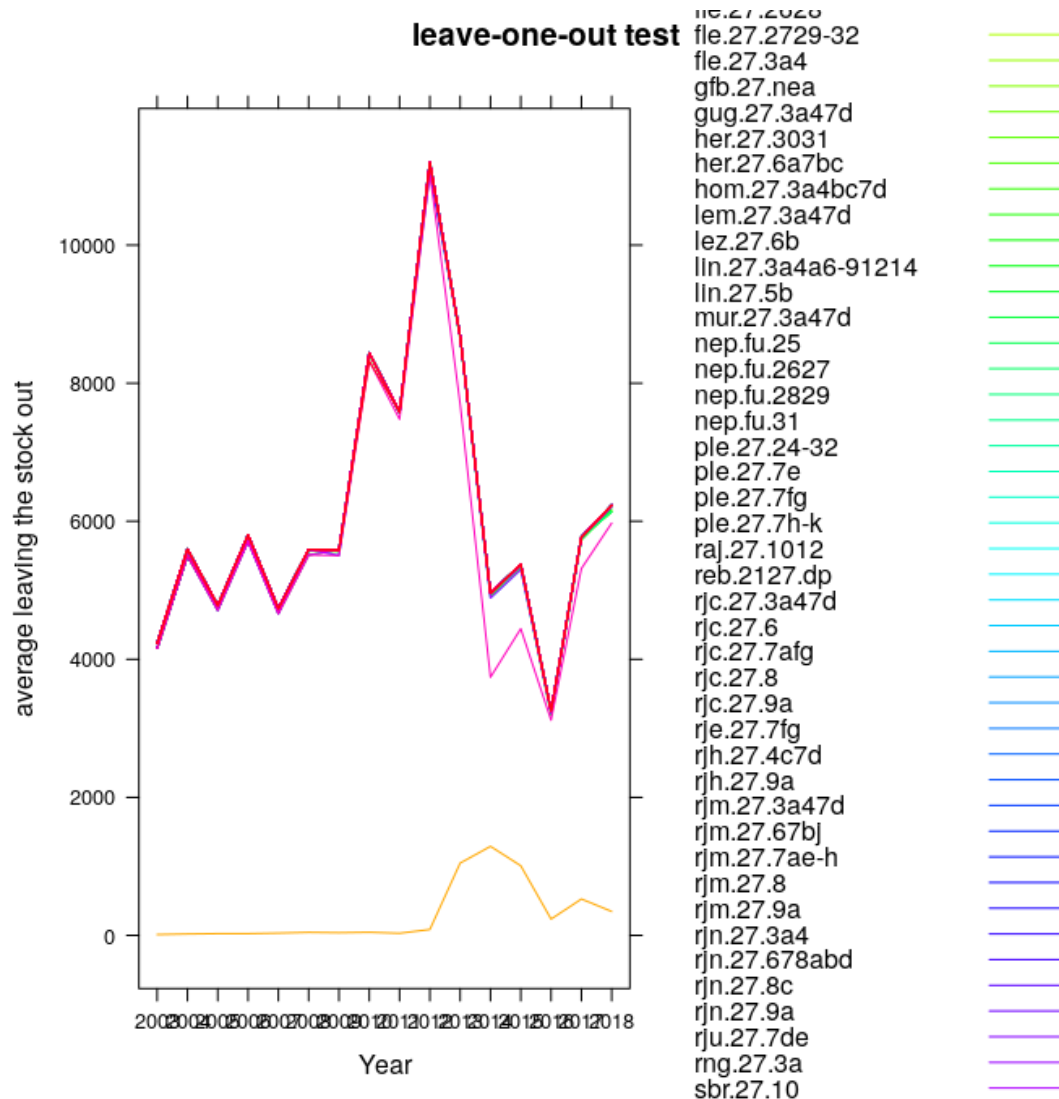
### 4 Individual stocks' impact on average estimates with leave-one-out algorithm

```

test2 <- split(stks, stks)
for(i in stks){
  test2[[i]] <- data.frame(nd, spp=i,
    avg=tapply(df0[df0$FishStock!=i, 'StockSize'], df0[df0$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